City of San Diego

CONTRACTOR'S NAME: Flatiron West, Inc.
ADDRESS: 16470 West Bernardo Drive, San Diego, CA 92127
TELEPHONE NO.: **FAX NO.:**
CITY CONTACT: Stephen Samara, Principal Contract Specialist, Email: SSamara@sandiego.gov
Phone No. (619) 533-3619
J. Bermudo / A. Jaro / L. I. Russell

BIDDING DOCUMENTS

FINAL

e - Bidding

FOR

MORENA PUMP STATION

BID NO.: **K-21-1801-DBB-3-A**
SAP NO. (WBS/IO/CC): **B-15141**
CLIENT DEPARTMENT: **2000**
COUNCIL DISTRICT: **2, 7**
PROJECT TYPE: **KA, BP**

THIS CONTRACT WILL BE SUBJECT TO THE FOLLOWING:

- PROJECT LABOR AGREEMENT (PLA)
- PHASED-FUNDING
- FEDERAL EQUAL OPPORTUNITY CONTRACTING REQUIREMENTS.
- ELIGIBLE FOR JOINT VENTURE PREQUALIFICATION STATUS (see Instructions to Bidders)
- PREVAILING WAGE RATES: STATE ☒ FEDERAL ☒
- SKILLED AND TRAINED WORKFORCE
- THIS IS A CASRF AND EPA FUNDED CONTRACT THROUGH THE STATE OF CALIFORNA AND ENVIRONMENTAL PROTECTION AGENCY AND UNITED STATES ENVIRONMENTAL PROTECTION AGENCY UNDER THE FEDERAL WATER INFRASTRUCTURE FINANCE AND INNOVATION ACT (WIFIA), PROP. 68 AND BUREAU OF RECLAMATION (BOR).

BID DUE DATE:

2:00 PM
DECEMBER 17, 2020

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

http://www.sandiego.gov/cip/bidopps/index.shtml

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:

Shapiro, Alan — Digitally signed by Shapiro, Alan DN: cn=Shapiro, Alan, ou=USSDG1 Reason: I have reviewed this document Date: 2020.10.19 09:08:43 -07'00'

10/19/2020 Seal:

1) Registered Engineer (Morena Pump Station) Date

Nabil Batta

10/19/2020 Seal:

2) For City Engineer (Morena Pump Station) Date

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REQUIRED DOCUMENTS SCHEDULE DURING BIDDING AND AWARDING

The Bidder's attention is directed to the City's Municipal Code §22.0807(e), (3)-(5) for important information regarding grounds for debarment for failure to submit required documentation.

The specified Equal Opportunity Contracting Program (EOCP) forms are available for download from the City's web site at:

http://www.sandiego.gov/eoc/forms/index.shtml

FEDERAL DOCUMENTS SUBMITTAL REQUIREMENTS

ITEM	DOCUMENT TO BE SUBMITTED	WHEN DUE	FROM
1.	Bid Bond (PDF via PlanetBids)	At Time of Bid	ALL BIDDERS
2.	Contractors Certification of Pending Actions	At Time of Bid	ALL BIDDERS
3.	Mandatory Disclosure of Business Interests	At Time of Bid	ALL BIDDERS
4.	Disclosure of Lobbying Activities	At Time of Bid	ALL BIDDERS
5.	Form 4500-3: DBE Subcontractor Performance Form	At Time of Bid	ALL BIDDERS
6.	Form 4500 -4: DBE Subcontractor Utilization Form	At Time of Bid	ALL BIDDERS
7.	Commitment to Comply with Skilled and Trained Workforce Certification Forms	At Time of Bid	ALL BIDDERS
8.	Debarment and Suspension Certification for Prime Contractors	At Time of Bid	ALL BIDDERS
9.	Debarment and Suspension Certification for Subcontractors, Suppliers & Mfgrs	At Time of Bid	ALL BIDDERS
10.	OCIP Credit Worksheet	By 5PM, 2 working days After Bid Opening	ALL BIDDERS
11.	Bid Bond (Original)	By 5PM, 3 working days After Bid Opening	ALL BIDDERS
12.	Phase Funding Schedule Agreement	Within 10 working days of receipt by the bidder of the Notice of Intent to Award	APPARENT LOW BIDDER

ITEM	DOCUMENT TO BE SUBMITTED	WHEN DUE	FROM
13.	Federal Good Faith Documentation	By 5PM, 4 working days After Bid Opening	ALL BIDDERS
14.	Form AA61 – List of Work Made Available	By 5PM, 4 working days After Bid Opening	ALL BIDDERS
15.	Form AA62 – Summary of Bids Received	By 5PM, 4 working days After Bid Opening	ALL BIDDERS
16.	Form AA63 – Good Faith Effort List of Subcontractors Solicited	By 5PM, 4 working days After Bid Opening	ALL BIDDERS
17.	Escrow Bid Document, See Attachment H	By 5PM, 4 working days After Bid Opening	ALL BIDDERS
18.	Payment & Performance Bond; Certificates of Insurance and Endorsements; and Signed Contract Agreement Page	Within 10 working days of receipt by bidder of contract and NOI	AWARDED BIDDER
19.	PLA FORMS, See Attachment I	Within 10 working days of NOI	AWARDED BIDDER
20.	OCIP Enrollment Forms	Within 15 working days of NOI	AWARDED BIDDER
21.	Form UR-334: California State Revolving Funds (CASRF)	Annually. See Attachment D requirements.	AWARDED BIDDER
22.	Form 4500 -2: DBE Subcontractor Participation Form	See Attachment D requirements.	AWARDED BIDDER
23.	Skilled and Trained Workforce Certification Forms	Monthly. See NIB Section 8	AWARDED BIDDER

NOTICE INVITING BIDS

1. **SUMMARY OF WORK:** This is the City of San Diego's (City) solicitation process to acquire Construction services for **Morena Pump Station.** For additional information refer to Attachment A.

2. **FULL AND OPEN COMPETITION:** This solicitation is subject to full and open competition and may be bid by Contractors on the City's approved Prequalified Contractors List. For information regarding the Contractors Prequalified list visit the City's web site: http://www.sandiego.gov.

3. **ESTIMATED CONSTRUCTION COST:** The City's estimated total construction cost for this project is **$110,000,000**.

4. **BID DUE DATE AND TIME ARE: December 17, 2020** at **2:00 PM.**

5. **PREVAILING WAGE RATES APPLY TO THIS CONTRACT:** Refer to Attachment D.

6. **LICENSE REQUIREMENT** To be eligible for award of this contract, Prime contractor must possess the following licensing classification: **A**

6.1 **Specialty License Requirements:** All plumbing or pipefitting work that falls within the classification of a C-36 License shall be performed under a contract or subcontract with a contractor or a subcontractor with a C-36 License. All electrical work that falls within the classification of a C-10 License shall be performed under a contract or subcontract with a contractor or a subcontractor with a C-10 License.

7. **ESCROW BID DOCUMENT APPLY TO THIS CONTRACT:** Refer to Attachment H**.**

8. **SKILLED AND TRAINED WORKFORCE LABOR REQUIREMENTS:**

8.1. The Contractor and its subcontractors at every tier shall use a skilled and trained workforce to perform all work on the project or contract that falls within an apprenticeable occupation in the building and construction trades, as set forth in 8California Public Contract Code section 2601, including the exceptions in sections 260l(d)(5) and 2601 (d)(6). Contractor shall provide to the City a report demonstrating compliance with this section on a monthly basis, to be included with monthly pay requests. The City may withhold progress payments or retention in accordance with California Public Contract Code section 2602(b) if the Contractor fails to provide the monthly report required by this section, provides a report that is incomplete, or provides a report that does not demonstrate compliance with this section. Payment may be withheld until the Contractor provides a plan to achieve substantial compliance with this section prior to completion of the contract that is acceptable to the City, with respect to the relevant apprenticeable occupation.

This section references provisions of the California Public Contract Code for convenience only. The City is not electing to incorporate other provisions of Chapter 2.9 of the California Public Contract Code not referenced herein, including but not limited to provisions for State enforcement. Instead, failure to comply with this section is considered a material breach of this contract which could affect the Contractor's ability to perform future work for the City pursuant to Chapter 2, Article 2, Division 8 of the San Diego Municipal Code regarding debarment.

8.2. Submittal Requirements

Contracts must submit proof of a Commitment to Comply with Skilled and Trained Workforce Requirements at bid due date. Contractor and its subcontractors at every tier will use a skilled and trained workforce to perform all work on the project or a contract that falls within an apprenticeship occupation in the building and construction trades in accordance with Chapter 2.9 (commencing with Section 2600) of Part 1 of Division 2 of the Public Contract Code. City will monitor Contractor's compliance with these requirements and Contractor, on behalf of itself and its subcontractors at every tier, shall provide on a monthly basis a Skilled and Trained Workforce Certification Form and Skilled and Trained Workforce Monthly Compliance Report demonstrating compliance. If the monthly Skilled and Trained Workforce Certification Form and Monthly Compliance Report are not provided within 30 days or if Contractor provides a report that is incomplete, City shall withhold further payments until a complete report is provided. If the Skilled and Trained Workforce Certification form does not establish compliance with Section 132354.7, City shall withhold further payments until Contractor provides a plan to achieve substantial compliance with the skilled and trained workforce requirements, with respect to the relevant apprenticeable occupation, prior to the completion of the project. Any withholding will be released for payment on the monthly estimate for partial payments next following the date that all the satisfactory compliance of the requirements for which the retention was made are submitted.

9. VETERANS OUTREACH:

Military veterans bring unique skills to City projects due to their mission-oriented training and experience, and dedication to the job. The City desires to facilitate the entry into the building and construction trades for veterans interested in careers in the industry. Within (30) days after notice that it is the apparent low bidder. Contractor shall contact "Helmets to Hardhats" or "UA Veterans in Piping" on behalf of itself and its subcontractors, for potential job referrals and employment of veterans on the project. Contractor may contact other veterans programs in its discretion, but if neither of the above referenced programs are contacted, the Contractor must receive prior written approval from the City that it is an equivalent veterans program. Contacting multiple veterans programs is highly encouraged, but not required. Within ninety (90) days after issuance of a Notice to Proceed for construction of the project. Contractor shall provide the City with a written report detailing the veterans programs contacted, opportunities offered by the Contractor and its subcontractors, applications received and for what construction trades, and how many veterans were hired through the programs. Hiring veterans to work on the project is not mandatory, but information received from the Contractor may be used by the City in the future to develop a veteran's outreach program for City contracting.

10. BUSINESS COOPERATION TAX PROGRAM:

You must exercise your right to obtain a California State of Board of Equalization (BOE) sub-permit for the jobsite and allocate all eligible Bradley-Burns Uniform Local Sales and Use Tax (Use Tax) to the City.

The Contractor and Subcontractors who meet the minimum California Department of Tax and Fee Administration (CDTFA) contract threshold (currently $5M) and who are purchasing materials and/or fixtures over $100,000 in value, must apply for a jobsite sub-permit (job-site specific sellers permit), prior to NTP. In addition, you will ensure that all eligible subcontractors will exercise their

right to obtain this BOE sub-submit and allocate all eligible Use Tax to the City. The City will not issue a notice to proceed unless you and your eligible subcontractors have obtained this sub-permit from the BOE. If there is added work at a later date that meets this criteria the same process shall apply prior to purchasing material and/or fixtures for added work. And it will also be part of the close-out process (permit closeout). More information on obtaining this permit can be found by contacting the local BOE office.

11. PROJECT LABOR AGREEMENT. As a condition of final contract award, the Apparent Low Bidder must sign and execute a Letter of Assent to the Project Labor Agreement that the City has negotiated which is listed as Attachment A to the Project Labor Agreement. A copy of the Project Labor Agreement (PLA) is attached as Attachment I of this Contract Document.

12. SUBCONTRACTING PARTICIPATION PERCENTAGES: Subcontracting participation percentages apply to this contract.

12.1. The City affirms that in any contract entered into pursuant to this advertisement, DBE will be afforded full opportunity to submit Bids in response to this invitation.

12.2. This Federally assisted project includes subcontracting participation percentages for DBE participation. DBE goal commitments and Good Faith Efforts (GFE) shall be made prior to bidding. DBE commitments and GFE made after the Bid opening will not be considered for the Award of Contract.

12.3. This project is subject to the federal equal opportunity regulations and the following requirements. The City reserves the right to audit the Contractor's compliance with the federal requirements set forth below.

12.4. The following are federally subcontracting participation percentages. For the purpose of achieving the subcontractor participation percentage, Additive or Deductive Alternates and Type II Allowance Bid Items will not be included in the calculation.

12.5. Environmental Protection Agency (EPA) - In accordance with EPA's Program for Utilization of Small, Minority Disadvantaged and Women Business Enterprises in procurement under Federal assistance programs, the Contractor agrees to the applicable "fair share" objectives negotiated with EPA as follows:

12.6. California State Water Resources Control Board Clean Water State Revolving Fund (CWSRF):

		MBE*	WBE*
1.	Construction	2%	1%
2.	Supplies	1%	1%
3.	Services	1%	1%
4.	Equipment (combined in above)	1%	1%

Note: MBEs and WBEs shall be certified by EPA, SBA, DOT or by state, local, Tribal, or private entities whose certification criteria match EPAs in order to be counted toward MBE/WBE accomplishments. MBEs and WBEs are a part of the larger universe of DBEs.

12.7. Bid **SHALL** be **declared non-responsive** if the Bidder fails any of the following conditions:

12.7.1. Submission of GFE documentation, as specified in Attachment D.

12.7.2. Attending one of the Pre-Bid Meetings.

12.7.3. Submit Good Faith Effort (GFE) documentation, saved in searchable Portable Document Format (PDF) and stored on a Universal Serial Bus (USB) Type-A, Compact Disc (CD) or Digital Video Disc (DVD), demonstrating the Bidder made a good faith effort to outreach to and include DBE Subcontractors required in this document by 5 PM, 4 Working Days after the Bid opening.

Due to circumstances related to Covid-19, until further notice, all submittals in searchable PDF shall be submitted electronically within the prescribed time identified in the contract documents via a File Cloud link provided by the Contract Specialist to all bidders.

13. MANDATORY ONLINE PRE-BID MEETING VIA GOTOMEETING:

Bidders are **required** to attend a Pre-Bid Meeting. Two mandatory online pre-bid meetings will be held.

The **First** Meeting will be on: **Thursday, October 29. 2020** at **10:00 AM** at GoToMeeting.

Please join the pre-bid meeting from your computer, tablet, or smartphone. You can also dial in using your phone.

https://global.gotomeeting.com/join/917374909
You can also dial in using your phone
United States: +1 (571) 317-3122
Access Code: 917-374-909

The **Second** meeting will be on: **Monday, November 2, 2020** at **10:00 AM** at GoToMeeting.

Please join the pre-bid meeting from your computer, tablet or smartphone. You can also dial in using your phone.

https://global.gotomeeting.com/join/858763077
You can also dial in using your phone.
United States: +1 (224) 501-3412
Access Code: 858-763-077

New to GoToMeeting? Get the app now and be ready when your first meeting starts:

Please Note: You will need to join the meeting with a computer, tablet or smartphone with the GoToMeetings App in place in order to sign in via the Chat feature as attendance at the meeting will be evidenced by the Chat sign-in. The Chat feature will also be used for attendees to ask any questions.

The purpose of the meetings is to discuss the scope of the project, submittal requirements, the pre-qualification process, the Project Labor Agreement requirements, OCIP requirements, and Equal

Opportunity Contracting Program requirements and reporting procedures. Failure to attend **ONE** of the Mandatory Pre-Bid Meeting may result in the Bid being deemed non-responsive.

Upon entering the meeting, all attendees **must** use the chat feature to sign in with the following information: Name of firm, Attendee's name, Phone number, Email address, and whether the attendee's firm is a Prime or Subcontractor.

The GoToMeetings will open thirty minutes prior to the start times listed above to allow the attendees the opportunity to sign in by the deadline.

Bidders may not be admitted after the specified start time of the mandatory Pre-Bid Meeting.

14. PRE-BID SITE VISIT: All those wishing to submit a bid are encouraged to visit the Work Site. Due to COVID-19 gathering limitations, a guided group tour of the future Morena Pump Station site on Custer Street will not be available. However, the City is providing an opportunity for prime contractor teams to access the site for a self-guided walkthrough of the grounds and the current buildings (the old San Diego Humane Society property).

Site visits will be available by appointment only for each prime contractor team. No more than 10 people (any combination of team members from the prime contractor and subcontractors) will be allowed to participate in the site visit. All attendees MUST have an appropriate mask or facial covering to be granted access to the property. Each team will have up to 25 minutes to walk the site and can take any notes, photos or videos desired.

City team members will be present to escort the team around the property, ensure the safety of all participants and keep everyone on schedule, but will not be taking any questions or providing any commentary. Questions must be submitted in writing to the contract specialist on the cover of the solicitation.

To schedule a site visit, please email purewatersd@sandiego.gov with the subject line "Morena Pump Station Site Visit" and list the names/organizations of the individuals attending, along with your top 3 preferred time slots from the following:

Morning – Wednesday, Nov. 4	**Afternoon – Wednesday, Nov. 4**
9 a.m. – 9:25 a.m.	1 p.m. – 1:25 p.m.
9:30 a.m. – 9:55 a.m.	1:30 p.m. – 1:55 p.m.
10 a.m. – 10:25 a.m.	2 p.m. – 2:25 p.m.
10:30 a.m. – 10:55 a.m.	2:30 p.m. – 2:55 p.m.
11 a.m. – 11:25 a.m.	3 p.m. – 3:25 p.m.
11:30 a.m. – 11:55 a.m.	3:30 p.m. – 3:55 p.m.

Appointments will be scheduled in the order received. You will receive an email reply confirming your assigned time slot and providing additional instructions for the site visit.

15. AWARD PROCESS:

15.1. The Award of this contract is contingent upon the Contractor's compliance with all conditions of Award as stated within these documents and within the Notice of Intent to Award.

15.2. Upon acceptance of bids and determination of the apparent low bidder, the City will prepare the contract documents for execution within approximately 21 days of the date of the bid opening. The City will then award the contract upon receipt of properly signed Contract, bonds, and insurance documents.

15.3. This contract will be deemed executed and effective only upon the signing of the Contract by the Mayor or his designee and approval as to form by the City Attorney's Office.

15.4. The low Bid will be determined by Base Bid.

16. SUBMISSION OF QUESTIONS:

16.1. The Director (or Designee) of Engineering & Capital Projects Department is responsible for opening, examining, and evaluating the competitive Bids submitted to the City for the acquisition, construction and completion of any public improvement except when otherwise set forth in these documents. Any questions related to this solicitation shall be submitted to: Stephen Samara @ ssamara@sandiego.gov

16.2. Questions received less than 14 days prior to the date for opening of Bids may not be considered.

16.3. Questions or clarifications deemed by the City to be material shall be answered via issuance of an addendum and posted to the City's online bidding service.

16.4. Only questions answered by formal written addenda shall be binding. Oral and other interpretations or clarifications shall be without legal effect. It is the Bidder's responsibility to be informed of any addenda that have been issued and to include all such information in its Bid.

17. PHASED FUNDING: For Phased Funding Conditions, see Attachment B.

18. OWNER CONTROLLED INSURANCE PROGRAM (OCIP): The City has implemented an Owner-Controlled Insurance Program (OCIP) for its Pure Water Projects. In this OCIP, the City furnishes Workers' Compensation, General, Excess, Pollution Liability and Builder's Risk insurance associated with construction of the Work, as detailed in Section 7- Responsibilities of the Contractor. Bidders, as well as all of their subcontractors, with a subcontract amount of greater than one half of one percent of the Contractors bid amount shall complete OCIP credit worksheets. Bidders shall submit, as well as OCIP credit worksheets obtained from all their subcontractors, the OCIP credit worksheets two business days after bid opening. Failure to comply with this requirement shall render the bid non-responsive and ineligible for award.

1. PREQUALIFICATION OF CONTRACTORS:

1.1. Contractors submitting a Bid must be pre-qualified for the total amount proposed, including all alternate items, prior to the date of submittal. Bids from contractors who have not been pre-qualified as applicable and Bids that exceed the maximum dollar amount at which contractors are pre-qualified may be deemed **non-responsive** and ineligible for award.

1.2. The completed application must be submitted online no later than 2 weeks prior to the bid opening.

1.3. **Joint Venture Bidders Cumulative Maximum Bidding Capacity:** For projects with an engineer's estimate of $30,000,000 or greater, Joint Ventures submitting bids may be deemed responsive and eligible for award if the cumulative maximum bidding capacity of the individual Joint Venture entities is equal to or greater than the total amount proposed.

1.3.1. Each of the entities of the Joint Venture must have been previously prequalified at a minimum of $15,000,000.

1.3.2. Bids submitted with a total amount proposed of less than $30,000,000 are not eligible for Cumulative Maximum Bidding Capacity prequalification. To be eligible for award in this scenario, the Joint Venture itself or at least one of the Joint Venture entities must have been prequalified for the total amount proposed.

1.3.3. Bids submitted by Joint Ventures with a total amount proposed of $30,000,000 or greater on a project with an engineer's estimate of less than $30,000,000 are not eligible for Cumulative Maximum Bidding Capacity prequalification.

1.3.4. The Joint Venture designated as the Apparent Low Bidder shall provide evidence of its corporate existence and furnish good and approved bonds in the name of the Joint Venture within 14 Calendar Days of receipt by the Bidder of a form of contract for execution.

1.4. Complete information and links to the on-line prequalification application are available at:

http://www.sandiego.gov/cip/bidopps/prequalification

1.5. Due to the City's responsibility to protect the confidentiality of the contractors' information, City staff will not be able to provide information regarding contractors' prequalification status over the telephone. Contractors may access real-time information about their prequalification status via their vendor profile on PlanetBids™.

2. ELECTRONIC FORMAT RECEIPT AND OPENING OF BIDS:

Bids will be received in electronic format (eBids) EXCLUSIVELY at the City of San Diego's electronic bidding (eBidding) site, at: http://www.sandiego.gov/cip/bidopps/index.shtml and are due by the date, and time shown on the cover of this solicitation.

2.1. **BIDDERS MUST BE PRE-REGISTERED** with the City's bidding system and possess a system-assigned Digital ID in order to submit and electronic bid.

2.2. The City's bidding system will automatically track information submitted to the site including IP addresses, browsers being used and the URLs from which information was submitted. In addition, the City's bidding system will keep a history of every login instance including the time of login, and other information about the user's computer configuration such as the operating system, browser type, version, and more. Because of these security features, Contractors who disable their browsers' cookies will not be able to log in and use the City's bidding system.

2.3. The City's electronic bidding system is responsible for bid tabulations. Upon the bidder's or proposer's entry of their bid, the system will ensure that all required fields are entered. **The system will not accept a bid for which any required information is missing.** This includes all necessary pricing, subcontractor listing(s) and any other essential documentation and supporting materials and forms requested or contained in these solicitation documents.

2.4. **BIDS REMAIN SEALED UNTIL BID DEADLINE.** eBids are transmitted into the City's bidding system via hypertext transfer protocol secure (https) mechanism using SSL 128-256 bit security certificates issued from Verisign/Thawte which encrypts data being transferred from client to server. Bids submitted prior to the "Bid Due Date and Time" are not available for review by anyone other than the submitter who has until the "Bid Due Date and Time" to change, rescind or retrieve its proposal should it desire to do so.

2.5. **BIDS MUST BE SUBMITTED BY BID DUE DATE AND TIME**. Once the bid deadline is reached, no further submissions are accepted into the system. Once the Bid Due Date and Time has lapsed, bidders, proposers, the general public, and City staff are able to immediately see the results on line. City staff may then begin reviewing the submissions for responsiveness, EOCP compliance and other issues. The City may require any Bidder to furnish statement of experience, financial responsibility, technical ability, equipment, and references.

2.6. **RECAPITULATION OF THE WORK**. Bids shall not contain any recapitulation of the Work. Conditional Bids may be rejected as being non-responsive. Alternative proposals will not be considered unless called for.

2.7. **BIDS MAY BE WITHDRAWN** by the Bidder only up to the bid due date and time.

2.7.1. Important Note: Submission of the electronic bid into the system may not be instantaneous. Due to the speed and capabilities of the user's internet service provider (ISP), bandwidth, computer hardware and other variables, it may take time for the bidder's submission to upload and be received by the City's eBidding system. It is the bidder's sole responsibility to ensure their bids are received on time by the City's eBidding system. The City of San Diego is not responsible for bids that do not arrive by the required date and time.

2.8. ACCESSIBILITY AND AMERICANS WITH DISABILITIES ACT (ADA) COMPLIANCE: To request a copy of this solicitation in an alternative format, contact the Public Works Contract Specialist listed on the cover of this solicitation at least five (5) working days prior to the Bid/Proposal due date to ensure availability.

3. ELECTRONIC BID SUBMISSIONS CARRY FULL FORCE AND EFFECT:

3.1. The bidder, by submitting its electronic bid, acknowledges that doing so carries the same force and full legal effect as a paper submission with a longhand (wet) signature.

3.2. By submitting an electronic bid, the bidder certifies that the bidder has thoroughly examined and understands the entire Contract Documents (which consist of the plans and specifications, drawings, forms, affidavits and the solicitation documents), and that by submitting the eBid as its bid proposal, the bidder acknowledges, agrees to and is bound by the entire Contract Documents, including any addenda issued thereto, and incorporated by reference in the Contract Documents.

3.3. The Bidder, by submitting its electronic bid, agrees to and certifies under penalty of perjury under the laws of the State of California, that the certification, forms and affidavits submitted as part of this bid are true and correct.

3.4. The Bidder agrees to the construction of the project as described in Attachment "A – Scope of Work" for the City of San Diego, in accordance with the requirements set forth herein for the electronically submitted prices. The Bidder guarantees the Contract Price for a period of 120 days (90 days for federally funded contracts and contracts valued at $500,000 or less) from the date of Bid opening. The duration of the Contract Price guarantee shall be extended by the number of days required for the City to obtain all items necessary to fulfill all conditions precedent.

4. BIDS ARE PUBLIC RECORDS: Upon receipt by the City, Bids shall become public records subject to public disclosure. It is the responsibility of the respondent to clearly identify any confidential, proprietary, trade secret or otherwise legally privileged information contained within the Bid. General references to sections of the California Public Records Act (PRA) will not suffice. If the Contractor does not provide applicable case law that clearly establishes that the requested information is exempt from the disclosure requirements of the PRA, the City shall be free to release the information when required in accordance with the PRA, pursuant to any other applicable law, or by order of any court or government agency, and the Contractor will hold the City harmless for release of this information.

5. CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM:

5.1. **Prior** to the Award of the Contract or Task Order, you and your Subcontractors and Suppliers must register with the City's web-based vendor registration and bid management system. For additional information go to:

http://www.sandiego.gov/purchasing/bids-contracts/vendorreg

5.2. The City may not award the contract until registration of all subcontractors and suppliers is complete. In the event this requirement is not met within the time frame specified in the Notice of Intent to Award letter, the City reserves the right to rescind the Notice of Award / Intent to Award and to make the award to the next responsive and responsible bidder / proposer.

6. JOINT VENTURE CONTRACTORS: Provide a copy of the Joint Venture agreement and the Joint Venture license to the City within 14 Calendar Days after receiving the Contract forms.

7. INSURANCE REQUIREMENTS:

7.1. All certificates of insurance and endorsements required by the contract are to be provided upon issuance of the City's Notice of Intent to Award letter.

7.2. Refer to sections 7-4, "Owner Controlled Insurance Program" of the OCIP insurance requirements which must be met.

8. REFERENCE STANDARDS: Except as otherwise noted or specified, the Work shall be completed in accordance with the following standards:

Title	Edition	Document Number
Standard Specifications for Public Works Construction ("The GREENBOOK") http://www.greenbookspecs.org/	2015	PWPI070116-01
City of San Diego Standard Specifications for Public Works Construction ("The WHITEBOOK") https://www.sandiego.gov/ecp/edocref/greenbook	2015	PWPI070116-02
City of San Diego Standard Drawings* https://www.sandiego.gov/ecp/edocref/standarddraw	2016	PWPI070116-03
Citywide Computer Aided Design and Drafting (CADD) Standards https://www.sandiego.gov/ecp/edocref/drawings	2016	PWPI092816-04
California Department of Transportation (CALTRANS) Standard Specifications https://dot.ca.gov/programs/design/ccs-standard-plans-and-standard-specifications	2015	PWPI092816-05
CALTRANS Standard Plans https://dot.ca.gov/programs/design/ccs-standard-plans-and-standard-specifications	2015	PWPI092816-06
CaliforniaManual on Uniform Traffic Control Devices Revision 5 (CA MUTCD 2014 Rev 5) http://www.dot.ca.gov/programs/safety-programs/camutcd/camutcd-rev5	2014	PWPI042220-09
NOTE: *Available online under Engineering Documents and References at: https://www.sandiego.gov/ecp/edocref/		

9. CITY'S RESPONSES AND ADDENDA: The City, at its discretion, may respond to any or all questions submitted in writing via the City's eBidding web site in the **form of an addendum**. No other responses to questions, oral or written shall be of any force or effect with respect to this solicitation. The changes to the Contract Documents through addenda are made effective as though originally issued with the Bid. The Bidders shall acknowledge the receipt of Addenda at the time of bid submission.

10. CITY'S RIGHTS RESERVED: The City reserves the right to cancel the Notice Inviting Bids at any time, and further reserves the right to reject submitted Bids, without giving any reason for such action, at its sole discretion and without liability. Costs incurred by the Bidder(s) as a result of preparing Bids under the Notice Inviting Bids shall be the sole responsibility of each bidder. The Notice Inviting Bids creates or imposes no obligation upon the City to enter a contract.

11. CONTRACT PRICING: This solicitation is for a Lump Sum contract with Unit Price provisions as set forth herein. The Bidder agrees to perform construction services for the City of San Diego in accordance with these contract documents for the prices listed below. The Bidder further agrees to guarantee the Contract Price for a period of 120 days from the date of Bid opening. The duration of the Contract Price guarantee may be extended, by mutual consent of the parties, by the number of days required for the City to obtain all items necessary to fulfill all contractual conditions.

12. SUBCONTRACTOR INFORMATION:

12.1. LISTING OF SUBCONTRACTORS. In accordance with the requirements provided in the "Subletting and Subcontracting Fair Practices Act" of the California Public Contract Code, the Bidder shall provide the **NAME** and **ADDRESS** of each Subcontractor who will perform work, labor, render services or who specially fabricates and installs a portion [type] of the work or improvement, in an amount in excess of 0.5% of the Contractor's total Bid. The Bidder shall also state within the description, whether the subcontractor is a **CONSTRUCTOR**, **CONSULTANT** or **SUPPLIER**. The Bidder shall state the **DIR REGISTRATION NUMBER** for all subcontractors and shall further state within the description, the **PORTION** of the work which will be performed by each subcontractor under this Contract. The Contractor shall list only one Subcontractor for each portion of the Work. The **DOLLAR VALUE** of the total Bid to be performed shall be stated for all subcontractors listed. Failure to comply with this requirement may result in the Bid being rejected as **non-responsive** and ineligible for award. The Bidder's attention is directed to the Special Provisions – Section 2-3.2, "SELF-PERFORMANCE", which stipulates the percent of the Work to be performed with the Bidders' own forces. The Bidder shall list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which Bidders are seeking recognition towards achieving any mandatory, voluntary (or both) subcontracting participation goals.

Additionally, pursuant to California Senate Bill 96 and in accordance with the requirements of Labor Code sections 1771.1 and 1725.5, by submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the California Department of Industrial Relations (DIR). **The Bidder shall provide the name, address, license number, DIR registration number of any Subcontractor – regardless of tier** - who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement pursuant to the contract.

12.2. LISTING OF SUPPLIERS. Any Bidder seeking the recognition of Suppliers of equipment, materials, or supplies obtained from third party Suppliers towards achieving any mandatory or voluntary (or both) subcontracting participation goals shall provide, at a minimum, the **NAME**, **LOCATION (CITY), DIR REGISTRATION NUMBER** and the **DOLLAR VALUE** of each supplier. The Bidder will be credited up to 60% of the amount to be paid to the Suppliers for materials and supplies unless vendor manufactures or substantially alters materials and supplies, in which case, 100% will be credited. The Bidder is to indicate within the description whether the listed firm is a supplier or manufacturer. If no indication is provided, the listed firm will be credited at 60% of the listed dollar value for purposes of calculating the Subcontractor Participation Percentage.

12.3. LISTING OF SUBCONTRACTORS OR SUPPLIERS FOR ALTERNATES. For subcontractors or suppliers to be used on additive or deductive alternate items, in addition to the above

requirements, bidder shall further note "ALTERNATE" and alternate item number within the description.

13. SUBMITTAL OF "OR EQUAL" ITEMS: See Section 4-1.6, "Trade Names" in The WHITEBOOK and as amended in the SSP.

14. AWARD:

14.1. The Award of this contract is contingent upon the Contractor's compliance with all conditions precedent to Award.

14.2. Upon acceptance of a Bid, the City will prepare contract documents for execution within approximately 21 days of the date of the Bid opening and award the Contract approximately within 7 days of receipt of properly executed Contract, bonds, and insurance documents.

14.3. This contract will be deemed executed and effective only upon the signing of the Contract by the Mayor or his designee and approval as to form the City Attorney's Office.

15. SUBCONTRACT LIMITATIONS: The Bidder's attention is directed to Standard Specifications for Public Works Construction, Section 2.3, "SUBCONTRACTS" in The GREENBOOK and as amended in the SSP which requires the Contractor to self-perform not less than the specified amount. Failure to comply with this requirement shall render the bid **non-responsive** and ineligible for award.

16. AVAILABILITY OF PLANS AND SPECIFICATIONS: Contract Documents may be obtained by visiting the City's website: http://www.sandiego.gov/cip/. Plans and Specifications for this contract are also available for review in the office of the City Clerk or Engineering & Capital Projects Department, Contracts Division.

17. ONLY ONE BID PER CONTRACTOR SHALL BE ACCCEPTED: No person, firm, or corporation shall be allowed to make, file, or be interested in more than one (1) Bid for the same work unless alternate Bids are called for. A person, firm or corporation who has submitted a sub-proposal to a Bidder, or who has quoted prices on materials to a Bidder, is not hereby disqualified from submitting a sub-proposal or quoting prices to other Bidders or from submitting a Bid in its own behalf. Any Bidder who submits more than one bid will result in the rejection of all bids submitted.

18. SAN DIEGO BUSINESS TAX CERTIFICATE: The Contractor and Subcontractors, not already having a City of San Diego Business Tax Certificate for the work contemplated shall secure the appropriate certificate from the City Treasurer, Civic Center Plaza, First floor and submit to the Contract Specialist upon request or as specified in the Contract Documents. Tax Identification numbers for both the Bidder and the listed Subcontractors must be submitted on the City provided forms within these documents.

19. BIDDER'S GUARANTEE OF GOOD FAITH (BID SECURITY) FOR DESIGN-BID-BUILD CONTRACTS:

19.1. For bids $250,000 and above, bidders shall submit Bid Security at bid time. Bid Security shall be in one of the following forms: a cashier's check, or a properly certified check upon some responsible bank; or an approved corporate surety bond payable to the City of San Diego for an amount of not less than 10% of the total bid amount.

19.2. This check or bond, and the monies represented thereby, will be held by the City as a guarantee that the Bidder, if awarded the contract, will in good faith enter into the contract and furnish the required final performance and payment bonds.

19.3. The Bidder agrees that in the event of the Bidder's failure to execute this contract and provide the required final bonds, the money represented by the cashier's or certified check will remain the property of the City; and the Surety agrees that it will pay to the City the damages, not exceeding the sum of 10% of the amount of the Bid, that the City may suffer as a result of such failure.

19.4. At the time of bid submission, bidders must upload and submit an electronic PDF copy of the aforementioned bid security. Whether in the form of a cashier's check, a properly certified check or an approved corporate surety bond payable to the City of San Diego, the bid security must be uploaded to the City's eBidding system. By 5PM, 3 working days after the bid opening date, all bidders must provide the City with the original bid security.

19.5. Failure to submit the electronic version of the bid security at the time of bid submission AND failure to provide the original by 5PM, 3 working days after the bid opening date shall cause the bid to be rejected and deemed non-responsive.

Due to circumstances related to Covid-19, until further notice, all original bid bond submittals must be received by 5 PM, 3 working days after bid opening.

Upon circumstances returning to normal business as usual, the original bid bond shall once again be due by 5 PM the day after bid opening.

Original Bid Bond shall be submitted to:
Engineering & Capital Projects Department, Contracts Division
525 B Street, Suite 750 (7th Floor)
San Diego, California, 92101
To the Attention of the Contract Specialist on the Front Page of this solicitation.

20. AWARD OF CONTRACT OR REJECTION OF BIDS:

20.1. This contract may be awarded to the lowest responsible and reliable Bidder.

20.2. Bidders shall complete ALL eBid forms as required by this solicitation. Incomplete eBids will not be accepted.

20.3. The City reserves the right to reject any or all Bids, to waive any informality or technicality in Bids received, and to waive any requirements of these specifications as to bidding procedure.

20.4. Bidders will not be released on account of their errors of judgment. Bidders may be released only upon receipt by the City within 3 Working Days of the bid opening, written notice from the Bidder which shows proof of honest, credible, clerical error of a material nature, free from fraud or fraudulent intent; and of evidence that reasonable care was observed in the preparation of the Bid.

20.5. A bidder who is not selected for contract award may protest the award of a contract to another bidder by submitting a written protest in accordance with the San Diego Municipal Code.

20.6. The City of San Diego will not discriminate in the award of contracts with regard to race, religion creed, color, national origin, ancestry, physical handicap, marital status, sex or age.

20.7. Each Bid package properly signed as required by these specifications shall constitute a firm offer which may be accepted by the City within the time specified herein.

20.8. The City reserves the right to evaluate all Bids and determine the lowest Bidder on the basis of the base bid and any proposed alternates or options as detailed herein.

21. BID RESULTS:

21.1. The availability of the bids on the City's eBidding system shall constitute the public announcement of the apparent low bidder. In the event that the apparent low bidder is subsequently deemed non-responsive or non-responsible, a notation of such will be made on the eBidding system. The new ranking and apparent low bidder will be adjusted accordingly.

21.2. To obtain the bid results, view the results on the City's web site, or request the results by U.S. mail and provide a self-addressed, stamped envelope. If requesting by mail, be sure to reference the bid name and number. The bid tabulations will be mailed to you upon their completion. The results will not be given over the telephone.

22. THE CONTRACT:

22.1. The Bidder to whom award is made shall execute a written contract with the City of San Diego and furnish good and approved bonds and insurance certificates specified by the City within 14 days after receipt by Bidder of a form of contract for execution unless an extension of time is granted to the Bidder in writing.

22.2. If the Bidder takes longer than 14 days to fulfill these requirements, then the additional time taken shall be added to the Bid guarantee. The Contract shall be made in the form adopted by the City, which includes the provision that no claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.

22.3. If the Bidder to whom the award is made fails to enter into the contract as herein provided, the award may be annulled and the Bidder's Guarantee of Good Faith will be subject to forfeiture. An award may be made to the next lowest responsible and reliable Bidder who shall fulfill every stipulation embraced herein as if it were the party to whom the first award was made.

22.4. Pursuant to the San Diego City Charter section 94, the City may only award a public works contract to the lowest responsible and reliable Bidder. The City will require the Apparent Low Bidder to (i) submit information to determine the Bidder's responsibility and reliability, (ii) execute the Contract in form provided by the City, and (iii) furnish good and approved bonds and insurance certificates specified by the City within 14 Days, unless otherwise

approved by the City, in writing after the Bidder receives notification from the City, designating the Bidder as the Apparent Low Bidder and formally requesting the above mentioned items.

22.5. The award of the Contract is contingent upon the satisfactory completion of the above-mentioned items and becomes effective upon the signing of the Contract by the Mayor or designee and approval as to form by the City Attorney's Office. If the Apparent Low Bidder does not execute the Contract or submit required documents and information, the City may award the Contract to the next lowest responsible and reliable Bidder who shall fulfill every condition precedent to award. A corporation designated as the Apparent Low Bidder shall furnish evidence of its corporate existence and evidence that the officer signing the Contract and bond for the corporation is duly authorized to do so.

23. EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE OF WORK: The Bidder shall examine carefully the Project Site, the Plans and Specifications, other materials as described in the Special Provisions, Section 2-7, "SUBSURFACE DATA", and the proposal forms (e.g., Bidding Documents). The submission of a Bid shall be conclusive evidence that the Bidder has investigated and is satisfied as to the conditions to be encountered, as to the character, quality, and scope of work, the quantities of materials to be furnished, and as to the requirements of the Bidding Documents Proposal, Plans, and Specifications.

24. CITY STANDARD PROVISIONS: This contract is subject to the following standard provisions. See The WHITEBOOK for details.

24.1. The City of San Diego Resolution No. R-277952 adopted on May 20, 1991 for a Drug-Free Workplace.

24.2. The City of San Diego Resolution No. R-282153 adopted on June 14, 1993 related to the Americans with Disabilities Act.

24.3. The City of San Diego Municipal Code §22.3004 for Contractor Standards.

24.4. The City of San Diego's Labor Compliance Program and the State of California Labor Code §§1771.5(b) and 1776.

24.5. Sections 1777.5, 1777.6, and 1777.7 of the State of California Labor Code concerning the employment of apprentices by contractors and subcontractors performing public works contracts.

24.6. The City's Equal Benefits Ordinance (EBO), Chapter 2, Article 2, Division 43 of The San Diego Municipal Code (SDMC).

24.7. The City's Information Security Policy (ISP) as defined in the City's Administrative Regulation 90.63.

25. PRE-AWARD ACTIVITIES:

25.1. The contractor selected by the City to execute a contract for this Work shall submit the required documentation as specified in the herein and in the Notice of Award. Failure to provide the information as specified may result in the Bid being rejected as **non-responsive.**

25.2. The decision that bid is non-responsive for failure to provide the information required within the time specified shall be at the sole discretion of the City.

PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND

FAITHFUL PERFORMANCE BOND AND LABOR AND MATERIALMEN'S BOND:

Flatiron West, Inc. a corporation as principal and

Liberty Mutual Insurance Company, Travelers Casualty and Surety Company of America
Fidelity and Deposit Company of Maryland/Zurich American Insurance Company, Federal Insurance
Company, The Continental Insurance Company and Berkshire Hathaway Specialty Insurance Company, a corporation authorized to do business in the State of California, as Surety, hereby obligate themselves, their successors and assigns, jointly and severally, to The City of San Diego a municipal corporation in the sum of **One Hundred Ten Million Three Hundred Eighty Six Thousand Three Hundred Fifty Dollars and Zero Cents ($110,386,350.00)** for the faithful performance of the annexed contract, and in the sum of **One Hundred Ten Million Three Hundred Eighty Six Thousand Three Hundred Fifty Dollars and Zero Cents ($110,386,350.00)** for the benefit of laborers and materialmen designated below.

Conditions:

If the Principal shall faithfully perform the annexed contract with the City of San Diego, California, then the obligation herein with respect to a faithful performance shall be void; otherwise it shall remain in full force.

If the Principal shall promptly pay all persons, firms and corporations furnishing materials for or performing labor in the execution of this contract, and shall pay all amounts due under the California Unemployment Insurance Act then the obligation herein with respect to laborers and materialmen shall be void; otherwise it shall remain in full force.

The obligation herein with respect to laborers and materialmen shall inure to the benefit of all persons, firms and corporations entitled to file claims under the provisions of Article 2. Claimants, (iii) public works of improvement commencing with Civil Code Section 9100 of the Civil Code of the State of California.

Changes in the terms of the annexed contract or specifications accompanying same or referred to therein shall not affect the Surety's obligation on this bond, and the Surety hereby waives notice of same.

The Surety expressly agrees that the City of San Diego may reject any contractor or subcontractor which may be proposed by Surety in fulfillment of its obligations in the event of default by the Principal.

The Surety shall not utilize the Principal in completing the improvements and work specified in the Agreement in the event the City terminates the Principal for default.

PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND (continued)

Morena Pump Station, K-21-1801-DBB-3-A

Dated 2/24/2021

Approved as to Form

Mara W. Elliott, City Attorney

By _____
Deputy City Attorney

Approved:

By _____
Mayor or Designee

Flatiron West, Inc.
Principal

By _____

Mario Martinez, Vice President
Printed Name of Person Signing for Principal

See Attachment A
Surety

By See Attachment A
Attorney-in-fact

See Attachment A
Local Address of Surety

See Attachment A
Local Address (City, State) of Surety

See Attachment A
Local Telephone No. of Surety

Premium $ 835,851.00

Bond No. Liberty Bond No. 015212345
Travelers Bond No. 107341395
F&D/Zurich Bond No. 9360941
Federal Bond No. K40269678
Continental Bond No. 30112399
Berkshire Bond No. 47-SUR-300033-01-0495

ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of San Diego)

On March 4, 2021 before me, Brenda A. Mayer, Notary Public
(insert name and title of the officer)

personally appeared Mario Martinez,
who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/~~are~~ subscribed to the within instrument and acknowledged to me that he/~~she/they~~ executed the same in his/~~her/their~~ authorized capacity~~(ies)~~, and that by his/~~her/their~~ signature~~(s)~~ on the instrument the person~~(s)~~, or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

BRENDA A. MAYER
Notary Public - California
San Diego County
Commission # 2260201
My Comm. Expires Sep 28, 2022

Signature Brenda A. Mayer (Seal)

ATTACHMENT A

Liberty Mutual Insurance Company, a Massachusetts Corporation
Travelers Casualty and Surety Company of America, a Connecticut corporation
Fidelity and Deposit Company of Maryland, an Illinois corporation
Zurich American Insurance Company, a New York corporation
Federal Insurance Company, an Indiana corporation
The Continental Insurance Company, a Pennsylvania Corporation
Berkshire Specialty Insurance Company, a Nebraska Corporation

Liberty Mutual Insurance Company – A.M. Best Rating A XV; NAIC# 23043
175 Berkeley Street, Boston, MA 02116; Tel.: (212) 719-7750; Fax (212) 221-5608
Contact: David D. Roberts, Branch Manager, davidd.roberts@libertymutual.com
Mailing Address for Notices:
Gretchen Eck, Senior Surety Claims Counsel
2815 Forbs Avenue, Suite 102
Hoffman Estates, IL 60192
Bond No. 015212345

Travelers Casualty and Surety Company of America – A.M. Best Rating A++ XV; NAIC# 31194
Construction Services, One Tower Square, Hartford, CT 06183; Tel.: (860) 277-1914; Fax (860) 277-3931
Contact: Brian Bialaski, Vice President, bbialaski@travelers.com
Bond No. 107341395

Fidelity and Deposit Company of Maryland - A.M. Best Rating A+ XV; NAIC# 39306
Zurich American Insurance Company - A.M. Best Rating A+ XV; NAIC# 16535
1299 Zurich Way, 5th Floor, Schaumburg, IL 60196; Tel.: (410) 559-8739; Fax (410) 261-7957
Contact: Douglas Sauer, Underwriting Officer, douglas.sauer@zurichna.com
Bond No. 9360941

Federal Insurance Company – A.M. Best Rating A++ XV; NAIC# 20281
202B Hall's Mill Road, Whitehouse Station, NJ 08889; Tel.: (908) 903-3461; Fax (908) 526-2060
Contact: Matthew Lubin, Director, mlubin@chubb.com
Bond No. K40269678

The Continental Insurance Company – A.M. Best Rating A XV; NAIC# 35289
151 N Franklin Street, Chicago, IL 60606; Tel.: (212) 440-7356; Fax (212) 440-7351
Contact: Jon Fullerton, Branch Manager, jon.fullerton@cnasurety.com
Bond No. 30112399

Berkshire Specialty Insurance Company – A.M. Best Rating A++ XV; NAIC# 22276
1314 Douglas Street, Suite 1400, Omaha, NE 68102; Tel.: (770) 625-2509; Fax (N/A)
Contact: D. J. Conroy, Vice President, D.J.Conroy@bhspecialty.com
Bond No. 47-SUR-300033-01-0495

By: _____

Lisa M. Scavetta, Attorney-In-Fact
Turner Surety and Insurance Brokerage, Inc.
250 Pehle Avenue, Suite 311, Saddle Brook, NJ 07663
Office: 201-267-7507 | Fax: 201-267-7532
Email: lscavetta@tsibinc.com | CA License # 0E81386

CORPORATE ACKNOWLEDGMENT

Form 152

STATE OF NEW JERSEY
COUNTY OF BERGEN

On this 24th day of February, 2021 before me personally came Lisa M. Scavetta to me known, who, being by me duly sworn, did depose and say that she/he resides in Bronxville, New York that she/he is the ATTORNEY IN FACT of the LIBERTY MUTUAL INSURANCE COMPANY, TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA, FIDELITY AND DEPOSIT COMPANY OF MARYLAND, ZURICH AMERICAN INSURANCE COMPANY, FEDERAL INSURANCE COMPANY, THE CONTINENTAL INSURANCE COMPANY, BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY, the corporation described in and which executed the above instrument that she/he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that she/he signed her/his name thereto by like order.

(SEAL)

Bianca L. Meli

BIANCA L. MELI
NOTARY PUBLIC, STATE OF NEW JERSEY
MY COMMISSION EXPIRES
SEPTEMBER 30, 2024

LIBERTY MUTUAL INSURANCE COMPANY

FINANCIAL STATEMENT — DECEMBER 31, 2019

Assets

Cash and Bank Deposits	$778,754,989
*Bonds — U.S Government	2,780,808,610
*Other Bonds	12,645,608,792
*Stocks	16,385,435,431
Real Estate	235,608,378
Agents' Balances or Uncollected Premiums	6,217,983,641
Accrued Interest and Rents	102,273,390
Other Admitted Assets	11,957,106,292
Total Admitted Assets	**$51,103,579,523**

Liabilities

Unearned Premiums		$8,007,146,482
Reserve for Claims and Claims Expense		21,532,853,787
Funds Held Under Reinsurance Treaties		507,868,920
Reserve for Dividends to Policyholders		1,143,826
Additional Statutory Reserve		125,722,000
Reserve for Commissions, Taxes and Other Liabilities		4,117,460,075
Total		**$34,292,195,090**
Special Surplus Funds	$32,768,443	
Capital Stock	10,000,075	
Paid in Surplus	10,044,978,933	
Unassigned Surplus	6,723,636,983	
Surplus to Policyholders		**16,811,384,434**
Total Liabilities and Surplus		**$51,103,579,524**

* Bonds are stated at amortized or investment value; Stocks at Association Market Values.
The foregoing financial information is taken from Liberty Mutual Insurance Company's financial statement filed with the state of Massachusetts Department of Insurance.

I, TIM MIKOLAJEWSKI, Assistant Secretary of Liberty Mutual Insurance Company, do hereby certify that the foregoing is a true, and correct statement of the Assets and Liabilities of said Corporation, as of December 31, 2019, to the best of my knowledge and belief.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of said Corporation at Seattle, Washington, this 27th day of March, 2020.

T A Mikolajewski

Assistant Secretary

S-1262LMIC/a 3/20

This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

Certificate No: 8204080-974450

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That The Ohio Casualty Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, Charo J. Rosemond; Elliott W. Wolffe; James Baldassare Jr.; John F. Surano; Krista A. Burke; Lisa M. Scavetta; Maria L. Spadaccini; Nicholas F. Walsh; Sherryanne M. DePirro

all of the city of Saddle Brook state of NJ each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 3rd day of August, 2020.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

By: David M. Carey
David M. Carey, Assistant Secretary

State of PENNSYLVANIA
County of MONTGOMERY ss

On this 3rd day of August, 2020 before me personally appeared David M. Carey, who acknowledged himself to be the Assistant Secretary of Liberty Mutual Insurance Company, The Ohio Casualty Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at King of Prussia, Pennsylvania, on the day and year first above written.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Teresa Pastella, Notary Public
Upper Merion Twp., Montgomery County
My Commission Expires March 28, 2021
Member, Pennsylvania Association of Notaries

By: Teresa Pastella
Teresa Pastella, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS: Section 12. Power of Attorney.
Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII – Execution of Contracts: Section 5. Surety Bonds and Undertakings.
Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Renee C. Llewellyn, the undersigned, Assistant Secretary, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 24th day of February, 2021.

By: Renee C. Llewellyn
Renee C. Llewellyn, Assistant Secretary

LMS-12873 LMIC OGIC WAIC Multi Co_12/19

№ 2131

STATE OF CALIFORNIA

DEPARTMENT OF INSURANCE

SAN FRANCISCO

AMENDED

Certificate of Authority

THIS IS TO CERTIFY, *That, pursuant to the Insurance Code of the State of California,*

LIBERTY MUTUAL INSURANCE COMPANY

of BOSTON, MASSACHUSETTS *, organized under the laws of* MASSACHUSETTS *, subject to its Articles of Incorporation or other fundamental organizational documents, is hereby authorized to transact within this State, subject to all provisions of this Certificate, the following classes of insurance:* FIRE, MARINE, SURETY, DISABILITY, PLATE GLASS, LIABILITY, WORKMEN'S COMPENSATION, COMMON CARRIER LIABILITY, BOILER AND MACHINERY, BURGLARY, CREDIT, SPRINKLER, TEAM AND VEHICLE, AUTOMOBILE, AIRCRAFT and MISCELLANEOUS

as such classes are now or may hereafter be defined in the Insurance Laws of the State of California.

THIS CERTIFICATE *is expressly conditioned upon the holder hereof now and hereafter being in full compliance with all, and not in violation of any, of the applicable laws and lawful requirements made under authority of the laws of the State of California as long as such laws or requirements are in effect and applicable, and as such laws and requirements now are, or may hereafter be changed or amended.*

IN WITNESS WHEREOF, *effective as of the* 15TH *day of* NOVEMBER, 1961, *I have hereunto set my hand and caused my official seal to be affixed this* 15TH *day of* NOVEMBER, 1961.

F. BRITTON McCONNELL
Insurance Commissioner

By _____
Deputy

TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA

HARTFORD, CONNECTICUT 06183

FINANCIAL STATEMENT AS OF DECEMBER 31, 2019

CAPITAL STOCK $ 6,480,000

ASSETS		LIABILITIES & SURPLUS	
CASH AND INVESTED CASH	$ 90,238,215	UNEARNED PREMIUMS	$ 1,079,715,557
BONDS	3,590,884,327	LOSSES	772,047,572
STOCKS	297,933,044	LOSS ADJUSTMENT EXPENSES	174,714,866
INVESTMENT INCOME DUE AND ACCRUED	37,250,410	COMMISSIONS	46,970,467
OTHER INVESTED ASSETS	3,986,514	TAXES, LICENSES AND FEES	14,728,588
PREMIUM BALANCES	263,364,263	OTHER EXPENSES	43,134,646
NET DEFERRED TAX ASSET	52,134,926	CURRENT FEDERAL AND FOREIGN INCOME TAXES	12,674,197
REINSURANCE RECOVERABLE	31,203,529	REMITTANCES AND ITEMS NOT ALLOCATED	17,964,746
SECURITIES LENDING REINVESTED COLLATERAL ASSETS	3,732,602	AMOUNTS WITHHELD / RETAINED BY COMPANY FOR OTHERS	26,565,278
RECEIVABLES FROM PARENT, SUBSIDIARIES AND AFFILIATES	11,831,826	RETROACTIVE REINSURANCE RESERVE ASSUMED	826,255
ASSUMED REINSURANCE RECEIVABLE AND PAYABLE	567,396	POLICYHOLDER DIVIDENDS	11,482,845
OTHER ASSETS	3,574,968	PROVISION FOR REINSURANCE	9,837,205
		ADVANCE PREMIUM	2,140,883
		PAYABLE FOR SECURITIES LENDING	3,732,602
		CEDED REINSURANCE NET PREMIUMS PAYABLE	46,059,812
		OTHER ACCRUED EXPENSES AND LIABILITIES	421,937
		TOTAL LIABILITIES	$ 2,263,017,456
		CAPITAL STOCK	$ 6,480,000
		PAID IN SURPLUS	433,803,760
		OTHER SURPLUS	1,683,400,804
		TOTAL SURPLUS TO POLICYHOLDERS	$ 2,123,684,564
TOTAL ASSETS	$ 4,386,702,020	TOTAL LIABILITIES & SURPLUS	$ 4,386,702,020

STATE OF CONNECTICUT)

COUNTY OF HARTFORD) SS.

CITY OF HARTFORD)

MICHAEL J. DOODY, BEING DULY SWORN, SAYS THAT HE IS VICE PRESIDENT - FINANCE, OF TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA, AND THAT TO THE BEST OF HIS KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT STATEMENT OF THE FINANCIAL CONDITION OF SAID COMPANY AS OF THE 31ST DAY OF DECEMBER, 2019.

Michael J Doody

VICE PRESIDENT - FINANCE

NOTARY PUBLIC

SUBSCRIBED AND SWORN TO BEFORE ME THIS
26TH DAY OF MARCH, 2020

SUSAN M. WEISSLEDER
Notary Public
My Commission Expires November 30, 2022

TRAVELERS

Travelers Casualty and Surety Company of America
Travelers Casualty and Surety Company
St. Paul Fire and Marine Insurance Company

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company are corporations duly organized under the laws of the State of Connecticut (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint **Lisa M. Scavetta** of **SADDLE BROOK** New Jersey , their true and lawful Attorney-in-Fact to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed, and their corporate seals to be hereto affixed, this **17th** day of **January, 2019.**

State of Connecticut

City of Hartford ss.

By: _____
Robert L. Raney, Senior Vice President

On this the **17th** day of **January, 2019**, before me personally appeared **Robert L. Raney**, who acknowledged himself to be the Senior Vice President of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of said Companies by himself as a duly authorized officer.

IN WITNESS WHEREOF, I hereunto set my hand and official seal.

My Commission expires the **30th** day of **June, 2021**

_____
Anna P. Nowik, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, which resolutions are now in full force and effect, reading as follows:

RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

FURTHER RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

FURTHER RESOLVED, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

FURTHER RESOLVED, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, **Kevin E. Hughes**, the undersigned, Assistant Secretary of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which remains in full force and effect.

Dated this 24th day of February .2021

_____
Kevin E. Hughes, Assistant Secretary

To verify the authenticity of this Power of Attorney, please call us at 1-800-421-3880.
Please refer to the above-named Attorney-in-Fact and the details of the bond to which this Power of Attorney is attached.

№ 6516

STATE OF CALIFORNIA

DEPARTMENT OF INSURANCE

SAN FRANCISCO

Amended

Certificate of Authority

THIS IS TO CERTIFY, *That, pursuant to the Insurance Code of the State of California,*

Travelers Casualty and Surety Company of America

of Hartford, Connecticut *, organized under the laws of* Connecticut *, subject to its Articles of Incorporation or other fundamental organizational documents, is hereby authorized to transact within this State, subject to all provisions of this Certificate, the following classes of insurance:* Fire, Marine, Surety, Disability, Plate Glass, Liability, Workers' Compensation, Common Carrier Liability, Boiler and Machinery, Burglary, Credit, Sprinkler, Team and Vehicle, Automobile, Aircraft, and Miscellaneous *as such classes are now or may hereafter be defined in the Insurance Laws of the State of California.*

THIS CERTIFICATE *is expressly conditioned upon the holder hereof now and hereafter being in full compliance with all, and not in violation of any, of the applicable laws and lawful requirements made under authority of the laws of the State of California as long as such laws or requirements are in effect and applicable, and as such laws and requirements now are, or may hereafter be changed or amended.*

IN WITNESS WHEREOF, *effective as of the* 1st *day of* July, 1997, *I have hereunto set my hand and caused my official seal to be affixed this* 16th *day of* June, 19 97.

Chuck Quackenbush
Insurance Commissioner

By Victoria S. Sidbury
Deputy

NOTICE: Qualification with the Secretary of State must be accomplished as required by the California Corporations Code promptly after issuance of this Certificate of Authority. Failure to do so will be a violation of Ins. Code Sec. 701 and will be grounds for revoking this Certificate of Authority pursuant to the covenants made in the application therefor and the conditions contained herein.

THE FIDELITY AND DEPOSIT COMPANY

OF MARYLAND
1299 Zurich Way Schaumburg, IL 60196

Statement of Financial Condition
As Of December 31, 2019

ASSETS

Bonds		$ 255,279,821
Stocks		21,280,401
Cash and Short Term Investments		2,878,421
Reinsurance Recoverable		25,356,035
Federal Income Tax Recoverable		140,480
Other Accounts Receivable		20,383,843
TOTAL ADMITTED ASSETS		$ 325,319,001

LIABILITIES, SURPLUS AND OTHER FUNDS

Reserve for Taxes and Expenses		$ 795,381
Ceded Reinsurance Premiums Payable		43,024,327
Remittances and Items Unallocated		0
Payable to parents, subs and affiliates		0
Securities Lending Collateral Liability		0
TOTAL LIABILITIES		$ 43,819,708
Capital Stock, Paid Up	$ 5,000,000	
Surplus	276,499,293	
Surplus as regards Policyholders		281,499,293
TOTAL		$ 325,319,001

Securities carried at $164,223,431 in the above statement are deposited with various states as required by law.

Securities carried on the basis prescribed by the National Association of Insurance Commissioners. On the basis of market quotations for all bonds and stocks owned, the Company's total admitted assets at December 31, 2019 would be $322,248,132 and surplus as regards policyholders $288,428,424.

I, LAURA J. LAZARCZYK, Corporate Secretary of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing statement is a correct exhibit of the assets and liabilities of the said Company on the 31st day of December, 2019.

Laura J Lazarczyk
Corporate Secretary

State of Illinois
City of Schaumburg } SS:

Subscribed and sworn to, before me, a Notary Public of the State of Illinois, in the City of Schaumburg, this 25th day of February, 2020.

Daryl Joiner
Notary Public

DARRYL JOINER
OFFICIAL SEAL
Notary Public - State of Illinois
My Commission Expires 2/24/2022

ZURICH AMERICAN INSURANCE COMPANY
COMPARATIVE BALANCE SHEET
4 WORLD TRADE CENTER, 150 GREENWICH STREET, NEW YORK, NY 10007
As of December 31, 2019 and December 31, 2018

	12/31/2019	12/31/2018
Assets		
Bonds	$ 16,780,375,969	$ 17,540,109,648
Preferred Stock	-	-
Common Stock	3,121,559,258	3,132,639,174
Real Estate	1,273,640,596	1,373,151,270
Other Invested Assets	1,185,313,467	1,113,225,492
Derivatives	21,358	642,656
Short-term Investments	14,532,665	24,895,313
Receivable for securities	114,199,089	75,504,004
Cash and cash equivalents	42,548,382	(38,621,060)
Securities lending reinvested collateral assets	55,769,285	47,379,583
Employee Trust for Deferred Compensation Plan	129,612,266	142,053,861
Total Cash and Invested Assets	$ 22,717,572,333	$ 23,410,979,940
Premiums Receivable	$ 4,775,851,073	$ 4,800,865,144
Funds Held with Reinsurers	97,862	371,693
Reinsurance Recoverable	1,497,744,413	1,298,188,705
Accrued Investment Income	127,170,427	126,363,306
Federal Income Tax Recoverable	565,755,651	503,312,859
Due from Affiliates	204,233,875	205,170,893
Other Assets	527,556,278	602,852,006
Total Assets	$ 30,415,981,911	$ 30,948,104,546
Liabilities and Policyholders' Surplus		
Liabilities:		
Loss and LAE Reserves	$ 12,626,869,059	$ 13,849,911,195
Unearned Premium Reserve	3,845,794,904	3,819,936,876
Funds Held with Reinsurers	385,953,985	559,639,569
Loss In Course of Payment	1,442,194,686	959,528,132
Commission Reserve	124,215,143	120,056,749
Federal Income Tax Payable	-	-
Remittances and Items Unallocated	147,106,142	19,668,701
Payable to parent, subs and affiliates	294,896,500	106,578,289
Provision for Reinsurance	110,765,261	213,799,231
Ceded Reinsurance Premiums Payable	1,821,418,177	1,939,296,998
Securities Lending Collateral Liability	55,769,285	47,379,583
Other Liabilities	1,887,566,082	2,136,803,941
Total Liabilities	$ 22,742,549,225	$ 23,772,599,265
Policyholders' Surplus:		
Common Capital Stock	$ 5,000,000	$ 5,000,000
Paid-In and Contributed Surplus	4,394,131,321	4,394,131,321
Surplus Notes	-	-
Special Surplus Funds	2,910,000	5,106,000
Cumulative Unrealized Gain	118,847,749	52,396,417
Unassigned Surplus	3,152,543,616	2,718,871,543
Total Policyholders' Surplus	$ 7,673,432,686	$ 7,175,505,281
Total Liabilities and Policyholders' Surplus	$ 30,415,981,911	$ 30,948,104,546

I, LAURA J. LAZARCZYK, Corporate Secretary of ZURICH AMERICAN INSURANCE COMPANY do hereby certify that the foregoing statement is a correct exhibit of the assets and liabilities of the said Company, on the 31st day of December, 2019, according to the best of my information, knowledge and belief.

Laura J. Lazarczyk
Corporate Secretary

State of Illinois
County of Cook } SS:

Subscribed and sworn to, before me, a Notary Public of the State of Illinois, in the City of Schaumburg, this 25th day of February, 2020.

Darryl Joiner
Notary public

DARRYL JOINER
OFFICIAL SEAL
Notary Public - State of Illinois
My Commission Expires 2/24/2022

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by **Robert D. Murray**, Vice President, in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint, Krista A. BURKE, Charo J. ROSEMOND, Maria L. SPADACCINI, Sherryanne M. DEPIRRO, Nicholas F. WALSH, Lisa M. SCAVETTA, Elliott W. WOLFFE, James BALDASSARE, JR. And John F. SURANO, of Saddle Brook, New Jersey, its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: any and all bonds and undertakings, and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons. The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said **ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND**, this 28th day of July A.D. 2020.

ATTEST:
ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: *Robert D. Murray*
Vice President

By: *Dawn E. Brown*
Secretary

State of Maryland
County of Baltimore

On this 28th day of July , 2020, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **Robert D. Murray, Vice President and Dawn E. Brown, Secretary** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, deposeth and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Constance A. Dunn, Notary Public
My Commission Expires: July 9, 2023

EXTRACT FROM BY-LAWS OF THE COMPANIES

"Article V, Section 8, Attorneys-in-Fact. The Chief Executive Officer, the President, or any Executive Vice President or Vice President may, by written instrument under the attested corporate seal, appoint attorneys-in-fact with authority to execute bonds, policies, recognizances, stipulations, undertakings, or other like instruments on behalf of the Company, and may authorize any officer or any such attorney-in-fact to affix the corporate seal thereto; and may with or without cause modify of revoke any such appointment or authority at any time."

CERTIFICATE

I, the undersigned, Vice President of the ZURICH AMERICAN INSURANCE COMPANY, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that Article V, Section 8, of the By-Laws of the Companies is still in force.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the ZURICH AMERICAN INSURANCE COMPANY at a meeting duly called and held on the 15th day of December 1998.

RESOLVED: "That the signature of the President or a Vice President and the attesting signature of a Secretary or an Assistant Secretary and the Seal of the Company may be affixed by facsimile on any Power of Attorney...Any such Power or any certificate thereof bearing such facsimile signature and seal shall be valid and binding on the Company."

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994, and the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies, this 24th day of February, 2021.

Brian M. Hodges, Vice President

TO REPORT A CLAIM WITH REGARD TO A SURETY BOND, PLEASE SUBMIT A COMPLETE DESCRIPTION OF THE CLAIM INCLUDING THE PRINCIPAL ON THE BOND, THE BOND NUMBER, AND YOUR CONTACT INFORMATION TO:

Zurich Surety Claims
1299 Zurich Way
Schaumburg, IL 60196-1056
www.reportsfclaims@zurichna.com
800-626-4577

No. 4662

STATE OF CALIFORNIA

DEPARTMENT OF INSURANCE

SAN FRANCISCO

Amended

Certificate of Authority

THIS IS TO CERTIFY, *That, pursuant to the Insurance Code of the State of California,*

Fidelity and Deposit Company of Maryland

of Baltimore, Maryland, organized under the laws of Maryland, subject to its Articles of Incorporation or other fundamental organizational documents, is hereby authorized to transact within this State, subject to all provisions of this Certificate, the following classes of insurance: ***Fire, Marine, Surety, Plate Glass, Liability, Workers' Compensation, Common Carrier Liability, Boiler and Machinery, Burglary, Credit, Sprinkler, Team and Vehicle, Automobile, Aircraft, and Miscellaneous*** *as such classes are now or may hereafter be defined in the Insurance Laws of the State of California.*

THIS CERTIFICATE *is expressly conditioned upon the holder hereof now and hereafter being in full compliance with all, and not in violation of any, of the applicable laws and lawful requirements made under authority of the laws of the State of California as long as such laws or requirements are in effect and applicable, and as such laws and requirements now are, or may hereafter be changed or amended.*

IN WITNESS WHEREOF, *effective as of the 29th day of January, 1985, I have hereunto set my hand and caused my official seal to be affixed this 29th day of January, 1985.*

Fee	$50.00		Bruce Bunner *Insurance Commissioner*
Rec. No.	S4314		
Filed	12/3/84	*By*	Victoria S. Sidbury *Deputy*

Certification

I, the undersigned Insurance Commissioner of the State of California, do hereby certify that I have compared the above copy of Certificate of Authority with the duplicate of original now on file in my office, and that the same is a full, true, and correct transcript thereof, and of the whole of said duplicate, and said Certificate of Authority is now in full force and effect.

IN WITNESS WHEREOF, *I have hereunto set my hand and caused my official seal to be affixed this 3rd day of August, 2000.*

J. Clark Kelso
Acting Insurance Commissioner

Pauline D'Andrea
Deputy

No. 6837

STATE OF CALIFORNIA

DEPARTMENT OF INSURANCE

SAN FRANCISCO

Certificate of Authority

THIS IS TO CERTIFY, *That, pursuant to the Insurance Code of the State of California,*

Zurich American Insurance Company

of New York, New York, organized under the laws of New York, subject to its Articles of Incorporation or other fundamental organizational documents, is hereby authorized to transact within this State, subject to all provisions of this Certificate, the following classes of insurance:

Fire, Marine Surety, Disability, Plate Glass, Liability, Workers' Compensation, Common Carrier Liability, Boiler and Machinery, Burglary, Credit, Sprinkler, Team and Vehicle, Automobile, Aircraft, and Miscellaneous

as such classes are now or may hereafter be defined in the Insurance Laws of the State of California.

THIS CERTIFICATE *is expressly conditioned upon the holder hereof now and hereafter being in full compliance with all, and not in violation of any, of the applicable laws and lawful requirements made under authority of the laws of the State of California as long as such laws or requirements are in effect and applicable, and as such laws and requirements now are, or may hereafter be changed or amended.*

IN WITNESS WHEREOF, *effective as of the 1st day of January, 1999, I have hereunto set my hand and caused my official seal to be affixed this 30th day of April, 1999.*

Fee $2,833.00

Rec. No.

Chuck Quackenbush
Insurance Commissioner

Filed 12/30/98 *By* *Victoria S. Sidbury*
Deputy

Certification

I, the undersigned Insurance Commissioner of the State of California, do hereby certify that I have compared the above copy of Certificate of Authority with the duplicate of original now on file in my office, and that the same is a full, true, and correct transcript thereof, and of the whole of said duplicate, and said Certificate of Authority is now in full force and effect.

IN WITNESS WHEREOF, *I have hereunto set my hand and caused my official seal to be affixed this 12th day of July, 2004.*

John Garamendi
Insurance Commissioner

By Pauline D'Andrea
Pauline D'Andrea

FEDERAL INSURANCE COMPANY

STATEMENT OF ASSETS, LIABILITIES AND SURPLUS TO POLICYHOLDERS

Statutory Basis

December 31, 2019

(in thousands)

ASSETS		*LIABILITIES AND SURPLUS TO POLICYHOLDERS*	
Cash and Short Term Investments	$ (429,780)	Outstanding Losses and Loss Expenses	$ 6,823,691
United States Government, State and Municipal Bonds	4,559,706	Reinsurance Payable on Losses and Expenses	1,433,250
Other Bonds	5,314,219	Unearned Premiums	2,014,727
Stocks	32,735	Ceded Reinsurance Premiums Payable	353,115
Other Invested Assets	1,028,733	Other Liabilities	849,544
TOTAL INVESTMENTS	10,506,613	TOTAL LIABILITIES	11,474,327
Investments in Affiliates:		Capital Stock	20,980
Great Northern Ins. Co.	395,442	Paid-In Surplus	2,711,474
Vigilant Ins. Co.	341,290	Unassigned Funds	1,306,881
Chubb Indemnity Ins. Co.	178,808		
Chubb National Ins. Co.	181,053	SURPLUS TO POLICYHOLDERS	4,039,335
Other Affiliates	97,150		
Premiums Receivable	1,511,096		
Other Assets	2,302,210		
TOTAL ADMITTED ASSETS	$ 15,513,662	TOTAL LIABILITIES AND SURPLUS	$ 15,513,662

Investments are valued in accordance with requirements of the National Association of Insurance Commissioners. At December 31, 2019, investments with a carrying value of $508,749,121 were deposited with government authorities as required by law.

STATE OF PENNSYLVANIA

COUNTY OF PHILADELPHIA

John Taylor, being duly sworn, says that he is Senior Vice President of Federal Insurance Company and that to the best of his knowledge and belief the foregoing is a true and correct statement of the said Company's financial condition as of the 31 st day of December, 2019.

Sworn before me this April 14, 2020

DocuSigned by:
John Taylor
D28C1FBD5...
Senior Vice President

Notary Public

August 8, 2023
My commission expires

Commonwealth of Pennsylvania - Notary Seal
Diane Wright, Notary Public
Philadelphia County
My commission expires August 8, 2023
Commission number 1235745
Member, Pennsylvania Association of Notaries

CHUBB

Power of Attorney

Federal Insurance Company | Vigilant Insurance Company | Pacific Indemnity Company
Westchester Fire Insurance Company | ACE American Insurance Company

Know All by These Presents, that **FEDERAL INSURANCE COMPANY**, an Indiana corporation, **VIGILANT INSURANCE COMPANY**, a New York corporation, **PACIFIC INDEMNITY COMPANY**, a Wisconsin corporation, **WESTCHESTER FIRE INSURANCE COMPANY** and **ACE AMERICAN INSURANCE COMPANY** corporations of the Commonwealth of Pennsylvania, do each hereby constitute and appoint James Baldassare Jr., Krista A. Burke, Sherryanne M. DePirro, Charo J. Rosemond, Lisa M. Scavetta, Maria L. Spadaccini, John F. Surano, Nicholas F. Walsh and Elliott W. Wolffe of Saddle Brook, New Jersey ----------

each as their true and lawful Attorney-in-Fact to execute under such designation in their names and to affix their corporate seals to and deliver for and on their behalf as surety thereon or otherwise, bonds and undertakings and other writings obligatory in the nature thereof (other than bail bonds) given or executed in the course of business, and any instruments amending or altering the same, and consents to the modification or alteration of any instrument referred to in said bonds or obligations.

In Witness Whereof, said **FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY** and **ACE AMERICAN INSURANCE COMPANY** have each executed and attested these presents and affixed their corporate seals on this **29th** day of **July, 2020**.

Dawn M. Chloros, Assistant Secretary

Stephen M Haney, Vice President

STATE OF NEW JERSEY
County of Hunterdon ss:

On this **29th** day of **July, 2020** before me, a Notary Public of New Jersey, personally came Dawn M. Chloros and Stephen M. Haney, to me known to be Assistant Secretary and Vice President, respectively, of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY, the companies which executed the foregoing Power of Attorney, and the said Dawn M. Chloros and Stephen M. Haney, being by me duly sworn, severally and each for herself and himself did depose and say that they are Assistant Secretary and Vice President, respectively, of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY and know the corporate seals thereof, that the seals affixed to the foregoing Power of Attorney are such corporate seals and were thereto affixed by authority of said Companies; and that their signatures as such officers were duly affixed and subscribed by like authority.

Notarial Seal

KATHERINE J. ADELAAR
NOTARY PUBLIC OF NEW JERSEY
No. 2316686
Commission Expires July 16, 2024

Notary Public

CERTIFICATION

Resolutions adopted by the Boards of Directors of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY on August 30, 2016; WESTCHESTER FIRE INSURANCE COMPANY on December 11, 2006; and ACE AMERICAN INSURANCE COMPANY on March 20, 2009:

"RESOLVED, that the following authorizations relate to the execution, for and on behalf of the Company, of bonds, undertakings, recognizances, contracts and other written commitments of the Company entered into in the ordinary course of business (each a "Written Commitment"):

(1) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise.

(2) Each duly appointed attorney-in-fact of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise, to the extent that such action is authorized by the grant of powers provided for in such person's written appointment as such attorney-in-fact.

(3) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to appoint in writing any person the attorney-in-fact of the Company with full power and authority to execute, for and on behalf of the Company, under the seal of the Company or otherwise, such Written Commitments of the Company as may be specified in such written appointment, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.

(4) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to delegate in writing to any other officer of the Company the authority to execute, for and on behalf of the Company, under the Company's seal or otherwise, such Written Commitments of the Company as are specified in such written delegation, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.

(5) The signature of any officer or other person executing any Written Commitment or appointment or delegation pursuant to this Resolution, and the seal of the Company, may be affixed by facsimile on such Written Commitment or written appointment or delegation.

FURTHER RESOLVED, that the foregoing Resolution shall not be deemed to be an exclusive statement of the powers and authority of officers, employees and other persons to act for and on behalf of the Company, and such Resolution shall not limit or otherwise affect the exercise of any such power or authority otherwise validly granted or vested."

I, Dawn M. Chloros, Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY (the "Companies") do hereby certify that

(i) the foregoing Resolutions adopted by the Board of Directors of the Companies are true, correct and in full force and effect,
(ii) the foregoing Power of Attorney is true, correct and in full force and effect.

Given under my hand and seals of said Companies at Whitehouse Station, NJ, this 24th day of February 2021

Dawn M. Chloros, Assistant Secretary

IN THE EVENT YOU WISH TO VERIFY THE AUTHENTICITY OF THIS BOND OR NOTIFY US OF ANY OTHER MATTER, PLEASE CONTACT US AT:
Telephone (908) 903-3493 Fax (908) 903-3656 e-mail: surety@chubb.com

No. 5389

STATE OF CALIFORNIA

DEPARTMENT OF INSURANCE

SAN FRANCISCO

Amended

Certificate of Authority

THIS IS TO CERTIFY, *That, pursuant to the Insurance Code of the State of California,*

Federal Insurance Company

of Indianapolis, Indiana, organized under the laws of Indiana, subject to its Articles of Incorporation or other fundamental organizational documents, is hereby authorized to transact within this State, subject to all provisions of this Certificate, the following classes of insurance:

Fire, Marine, Surety, Disability, Plate Glass, Liability, Workers' Compensation, Common Carrier Liability, Boiler and Machinery, Burglary, Credit, Sprinkler, Team and Vehicle, Automobile, Aircraft, and Miscellaneous

as such classes are now or may hereafter be defined in the Insurance Laws of the State of California.

THIS CERTIFICATE *is expressly conditioned upon the holder hereof now and hereafter being in full compliance with all, and not in violation of any, of the applicable laws and lawful requirements made under authority of the laws of the State of California as long as such laws or requirements are in effect and applicable, and as such laws and requirements now are, or may hereafter be changed or amended.*

IN WITNESS WHEREOF, *effective as of the 15th day of October, 1990, I have hereunto set my hand and caused my official seal to be affixed this 15th day of October, 1990.*

Fee $77.00

Rec. No. 542421

Filed 5/30/90

Roxani M. Gillespie
Insurance Commissioner

By *Victoria S. Sidbury*
Deputy

Certification

I, the undersigned Insurance Commissioner of the State of California, do hereby certify that I have compared the above copy of Certificate of Authority with the duplicate of original now on file in my office, and that the same is a full, true, and correct transcript thereof, and of the whole of said duplicate, and said Certificate of Authority is now in full force and effect.

IN WITNESS WHEREOF, *I have hereunto set my hand and caused my official seal to be affixed this 23rd day of June, 2016.*

Dave Jones
Insurance Commissioner

By Pauline D'Andrea
Pauline D'Andrea

THE CONTINENTAL INSURANCE COMPANY
Radnor, Pennsylvania
Statement of Net Admitted Assets and Liabilities
December 31, 2019

ASSETS

Bonds	$	1,481,607,790
Stocks		149,068,820
Cash and short-term investments		46,365,488
Receivables for securities		5,096
Investment income due and accrued		17,241,033
Amounts recoverable from reinsurers		69,267,722
Funds held by or deposited with reinsured companies		1,510,746
Current federal and foreign income tax recoverable and interest thereon		27
Net deferred tax asset		45,370,451
Premiums and considerations		37,682,138
Other assets		5,084,554
Total Assets	$	1,853,203,866

LIABILITIES AND SURPLUS

Losses	$	695,841,667
Loss adjustment expense		35,324,809
Unearned premiums		-
Other expenses		-
Ceded reinsurance premiums payable (net of ceding commissions)		39,039,533
Funds held by company under reinsurance treaties		2,271,425
Provision for reinsurance		46,000,000
Other liabilities		(650,201,839)
Total Liabilities	$	168,275,595

Surplus Account:			
Capital paid up	$	53,566,360	
Gross paid in and contributed surplus		1,423,436,994	
Special Surplus		380,695,800	
Unassigned funds		(172,770,883)	
Surplus as regards policyholders			$ 1,684,928,271
Total Liabilities and Capital			$ 1,853,203,866

I, Amy Smith, Senior Vice President of Continental Insurance Company hereby certify that the above is an accurate representation of the financial statement of the Company dated December 31, 2019, as filed with the various Insurance Departments and is a true and correct statement of the condition of Continental Insurance Company as of that date.

THE CONTINENTAL INSURANCE COMPANY

By _____
Senior Vice President

Subscribed and sworn to me this 11th day of March, 2020.

My commission expires:

YOLANDA JIMENEZ
OFFICIAL SEAL
Notary Public, State of Illinois
My Commission Expires
September 24, 2021

By _____
Notary Public

POWER OF ATTORNEY APPOINTING INDIVIDUAL ATTORNEY-IN-FACT

Know All Men By These Presents, That The Continental Insurance Company, a Pennsylvania insurance company, is a duly organized and existing insurance company having its principal office in the City of Chicago, and State of Illinois, and that it does by virtue of the signature and seal herein affixed hereby make, constitute and appoint

Elliott W Wolffe, Maria L Spadaccini, James Baldassare Jr, Sherryanne M DePirro, Nicholas F Walsh, Lisa M Scavetta, Krista A Burke, Charo J Rosemond, John F Surano, Individually

of Saddle Brook, NJ, its true and lawful Attorney(s)-in-Fact with full power and authority hereby conferred to sign, seal and execute for and on its behalf bonds, undertakings and other obligatory instruments of similar nature

- In Unlimited Amounts -

and to bind them thereby as fully and to the same extent as if such instruments were signed by a duly authorized officer of the insurance company and all the acts of said Attorney, pursuant to the authority hereby given is hereby ratified and confirmed.

This Power of Attorney is made and executed pursuant to and by authority of the By-Law and Resolutions, printed on the reverse hereof, duly adopted, as indicated, by the Board of Directors of the insurance company.

In Witness Whereof, The Continental Insurance Company has caused these presents to be signed by its Vice President and its corporate seal to be hereto affixed on this 19th day of August, 2020.

The Continental Insurance Company

Paul T. Bruflat — Vice President

State of South Dakota, County of Minnehaha, ss:

On this 19th day of August, 2020, before me personally came Paul T. Bruflat to me known, who, being by me duly sworn, did depose and say: that he resides in the City of Sioux Falls, State of South Dakota; that he is a Vice President of The Continental Insurance Company, a Pennsylvania insurance company, described in and which executed the above instrument; that he knows the seal of said insurance company; that the seal affixed to the said instrument is such corporate seal; that it was so affixed pursuant to authority given by the Board of Directors of said insurance company and that he signed his name thereto pursuant to like authority, and acknowledges same to be the act and deed of said insurance company.

J. MOHR NOTARY PUBLIC SOUTH DAKOTA

My Commission Expires June 23, 2021

J. Mohr — Notary Public

CERTIFICATE

I, D. Johnson, Assistant Secretary of The Continental Insurance Company, a Pennsylvania insurance company, do hereby certify that the Power of Attorney herein above set forth is still in force, and further certify that the By-Law and Resolution of the Board of Directors of the insurance company printed on the reverse hereof is still in force. In testimony whereof I have hereunto subscribed my name and affixed the seal of the said insurance company this 24th day of February 2021

The Continental Insurance Company

D. Johnson — Assistant Secretary

Form F6850-4/2012

Go to www.cnasurety.com > Owner / Obligee Services > Validate Bond Coverage, if you want to verify bond authenticity.

Authorizing By-Laws and Resolutions

ADOPTED BY THE BOARD OF DIRECTORS OF THE CONTINENTAL INSURANCE COMPANY:

This Power of Attorney is made and executed pursuant to and by authority of the following By-Law duly adopted by the Board of Directors of the Company at a meeting held on May 10, 1995.

> "RESOLVED: That any Group Vice President may authorize an officer to sign specific documents, agreements and instruments on behalf of the Company provided that the name of such authorized officer and a description of the documents, agreements or instruments that such officer may sign will be provided in writing by the Group Vice President to the Secretary of the Company prior to such execution becoming effective.

This Power of Attorney is signed by Paul T. Bruflat, Vice President, who has been authorized pursuant to the above resolution to execution power of attorneys on behalf of The Continental Insurance Company.

This Power of Attorney is signed and sealed by facsimile under and by the authority of the following Resolution adopted by the Board of Directors of the Company by unanimous written consent dated the 25th day of April, 2012.

> "Whereas, the bylaws of the Company or specific resolution of the Board of Directors has authorized various officers (the "Authorized Officers") to execute various policies, bonds, undertakings and other obligatory instruments of like nature; and
>
> Whereas, from time to time, the signature of the Authorized Officers, in addition to being provided in original, hard copy format, may be provided via facsimile or otherwise in an electronic format (collectively, "Electronic Signatures"), Now therefore be it resolved: that the Electronic Signature of any Authorized Officer shall be valid and binding on the Company."

STATE OF CALIFORNIA
DEPARTMENT OF INSURANCE Nº 08299
SAN FRANCISCO

Amended

Certificate of Authority

THIS IS TO CERTIFY THAT, *Pursuant to the Insurance Code of the State of California,*

The Continental Insurance Company

of Pennsylvania , *organized under the laws of* Pennsylvania , *subject to its Articles of Incorporation or other fundamental organizational documents, is hereby authorized to transact within the State, subject to all provisions of this Certificate, the following classes of insurance:* Fire, Marine, Surety, Disability, Plate Glass, Liability, Workers' Compensation, Common Carrier Liability, Boiler and Machinery, Burglary, Credit, Sprinkler, Team and Vehicle, Automobile, Aircraft, and Miscellaneous

as such classes are now or may hereafter be defined in the Insurance Laws of the State of California.

THIS CERTIFICATE *is expressly conditioned upon the holder hereof now and hereafter being in full compliance with all, and not in violation of any, of the applicable laws and lawful requirements made under authority of the laws of the State of California as long as such laws or requirements are in effect and applicable, and as such laws and requirements now are, or may hereafter be changed or amended.*

IN WITNESS WHEREOF, *effective as of the* 4th *day of* December, 2006, *I have hereunto set my hand and caused my official seal to be affixed this* 4th *day of* December, 2006

John Garamendi
Insurance Commissioner

By Patricia K. Staggs
for Richard D. Baum
Chief Deputy

NOTICE:
Qualification with the Secretary of State must be accomplished as required by the California Corporations Code promptly after issuance of this Certificate of Authority. Failure to do so will be a violation of Insurance Code Section 701 and will be grounds for revoking this Certificate of Authority pursuant to the convenants made in the application therefor and the conditions contained herein.

FORM CS-3 OSP 00

BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY

1314 Douglas Street, Suite 1400, Omaha, Nebraska 68102-1944

ADMITTED ASSETS*

	12/31/2019	12/31/2018	12/31/2017
Total invested assets	$ 5,172,183,338	$ 4,313,185,189	$ 4,516,104,907
Premium & agent balances (n	368,086,012	301,849,144	297,141,264
All other assets	127,524,677	140,930,406	137,220,394
Admitted Assets	$ 5,667,794,027	$ 4,755,964,739	$ 4,950,466,565

LIABILITIES & SURPLUS*

	12/31/2019	12/31/2018	12/31/2017
Loss & loss exp. unpaid	$ 634,745,558	$ 463,103,223	$ 327,823,391
Unearned premiums	314,117,549	241,835,588	209,113,536
All other liabilities	744,738,458	570,628,148	663,892,150
Total Liabilities	1,693,601,565	1,275,566,959	1,200,829,077
Total Policyholders' Surplu	3,974,192,463	3,480,397,780	3,749,637,488
Total Liabilities & Surplus	$ 5,667,794,028	$ 4,755,964,739	$ 4,950,466,565

* Assets, liabilities and surplus are presented on a Statutory Accounting Basis as promulgated by the NAIC and/or the laws of the company's domiciliary state.

Berkshire Hathaway Specialty Insurance

Power Of Attorney

BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY
NATIONAL INDEMNITY COMPANY / NATIONAL LIABILITY & FIRE INSURANCE COMPANY

Know all men by these presents, that **BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY**, a corporation existing under and by virtue of the laws of the State of Nebraska and having an office at One Lincoln Street, 23rd Floor, Boston, Massachusetts 02111, **NATIONAL INDEMNITY COMPANY**, a corporation existing under and by virtue of the laws of the State of Nebraska and having an office at 3024 Harney Street, Omaha, Nebraska 68131 and **NATIONAL LIABILITY & FIRE INSURANCE COMPANY**, a corporation existing under and by virtue of the laws of the State of Connecticut and having an office at 100 First Stamford Place, Stamford, Connecticut 06902 (hereinafter collectively the "Companies"), pursuant to and by the authority granted as set forth herein, do hereby name, constitute and appoint: **Lisa M. Scavetta, Sherryanne M. DePirro, Maria L. Spadaccini, Nicholas F. Walsh, Elliott W. Wolffe, Andrew Waterbury, James Baldassare, Jr., Krista A. Burke, Charo J. Rosemond, John F. Surano, 250 Pehle Avenue, Suite 311 of the city of Saddle Brook, State of New Jersey,** their true and lawful attorney(s)-in-fact to make, execute, seal, acknowledge, and deliver, for and on their behalf as surety and as their act and deed, any and all undertakings, bonds, or other such writings obligatory in the nature thereof, in pursuance of these presents, the execution of which shall be as binding upon the Companies as if it has been duly signed and executed by their regularly elected officers in their own proper persons. **This authority for the Attorney-in-Fact shall be limited to the execution of the attached bond(s) or other such writings obligatory in the nature thereof.**

In witness whereof, this Power of Attorney has been subscribed by an authorized officer of the Companies, and the corporate seals of the Companies have been affixed hereto this date of December 20, 2018. This Power of Attorney is made and executed pursuant to and by authority of the Bylaws, Resolutions of the Board of Directors, and other Authorizations of **BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY, NATIONAL INDEMNITY COMPANY** and **NATIONAL LIABILITY & FIRE INSURANCE COMPANY**, which are in full force and effect, each reading as appears on the back page of this Power of Attorney, respectively. **The following signature by an authorized officer of the Company may be a facsimile, which shall be deemed the equivalent of and constitute the written signature of such officer of the Company for all purposes regarding this Power of Attorney, including satisfaction of any signature requirements on any and all undertakings, bonds, or other such writings obligatory in the nature thereof, to which this Power of Attorney applies.**

BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY,

By: _____
David Fields, Executive Vice President

NATIONAL INDEMNITY COMPANY,
NATIONAL LIABILITY & FIRE INSURANCE COMPANY,

By: _____
David Fields, Vice President

NOTARY
State of Massachusetts, County of Suffolk, ss:
On this 20th day of December, 2018, before me appeared David Fields, Executive Vice President of BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY and Vice President of NATIONAL INDEMNITY COMPANY and NATIONAL LIABILITY & FIRE INSURANCE COMPANY, who being duly sworn, says that his capacity is as designated above for such Companies; that he knows the corporate seals of the Companies; that the seals affixed to the foregoing instrument are such corporate seals; that they were affixed by order of the board of directors or other governing body of said Companies pursuant to its Bylaws, Resolutions and other Authorizations, and that he signed said instrument in that capacity of said Companies.

[Notary Seal]

GEOFFERY A. DELISIO
Notary Public
Commonwealth of Massachusetts
My Comm. Expires November 29, 2024

_____
Notary Public

I, Ralph Tortorella, the undersigned, Officer of **BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY, NATIONAL INDEMNITY COMPANY** and **NATIONAL LIABILITY & FIRE INSURANCE COMPANY**, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies which is in full force and effect and has not been revoked. IN TESTIMONY WHEREOF, see hereunto affixed the seals of said Companies this February 24, 2021.

_____
Officer

To verify the authenticity of this Power of Attorney please contact us at: BHSI Surety Department, Berkshire Hathaway Specialty Insurance Company, One Lincoln Street, 23rd Floor Boston, MA 02111 | (770) 625-2516 or by email at Jennifer.Porter@bhspecialty.com *THIS POWER OF ATTORNEY IS VOID IF ALTERED*

To notify us of a claim please contact us on our 24-hour toll free number at (855) 453-9675, via email at claimsnotice@bhspecialty.com, via fax to (617) 507-8259, or via mail.

BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY (BYLAWS)

ARTICLE V.

CORPORATE ACTIONS

. . . .

EXECUTION OF DOCUMENTS:

. . . .

Section 6.(b) The President, any Vice President or the Secretary, shall have the power and authority:

(1) To appoint Attorneys-in-fact, and to authorize them to execute on behalf of the Company bonds and other undertakings, and

(2) To remove at any time any such Attorney-in-fact and revoke the authority given him.

NATIONAL INDEMNITY COMPANY (BY-LAWS)

Section 4. Officers, Agents, and Employees:

A. The officers shall be a President, one or more Vice Presidents, a Secretary, one or more Assistant Secretaries, a Treasurer, and one or more Assistant Treasurers none of whom shall be required to be shareholders or Directors and each of whom shall be elected annually by the Board of Directors at each annual meeting to serve a term of office of one year or until a successor has been elected and qualified, may serve successive terms of office, may be removed from office at any time for or without cause by a vote of a majority of the Board of Directors, and shall have such powers and rights and be charged with such duties and obligations as usually are vested in and pertain to such office or as may be directed from time to time by the Board of Directors; and the Board of Directors or the officers may from time to time appoint, discharge, engage, or remove such agents and employees as may be appropriate, convenient, or necessary to the affairs and business of the corporation.

NATIONAL INDEMNITY COMPANY (BOARD RESOLUTION ADOPTED AUGUST 6, 2014)

RESOLVED, That the President, any Vice President or the Secretary, shall have the power and authority to (1) appoint Attorneys-in-fact, and to authorize them to execute on behalf of this Company bonds and other undertakings and (2) remove at any time any such Attorney-in-fact and revoke the authority given.

NATIONAL LIABILITY & FIRE INSURANCE COMPANY (BY-LAWS)

ARTICLE IV

Officers

Section 1. Officers, Agents and Employees:

A. The officers shall be a president, one or more vice presidents, one or more assistant vice presidents, a secretary, one or more assistant secretaries, a treasurer, and one or more assistant treasurers, none of whom shall be required to be shareholders or directors, and each of whom shall be elected annually by the board of directors at each annual meeting to serve a term of office of one year or until a successor has been elected and qualified, may serve successive terms of office, may be removed from office at any time for or without cause by a vote of a majority of the board of directors. The president and secretary shall be different individuals. Election or appointment of an officer or agent shall not create contract rights. The officers of the Corporation shall have such powers and rights and be charged with such duties and obligations as usually are vested in and pertain to such office or as may be directed from time to time by the board of directors; and the board of directors or the officers may from time to time appoint, discharge, engage, or remove such agents and employees as may be appropriate, convenient, or necessary to the affairs and business of the Corporation.

NATIONAL LIABILITY & FIRE INSURANCE COMPANY (BOARD RESOLUTION ADOPTED AUGUST 6, 2014)

RESOLVED, That the President, any Vice President or the Secretary, shall have the power and authority to (1) appoint Attorneys-in-fact, and to authorize them to execute on behalf of this Company bonds and other undertakings and (2) remove at any time any such Attorney-in-fact and revoke the authority given.

No. 3148-4

STATE OF CALIFORNIA

DEPARTMENT OF INSURANCE

SAN FRANCISCO

Amended

Certificate of Authority

THIS IS TO CERTIFY *that, pursuant to the Insurance Code of the State of California,*

Berkshire Hathaway Specialty Insurance Company

of Nebraska, organized under the laws of Nebraska, subject to its Articles of Incorporation or other fundamental organizational documents, is hereby authorized to transact within this State, subject to all provisions of this Certificate, the following classes of insurance:

Fire, Marine, Surety, Disability, Plate Glass, Liability, Workers' Compensation, Common Carrier Liability, Boiler and Machinery, Burglary, Sprinkler, Automobile, Aircraft, and Miscellaneous

as such classes are now or may hereafter be defined in the Insurance Laws of the State of California.

THIS CERTIFICATE *is expressly conditioned upon the holder hereof now and hereafter being in full compliance with all, and not in violation of any, of the applicable laws and lawful requirements made under authority of the laws of the State of California as long as such laws or requirements are in effect and applicable, and as such laws and requirements now are, or may hereafter be changed or amended.*

IN WITNESS WHEREOF, *effective as of the 4th day of September, 2015, I have hereunto set my hand and caused my official seal to be affixed this 4th day of September, 2015.*

Dave Jones
Insurance Commissioner

By

Susan J. Stapp
for Nettie Hoge
Chief Deputy

NOTICE:
Qualification with the Secretary of State must be accomplished as required by the California Corporations Code promptly after issuance of this Certificate of Authority. Failure to do so will be a violation of Insurance Code section 701 and will be grounds for revoking this Certificate of Authority pursuant to the covenants made in the application therefor and the conditions contained herein.

ATTACHMENTS

ATTACHMENT A

SCOPE OF WORK

SCOPE OF WORK

1. **SCOPE OF WORK:** The project consists of the demolition of existing facilities at the proposed Morena Pump Station site, the construction of a new 37.7 MGD Morena Wastewater Pump Station Facility, including Odor Control Systems, Electrical Building, Screening Facility, High Purity Oxygen System, Maintenance Building, associated civil site work including storm drainage, yard piping, perimeter walls, access gates, pavement, landscaping and other appurtenances. The project also includes the construction of 48-inch, 60-inch & 66-inch diversion and overflow sewers, three diversion structures with slide gates and one junction structure on Friars Rd.

1.1 The Work shall be performed in accordance with:

- Plans numbered **40421-1-D** through **40421–287-D** for the Morena Pump Station.

  Refer to this link for the PDF of the plans.

  https://filecloud.sandiego.gov/url/1801a

- General Requirements as detailed in DIV 01 of CSI shall support equivalent sections as defined in the Whitebook.

- The "Technical Specifications" are broken down such: DIV 01 shall be applied to all aspects of the aforementioned items, including all work within Friars Road and adjacent to the Pump Station Site; DIV 02 through DIV 44 shall only be applied to all work within the Pump Station Site, all trenchless work and all junction and diversion structures.

- Right of Way Improvements not described above such as curb, gutter, sidewalk, asphalt paving, driveways and traffic control shall be performed per Whitebook and City Standards unless otherwise noted.

2. **LOCATION OF WORK:** The location of the Work is as follows:

Morena Pump Station site located at 887 Sherman St. San Diego, CA 92110.

Diversion Sewers and Structures located on Friars Rd bound by the Interstate 5 to the West and Napa St. to the East.

3. **CONTRACT TIME:** The Contract Time for completion of the Work, including the Plant Establishment Period, and overall Pure Water Phase 1 commissioning, shall be 925 Working Days.

Activity	Working Days from Start of Contract
Notice to Proceed	0 days
Intermediate Substantial Completion	750 days
Substantial Completion	895 days
Final Completion	925 days

The Contractor shall have 750 Working Days to complete Intermediate Substantial Completion. After Intermediate Substantial Completion the Contractor shall support the pumping of wastewater to the NCWRP as part of the Pure Water Phase 1 Integrated Facilities Acceptance to obtain Substantial Completion. Contractor's support after Intermediate Substantial Completion is described in Section 01 91 14 Testing, Integration and Startup and will include the following activities:

- Increase Flow to NCWRP
- Integration Period
- Integrated Facilities Acceptance Testing

ATTACHMENT B

PHASED FUNDING PROVISIONS

PHASED FUNDING PROVISIONS

1. PRE-AWARD

1.1. Within 10 Working Days of the Notice of Intent to Award, the Contractor must contact the Project Manager to discuss fund availability for each phase and shall also submit the following:

1.1.1. Construction Cost Loaded Schedule in accordance with 6-1, "CONSTRUCTION SCHEDULE AND COMMENCEMENT OF THE WORK" and 9-3, "PAYMENT.

1.2. Contractor's failure to perform any of the following may result cancelling the award of the Contract:

1.2.1. Meeting with the City's Project Manager to discuss the Phased Funding Schedule.

1.2.2. Agreeing to a Phased Funding Schedule within **22** days of meeting with the City's Project Manager.

2. POST-AWARD

2.1. Do not start any construction activities for the next phase until the Notice to Proceed (NTP) has been issued by the City. The City will issue a separate NTP for each phase.

2.2. The City may issue the NTP for a subsequent phase before the completion of the preceding phase.

PHASED FUNDING SCHEDULE AGREEMENT

The particulars left blank below, such as the total number of phases and the amounts assigned to each phase, will be completed with funding specific information from the Pre-Award Schedule and Construction Cost Loaded Schedule submitted to and approved by the City.

BID NUMBER:_____

CONTRACT OR TASK TITLE:_____

CONTRACTOR:_____

Funding Phase	Phase Description	Phase Start	Phase Finish	Not-to-Exceed Amount
1				$
2				$
3				$
			Contract Total	$

Notes:

1) WHITEBOOK section 6-1.4, "Phased Funding Compensation" applies.
2) The total of all funding phases shall be equal to the TOTAL BID PRICE as shown on BID SCHEDULE 1 - PRICES.
3) This PHASED FUNDING SCHEDULE AGREEMENT will be incorporated into the CONTRACT and shall only be revised by written modifications to the CONTRACT.

CITY OF SAN DIEGO

PRINT NAME:_____

Construction Senior Engineer

Signature:_____

Date:_____

PRINT NAME:_____

Design Senior Engineer

Signature:_____

Date:_____

CONTRACTOR

PRINT NAME:_____

Title:_____

Signature:_____

Date:_____

ATTACHMENT C

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ATTACHMENT D

CALIFORNIA STATE REVOLVING FUND (CASRF), METROPOLITAN WATER DISTRICT 2014 LOCAL RESOURCES PROGRAM, AND ENVIRONMENTAL PROTECTION AGENCY (EPA) REQUIREMENTS:

CLEAN WATER STATE REVOLVING FUND (CWSRF)

DRINKING WATER STATE REVOLVING FUND (DWSRF)

WATER INFRASTRUCTURE FINANCE AND INNOVATION ACT (WIFIA)

PROP 68

BUREAU OF RECLAMATION (BOR)

IN THE EVENT THAT THESE REQUIREMENTS CONFLICT WITH THE CITY'S GENERAL EOC REQUIREMENTS, THE FUNDING AGENCY'S REQUIREMENTS WILL CONTROL.

1. WATER INFRASTRUCTURE FINANCE AND INNOVATION ACT (WIFIA) PROGRAM, 2014 LOCAL RESOURCES PROGRAM, AND CALIFORNIA STATE REVOLVING FUND (CASRF) REQUIREMENTS.

The City anticipates receiving financial assistance from the Federal Government, the Metropolitan Water District of Southern California, and the State of California for this project. The following requirements are conditions of the receipt of financial assistance from the United States Environmental Protection Agency under the Federal **Water Infrastructure Finance and Innovation Act (WIFIA**), the **Metropolitan Water District** under the **2014 Local Resources Program**, and the State Water Resources Control Board under the **California Water State Revolving Fund (CASRF)** program. The firm contracting with the City (Contractor) shall comply with all of the following requirements. If there are other provisions in the Contract Documents that address the same subjects as this exhibit, Contractor shall comply with both provisions, with the more stringent requirements controlling. If there is a direct conflict between the Agreement and this exhibit, the requirements of this Exhibit shall control in order to preserve the City's eligibility to receive financial assistance.

1.1. RECORDS. Contractor shall maintain separate books, records and other material relative to the Project. Contractor shall also retain such books, records, and other material for itself and for each subcontractor who performed or performs work on this project for a minimum of thirty-six (36) years after Project Completion. Contractor shall require that such books, records, and other material are subject at all reasonable times (at a minimum during normal business hours) to inspection, copying, and audit by the State Water Board, the California State Auditor, the Bureau of State Audits, the United States Environmental Protection Agency (USEPA), the Office of Inspector General, the Internal Revenue Service, the Governor, or any authorized representatives of the aforementioned. Contractor shall allow and shall require its subcontractors to allow interviews during normal business hours of any employees who might reasonably have information related to such records. Contractor agrees to include a similar duty regarding audit, interviews, and records retention in any subcontract related to the performance of this Agreement. The provisions of this section shall survive the termination or expiration of this Agreement. (CWSRF Agmt. § 2.17(b); DWSRF Agmt. Ex. C § C.3.2(d)).

1.2. BONDS. For construction contracts of $250,000 or more, Contractor shall not begin construction until after it has provided the City with performance and payment bonds each for 100% of the contract value. (CWSRF Agmt. § 4.3; DWSRF Agmt. Ex. C § C.3.6).

1.3. COMPLIANCE WITH LAWS AND REGULATIONS. Contractor shall, at all times, comply with and require its subcontractors to comply with all applicable federal and state laws, rules, guidelines, regulations, and requirements. Without limitation of the foregoing, to the extent applicable, Contractor shall:

(a) Comply with and require its subcontractors on the Project to comply with federal DBE requirements.

(b) Comply with and require its subcontractors to comply with the list of federal laws in this **Attachment D**. (CWSRF Agmt. § 4.5; DWSRF Agmt. Ex. C § C.3.8).

1.4. INDEMNIFICATION.

a) Contractor shall defend, indemnify and hold harmless the State Water Quality Control Board, the California Infrastructure and Economic Development Bank (Bank), and any trustee, and their officers, employees, and agents for the Bonds issued by the Bank, if any, to the same extent Contractor is obligated to defend, indemnify, and hold harmless the City under the Agreement. Contractor shall require its subcontractors to similarly defend, indemnify, and hold harmless the State Water Quality Control Board, the Bank, and any trustee, and their officers, employees, and agents for the Bonds issued by the Bank, if any, to the same extent its subcontractors are obligated to defend, indemnify, and hold harmless the Contractor. CWSRF Agmt. § 4.11; DWSRF Agmt. Ex. C § C.3.17).

b) Except for the sole negligence or willful misconduct of the Metropolitan Water District of Southern California (Metropolitan), Contractor agrees at its sole cost and expense to protect, indemnify, defend, and hold harmless Metropolitan and its Board of Directors, officers, representatives, agents and employees from and against any and all claims and liability of any kind (including, but not limited to, any claims or liability for injury or death to any person, damage to property, natural resources or the environment, or water quality problems) that arise out of or relate to San Diego's approval, construction, operation, repair or ownership of the Project. Such indemnity shall include all damages and losses related to any claim made, whether or not a court action is filed, and shall include attorney fees, administrative and overhead costs, engineering and consulting fees and all other costs related to or arising out of such claim of liability, but shall exclude damages and losses that arise from the sole negligence or willful misconduct of Metropolitan. (LRP Agmt. § 8.2).

1.5. NON-DISCRIMINATION REQUIREMENTS.

a) During the performance of this Agreement, Contractor and its subcontractors shall not unlawfully discriminate, harass, or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religion, religious creed, national origin, sexual orientation, mental or physical disability (including HIV and AIDS), mental disability, medical condition, age, marital status, denial of family and medical care leave, or genetic information, gender, gender identity, gender expression, or military and veteran status.

b) Contractor and its subcontractors shall ensure that the evaluation and treatment of their employees and applicants for employment are free from such discrimination and harassment.

c) Contractor and its subcontractors shall comply with the provisions of the Fair Employment and Housing Act and the applicable regulations promulgated thereunder. (Gov. Code, §12990, subds. (a)-(f) et seq.; Cal. Code Regs., tit. 2,§ 7285 et seq.) Such regulations are incorporated into this Agreement by reference and made a part hereof as if set forth in full.

d) Contractor and its subcontractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement. (CWSRF Agmt. § 4.15(e)-(h); DWSRF Agmt. Ex. C § C.3.21(e)-(h)).

1.6. INSURANCE. For any policy of general liability insurance concerning the construction of the Project, Contractor will cause, and will require its subcontractors to cause, a certificate of insurance to be issued showing the State Water Quality Control Board, its officers, agents, employees, and servants as additional insured. (CWSRF Agmt. § 4.17; DWSRF Agmt. Ex. C § C.3.25).

1.7. EXCLUDED PARTIES. Contractor shall not contract with any party who is debarred or suspended or otherwise excluded from or ineligible for participation in any work overseen, directed, funded, or administered by the State Water Board program for which this funding is authorized. For any work related to this Agreement, Contractor shall not contract with any individual or organization on the State Water Board's List of Disqualified Businesses and Persons that is identified as debarred or suspended or otherwise excluded from or ineligible for participation in any work overseen, directed, funded, or administered by the State Water Board program for which funding under this Agreement is authorized. The State Water Board's List of Disqualified Businesses and Persons is located at:

http://www.waterboards.ca.gov/water_issues/programs/enforcement/fwa/dbp.shtm

(CWSRF Agmt. § 4.18; DWSRF Agmt. Ex. C § C.3.26).

1.8. PREVAILING WAGES. Contractor shall comply with all California State and Federal prevailing wage laws. Contractor shall include in its subcontracts the full the language provided in this **Attachment D** regarding federal prevailing wages. (CWSRF Agmt. § 4.19; DWSRF Agmt. Ex. C § C.3.28).

1.9. SIGNAGE. Upon the direction of the City, Contractor shall place a sign at least four feet tall by eight feet wide made of ¾ inch thick exterior grade plywood or other approved material in a prominent location on the Project site and shall maintain the sign in good condition for the duration of the construction period. The sign must include the following disclosure statement and color logos (available from the State Water Resources Control Board):

"*Funding for this $[insert value] million [insert name] project has been provided in full or in part by California State Revolving Funds through an agreement with the State Water Resources Control Board. California's State Revolving Funds are capitalized through a variety of funding sources, including grants from the United States Environmental Protection Agency and state bond proceeds*."

The Project sign may include another agency's required promotional information so long as the above logos and disclosure statement are equally prominent on the sign. The sign

shall be prepared in a professional manner. (CWSRF Agmt. Ex. A § 9; DWSRF Agmt. Ex. A § A.2.3).

See **Attachment E – Supplementary Special Provisions, Section 7-10.6.2, "Project Identification Sign"** for more information.

1.10. DISCLAIMER. Funding for this project has been provided in full or in part through an agreement with the State Water Resources Control Board. California's State Revolving Funds are capitalized through a variety of funding sources, including grants from the United States Environmental Protection Agency and state bond proceeds. The contents of this document do not necessarily reflect the views and policies of the foregoing, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. (DWSRF Agmt. Ex. A § A.2.1).

1.11. FEDERAL AWARD CONDITIONS. Contractor shall comply with the following federal conditions:

1. **American Iron and Steel**. Unless the City has obtained a waiver from USEPA on file with the State Water Board or unless this Project is not a project for the construction, alteration, maintenance or repair of a public water system or treatment work, Contractor shall not purchase "iron and steel products" produced outside of the United States on this Project. Unless the City has obtained a waiver from USEPA on file with the State Water Board or unless this Project is not a project for the construction, alteration, maintenance or repair of a public water system or treatment work, Contractor shall ensure that all "iron and steel products" used in the Project were or will be produced in the United States. For purposes of this section, the term "iron and steel products" means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials. "Steel" means an alloy that includes at least 50 percent iron, between .02 and 2 percent carbon, and may include other elements. CWSRF Agmt. Ex. E § A(1); DWSRF Agmt. Ex. C § C.4.3.i; WIFIA Agmt. §§ 12(j), 14(l))

2. **Wage Rate Requirements (Davis-Bacon)**. Contractor shall include in its subcontracts the full the language provided in **Attachment D**, Section 9, regarding federal prevailing wages. CWSRF Agmt. Ex. E § A(2); DWSRF Agmt. Ex. C § C.4.3.ii; WIFIA Agmt. §§ 12(j), 14(l)).

3. **Reserved.**

4. **Copyright and Patent.** USEPA and the State Water Board have the right to reproduce, publish, use and authorize others to reproduce, publish and use copyrighted works or other data developed pursuant to this Agreement. Where an invention is made with Project Funds, USEPA and the State Water Board retain the right to a worldwide, nonexclusive, nontransferable, irrevocable, paid-up license to practice the invention owned by Contractor. Contractor must utilize the Interagency Edison extramural invention reporting system at http://iEdison.gov and shall notify the State Water Board when an invention report, patent report, or utilization report is filed. (CWSRF Agmt. Ex. E § A(5)(e); DWSRF Agmt. Ex. C § C.4.3.i)

5. **Credit.** Contractor agrees that any reports, documents, publications or other materials developed for public distribution supported by this Agreement shall contain the following statement (CWSRF Agmt. Ex. E § A(5)(f)):

"*This project has been funded wholly or in part by the United States Environmental Protection Agency and the State Water Resources Control Board. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency or the State Water Resources Control Board, nor does the EPA or the Board endorse trade names or recommend the use of commercial products mentioned in this document.*"

6. **Trafficking in Persons.** Contractor, its employees, its subcontractors and their employees may not engage in severe forms of trafficking in persons during the term of this Agreement, procure a commercial sex act during the term of this Agreement, or use forced labor in the performance of this Agreement. Contractor must include this provision in its subcontracts under this Agreement. Contractor must inform the City immediately of any information regarding a violation of the foregoing. Contractor understands that failure to comply with this provision may subject the State Water Board to loss of federal funds, and the loss of funding for this Project. (CWSRF Agmt. Ex. E § A(5)(h); DWSRF Agmt. Ex. C § C.4.3.xiii).

1.12. CIVIL RIGHTS OBLIGATIONS. Contractor shall comply with the following federal non-discrimination requirements CWSRF Agmt. Ex. E § B; DWSRF Agmt. Ex. C § C.4.3.xv; WIFIA Agmt. Ex. E):

a) Title VI of the Civil Rights Act of 1964, which prohibits discrimination based on race, color, and national origin, including limited English proficiency (LEP).

b) Section 504 of the Rehabilitation Act, 29 USC 794, supplemented by EO 11914, 41 FR 17871, April 29, 1976 and 11250, 30 FR 13003, October 13, 1965, which prohibits discrimination against persons with disabilities..

c) The Age Discrimination Act, 42 USC 6101 et seq, which prohibits age discrimination.

d) Section 13 of the Federal Water Pollution Control Act Amendments of 1972, which prohibits discrimination on the basis of sex.

e) 40 CFR Part 7, as it relates to the foregoing.

f) Executive Order No. 11246. Contractor shall include in its subcontracts related to the Project the following provisions (41 CFR § 60-1.4(b)):

"During the performance of this contract, the contractor agrees as follows:

"(1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available

to employees and applicants for employment, notices to be provided by the City setting forth the provisions of this nondiscrimination clause.

"(2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

"(3) The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.

"(4) The contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided by the City advising the labor union or workers' representatives of the contractor's commitments under section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

"(5) The contractor will comply with all provisions of Executive Order 11246 of September. 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

"(6) The contractor will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

"(7) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

"(8) The contractor will include the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive

Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as may be directed by the Secretary of Labor as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such, the contractor may request the United States to enter into such litigation to protect the interests of the United States."

g) **Disadvantaged Business Enterprises (40 CFR Part 33).** Contractor agrees to comply with the requirements of USEPA's Program for Utilization of Small, Minority and Women's Business Enterprises. The DBE rule can be accessed at www.epa.gov/osbp. Contractor shall comply with 40 CFR Section 33.301, and retain all records documenting compliance with the six good faith efforts. The Contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 40 CFR part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the Contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies. (CWSRF Agmt. Ex. E § D(2); DWSRF Agmt. Ex. A § A.2.2.5; WIFIA Agmt. Ex. E, 40 CFR 33.302(i))

1.13. PROCUREMENT PROHIBITIONS UNDER SECTION 306 OF THE CLEAN AIR ACT AND SECTION 508 OF THE CLEAN WATER ACT, INCLUDING EXECUTIVE ORDER 11738, ADMINISTRATION OF THE CLEAN AIR ACT AND THE FEDERAL WATER POLLUTION CONTROL ACT WITH RESPECT TO FEDERAL CONTRACTS, GRANTS, OR LOANS; 42 USC § 7606; 33 USC § 1368. Except where the purpose of this Agreement is to remedy the cause of the violation, Contractor may not procure goods, services, or materials from suppliers excluded under the federal System for Award Management: http://www.sam.gov/.

1.14. Debarment and Suspension Executive Order 12549 (1986). Contractor certifies that it will not knowingly enter into a contract with anyone who is ineligible under the 2 CFR part 180 and part 1532 to participate in the Project. Suspension and debarment information can be accessed at http://www.sam.gov. Contractor represents and warrants that it has or will include a term or conditions requiring compliance with this provision in all of its subcontracts under this Agreement. (WIFIA Agmt. Ex. E, Debarment and Suspension, Executive Order 12549.

1.15. SECURE CONNECTION. Contractor agrees that if its network or information system is connected to USEPA networks to transfer data using systems other than the Environmental Information Exchange Network or USEPA's Central Data Exchange, it will ensure that any connections are secure. (CWSRF Agmt. Ex. E § D(5); DWSRF Agmt. Ex. C § C.4.3.xxii).

1.16. GEOSPATIAL DATA STANDARDS. All geospatial data created pursuant to this Agreement that is submitted to the State Water Board for use by USEPA or that is submitted directly to USEPA must be consistent with Federal Geographic Data Committee endorsed standards. Information on these standards may be found at www.fgdc.gov. (CWSRF Agmt. Ex. E § E; DWSRF Agmt. Ex. C § C.4.3.xxiii)

1.17. FEDERAL LOBBYING RESTRICTIONS. Recipients of federal financial assistance may not pay any person for influencing or attempting to influence any officer or employee of a federal agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress with respect to the award, continuation, renewal, amendment, or modification of a federal grant, loan, or contract. These requirements are implemented for USEPA in 40 CFR Part 34, which also describes types of activities, such as legislative liaison activities and professional and technical services, which are not subject to this prohibition. Upon award of this contract, Contractor shall complete and submit to the City the certification and disclosure forms in Appendix A and Appendix B to 40 CFR Part 34. Contractor shall also require all subcontractors and suppliers of any tier awarded a subcontract over $100,000 to similarly complete and submit the certification and disclosure forms pursuant to the process set forth in 40 CFR 34.110. (WIFIA Agmt. Ex. E, Section 319 of Pub. L. 101-121).

2. NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246) located at 41 CFR § 60-4.2:

2.1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.

2.2. The goal and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, as follows:

		Goal
1.	Minority Participation:	16.9%
2.	Female Participation:	6.9%

2.3. These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the Contractor performs Work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the Work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both federally involved and non-federally involved construction.

2.4. The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals.

2.5. The hours of minority and female employment and training shall be substantially uniform throughout the length of the Contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the Contract, the Executive Order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

2.6. The Contractor shall provide written notification to the Director the Office of Federal Contract Compliance Programs within 10 Working Days of award of any Subcontract in excess of $10,000 at any tier for Work under the Contract resulting from this solicitation. The notification shall list the name, address and telephone number of the Subcontractor; employer identification number of the Subcontractor; estimated dollar amount of the Subcontract; estimated starting and completion dates of the Subcontract; and the geographical area in which the subcontract is to be performed. The "covered area" is the City of San Diego.

3. EQUAL OPPORTUNITY CLAUSES:

3.1. The following equal opportunity clauses are incorporated by reference herein:

1. The equal opportunity clause located 41 CFR 60.1.4(a), which specifies the obligations imposed under Executive Order 11246.
2. The equal opportunity clause located at 41 CFR 60-741.5, which contains the obligations imposed by Section 503 of the Rehabilitation Act of 1973.
3. The "Equal Opportunity Clause" (Resolution No. 765092) filed on December 4, 1978, in the Office of the City Clerk, San Diego, California and incorporated in the "Standard Federal Employment Opportunity Construction Contract Specifications (Executive Order 11246 - Document No. 769023, filed September 11, 1984, in the Office of the City Clerk, San Diego, California) is applicable to all non-exempt City construction contracts and subcontracts of $2,000 or more.
4. Age Discrimination Act of 1975, Pub. L. 94-135.
5. Title VI of the Civil Rights Act of 1964, Pub. L. 88-352.
6. Section 13 of the Federal Water Pollution Control Acts Amendments of 1972, Pub. L. 92-5200 (the Clean Water Act).
7. Section 504 of the Rehabilitation Act of 1973, Pub. L. 93-112 (Executive Orders 11914 and 11250).
8. Women's Minority Business Enterprises, Executive Orders 11625, 12138 and 12432.
9. Section 129 of the Small Business Administration Reauthorization and Amendment Act of 1988, Pub. L. 100-590.

4. STANDARD FEDERAL EQUAL EMPLOYMENT SPECIFICATIONS:

4.1. The Contractor is required to comply with the 15 "Standard Federal Equal Employment Specifications" in section 4.2 below and also located in 41 CFR 60-4.3 for federal and federally assisted construction contracts in excess of $10,000.

4.2. Standard Federal Equal Employment Specifications.

1. As used in these specifications:
   a) Covered area" means the geographical area described in the solicitation from which this contract resulted;
   b) "Director" **means Director, Office of Federal Contract Compliance Programs, United** States Department of Labor, or any person to whom the Director delegates authority;

c) "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.

d) Minority" includes:

i. Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

ii. Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);

iii. Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

iv. American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in item 7, paragraphs "a" through "p", of this section below. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form,

and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

   a) Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities

   b) Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

   c) Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

   d) Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement

has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

e) Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.

f) Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g) Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h) Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.

i) Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j) Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.

k) Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR part 60-3.

l) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m) Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

n) Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o) Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p) Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (item 7, paragraphs "a" through "p", of this section). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under item 7, paragraphs "a" through "p", of this section that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in

violation of the Executive Order if a specific minority group of women is underutilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, sexual orientation, gender identity, or national origin.

11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in item 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

4.3. Segregated Facilities (41 CFR 60-1.8). The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, sexual orientation, gender identity, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensuring that its employees are not assigned to perform their services at any location, under the

contractor's control, where the facilities are segregated. This obligation extends to all contracts containing the equal opportunity clause regardless of the amount of the contract. The term "facilities," as used in this section, means waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, wash rooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees; Provided, That separate or single-user restrooms and necessary dressing or sleeping areas shall be provided to assure privacy between the sexes.

5. VIOLATION OR BREACH OF REQUIREMENTS:

5.1. If at any time during the course of the Contract there is a violation of the Affirmative Action or Equal Employment Opportunity requirements by the Contractor, or the Subcontractors, the City will notify the Contractor of the breach. The City may withhold any further progress payments to the Contractor until the City is satisfied that the Contractor and Subcontractors are in full compliance with these requirements.

6. MONTHLY EMPLOYMENT UTILIZATION REPORTS:

6.1. Refer to GENERAL EQUAL OPPORTUNITY CONTRACTING PROGRAM REQUIREMENTS, CONSTRUCTION CONTRACTOR REQUIREMENTS in The WHITEBOOK and the following:

1. Federal and Non-Federal Work in San Diego County. Submit an updated list only if work is complete or new contracts have been awarded during the span of this project.

7. RECORDS OF PAYMENTS TO DBEs:

7.1. The Contractor shall maintain records and documents of payments to DBEs for 5 years following the NOC. These records shall be made available for inspection upon request by any authorized representative of the City, funding agency, or both. The reporting requirement shall be extended to any certified DBE Subcontractor.

8. FEDERAL WAGE REQUIREMENTS FOR FEDERALLY FUNDED PROJECTS:

8.1. The successful Bidder's work shall be required to comply with Executive Order 11246, entitled "Equal Employment Opportunity,", as amended by Executive Order 11375, and as supplemented in Department of Labor regulations (41 CFR chapter 60).

8.2. This Executive Order pertains to Equal Employment Opportunity regulations and contains significant changes to the regulations including new goals and timetables for women in construction and revised goals and time-tables for minorities in construction.

8.3. Minimum wage rates for this project have been predetermined by the Secretary of Labor and are set forth in the Decision of the Secretary and bound into the specifications book. Should there be any difference between the state or federal wage rates, including health and welfare funds for any given craft, mechanic, or similar classifications needed to execute the Work, it shall be mandatory upon the Contractor or subcontractor to pay the higher of the two rates.

8.4. The minimum wage rate to be paid by the Contractor and the Subcontractors shall be in accordance with the Federal Labor Standards Provisions (see below) and Federal Wage Rates (see Wage Rates below) and General Prevailing Wage Determination made by the State of California, Director of Industrial Relations pursuant to California Labor Code Part 7, Chapter 1, Article 2, Sections 1770, 1773 and 1773.1, whichever is higher.

8.5. A Contractor having 50 or more employees and its Subcontractors having 50 or more employees and who may be awarded a contract of $50,000 or more will be required to maintain an affirmative action program, the standards for which are contained in the specifications.

8.6. To be eligible for award, each Bidder shall comply with the affirmative action requirements which are contained in the specifications

8.7. Women will be afforded equal opportunity in all areas of employment. However, the employment of women shall not diminish the standards of requirements for the employment of minorities.

9. PREVAILING WAGE RATES: Pursuant to San Diego Municipal Code section 22.3019, construction, alteration, demolition, repair and maintenance work performed under this Contract is subject to State prevailing wage laws. For construction work performed under this Contract cumulatively exceeding $25,000 and for alteration, demolition, repair and maintenance work performed under this Contract cumulatively exceeding $15,000, the Contractor and its subcontractors shall comply with State prevailing wage laws including, but not limited to, the requirements listed below.

9.1. Compliance with Prevailing Wage Requirements. Pursuant to sections 1720 through 1861 of the California Labor Code, the Contractor and its subcontractors shall ensure that all workers who perform work under this Contract are paid not less than the prevailing rate of per diem wages as determined by the Director of the California Department of Industrial Relations (DIR). This includes work performed during the design and preconstruction phases of construction including, but not limited to, inspection and land surveying work.

9.1.1. Copies of such prevailing rate of per diem wages are on file at the City and are available for inspection to any interested party on request. Copies of the prevailing rate of per diem wages also may be found at http://www.dir.ca.gov/OPRL/DPreWageDetermination.htm. Contractor and its subcontractors shall post a copy of the prevailing rate of per diem wages determination at each job site and shall make them available to any interested party upon request.

9.1.2. The wage rates determined by the DIR refer to expiration dates. If the published wage rate does not refer to a predetermined wage rate to be paid after the expiration date, then the published rate of wage shall be in effect for the life of this Contract. If the published wage rate refers to a predetermined wage rate to become effective upon expiration of the published wage rate and the predetermined wage rate is on file with the DIR, such predetermined wage rate shall become effective on the date following the expiration date and shall apply to this Contract in the same manner as if it had been published in said publication. If the predetermined wage rate refers to one or more additional expiration dates with additional predetermined wage rates, which expiration dates occur during the life of this Contract, each successive predetermined wage rate shall apply to this Contract on the date following the expiration date of the previous wage rate. If the last of such predetermined wage rates expires during the life of this Contract, such wage rate shall apply to the balance of the Contract.

9.2. Penalties for Violations. Contractor and its subcontractors shall comply with California Labor Code section 1775 in the event a worker is paid less than the prevailing wage rate

for the work or craft in which the worker is employed. This shall be in addition to any other applicable penalties allowed under Labor Code sections 1720 – 1861.

9.3. **Payroll Records.** Contractor and its subcontractors shall comply with California Labor Code section 1776, which generally requires keeping accurate payroll records, verifying and certifying payroll records, and making them available for inspection. Contractor shall require its subcontractors to also comply with section 1776. Contractor and its subcontractors shall submit weekly certified payroll records online via the City's web-based Labor Compliance Program. Contractor is responsible for ensuring its subcontractors submit certified payroll records to the City.

9.3.1. Contractor their subcontractors shall also furnish records specified in Labor Code section 1776 directly to the Labor Commissioner in the manner required by Labor Code section 1771.4.

9.4. **Apprentices.** Contractor and its subcontractors shall comply with California Labor Code sections 1777.5, 1777.6 and 1777.7 concerning the employment and wages of apprentices. Contractor is held responsible for the compliance of their subcontractors with sections 1777.5, 1777.6 and 1777.7.

9.5. **Working Hours.** Contractor and their subcontractors shall comply with California Labor Code sections 1810 through 1815, including but not limited to: (i) restrict working hours on public works contracts to eight hours a day and forty hours a week, unless all hours worked in excess of 8 hours per day are compensated at not less than 1½ times the basic rate of pay; and (ii) specify penalties to be imposed on contractors and subcontractors of $25 per worker per day for each day the worker works more than 8 hours per day and 40 hours per week in violation of California Labor Code sections1810 through 1815.

9.6. **Required Provisions for Subcontracts.** Contractor shall include at a minimum a copy of the following provisions in any contract they enter into with a subcontractor: California Labor Code sections 1771, 1771.1, 1775, 1776, 1777.5, 1810, 1813, 1815, 1860 and 1861.

9.7. **Labor Code Section 1861 Certification.** Contractor in accordance with California Labor Code section 3700 is required to secure the payment of compensation of its employees and by signing this Contract, Contractor certifies that "I am aware of the provisions of Section 3700 of the California Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this Contract."

9.8. **Labor Compliance Program**. The City has its own Labor Compliance Program authorized in August 2011 by the DIR. The City will withhold contract payments when payroll records are delinquent or deemed inadequate by the City or other governmental entity, or it has been established after an investigation by the City or other governmental entity that underpayment(s) have occurred. For questions or assistance, please contact the City of San Diego's Prevailing Wage Unit at 858-627-3200.

9.9. **Contractor and Subcontractor Registration Requirements.** This project is subject to compliance monitoring and enforcement by the DIR. A contractor or subcontractor shall not be qualified to bid on, be listed in a bid or proposal, subject to the requirements of section 4104 of the Public Contract Code, or engage in the performance of any contract for

public work, unless currently registered and qualified to perform public work pursuant to Labor Code section 1725.5. It is not a violation of this section for an unregistered contractor to submit a bid that is authorized by Section 7029.1 of the Business and Professions code or by Section 10164 or 20103.5 of the Public Contract Code, provided the contractor is registered to perform public work pursuant to Section 1725.5 at the time the contract is awarded.

9.9.1. A Contractor's inadvertent error in listing a subcontractor who is not registered pursuant to Labor Code section 1725.5 in response to a solicitation shall not be grounds for filing a bid protest or grounds for considering the bid non-responsive provided that any of the following apply: (1) the subcontractor is registered prior to bid opening; (2) within twenty-four hours after the bid opening, the subcontractor is registered and has paid the penalty registration fee specified in Labor Code section 1725.5; or (3) the subcontractor is replaced by another registered subcontractor pursuant to Public Contract Code section 4107.

9.9.2. By submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the DIR in compliance with Labor Code sections 1771.1 and 1725.5, and Contractor shall provide proof of registration for themselves and all listed subcontractors to the City at the time of bid or proposal due date or upon request.

9.10. Stop Order. For Contractor or its subcontractors engaging in the performance of any public work contract without having been registered in violation of Labor Code sections 1725.5 or 1771.1, the Labor Commissioner shall issue and serve a stop order prohibiting the use of the unregistered contractors or unregistered subcontractor(s) on ALL public works until the unregistered contractor or unregistered subcontractor(s) is registered. Failure to observe a stop order is a misdemeanor.

9.11. List of all Subcontractors. The City may ask Contractor for the most current list of subcontractors (regardless of tier), along with their DIR registration numbers, utilized on this Agreement at any time during performance of this contract, and Contractor shall provide the list within ten (10) working days of the City's request. Additionally, Contractor shall provide the City with a complete list of all subcontractors utilized on this contract (regardless of tier), within ten working days of the completion of the contract, along with their DIR registration numbers. The City shall withhold final payment to Contractor until at least 30 days after this information is provided to the City.

9.12. Exemptions for Small Projects. There are limited exemptions for installation, alteration, demolition, or repair work done on projects of $25,000 or less. The Contractor shall still comply with Labor Code sections 1720 et. seq. The only recognized exemptions are listed below:

9.12.1. Registration. The Contractor will not be required to register with the DIR for small projects. (Labor Code section 1771.1

9.12.2. Certified Payroll Records. The records required in Labor Code section 1776 shall be required to be kept and submitted to the City of San Diego, but will not be required to be submitted online with the DIR directly. The Contractor will need to keep those records for at least three years following the completion of the Contract. (Labor Code section 1771.4).

9.12.3. List of all Subcontractors. The Contractor shall not be required to hire only registered subcontractors and is exempt from submitting the list of all subcontractors that is required in section 4.20.11 above. (Labor code section 1773.3).

10. DAVIS-BACON WAGE RATES AND PROVISIONS:

10.1. WAGE RATES This contract shall be subject to the following Davis-Bacon Wage Decisions:

10.2. CWSRF and DWSRF DAVIS BACON PROVISIONS. Contractor shall include the language in this section in all of its subcontracts for the Project. Contractor and all subcontractors working on the Project shall comply with any provisions herein applicable to contractors and subcontractors, respectively.

WAGE RATES: This contract shall be subject to the following Davis-Bacon Wage Decisions:

"General Decision Number: CA20200001 10/09/2020

Superseded General Decision Number: CA20190001

State: California

Construction Types: Building, Heavy (Heavy and Dredging), Highway and Residential

County: San Diego County in California.

BUILDING CONSTRUCTION PROJECTS; DREDGING PROJECTS (does not include hopper dredge work); HEAVY CONSTRUCTION PROJECTS (does not include water well drilling); HIGHWAY CONSTRUCTION PROJECTS; RESIDENTIAL CONSTRUCTION PROJECTS (consisting of single family homes and apartments up to and including 4 stories)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.80 for calendar year 2020 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.80 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2020. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate,if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2020
1	01/10/2020
2	01/31/2020
3	03/06/2020
4	04/17/2020
5	05/29/2020
6	06/05/2020
7	07/03/2020
8	07/17/2020
9	07/24/2020

Modification Number	Publication Date
10	07/31/2020
11	08/07/2020
12	08/14/2020
13	08/21/2020
14	08/28/2020
15	09/04/2020
16	09/25/2020
17	10/02/2020
18	10/09/2020

ASBE0005-002 09/01/2019

	Rates	Fringes
Asbestos Workers/Insulator (Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems)	$ 43.77	22.48
Fire Stop Technician (Application of Firestopping Materials for wall openings and penetrations in walls, floors, ceilings and curtain walls)	$ 28.92	18.73

ASBE0005-004 07/01/2019

	Rates	Fringes
Asbestos Removal worker/hazardous material handler (Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing of all insulation materials from mechanical systems, whether they contain asbestos or not)	$ 20.63	12.17

BOIL0092-003 03/01/2018

	Rates	Fringes
BOILERMAKER	$ 44.07	33.52

BRCA0004-008 11/01/2018

	Rates	Fringes
BRICKLAYER; MARBLE SETTER	$ 38.21	17.44

BRCA0018-004 06/01/2019

	Rates	Fringes
MARBLE FINISHER	$ 33.43	14.11
TILE FINISHER	$ 28.23	12.65
TILE LAYER	$ 40.07	18.36

BRCA0018-010 09/01/2020

	Rates	Fringes
TERRAZZO FINISHER	$ 33.66	14.20
TERRAZZO WORKER/SETTER	$ 41.60	14.73

CARP0409-002 07/01/2016

	Rates	Fringes
Diver		
(1) Wet	$ 712.48	17.03
(2) Standby	$ 356.24	17.03
(3) Tender	$ 348.24	17.03
(4) Assistant Tender	$ 324.24	17.03

Amounts in ""Rates' column are per day

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 CARP0409-008 08/01/2010
                                    Rates             Fringes
Modular Furniture Installer......$ 17.00              7.41
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 CARP0547-001 07/01/2018
                                    Rates             Fringes
CARPENTER
     (1)  Bridge..................$ 42.34             19.17
     (2)  Commercial Building....$ 37.11             19.17
     (3)  Heavy & Highway........$ 42.21             19.17
     (4)  Residential Carpenter..$ 29.69             19.17
     (5)  Residential
     Insulation Installer........$ 18.00              8.16
MILLWRIGHT.......................$ 48.71             19.17
PILEDRIVERMAN....................$ 42.34             19.17
----------------------------------------------------------------
 CARP0547-002 07/01/2017
                                    Rates             Fringes
Drywall
     (1) Work on wood framed
     construction of single
     family residences,
     apartments or condominiums
     under four stories
      Drywall Installer/Lather...$ 22.95             18.85
      Drywall Stocker/Scrapper...$ 12.50             12.27
     (2) All other work
      Drywall Installer/Lather...$ 32.00             17.63
      Drywall Stocker/Scrapper...$ 12.50             12.27
----------------------------------------------------------------
 ELEC0569-001 06/01/2020
                                    Rates          Fringes
Electricians (Tunnel Work)
     Cable Splicer...............$ 51.38          3%+14.88
     Electrician.................$ 50.63          3%+14.88
Electricians: (All Other
Work, Including 4 Stories
Residential)
     Cable Splicer...............$ 45.75          3%+14.88
     Electrician.................$ 45.00          3%+14.88
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 ELEC0569-004 06/01/2020
                                    Rates          Fringes
ELECTRICIAN (Sound &
Communications Sound
Technician).....................$ 33.95             13.55
  SCOPE OF WORK Assembly, installation, operation, service and
  maintenance of components or systems as used in closed circuit
  television, amplified master television distribution, CATV on
  private property, intercommunication, burglar alarm, fire
  alarm, life support and all security alarms, private and
  public telephone and related telephone interconnect, public
  address, paging, audio, language, electronic, background music
  system less than line voltage or any system acceptable for
  class two wiring for private, commercial, or industrial use
  furnished by leased wire, freuency modulation or other
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recording devices, electrical apparatus by means of which electricity is applied to the amplification, transmission, transference, recording or reproduction of voice, music, sound, impulses and video. Excluded from this Scope of Work - transmission, service and maintenance of background music. All of the above shall include the installation and transmission over fiber optics.

ELEC0569-005 06/01/2020

	Rates	Fringes
Sound & Communications		
Sound Technician	$ 33.95	13.55

SCOPE OF WORK Assembly, installation, operation, service and maintenance of components or systems as used in closed circuit television, amplified master television distribution, CATV on private property, intercommunication, burglar alarm, fire alarm, life support and all security alarms, private and public telephone and related telephone interconnect, public address, paging, audio, language, electronic, background music system less than line voltage or any system acceptable for class two wiring for private, commercial, or industrial use furnished by leased wire, freuency modulation or other recording devices, electrical apparatus by means of which electricity is applied to the amplification, transmission, transference, recording or reproduction of voice, music, sound, impulses and video. Excluded from this Scope of Work - transmission, service and maintenance of background music. All of the above shall include the installation and transmission over fiber optics.

SOUND TECHNICIAN: Terminating, operating and performing final check-out

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ELEC0569-006 10/01/2018

Work on street lighting; traffic signals; and underground systems and/or established easements outside of buildings

	Rates	Fringes
Traffic signal, street light and underground work		
Utility Technician #1	$ 32.44	8.67
Utility Technician #2	$ 27.05	8.51

STREET LIGHT & TRAFFIC SIGNAL WORK:

UTILITY TECHNICIAN #1: Installation of street lights and traffic signals, including electrical circuitry, programmable controller, pedestal-mounted electrical meter enclosures and laying of pre-assembled cable in ducts. The layout of electrical systems and communication installation including proper position of trench depths, and radius at duct banks, location for manholes, street lights and traffic signals.

UTILITY TECHNICIAN #2: Distribution of material at jobsite, installation of underground ducts for electrical, telephone, cable TV land communication systems. The setting, leveling, grounding and racking of precast manholes, handholes and transformer pads.

ELEC0569-008 08/31/2020

	Rates	Fringes
ELECTRICIAN (Residential, 1-3 Stories)	$ 35.74	7.68

ELEC1245-001 06/01/2020

	Rates	Fringes
LINE CONSTRUCTION		
(1) Lineman; Cable splicer	$ 59.14	20.78
(2) Equipment specialist (operates crawler tractors, commercial motor vehicles, backhoes, trenchers, cranes (50 tons and below), overhead & underground distribution line equipment)	$ 47.24	19.59
(3) Groundman	$ 36.12	19.19
(4) Powderman	$ 51.87	18.79

HOLIDAYS: New Year's Day, M.L. King Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day and day after Thanksgiving, Christmas Day

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ELEV0018-001 01/01/2020

	Rates	Fringes
ELEVATOR MECHANIC	$ 57.40	34.765+a+b

FOOTNOTE:
a. PAID VACATION: Employer contributes 8% of regular hourly rate as vacation pay credit for employees with more than 5 years of service, and 6% for 6 months to 5 years of service.
b. PAID HOLIDAYS: New Years Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Friday after Thanksgiving, and Christmas Day.

ENGI0012-003 07/01/2020

	Rates	Fringes
OPERATOR: Power Equipment (All Other Work)		
GROUP 1	$ 48.25	27.20
GROUP 2	$ 49.03	27.20
GROUP 3	$ 49.32	27.20
GROUP 4	$ 50.81	27.20
GROUP 5	$ 48.96	25.25
GROUP 6	$ 51.03	27.20
GROUP 8	$ 51.14	27.20
GROUP 9	$ 49.29	25.25

	Rates	Fringes
GROUP 10	$ 51.26	27.20
GROUP 11	$ 49.41	25.25
GROUP 12	$ 51.43	27.20
GROUP 13	$ 51.53	27.20
GROUP 14	$ 51.56	27.20
GROUP 15	$ 51.64	27.20
GROUP 16	$ 51.76	27.20
GROUP 17	$ 51.93	27.20
GROUP 18	$ 52.03	27.20
GROUP 19	$ 52.14	27.20
GROUP 20	$ 52.26	27.20
GROUP 21	$ 52.43	27.20
GROUP 22	$ 52.53	27.20
GROUP 23	$ 52.64	27.20
GROUP 24	$ 52.76	27.20
GROUP 25	$ 52.93	27.20
OPERATOR: Power Equipment (Cranes, Piledriving & Hoisting)		
GROUP 1	$ 49.60	27.20
GROUP 2	$ 50.38	27.20
GROUP 3	$ 50.67	27.20
GROUP 4	$ 50.81	27.20
GROUP 5	$ 51.03	27.20
GROUP 6	$ 51.14	27.20
GROUP 7	$ 51.26	27.20
GROUP 8	$ 51.43	27.20
GROUP 9	$ 51.60	27.20
GROUP 10	$ 52.60	27.20
GROUP 11	$ 53.60	27.20
GROUP 12	$ 54.60	27.20
GROUP 13	$ 55.60	27.20
OPERATOR: Power Equipment (Tunnel Work)		
GROUP 1	$ 50.10	27.20
GROUP 2	$ 50.88	27.20
GROUP 3	$ 51.17	27.20
GROUP 4	$ 51.31	27.20
GROUP 5	$ 51.53	27.20
GROUP 6	$ 51.64	27.20
GROUP 7	$ 51.76	27.20

PREMIUM PAY:

$3.75 per hour shall be paid on all Power Equipment Operator work on the followng Military Bases: China Lake Naval Reserve, Vandenberg AFB, Point Arguello, Seely Naval Base, Fort Irwin, Nebo Annex Marine Base, Marine Corp Logistics Base Yermo, Edwards AFB, 29 Palms Marine Base and Camp Pendleton

Workers required to suit up and work in a hazardous material environment: $2.00 per hour additional. Combination mixer and compressor operator on gunite work shall be classified as a concrete mobile mixer operator.

SEE ZONE DEFINITIONS AFTER CLASSIFICATIONS

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Bargeman; Brakeman; Compressor operator; Ditch Witch, with seat or similar type equipment; Elevator operator-inside; Engineer Oiler; Forklift operator (includes loed, lull or similar types under 5 tons; Generator operator; Generator, pump or compressor plant operator; Pump operator; Signalman; Switchman

GROUP 2: Asphalt-rubber plant operator (nurse tank operator); Concrete mixer operator-skip type; Conveyor operator; Fireman; Forklift operator (includes loed, lull or similar types over 5 tons; Hydrostatic pump operator; oiler crusher (asphalt or concrete plant); Petromat laydown machine; PJU side dum jack; Screening and conveyor machine operator (or similar types); Skiploader (wheel type up to 3/4 yd. without attachment); Tar pot fireman; Temporary heating plant operator; Trenching machine oiler

GROUP 3: Asphalt-rubber blend operator; Bobcat or similar type (Skid steer); Equipment greaser (rack); Ford Ferguson (with dragtype attachments); Helicopter radioman (ground); Stationary pipe wrapping and cleaning machine operator

GROUP 4: Asphalt plant fireman; Backhoe operator (mini-max or similar type); Boring machine operator; Boxman or mixerman (asphalt or concrete); Chip spreading machine operator; Concrete cleaning decontamination machine operator; Concrete Pump Operator (small portable); Drilling machine operator, small auger types (Texoma super economatic or similar types - Hughes 100 or 200 or similar types - drilling depth of 30' maximum); Equipment greaser (grease truck); Guard rail post driver operator; Highline cableway signalman; Hydra-hammer-aero stomper; Micro Tunneling (above ground tunnel); Power concrete curing machine operator; Power concrete saw operator; Power-driven jumbo form setter operator; Power sweeper operator; Rock Wheel Saw/Trencher; Roller operator (compacting); Screed operator (asphalt or concrete); Trenching machine operator (up to 6 ft.); Vacuum or much truck

GROUP 5: Equipment Greaser (Grease Truck/Multi Shift).

GROUP 6: Articulating material hauler; Asphalt plant engineer; Batch plant operator; Bit sharpener; Concrete joint machine operator (canal and similar type); Concrete planer operator; Dandy digger; Deck engine operator; Derrickman (oilfield type); Drilling machine operator, bucket or auger types (Calweld 100 bucket or similar types - Watson 1000 auger or similar types - Texoma 330, 500 or 600 auger or similar types - drilling depth of 45' maximum); Drilling machine operator; Hydrographic seeder machine operator (straw, pulp or seed), Jackson track maintainer, or similar type; Kalamazoo Switch tamper, or similar type; Machine tool operator; Maginnis internal full

slab vibrator, Mechanical berm, curb or gutter(concrete or asphalt); Mechanical finisher operator (concrete, Clary-Johnson-Bidwell or similar); Micro tunnel system (below ground); Pavement breaker operator (truck mounted); Road oil mixing machine operator; Roller operator (asphalt or finish), rubber-tired earth moving equipment (single engine, up to and including 25 yds. struck); Self-propelled tar pipelining machine operator; Skiploader operator (crawler and wheel type, over 3/4 yd. and up to and including 1-1/2 yds.); Slip form pump operator (power driven hydraulic lifting device for concrete forms); Tractor operator-bulldozer, tamper-scraper (single engine, up to 100 h.p. flywheel and similar types, up to and including D-5 and similar types); Tugger hoist operator (1 drum); Ultra high pressure waterjet cutting tool system operator; Vacuum blasting machine operator

GROUP 8: Asphalt or concrete spreading operator (tamping or finishing); Asphalt paving machine operator (Barber Greene or similar type); Asphalt-rubber distribution operator; Backhoe operator (up to and including 3/4 yd.), small ford, Case or similar; Cast-in-place pipe laying machine operator; Combination mixer and compressor operator (gunite work); Compactor operator (self-propelled); Concrete mixer operator (paving); Crushing plant operator; Drill Doctor; Drilling machine operator, Bucket or auger types (Calweld 150 bucket or similar types - Watson 1500, 2000 2500 auger or similar types - Texoma 700, 800 auger or similar types - drilling depth of 60' maximum); Elevating grader operator; Grade checker; Gradall operator; Grouting machine operator; Heavy-duty repairman; Heavy equipment robotics operator; Kalamazoo balliste regulator or similar type; Kolman belt loader and similar type; Le Tourneau blob compactor or similar type; Loader operator (Athey, Euclid, Sierra and similar types); Mobark Chipper or similar; Ozzie padder or similar types; P.C. slot saw; Pneumatic concrete placing machine operator (Hackley-Presswell or similar type); Pumpcrete gun operator; Rock Drill or similar types; Rotary drill operator (excluding caisson type); Rubber-tired earth-moving equipment operator (single engine, caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. up to and including 50 cu. yds. struck); Rubber-tired earth-moving equipment operator (multiple engine up to and including 25 yds. struck); Rubber-tired scraper operator (self-loading paddle wheel type-John Deere, 1040 and similar single unit); Self-propelled curb and gutter machine operator; Shuttle buggy; Skiploader operator (crawler and wheel type over 1-1/2 yds. up to and including 6-1/2 yds.); Soil remediation plant operator; Surface heaters and planer operator; Tractor compressor drill combination operator; Tractor operator (any type larger than D-5 - 100 flywheel h.p. and over, or similar-bulldozer, tamper, scraper and push tractor single engine); Tractor operator (boom attachments), Traveling pipe wrapping, cleaning and bendng machine operator; Trenching machine operator (over 6 ft. depth capacity, manufacturer's rating); trenching Machine with Road Miner attachment (over 6 ft depth capacity): Ultra high pressure waterjet cutting tool system mechanic; Water pull (compaction) operator

GROUP 9: Heavy Duty Repairman

GROUP 10: Drilling machine operator, Bucket or auger types (Calweld 200 B bucket or similar types-Watson 3000 or 5000 auger or similar types-Texoma 900 auger or similar types-drilling depth of 105' maximum); Dual drum mixer, dynamic compactor LDC350 (or similar types); Monorail locomotive operator (diesel, gas or electric); Motor patrol-blade operator (single engine); Multiple engine tractor operator (Euclid and similar type-except Quad 9 cat.); Rubber-tired earth-moving equipment operator (single engine, over 50 yds. struck); Pneumatic pipe ramming tool and similar types; Prestressed wrapping machine operator; Rubber-tired earth-moving equipment operator (single engine, over 50 yds. struck); Rubber tired earth moving equipment operator (multiple engine, Euclid, caterpillar and similar over 25 yds. and up to 50 yds. struck), Tower crane repairman; Tractor loader operator (crawler and wheel type over 6-1/2 yds.); Woods mixer operator (and similar Pugmill equipment)

GROUP 11: Heavy Duty Repairman - Welder Combination, Welder - Certified.

GROUP 12: Auto grader operator; Automatic slip form operator; Drilling machine operator, bucket or auger types (Calweld, auger 200 CA or similar types - Watson, auger 6000 or similar types - Hughes Super Duty, auger 200 or similar types - drilling depth of 175' maximum); Hoe ram or similar with compressor; Mass excavator operator less tha 750 cu. yards; Mechanical finishing machine operator; Mobile form traveler operator; Motor patrol operator (multi-engine); Pipe mobile machine operator; Rubber-tired earth- moving equipment operator (multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck); Rubber-tired self- loading scraper operator (paddle-wheel-auger type self-loading - two (2) or more units)

GROUP 13: Rubber-tired earth-moving equipment operator operating equipment with push-pull system (single engine, up to and including 25 yds. struck)

GROUP 14: Canal liner operator; Canal trimmer operator; Remote- control earth-moving equipment operator (operating a second piece of equipment: $1.00 per hour additional); Wheel excavator operator (over 750 cu. yds.)

GROUP 15: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. and up to and including 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine-up to and including 25 yds. struck)

GROUP 16: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 17: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine, Euclid, Caterpillar and similar, over 50 cu. yds. struck); Tandem tractor operator (operating crawler type tractors in tandem - Quad 9 and similar type)

GROUP 18: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, up to and including 25 yds. struck)

GROUP 19: Rotex concrete belt operator (or similar types); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds.and up to and including 50 cu. yds. struck); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - multiple engine, up to and including 25 yds. struck)

GROUP 20: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps, and similar types in any combination, excluding compaction units - multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 21: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck)

GROUP 22: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, up to and including 25 yds. struck)

GROUP 23: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. and up to and including 50 yds. struck); Rubber-tired earth-moving equipment operator, operating with the tandem push-pull system (multiple engine, up to and including 25 yds. struck)

GROUP 24: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 25: Concrete pump operator-truck mounted; Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck)

CRANES, PILEDRIVING AND HOISTING EQUIPMENT CLASSIFICATIONS

GROUP 1: Engineer oiler; Fork lift operator (includes loed, lull or similar types)

GROUP 2: Truck crane oiler

GROUP 3: A-frame or winch truck operator; Ross carrier operator (jobsite)

GROUP 4: Bridge-type unloader and turntable operator; Helicopter hoist operator

GROUP 5: Hydraulic boom truck; Stinger crane (Austin-Western or similar type); Tugger hoist operator (1 drum)

GROUP 6: Bridge crane operator; Cretor crane operator; Hoist operator (Chicago boom and similar type); Lift mobile operator; Lift slab machine operator (Vagtborg and similar types); Material hoist and/or manlift operator; Polar gantry crane operator; Self Climbing scaffold (or similar type); Shovel, backhoe, dragline, clamshell operator (over 3/4 yd. and up to 5 cu. yds. mrc); Tugger hoist operator

GROUP 7: Pedestal crane operator; Shovel, backhoe, dragline, clamshell operator (over 5 cu. yds. mrc); Tower crane repair; Tugger hoist operator (3 drum)

GROUP 8: Crane operator (up to and including 25 ton capacity); Crawler transporter operator; Derrick barge operator (up to and including 25 ton capacity); Hoist operator, stiff legs, Guy derrick or similar type (up to and including 25 ton capacity); Shovel, backhoe, dragline, clamshell operator (over 7 cu. yds., M.R.C.)

GROUP 9: Crane operator (over 25 tons and up to and including 50 tons mrc); Derrick barge operator (over 25 tons up to and including 50 tons mrc); Highline cableway operator; Hoist operator, stiff legs, Guy derrick or similar type (over 25 tons up to and including 50 tons mrc); K-crane operator; Polar crane operator; Self erecting tower crane operator maximum lifting capacity ten tons

GROUP 10: Crane operator (over 50 tons and up to and including 100 tons mrc); Derrick barge operator (over 50 tons up to and including 100 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 50 tons up to and including 100 tons mrc), Mobile tower crane operator (over 50 tons, up to and including 100 tons M.R.C.); Tower crane operator and tower gantry

GROUP 11: Crane operator (over 100 tons and up to and including 200 tons mrc); Derrick barge operator (over 100 tons up to and including 200 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 100 tons up to and including 200 tons mrc); Mobile tower crane operator (over 100 tons up to and including 200 tons mrc)

GROUP 12: Crane operator (over 200 tons up to and including 300 tons mrc); Derrick barge operator (over 200 tons up to and including 300 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 200 tons, up to and including 300 tons mrc); Mobile tower crane operator (over 200 tons, up to and including 300 tons mrc)

GROUP 13: Crane operator (over 300 tons); Derrick barge operator (over 300 tons); Helicopter pilot; Hoist operator, stiff legs, Guy derrick or similar type (over 300 tons); Mobile tower crane operator (over 300 tons)

TUNNEL CLASSIFICATIONS

GROUP 1: Skiploader (wheel type up to 3/4 yd. without attachment)

GROUP 2: Power-driven jumbo form setter operator

GROUP 3: Dinkey locomotive or motorperson (up to and including 10 tons)

GROUP 4: Bit sharpener; Equipment greaser (grease truck); Slip form pump operator (power-driven hydraulic lifting device for concrete forms); Tugger hoist operator (1 drum); Tunnel locomotive operator (over 10 and up to and including 30 tons)

GROUP 5: Backhoe operator (up to and including 3/4 yd.); Small Ford, Case or similar; Drill doctor; Grouting machine operator; Heading shield operator; Heavy-duty repairperson; Loader operator (Athey, Euclid, Sierra and similar types); Mucking machine operator (1/4 yd., rubber-tired, rail or track type); Pneumatic concrete placing machine operator (Hackley-Presswell or similar type); Pneumatic heading shield (tunnel); Pumpcrete gun operator; Tractor compressor drill combination operator; Tugger hoist operator (2 drum); Tunnel locomotive operator (over 30 tons)

GROUP 6: Heavy Duty Repairman

GROUP 7: Tunnel mole boring machine operator

ENGINEERS ZONES

$1.00 additional per hour for all of IMPERIAL County and the portions of KERN, RIVERSIDE & SAN BERNARDINO Counties as defined below:

That area within the following Boundary: Begin in San Bernardino County, approximately 3 miles NE of the intersection of I-15 and the California State line at that point which is the NW corner of Section 1, T17N,m R14E, San Bernardino Meridian. Continue W in a straight line to that point which is the SW corner of the northwest quarter of Section 6, T27S, R42E, Mt. Diablo Meridian. Continue North to the intersection with the Inyo County Boundary at that point which is the NE corner of the western half of the northern quarter of Section 6, T25S, R42E, MDM. Continue W along the Inyo and San Bernardino County boundary until the intersection with Kern County, as that point which is the SE corner of Section 34, T24S, R40E, MDM. Continue W along the Inyo and Kern County boundary until the intersection with Tulare County, at that point which is the SW corner of the SE quarter of Section 32, T24S, R37E, MDM. Continue W along the Kern and Tulare County boundary, until that point which is the NW corner of T25S, R32E, MDM. Continue S following R32E lines to the NW corner of T31S, R32E, MDM. Continue W to the NW corner of T31S, R31E, MDM. Continue S to the SW corner of T32S, R31E, MDM. Continue W to SW corner of SE quarter of Section 34, T32S, R30E, MDM. Continue S to SW corner of T11N, R17W, SBM. Continue E along south boundary of T11N, SBM to SW corner of T11N, R7W, SBM. Continue S to SW corner of T9N, R7W, SBM. Continue E along south boundary of T9N, SBM to SW corner of T9N, R1E, SBM. Continue S along west boundary of R1E, SMB to Riverside County line at the SW corner of T1S, R1E, SBM. Continue E along south boundary of T1s, SBM (Riverside County Line) to SW corner of T1S, R10E, SBM. Continue S along west boundary of R10E, SBM to Imperial County line at the SW corner of T8S, R10E, SBM. Continue W along Imperial and Riverside county line to NW corner of T9S, R9E, SBM. Continue S along the boundary between Imperial and San Diego Counties, along the west edge of R9E, SBM to the south boundary of Imperial County/California state line. Follow the California state line west to Arizona state line, then north to Nevada state line, then continuing NW back to start at the point which is the NW corner of Section 1, T17N, R14E, SBM

$1.00 additional per hour for portions of SAN LUIS OBISPO, KERN, SANTA BARBARA & VENTURA as defined below:

That area within the following Boundary: Begin approximately 5 miles north of the community of Cholame, on the Monterey County and San Luis Obispo County boundary at the NW corner of T25S, R16E, Mt. Diablo Meridian. Continue south along the west side of R16E to the SW corner of T30S, R16E, MDM. Continue E to SW

corner of T30S, R17E, MDM. Continue S to SW corner of T31S, R17E, MDM. Continue E to SW corner of T31S, R18E, MDM. Continue S along West side of R18E, MDM as it crosses into San Bernardino Meridian numbering area and becomes R30W. Follow the west side of R30W, SBM to the SW corner of T9N, R30W, SBM. Continue E along the south edge of T9N, SBM to the Santa Barbara County and Ventura County boundary at that point whch is the SW corner of Section 34.T9N, R24W, SBM, continue S along the Ventura County line to that point which is the SW corner of the SE quarter of Section 32, T7N, R24W, SBM. Continue E along the south edge of T7N, SBM to the SE corner to T7N, R21W, SBM. Continue N along East side of R21W, SBM to Ventura County and Kern County boundary at the NE corner of T8N, R21W. Continue W along the Ventura County and Kern County boundary to the SE corner of T9N, R21W. Continue North along the East edge of R21W, SBM to the NE corner of T12N, R21W, SBM. Continue West along the north edge of T12N, SBM to the SE corner of T32S, R21E, MDM. [T12N SBM is a think strip between T11N SBM and T32S MDM]. Continue North along the East side of R21E, MDM to the Kings County and Kern County border at the NE corner of T25S, R21E, MDM, continue West along the Kings County and Kern County Boundary until the intersection of San Luis Obispo County. Continue west along the Kings County and San Luis Obispo County boundary until the intersection with Monterey County. Continue West along the Monterey County and San Luis Obispo County boundary to the beginning point at the NW corner of T25S, R16E, MDM.

$2.00 additional per hour for INYO and MONO Counties and the Northern portion of SAN BERNARDINO County as defined below:

That area within the following Boundary: Begin at the intersection of the northern boundary of Mono County and the California state line at the point which is the center of Section 17, T10N, R22E, Mt. Diablo Meridian. Continue S then SE along the entire western boundary of Mono County, until it reaches Inyo County at the point which is the NE corner of the Western half of the NW quarter of Section 2, T8S, R29E, MDM. Continue SSE along the entire western boundary of Inyo County, until the intersection with Kern County at the point which is the SW corner of the SE 1/4 of Section 32, T24S, R37E, MDM. Continue E along the Inyo and Kern County boundary until the intersection with San Bernardino County at that point which is the SE corner of section 34, T24S, R40E, MDM. Continue E along the Inyo and San Bernardino County boundary until the point which is the NE corner of the Western half of the NW quarter of Section 6, T25S, R42E, MDM. Continue S to that point which is the SW corner of the NW quarter of Section 6, T27S, R42E, MDM. Continue E in a straight line to the California and Nevada state border at the point which is the NW corner of Section 1, T17N, R14E, San Bernardino Meridian. Then continue NW along the state line to the starting point, which is the center of Section 18, T10N, R22E, MDM.

REMAINING AREA NOT DEFINED ABOVE RECIEVES BASE RATE

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 ENGI0012-004 08/01/2020
                                  Rates            Fringes
OPERATOR:  Power Equipment
(DREDGING)
     (1) Leverman.................$ 56.40           30.00
     (2) Dredge dozer.............$ 50.43           30.00
     (3) Deckmate.................$ 50.32           30.00
     (4) Winch operator (stern
     winch on dredge).............$ 49.77           30.00
     (5) Fireman-Oiler,
     Deckhand, Bargeman,
     Leveehand....................$ 49.23           30.00
     (6) Barge Mate...............$ 49.84           30.00
----------------------------------------------------------------
 IRON0433-006 07/01/2020
                                  Rates            Fringes
IRONWORKER
     Fence Erector................$ 34.58           24.81
     Ornamental, Reinforcing
     and Structural...............$ 41.00           33.45

PREMIUM PAY:

$6.00 additional per hour at the following locations:

China Lake Naval Test Station, Chocolate Mountains Naval
Reserve-Niland,
Edwards AFB, Fort Irwin Military Station, Fort Irwin Training
Center-Goldstone, San Clemente Island, San Nicholas Island,
Susanville Federal Prison, 29 Palms - Marine Corps, U.S. Marine
Base - Barstow, U.S. Naval Air Facility - Sealey, Vandenberg AFB

$4.00 additional per hour at the following locations:

Army Defense Language Institute - Monterey, Fallon Air Base,
Naval Post Graduate School - Monterey, Yermo Marine Corps
Logistics Center

$2.00 additional per hour at the following locations:

Port Hueneme, Port Mugu, U.S. Coast Guard Station - Two Rock



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 LABO0089-001 07/01/2020
                                  Rates            Fringes
LABORER (BUILDING and all
other Residential
Construction)
     Group 1......................$ 34.18           20.48
     Group 2......................$ 34.86           20.48
     Group 3......................$ 35.57           20.48
     Group 4......................$ 36.37           20.48
     Group 5......................$ 38.30           20.48
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	Rates	Fringes
LABORER (RESIDENTIAL CONSTRUCTION - See definition below)		
(1) Laborer	$ 30.82	18.80
(2) Cleanup, Landscape, Fencing (Chain Link & Wood)	$ 29.53	18.80

RESIDENTIAL DEFINITION: Wood or metal frame construction of single family residences, apartments and condominums - excluding (a) projects that exceed three stories over a garage level, (b) any utility work such as telephone, gas, water, sewer and other utilities and (c) any fine grading work, utility work or paving work in the future street and public right-of-way; but including all rough grading work at the job site behind the existing right of way

LABORER CLASSIFICATIONS

GROUP 1: Cleaning and handling of panel forms; Concrete Screeding for Rought Strike-off; Concrete, water curing; Demolition laborer; Flagman; Gas, oil and/or water pipeline laborer; General Laborer; General clean-up laborer; Landscape laborer; Jetting laborer; Temporary water and air lines laborer; Material hoseman (walls, slabs, floors and decks); Plugging, filling of Shee-bolt holes; Dry packing of concrete; Railroad maintenance, Repair Trackman and road beds, Streetcar and railroad construction trac laborers; Slip form raisers; Slurry seal crews (mixer operator, applicator operator, squeegee man, Shuttle man, top man), filling of cracks by any method on any surface; Tarman and mortar man; Tool crib or tool house laborer; Window cleaner; Wire Mesh puling-all concrete pouring operations

GROUP 2: Asphalt Shoveler; Cement Dumper (on 1 yard or larger mixer and handling bulk cement); Cesspool digger and installer; Chucktender; Chute man, pouring concrete, the handling of the cute from ready mix trucks, such as walls, slabs, decks, floors, foundations, footings, curbs, gutters and sidewalks; Concrete curer-impervious membrane and form oiler; Cutting torch operator (demoliton); Guinea chaser; Headboard man-asphlt; Laborer, packing rod steel and pans; membrane vapor barrier installer; Power broom sweepers (small); Riiprap, stonepaver, placing stone or wet sacked concrete; Roto scraper and tiller; Tank sealer and cleaner; Tree climber, faller, chain saw operator, Pittsburgh Chipper and similar type brush shredders; Underground laborers, including caisson bellower

GROUP 3: Buggymobile; Concrete cutting torch; Concrete cutting torch; Concrete pile cutter; Driller, jackhammer, 2 1/2 feet drill steel or longer; Dri Pak-it machine; High sealer (including drilling of same); Hydro seeder and similar type; Impact wrench, mult-plate; Kettlemen, potmen and mean applying asphalt, lay-kold, creosote, line caustic

and similar type materials (applying means applying, dipping, brushing or handling of such materials for pipe wrapping and waterproofing); Operators of pneumatic, gas, electric tools, vibratring machines, pavement breakers, air blasting, come-along, and similar mechanical tools not separately classified herein; Pipelayers back up man coating, grouting, making of joints, sealing, caulking, diapering and inclduing rubber gasket joints, pointing and any and all other services; Rotary Scarifier or multiple head concrete chipping scaarifier; Steel header board man and guideline setter; Tampers, Barko, Wacker and similar type; Trenching machine, handpropelled

GROUP 4: Asphalt raker, luterman, ironer, apshalt dumpman and asphalt spreader boxes (all types); Concrete core cutter (walls, floors or ceilings), Grinder or sander; Concrete saw man; cutting walls or flat work, scoring old or new concrete; Cribber, shorer, lagging, sheeting and trench bracing, hand-guided lagging hammer; Laser beam in connection with laborer's work; Oversize concrete vibrator operator 70 pounds and over; Pipelayer performing all services in the laying, installation and all forms of connection of pipe from the point of receiving pipe in the ditch until completion of oepration, including any and all forms of tubular material, whether pipe, metallic or non-metallic, conduit, and any other stationary type of tubular device used for the conveying of any substance or element, whether water, sewage, solid, gas, air or other product whatsoever and without regard to the nature of material from which the tubular material is fabricated; No joint pipe and stripping of same; Prefabricated manhole installer; Sandblaster (nozzleman), Porta shot-blast, water blasting

GROUP 5: Blasters Powderman-All work of loading holes, placing and blasting of all pwder and explosives of whatever type, regardless of method used for such loading and placing; Driller-all power drills, excluding jackhammer, whether core, diamond, wagon, track, multiple unit, and any and all other types of mechanical drills without regard to the form of motive power.

LABO0089-002 11/01/2019

	Rates	Fringes
LABORER (MASON TENDER)	$ 32.00	18.28

LABO0089-004 07/01/2020

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
Laborers:		
Group 1	$ 35.30	20.48
Group 2	$ 35.76	20.48
Group 3	$ 36.17	20.48
Group 4	$ 37.01	20.48
Group 5	$ 40.28	20.48

LABORER CLASSIFICATIONS

GROUP 1: Laborer: General or Construction Laborer, Landscape Laborer. Asphalt Rubber Material Loader. Boring Machine Tender (outside), Carpenter Laborer (cleaning, handling, oiling & blowing of panel forms and lumber), Concrete Laborer, Concrete Screeding for rough strike-off, Concrete water curing. Concrete Curb & Gutter laborer, Certified Confined Space Laborer, Demolition laborer & Cleaning of Brick and lumber,Expansion Joint Caulking; Environmental Remediation, Monitoring Well, Toxic waste and Geotechnical Drill tender, Fine Grader, Fire Watcher, Limbers, Brush Loader, Pilers and Debris Handlers. flagman. Gas Oil and Water Pipeline Laborer. Material Hoseman (slabs, walls, floors, decks); Plugging, filling of shee bolt holes; Dry packing of concrete and patching; Post Holer Digger (manual); Railroad maintenance, repair trackman, road beds; Rigging & signaling; Scaler, Slip-Form Raisers, Filling cracks on any surface, tool Crib or Tool House Laborer, Traffic control (signs, barriers, barricades, delineator, cones etc.), Window Cleaner

GROUP 2: Asphalt abatement; Buggymobile; Cement dumper (on 1 yd. or larger mixers and handling bulk cement); Concrete curer, impervious membrane and form oiler; Chute man, pouring concrete; Concrete cutting torch; Concrete pile cutter; driller/Jackhammer, with drill steel 2 1/'2 feet or longer; Dry pak-it machine; Fence erector; Pipeline wrapper, gas, oil, water, pot tender & form man; Grout man; Installation of all asphalt overlay fabric and materials used for reinforcing asphalt; Irrigation laborer; Kettleman-Potman hot mop, includes applying asphalt, lay-klold, creosote, lime caustic and similar tyhpes of materials (dipping, brushing, handling) and waterproofing; Membrane vapor barrier installer; Pipelayer backup man (coating, grouting, making of joints, sealing caulkiing, diapering including rubber basket joints, pointing); Rotary scarifier, multiple head concrete chipper; Rock slinger; Roto scraper & tiller; Sandblaster pot tender; Septic tank digger/installer; Tamper/wacker operator; Tank scaler & cleaner; Tar man & mortar man; Tree climber/faller, chainb saw operator, Pittsburgh chipper & similar type brush shredders.

GROUP 3: Asphalt, installation of all frabrics; Buggy Mobile Man, Bushing hammer; Compactor (all types), Concrete Curer - Impervious membrane, Form Oiler, Concrete Cutting Torch, Concrete Pile Cutter,Driller/Jackhammer with drill steel 2 1/2 ft or longer, Dry Pak-it machine, Fence erector including manual post hole digging, Gas oil or water Pipeline Wrapper - 6 ft pipe and over, Guradrail erector, Hydro seeder, Impact Wrench man (multi plate), kettleman-Potman Hot Mop includes applying Asphalt, Lay-Kold, Creosote, lime caustic and similar types of materials (dipping, brushing or handling) and waterproofing. Laser Beam in connection with Laborer work. High Scaler, Operators of Pneumatic Gas or Electric Tools,

Vibrating Machines, Pavement Breakers, Air Blasting, Come-Alongs and similar mechanical tools, Remote-Controlled Robotic Tools in connection with Laborers work. Pipelayer Backup Man (Coating, grouting,m makeing of joints, sealing, caulking, diapering including rubber gasket joints, pointing and other services). Power Post Hole Digger, Rotary Scarifier (multiple head concrete chipper scarifier), Rock Slinger, Shot Blast equipment (8 to 48 inches), Steel Headerboard Man and Guideline Setter, Tamper/Wacker operator and similar types, Trenching Machine hand propelled.

GROUP 4: Any worker exposed to raw sewage. Asphalt Raker, Luteman, Asphalt Dumpman, Asphalt Spreader Boxes, Concrete Core Cutter, Concrete Saw Man, Cribber, Shorer, Head Rock Slinger. Installation of subsurface instrumentation, monitoring wells or points, remediation system installer; Laborer, asphalt-rubber distributor bootman; Oversize concrete vibrator operators, 70 pounds or over. Pipelayer, Prfefabricated Manhole Installer, Sandblast Nozzleman (Water Balsting-Porta Shot Blast), Traffic Lane Closure.

GROUP 5: Blasters Powderman-All work of loading holes, placing and blasting of all powder and explosives of whatever type, regardless of method used for such loading and placing; Horizontal directional driller, Boring system, Electronic traking, Driller: all power drills excluding jackhammer, whether core, diamond, wagon, track, multiple unit, and all other types of mechanical drills without regard to form of motive power. Environmental remediation, Monitoring well, Toxic waste and Geotechnical driller, Toxic waste removal. Welding in connection with Laborer's work.

LABO0300-005 01/01/2018

	Rates	Fringes
Asbestos Removal Laborer	$ 33.19	17.78

SCOPE OF WORK: Includes site mobilization, initial site cleanup, site preparation, removal of asbestos-containing material and toxic waste, encapsulation, enclosure and disposal of asbestos- containing materials and toxic waste by hand or with equipment or machinery; scaffolding, fabrication of temporary wooden barriers and assembly of decontamination stations.

LABO0345-001 07/01/2020

	Rates	Fringes
LABORER (GUNITE)		
GROUP 1	$ 45.05	19.62
GROUP 2	$ 44.10	19.62
GROUP 3	$ 40.56	19.62

FOOTNOTE: GUNITE PREMIUM PAY: Workers working from a Bosn'n's Chair or suspended from a rope or cable shall receive 40 cents per hour above the foregoing applicable classification rates. Workers doing gunite and/or shotcrete work in a tunnel shall receive 35 cents per hour above the foregoing applicable classification rates, paid on a portal-to-portal basis. Any work performed on, in or above any smoke stack, silo, storage elevator or similar type of structure, when such structure is in excess of 75'-0"" above base level and which work must be performed in whole or in part more than 75'-0"" above base level, that work performed above the 75'-0"" level shall be compensated for at 35 cents per hour above the applicable classification wage rate.

GUNITE LABORER CLASSIFICATIONS

GROUP 1: Rodmen, Nozzlemen

GROUP 2: Gunmen

GROUP 3: Reboundmen

LABO1184-001 07/01/2020

	Rates	Fringes
Laborers: (HORIZONTAL DIRECTIONAL DRILLING)		
(1) Drilling Crew Laborer...	$ 37.85	15.99
(2) Vehicle Operator/Hauler.	$ 38.02	15.99
(3) Horizontal Directional Drill Operator.....	$ 39.87	15.99
(4) Electronic Tracking Locator.....	$ 41.87	15.99
Laborers: (STRIPING/SLURRY SEAL)		
GROUP 1.....	$ 39.06	19.01
GROUP 2.....	$ 40.36	19.01
GROUP 3.....	$ 42.37	19.01
GROUP 4.....	$ 44.11	19.01

LABORERS - STRIPING CLASSIFICATIONS

GROUP 1: Protective coating, pavement sealing, including repair and filling of cracks by any method on any surface in parking lots, game courts and playgrounds; carstops; operation of all related machinery and equipment; equipment repair technician

GROUP 2: Traffic surface abrasive blaster; pot tender - removal of all traffic lines and markings by any method (sandblasting, waterblasting, grinding, etc.) and preparation of surface for coatings. Traffic control person: controlling and directing traffic through both conventional and moving lane closures; operation of all related machinery and equipment

GROUP 3: Traffic delineating device applicator: Layout and application of pavement markers, delineating signs, rumble and traffic bars, adhesives, guide markers, other traffic delineating devices including traffic control. This category includes all traffic related surface preparation (sandblasting, waterblasting, grinding) as part of the application process. Traffic protective delineating system installer: removes, relocates, installs, permanently affixed roadside and parking delineation barricades, fencing, cable anchor, guard rail, reference signs, monument markers; operation of all related machinery and equipment; power broom sweeper

GROUP 4: Striper: layout and application of traffic stripes and markings; hot thermo plastic; tape traffic stripes and markings, including traffic control; operation of all related machinery and equipment

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LABO1414-003 08/05/2020

	Rates	Fringes
LABORER		
PLASTER CLEAN-UP LABORER....	$ 36.03	21.01
PLASTER TENDER.....	$ 38.58	21.01

Work on a swing stage scaffold: $1.00 per hour additional.

Work at Military Bases - $3.00 additional per hour:
Coronado Naval Amphibious Base, Fort Irwin, Marine Corps Air Station-29 Palms, Imperial Beach Naval Air Station, Marine Corps Logistics Supply Base, Marine Corps Pickle Meadows, Mountain Warfare Training Center, Naval Air Facility-Seeley, North Island Naval Air Station, Vandenberg AFB.

PAIN0036-001 07/01/2020

	Rates	Fringes
Painters: (Including Lead Abatement)		
(1) Repaint (excludes San Diego County).....	$ 29.59	17.12
(2) All Other Work.....	$ 33.12	17.24

REPAINT of any previously painted structure. Exceptions: work involving the aerospace industry, breweries, commercial recreational facilities, hotels which operate commercial establishments as part of hotel service, and sports facilities.

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 PAIN0036-010 10/01/2019
                                  Rates             Fringes
DRYWALL FINISHER/TAPER
     (1) Building & Heavy
     Construction.............$ 35.69             17.10
     (2) Residential
     Construction (Wood frame
     apartments, single family
     homes and  multi-duplexes
     up to and  including four
     stories).................$ 25.11             17.06
----------------------------------------------------------------
 PAIN0036-012 01/01/2020
                                  Rates             Fringes
GLAZIER.......................$ 44.55             17.06
----------------------------------------------------------------
 PAIN0036-019 06/01/2020
                                  Rates             Fringes
SOFT FLOOR LAYER..............$ 32.27             17.24
----------------------------------------------------------------
 PLAS0200-005 08/07/2019
                                  Rates             Fringes
PLASTERER.....................$ 43.73             16.03

  NORTH ISLAND NAVAL AIR STATION, COLORADO NAVAL AMPHIBIOUS
  BASE, IMPERIAL BEACH NAVAL AIR STATION:  $3.00 additional
  per hour.

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 PLAS0500-001 07/01/2018
                                  Rates             Fringes
CEMENT MASON/CONCRETE FINISHER
     GROUP 1..................$ 26.34             21.12
     GROUP 2..................$ 27.99             21.12
     GROUP 3..................$ 30.07             21.12

  CEMENT MASONS -  work inside the building line, meeting the
  following criteria:

  GROUP 1:  Residential wood frame project of any size;  work
  classified as Type III, IV or Type V construction;
  interior tenant improvement work regardless the size of the
  project; any wood frame project of four stories or less.

  GROUP 2: Work classified as type I and II construction

  GROUP 3: All other work

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PLUM0016-006 09/01/2020

	Rates	Fringes
PLUMBER, PIPEFITTER, STEAMFITTER		
Camp Pendleton; Vandenberg Air Force Base	$ 55.88	23.66
Work ONLY on new additions and remodeling of commercial buildings, bars, restaurants, and stores not to exceed 5,000 sq. ft. of floor space	$ 50.70	23.73
Work ONLY on strip malls, light commercial, tenant improvement and remodel work	$ 38.73	22.06
All other work except work on new additions and remodeling of bars, restaurant, stores and commercial buildings not to exceed 5,000 sq. ft. of floor space and work on strip malls, light commercial, tenant improvement and remodel work	$ 52.28	24.71

PLUM0016-011 09/01/2020

	Rates	Fringes
PLUMBER/PIPEFITTER		
Residential	$ 41.62	20.63

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* PLUM0345-001 09/01/2020

	Rates	Fringes
PLUMBER		
Landscape/Irrigation Fitter	$ 35.30	24.10
Sewer & Storm Drain Work	$ 39.39	21.48

ROOF0045-001 07/01/2020

	Rates	Fringes
ROOFER	$ 36.25	9.24

SFCA0669-001 04/01/2020

	Rates	Fringes
SPRINKLER FITTER	$ 41.57	24.10

SHEE0206-001 07/01/2020

	Rates	Fringes
SHEET METAL WORKER		
Camp Pendleton	$ 42.62	29.55
Except Camp Pendleton	$ 40.62	29.55
Sheet Metal Technician	$ 30.51	9.49

SHEET METAL TECHNICIAN - SCOPE:
a. Existing residential buildings, both single and multi-family, where each unit is heated and/or cooled by a

separate system b. New single family residential buildings including tracts. c. New multi-family residential buildings, not exceeding five stories of living space in height, provided each unit is heated or cooled by a separate system. Hotels and motels are excluded. d. LIGHT COMMERCIAL WORK: Any sheet metal, heating and air conditioning work performed on a project where the total construction cost, excluding land, is under $1,000,000 e. TENANT IMPROVEMENT WORK: Any work necessary to finish interior spaces to conform to the occupants of commercial buildings, after completion of the building shell

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TEAM0166-001 09/01/2019

	Rates	Fringes
Truck drivers:		
GROUP 1	$ 18.90	34.69
GROUP 2	$ 26.49	34.69
GROUP 3	$ 26.69	34.69
GROUP 4	$ 26.89	34.69
GROUP 5	$ 27.09	34.69
GROUP 6	$ 27.59	34.69
GROUP 7	$ 29.09	34.69

FOOTNOTE: HAZMAT PAY: Work on a hazmat job, where hazmat certification is required, shall be paid, in addition to the classification working in, as follows: Levels A, B and C - +$1.00 per hour. Workers shall be paid hazmat pay in increments of four (4) and eight (8) hours.

TRUCK DRIVER CLASSIFICATIONS

GROUP 1: Fuel Man, Swamper

GROUP 2: 2-axle Dump Truck, 2-axle Flat Bed,Concrete Pumping Truck, Industrial Lift Truck, Motorized Traffic Control, Pickup Truck on Jobsite

GROUP 3: 2-axle Water Truck, 3-axle Dump Truck, 3-axle Flat Bed, Erosion Control Nozzleman, Dump Crete Truck under 6.5 yd, Forklift 15,000 lbs and over, Prell Truck, Pipeline Work Truck Driver, Road Oil Spreader, Cement Distributor or Slurry Driver, Bootman, Ross Carrier

GROUP 4: Off-road Dump Truck under 35 tons 4-axles but less than 7-axles, Low-Bed Truck & Trailer, Transit Mix Trucks under 8 yd, 3-axle Water Truck, Erosion Control Driver, Grout Mixer Truck, Dump Crete 6.5yd and over, Dumpster Trucks, DW 10, DW 20 and over, Fuel Truck and Dynamite, Truck Greaser, Truck Mounted Mobile Sweeper 2-axle Winch Truck

GROUP 5: Off-road Dump Truck 35 tons and over, 7-axles or more, Transit Mix Trucks 8 yd and over, A-Frame Truck, Swedish Cranes

GROUP 6: Off-Road Special Equipment (including but not limited to Water Pull Tankers, Athey Wagons, DJB, B70 Wuclids or like Equipment)

GROUP 7: Repairman

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198

indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination

* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

Davis-Bacon Requirements

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in § 5.5(a)(4).

Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

Sub recipients may obtain wage determinations from the U.S. Department of Labor's web site, www.dol.gov.

(ii) (A) The sub recipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

1 The work to be performed by the classification requested is not performed by a classification in the wage determination; and

2 The classification is utilized in the area by the construction industry; and

3 The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the sub recipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the sub recipient (s) to the State award official. The State award official will transmit the request, to the Administrator of the Wage and Hour Division, Employment Standards

Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30- day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the sub recipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the

amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The sub recipient(s), shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the sub recipient, that is, the entity that receives the

sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the sub recipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at https://www.dol.gov/whd/forms/index.htm or its successor site.

The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the sub recipient(s) for transmission to the State or EPA if requested by EPA, the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sub recipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

1 That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

2 That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

3 That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(ii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or sub contractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the

registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may by appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and sub recipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

11. AGENCY SPECIFIC PROVISIONS:

Note: Failure to comply with these specifications e.g., taking the specified steps prior to Bid opening and submitting the forms with the Bid, will lead to the Bid being declared **non-responsive** and, therefore, shall be rejected.

11.1. EPA Requirements:

1. Federal Disadvantaged Business Enterprise (DBE) regulations apply to this project. (Reference 40 Code of Federal Regulations Part 33 - Participation by Disadvantaged Business Enterprises in U.S. Environmental Protection Agency Programs).

2. The responsive Bid shall conform to GFE to increase DBE awareness of procurement opportunities through race and gender neutral efforts. Race and gender neutral efforts are ones which increase awareness of contracting opportunities in general, including outreach, recruitment and technical assistance.

3. Bidder agrees that it will cooperate with and assist the City in fulfilling the DBE Good Faith Effort Requirement achieving "fair share objectives" and will exercise GFE to achieve such minimum participation of small, minority and women owned businesses. In particular, in submitting a bid, the Bidder shall, in the selection of Subcontractors, and Suppliers for the procurement of equipment, supplies, construction, and services related to the project, at a minimum, undertake the affirmative GFE steps.

4. In accordance with EPA's Program for Utilization of Small, Minority Disadvantaged and Women Business Enterprises in procurement under Federal assistance programs, the Contractor agrees to the applicable "fair share objectives" as specified in **Attachment D**.

5. The provisions in the Contract Documents have been incorporated to prevent unfair practices that adversely affect DBEs.

6. If a DBE Subcontractor fails to complete the Work under the subcontract for any reason, the Contractor shall employ the 6 GFE if soliciting a replacement Subcontractor. The Contractor shall employ the 6 GFE described below even if the Contractor has achieved its fair share objectives.

7. Good Faith Efforts:

    a. The Contractor shall demonstrate that efforts were made to attract DBEs on this contract. The "Good Faith" effort requires the Contractor and any Subcontractors to take the steps listed in these specifications to assure that DBEs are used whenever possible as sources of supplies, construction, equipment, or services even if the Contractor has achieved its fair share objectives.

    b. If the Contractor awards subcontracts, it shall require the Subcontractors to take the steps in these specifications.

c. For the EPA defined GFE, see the steps below:

i. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. For Indian Tribal, State and Local and Government recipients, this will include placing DBEs on solicitation lists and soliciting them whenever they are potential sources.

ii. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes posting solicitations for bids or proposals for a minimum of 30 Calendar Days (refer to 33 CFR 33.301) before the bid or proposal closing date.

iii. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. For Indian Tribal, State and local Government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process. Include with the GFE documentation a completed copy of the form AA61, "List of Work Made Available".

iv. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.

v. Use the services and assistance of the U.S. Small Business Administration (SBA) and the Minority Business Development Agency (MDBA) of the Department of Commerce (DOC). See "DBE Potential Resources Centers" Section in a later part these specifications.

vi. If the Contractor awards Subcontracts, the Contractor shall take the steps in the paragraphs above.

11.2. California State Revolving Fund (CASRF) Requirements:

11.2.1. Refer to Subsection 11.1, "EPA Requirements" above and the following:

11.2.2. The Bidder shall take affirmative steps prior to Bid opening to assure that MBE's and WBE's are used whenever possible as sources of supplies, construction and services.

11.2.3. The affirmative steps are defined for contracts funded by the California State Water Resources Control Board as follows:

1. Utilization of US Small Business Administration and Minority Business Development Agency (MBDA) resources is required at no cost. These

agencies offer several services, including Internet access to databases of DBEs.

2. For additional assistance, the Contractor can telephone the local offices of both agencies in their area (SBA Minority Enterprise Development Offices and DOC MBDA Regional Centers). The Internet web sites also include names, addresses, and phone or fax numbers of local SBA and MBDA centers. There are contact phone numbers listed in Step 3 that will assist you in reaching the 2 offices if the Internet is unavailable. Do not write to these sources.

3. The Contractor shall provide documentation that the local SBA/MBDA offices or web sites were notified of the contracting bid opportunity at least 30 Calendar Days prior to Bid opening and solicitation to DBE Subcontractors at least 15 Calendar Days prior to Bid opening. Documentation shall not only include the efforts to contact the information sources and list the Contract opportunity, but also the solicitation and response to the bid request.

4. Include qualified DBEs on solicitation lists and record the information. Solicitation shall be as broad as possible.

5. If DBE sources are not located, explain why and describe the efforts made.

6. The Contractor shall send invitations to at least 10 (or all, if less than 10) DBE vendors for each item of the Work referred by sources contacted. The invitations shall adequately specify the items for which bids are requested. The record of GFE shall indicate a real desire for a positive response, such as a certified mail receipt or a documented telephone conversation.

7. A regular letter or an unanswered telephone call is not an adequate "good faith" effort. A list of all Subcontractors, including the bidders not selected and non DBE Subcontractors, and bid amount for each item of the Work shall be submitted on Form AA62. If a low bid was not accepted, an explanation shall be provided.

11.2.4. See "DBE Potential Resources Centers" Section in a later part these specifications.

11.2.5. <u>Annual DBE Utilization Reporting:</u>

The Contractor shall report to the City on an annual basis, their utilization of Minority Business Enterprise and Women's Business Enterprise Subcontractors and Suppliers using California State Revolving Funds (CASRF) Form UR-334.

12. DBE POTENTIAL RESOURCES CENTERS:

12.1. Utilization of US Small Business Administration and Minority Business Development Agency (MBDA) resources is required at no cost. These agencies offer several services, including Internet access to databases of DBEs.

12.2. For additional assistance, the recipient or contractor can telephone the local offices of both agencies in their area (SBA Minority Enterprise Development Offices and DOC MBDA Regional Centers). The Internet web sites also include names, addresses, and phone or fax numbers of local SBA and MBDA centers. Do not write to these sources

12.3. The Contractor shall provide documentation that the local SBA/MBDA offices or web sites were notified of the contracting bid opportunity at least 30 Calendar Days prior to Bid opening and solicitation to DBE subcontractors at least 15 Calendar Days prior to Bid opening. Documentation shall not only include the efforts to contact the information sources and list the Contract opportunity, but also the solicitation and response to the bid request.

12.4. Include qualified DBEs on solicitation lists and record the information on Form AA63. Solicitation shall be as broad as possible.

12.5. If DBE sources are not located, explain why and describe the efforts made.

12.6. The Contractor shall send invitations to at least 10 (or all, if less than 10) DBE vendors for each item of work referred by sources contacted. The invitations shall adequately specify the items for which bids are requested. The record of "good faith" efforts shall indicate a real desire for a positive response, such as a certified mail receipt or a documented telephone conversation.

12.7. A regular letter or an unanswered telephone call is not an adequate "good faith" effort. A list of all sub-bidders, including the bidders not selected and non DBE Subcontractors, and bid amount for each item of the Work shall be submitted on Form AA62. If a low bid was not accepted, an explanation shall be provided.

12.8. Federal Agencies (must be contacted and solicitations posted on their websites):

Name and Address	Telephone and Web Site
U.S. Small Business Administration	(415) 744-6820 Extension 0
455 Market Street, Suite 600	Dynamic Small Business Search: https://catalog.data.gov/dataset/dynamic-small-business-search-dsbs-025a1
San Francisco, CA 94105	Bid Notification: https://catalog.data.gov/dataset/subcontracting-network-subnet-system
RE: Minority Enterprise Development Offices	
U.S. Department of Commerce	(415) 744-7415
Minority Business Development Agency	Website:
555 Montgomery Street	https://www.mbda.gov/
San Francisco, CA 94111	RE: Business Development Centers

12.9. State Agencies (must be contacted):

Name and Address	Telephone and Web Site
California Department of Transportation	Mailing Address: PO Box 942874
(CALTRANS) Business Enterprise Program[4]	Sacramento, CA 94274-0015
1820 Alhambra Blvd.	(916) 227-9599
Sacramento, CA 95816	DBE Database: https://dot.ca.gov/programs/civil-rights/dbe
CA Public Utilities Commission (CPUC)[5]	
505 Van Ness Avenue San Francisco, CA 94102-3298	Directory: https://sch.thesupplierclearinghouse.com/FrontEnd/SearchCertifiedDirectory.asp

Notes:

1. The Contractor shall use the SBA's Dynamic Business Search database to search for potential subcontractors, suppliers, and/or manufacturers. Bidder must provide a copy of all search records for items of work made available with GFE documentation.

2. Contractor shall use SUB-Net to post subcontracting opportunities. Contractor shall post Subcontractor opportunities at least 15 Working Days prior to bid opening. Small businesses can review this web site to identify opportunities in their areas of expertise. The web site is designed primarily as a place for large businesses to post solicitations and notices. Bidder **must** provide copy of the Display Solicitation Record identifying the date solicitation notice was posted with GFE documentation.

3. Contractor may use MBDA web portal to post subcontracting opportunities. If utilized, the Contractor shall post subcontractor opportunities at least 30 Calendar Days prior to Bid opening. Small businesses can review this web site to identify opportunities in their areas of expertise. The web site is designed primarily as a place for large businesses to post solicitations and notices. Provide copy of the Offer Overview with the GFE documentation.

4. Based on the federal DBE program, CALTRANS maintains a database and provides directories of minority and woman-owned firms. Bidder must provide a copy of all search records for items of work made available with GFE documentation.

5. CPUC maintains a database of DBE-owned business enterprises and serves to inform the public. Bidder **must** provide a copy of all search records for items of work made available with GFE documentation.

13. GOOD FAITH EFFORT DOCUMENTATION SUBMITTALS:

13.1. The affirmative GFE steps documentation shall be submitted **within 4 Working Days after the Bid Opening**. If this documentation is not submitted when due, the City will declare the Bid **non-responsive** and reject it.

13.2. The required documentation shall be submitted and logged in at the following address:

CITY OF SAN DIEGO
ENGINEERING & CAPITAL PROJECTS DEPARTMENT, CONTRACTS DIVISION
525 B STREET, SUITE 750
SAN DIEGO, CA 92101
SUBJECT: AFFIRMATIVE GOOD FAITH EFFORT DOCUMENTATION

BID NO. **K-21-1801-DBB-3-A**

13.3. The Contractor shall maintain the records documenting compliance with requirements including documentation of its GFE and data relied upon in formulating its fair share objectives.

14. FORMS:

14.1. The Contractor shall demonstrate that efforts were made to attract DBEs on this contract. The Contractor and Subcontractors shall take the steps listed in these specifications to assure that DBEs are used whenever possible as sources of supplies, construction, equipment, or services. In addition to the specified GFE documentation, the Bidder shall submit the following forms.

14.1.1. The Contractor shall demonstrate that efforts were made to attract DBEs on this contract. The Contractor and Subcontractors shall take the steps listed in these specifications to assure that DBEs are used whenever possible as sources of supplies, construction, equipment, or services. In addition to the specified GFE documentation, the Bidder shall submit the following forms.

14.1.1.1 The following form shall be submitted **with the Bid submittal**. Failure to include any of the forms shall cause the Bid to be deemed **non-responsive.**

1. Form 4500-3: DBE Subcontractor Performance Form

2. Form 4500-4: DBE Subcontractor Utilization Form

14.1.1.2 The following forms shall be completed and submitted within **4 Working Days after the Bid opening**. Failure to include any of the forms shall cause the Bid to be deemed **non-responsive**.

1. Form AA61: List of Work Made Available

2. Form AA62: Summary of Bids Received

3. Form AA63: Good Faith Effort List of Subcontractors Solicited

14.1.2. The following additional forms shall be submitted annually in accordance with Section 11 "AGENCY SPECIFIC PROVISIONS".

1. Form UR-334: California State Revolving Funds (CASRF)

14.1.3. Bidder is to provide the following form to all DBE subcontractors participating on this contract. Submittal of form is dependent on DBE subcontractor and is to be forwarded to the DBE coordinator at any time during the project period of performance.

1. Form 4500-2: DBE Subcontractor Participation Form.

FUNDING AGENCY PROVISIONS

FORMS

Disadvantaged Business Enterprise (DBE) Program

DBE Subcontractor Performance Form

This form is intended to capture the DBE[1] subcontractor's[2] description of work to be performed and the price of the work submitted to the prime contractor. A Financial Assistance Agreement Recipient must require its prime contractor to have its DBE subcontractors complete this form and include all completed forms in the prime contractor's bid or proposal package.

Subcontractor Name	Project Name	
Bid / Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.	Email Address	
Prime Contractor Name	Issuing/Funding Entity	

Contract Item Number	**Description of Work Submitted from the Prime Contractor Involving Construction, Services, Equipment or Supplies**	**Price of Work Submitted to the Prime Contractor**
DBE Certified By: ___ DOT ___ SBA ___ Other: _____	Meets/exceeds EPA certification standards? ___ YES ___ NO ___ Unknown	

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.2015 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

FORM 4500-3 (DBE Subcontractor Performance Form)

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	Date

Subcontractor Signature	Print Name
Title	Date

The public reporting and record keeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Do not send the completed form to this address.

FORM 4500-3 (DBE Subcontractor Performance Form)

Disadvantaged Business Enterprise (DBE) Program

DBE Subcontractor Utilization Form

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE[1] subcontractor's[2] and the estimated dollar amount of each subcontract. A Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposal package. Prime contractors should also maintain a copy of this form on file.

Prime Contractor Name		Project Name
Bid / Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.		Email Address
Issuing/Funding Entity		

I have identified potential DBE certified subcontractors. ___ YES ___ NO

If *yes*, please complete the table below. If *no*, please explain:

Subcontractor Name/ Company Name	**Company Address / Phone / Email**	**Estimated Dollar Amount**	**Currently DBE Certified?**

--Continue on back if needed--

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.2015 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

FORM 4500-4 (DBE Subcontractor Utilization Form)

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	Date

The public reporting and record keeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Do not send the completed form to this address.

FORM 4500-4 (DBE Subcontractor Utilization Form)

LIST OF WORK MADE AVAILABLE

List items of the Work the Bidder made available to DBE firms. Identify those items of the Work the Bidder might otherwise perform with its own forces and those items that have been broken down into economically feasible units to facilitate DBE participation. For each item listed, show the dollar amount and percentage of the Base Bid. The Bidder must demonstrate that enough work to meet the goal was made available to DBE firms.

SCOPE OF WORK MADE AVAILABLE	NAICS CODE	BIDDER NORMALLY PERFORMS ITEM (Y/N)	ITEM BROKEN DOWN TO FACILITATE PARTICIPATION (Y/N)	AMOUNT	PERCENTAGE OF BASE BID

SUMMARY OF BIDS RECEIVED

Company Name	NAICS CODES	Scope of Work	Selected (Y/N)	Bid Amount	DBE	Non-DBE	Explanation for not Selecting

USE ADDITIONAL FORMS AS NECESSARY

DISADVANTAGE BUSINESS ENTERPRISE (DBE)

GOOD FAITH EFFORT LIST OF SUBCONTRACTORS SOLICITED

Contractor Name	Contractor Address	How Located	Date of Contact	Contact Method	Scope of Work	Bidding (Yes/No)

USE ADDITIONAL FORMS AS NECESSARY

STATE WATER RESOURCES CONTROL BOARD – DIVISION OF FINANCIAL ASSISTANCE
DISADVANTAGED BUSINESS ENTERPRISE (DBE) UTILIZATION
CALIFORNIA STATE REVOLVING FUNDS (CASRF)
FORM UR-334

1. Grant/Finance Agreement Number:	2. Annual Reporting Period 10/1/___ through 09/30/_	3. Purchase Period of Financing Agreement:
4. Total Payments Paid to Prime Contractor or Sub-Contractors During Current Reporting Period: $		
5. Recipient's Name and Address:	6. Recipient's Contact Person and Phone Number:	

7. List All DBE Payments Paid by Recipient or Prime Contractor During Current Reporting Period:

Payment or Purchase Paid by Recipient or Prime Contractor	Amount Paid to Any DBE Contractor or Sub-Contractor For Service Provided to Recipient		Date of Payment (MM/DD/YY)	Procurement Type Code** (see below)	Name and Address of DBE Contractor of Sub-Contractor or Vendor
	MBE	WBE			

8. Initial here if no DBE contractors or sub-contractors paid during current reporting period:	
9. Initial here if all procurements for this contract are completed:	
10. Comments:	
11. Signature and Title of Recipient's Authorized Representative	12. Date

Email Form UR-334 to:

DrinkingWaterSRF@waterboards.ca.gov OR CleanWaterSRF@waterboards.ca.gov

Questions may be directed to:

Barbara August, SWRCB
Barbara.August@waterboards.ca.gov
Phone: (916) 341-6952
Fax: (916) 327-7469

****Procurement Type:**
1. Construction
2. Supplies
3. Services (includes business services; professional services; repair services and personnel services)
4. Equipment

STATE WATER RESOURCES CONTROL BOARD - DIVISION OF FINANCIAL ASSISTANCE
DISADVANTAGED BUSINESS ENTERPRISE (DBE) UTILIZATION
CALIFORNIA STATE REVOLVING FUNDS

INSTRUCTIONS FOR COMPLETING FORM UR-334

Box 1 Grant or Financing Agreement Number.

Box 2 Annual reporting period.

Box 3 Enter the dates between which you made procurements under this financing agreement or grant.

Box 4 Enter the total amount of payments paid to the contractor or sub-contractors during this reporting period.

Box 5 Enter Recipient's Name and Address.

Box 6 Enter Recipient's Contact Name and Phone Number.

Box 7 Enter details for the **DBE purchases only** and be sure to limit them to the current period. 1) Use either an "R" or a "C" to represent "Recipient" or "Contractor." 2) Enter a dollar total for DBE and total the two columns at the bottom of the section. 3) Provide the payment date. 4) Enter a product type choice from those at the bottom of the page. 5) List the vendor name and address in the right-hand column

Box 8 Initial here if no DBE contractors or sub-contractors were paid during this reporting period.

Box 9 Initial this box only if all purchases under this financing agreement or grant have been completed during this reporting period or a previous period. If you initial this box, we will no longer send you a survey.

Box 10 This box is for explanatory information or questions.

Box 11 Provide an authorized representative signature.

Box 12 Enter the date form completed.

Disadvantaged Business Enterprise (DBE) Program

DBE Subcontractor Participation Form

A Financial Assistance Agreement Recipient must require its prime contractors to provide this form to its DBE subcontractors. This form gives a DBE[1] subcontractor[2] the opportunity to describe work received and/or report any concerns regarding the funded project (e.g., in areas such as termination by prime contractor, late payments, etc.). The DBE subcontractor can, as an option, complete and submit this form to the DBE Coordinator at any time during the project period of performance.

Subcontractor Name	Project Name	
Bid / Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.	Email Address	
Prime Contractor Name	Issuing/Funding Entity	

Contract Item Number	**Description of Work Received from the Prime Contractor Involving Construction, Services, Equipment or Supplies**	**Amount Received by Prime Contractor**

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.2015 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

FORM 4500-2 (DBE Subcontractor Participation Form)

Please use the space below to report any concerns regarding the above funded project:

Subcontractor Signature	Print Name
Title	Date

The public reporting and record keeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Do not send the completed form to this address.

Send completed Form 4500-2 to:
Mr. Joe Ochab, DBE Coordinator
US EPA, Region 9
75 Hawthorne Street
San Francisco, CA 94105

FORM 4500-2 (DBE Subcontractor Participation Form)

ATTACHMENT E

SUPPLEMENTARY SPECIAL PROVISIONS

SUPPLEMENTARY SPECIAL PROVISIONS

The following Supplementary Special Provisions (SSP) modifies the following documents:

1. The **2015 Edition** of the Standard Specifications for Public Works Construction (The "GREENBOOK").

2. The **2015 Edition** of the City of San Diego Standard Specifications for Public Works Construction (The "WHITEBOOK"), including the following:

   a) General Provisions (A) for all Contracts.

SECTION 1 – TERMS, DEFINITIONS, ABBREVIATIONS, UNITS OF MEASURE, AND SYMBOLS

1-2 TERMS AND DEFINITIONS. To the "WHITEBOOK", items 42, 56, 69, and 102, DELETE in its entirety and SUBSTITUTE with the following:

42. **Field Order** - A Field Order is a written agreement by the Engineer to compensate you for Work items in accordance with 3-3, "EXTRA WORK" or 3-4, "CHANGED CONDITIONS". A Field Order does not change the Contract Price, Contract Time, or the scope intent of the Contract. The unused portion of the Field Order shall revert to the City upon Acceptance.

56. **Notice of Completion (NOC)** - A document recorded with the County of San Diego to signify that the Contract Work has been completed and accepted by the City.

69. **Punchlist** - A list of items of Work or corrections generated after a Walk-through that is conducted when you consider that the Work and Services are complete, and as verified by the Owner. The Punchlist may be completed in phases if defined in the Contract.

102. **Walk-through** - An inspection the City uses to verify the completion of the Project or phase of the Project and to generate a Punchlist prior to Acceptance.

To the "WHITEBOOK", item 54, "Normal Working Hours", ADD the following:

The **Normal Working Hours** are **8:00 AM** to **4:00 PM**. Construction activities outside of the normal working hours may occur with prior approval by the Resident Engineer, at no additional cost to the City.

To the "WHITEBOOK", ADD the following:

Item 108. Intermediate Substantial Completion

The time at which the Project's operating facilities or systems are sufficiently complete to provide Owner with uninterrupted temporary operations and maintenance of the overall facility as required to perform an integrated startup with other facilities within the Program.

These facilities include the North City Pure Water Facility (NCPWF), Morena Pump Station, Force Main and Brine Conveyance, North City Influent Pump Station and Conveyance, Metropolitan Biosolids Center, and the Pure Water Facility Pump Station. All facilities shall be fully operable to allow for a flow increase to the plant from the Morena Pump Station of 10% increase in flow per every ten days without interruption. The Contractor shall support all activities within the Integration period as described in Section 01 91 14 Testing, Integration, and Startup.

Item 109. Substantial Completion - The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, and that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

Item 110. Final Completion

Once Substantial Completion is finished, the following items are planned to be completed by the Owner prior to the Final Completion by the Contractor:

- The Contractor shall complete punch list fix-up as approved by the City prior to being provided with Final Completion.
- All Work required under Specification Section 01 77 00 Closeout Procedures shall have been completed.

Following Final Completion, the Owner shall provide acceptance of the facilities and take over operation of the facilities.

SECTION 2 - SCOPE AND CONTROL OF WORK

2-1.1.3 Requests for Information (RFI). To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. Should You discover a conflict, omission, errors in the Contract Documents, differences with existing field conditions, or have any questions concerning interpretation or clarification of Contract Documents, or when you propose deviations to the standards or design, you shall submit a Request for Information (RFI) to the City regarding your question or clarification within **1 Working Day**.

2. Your RFI shall meet the following requirements:

    a) All RFIs, whether by You or your Subcontractor or supplier at any tier, shall be submitted by You to the City.

    b) RFIs shall be numbered sequentially.

    c) You shall clearly and concisely set forth the single issue for which interpretation or clarification is sought, indicate Specification Section

numbers, Contract Drawing numbers, and details, or other items involved, and state why a response is required from the City.

d) RFIs shall be submitted within **1 Working Day** in order that they may be adequately researched and answered before the response affects any critical activity of the Work.

e) Should You believe that a response to an RFI causes a change to the requirements of the Contract, You shall, before proceeding, give written notice to the City, indicating that You believe that City response to the RFI to be a Change Order. Failure to give such written notice within **5 Working Days** of receipt of the City's response to the RFI shall waive Your right to seek additional time or cost.

3. The City will respond to RFIs within **5 Working Days** unless the City notifies You in writing that a response will take longer. The **5 Working Days** shall begin when the RFI is received and dated by the City. Responses from the City will not change any requirement of the Contract unless so noted by the City in the response to the RFI. The City will not issue a Change Order for Extra Work or additional time when the issue raised in the RFI was due to your fault, neglect, or any unauthorized deviations from the project design or specifications.

4. If You proceed in resolving a conflict, omission, or any error in the Contract Documents without sending the City an RFI in accordance with the requirements stated above, the City may require You to remove such work at Your cost or back charge You the cost to remove this work.

2-3.2 **Self Performance.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. You shall perform, with your own organization, Contract Work amounting to at least 35% of the base Bid.

2-3.4 **Subcontract Requirements.** To the "WHITEBOOK", ADD the following:

6. When a Subcontractor fails to prosecute a portion of the Work in a manner satisfactory to the City, you shall remove such Subcontractor immediately upon written request of the City, and shall request approval of a replacement Subcontractor to perform the Work in accordance with California Public Contract Code (PCC), Subletting and Subcontracting, Section 4107, at no added cost to the City.

2-4 **Contract Bonds.** To the "WHITEBOOK", item 1, DELETE in its entirety and SUBSTITUTE with the following:

1. Before execution of the Contract, file payment and performance bonds with the City to be approved by the Board in the amounts and for the purposes noted. Bonds shall be executed by a responsible surety as follows:

a) If the Work is being funded with state or local money, consistent with California Code of Civil Procedure §995.670, the Surety shall be an "admitted surety" authorized by the State of California Department of Insurance to transact surety insurance in the State.

b) If the Work is being funded with federal money, the Surety shall be listed in the U.S. Treasury Department Circular 570 and shall be in conformance with the specified Underwriting Limitations.

To the "WHITEBOOK", item 2, subsection "a", subsection "i", DELETE in its entirety and SUBSTITUTE with the following:

i. A "Payment Bond" (Materials and Labor Bond) is optional. If no bond is submitted, no payment shall be made until 35 Calendar Days after Acceptance and any lien requirements have been fulfilled. If a bond is submitted, progress payments shall be made in accordance with these Specifications.

To the "WHITEBOOK", item 2, subsection "d", DELETE in its entirety and SUBSTITUTE with the following:

d) For Contracts over $100,000:

i. A "Payment Bond" (Materials and Labor Bond) for 100% of the Contract Price to satisfy claims of material Suppliers and of mechanics and laborers employed on the Work. You shall maintain the bond in full force and effect until Acceptance and until all claims for materials and labor are paid and shall otherwise comply with the Government Code.

ii. A "Faithful Performance Bond" for 100% of the Contract Price to guarantee faithful performance of Work, within the time prescribed and in a manner satisfactory to the City, that materials and workmanship shall be free from original or developed defects.

To the "WHITEBOOK", item 7, DELETE in its entirety and SUBSTITUTE with the following:

7. You shall require the Surety to mail its standard "Bond Status" form to the Engineer at the following address:

Deputy Director
Construction Management and Field Engineering Division
9573 Chesapeake Drive San Diego, CA 92123

2-5.3.1 General. To the "WHITEBOOK", ADD the following:

2. For additional requirements related to submittals, refer to Technical Specification Section 01 33 00 "Submittal Procedures".

2-5.3.4 Supporting Information. To the "WHITEBOOK", ADD the following:

3. For landscaping and irrigation materials, submit samples and test results to the Engineer within 15 Days of the NTP.

2-5.4.1 **General.** To the "WHITEBOOK", ADD the following:

6. For additional requirements related to Red-lines and Record Documents, refer to:

   Technical Specifications, Section 01 77 00 "Closeout Procedures", Part 3 "Execution", Subsection 3.01 "Maintenance of Record Documents".

ADD:

2-5.4.2 **Asset Specific Red-lines.** To the "WHITEBOOK", ADD the following:

1. **Fiber Optic and WIFI Device Red-lines.** Fiber Optic and WIFI Device Red-lines shall clearly record by dimension from 2 known fixed points and by depth of underground facilities all deviations, modifications, and changes in the Work. Records, deviations, modifications, and changes on the day the Work is performed shall reflect the actual Work location and shall be marked in red at the scale of the Plan sheet on which they are recorded. Red-lines shall show the equipment locations and associated information for the following:

   a) Locations and depths of underground utilities.

   b) Revisions to the routing of piping and conduits.

   c) Actual equipment locations.

   d) Pull Boxes.

   e) Electrical Meter, including meter address.

   f) Items abandoned in place.

2-7 **SUBSURFACE DATA.** To the "WHITEBOOK", ADD the following:

4. In preparation of the Contract Documents, the designer has relied upon the following reports of explorations and tests of subsurface conditions at the Work Site:

   a) Geotechnical Report Morena Pump Station by AECOM Jan 5, 2018

   b) Addendum No 1 Geotech Report Morena Pump Station by AECOM Aug 13, 2018

   c) Addendum No 2 Geotech Report Morena Pump Station by AECOM Dec 12, 2018

   d) Addendum No 3 Geotech Report Morena Pump Station by AECOM Mar 21, 2019

   e) Geotechnical Baseline Report Friars Rd by AECOM Aug 13, 2018

   f) Fault Investigation Report Morena Pump Station By AECOM Sept 19, 2017

   g) Groundwater Level for Morena Pump Station by AECOM April 25, 2019.

5. The reports listed above are available for review by contacting the Contract Specialist or visiting:

https://drive.google.com/drive/folders/1ay8LaIMK3pFqbL0AvBSVK-oK5dcycdHk?usp=sharing

2-9.1 **Permanent Survey Markers.** To the "WHITEBOOK", item 3, DELETE in its entirety and SUBSTITUTE with the following:

3. You shall submit to the Engineer a minimum of 7 Days prior to the start of the Work a list of controlling survey monuments which may be disturbed. The City will perform the following:

   a) Set survey points outside the affected Work area that reference and locate each controlling survey monument that may be disturbed.

   b) File a Corner Record or Record of Survey with the County Surveyor after setting the survey points to be used for re-establishment of the disturbed controlling survey monuments.

   c) File a Corner Record or Record of Survey with the County Surveyor after re-establishment of the disturbed controlling survey monuments.

ADD:

2-10 **AUTHORITY OF THE BOARD AND THE ENGINEER.** To the "GREENBOOK", Paragraph (2), DELETE in its entirety and SUBSTITUTE with the following:

The decision of the Engineer is final and binding on all questions relating to: quantities; acceptability of material, equipment, or work; execution, progress or sequence of work; requests for information (RFI), and interpretation of the Plans, Specifications, or other Contract Documents. This shall be precedent to any payment under the Contract. The Engineer shall be the single point of contact and shall be included in all communications.

2-13 **FORMAL PARTNERING.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

Refer to Technical Specifications, Section 01 12 01 "Partnering" for requirements.

2-14.2 **Integration of the Work with Separate Contractors.** To the "WHITEBOOK", ADD the following:

2. The list of Separate Contractors includes:

   a) Morena Conveyance North, Juan-Elli Bermudo, 858-614-5802

   b) Morena Conveyance Middle, Juan-Elli Bermudo, 858-614-5802

   c) Morena Conveyance South, Juan-Elli Bermudo, 858-614-5802

   d) North City Water Reclamation Plant Expansion, Monika Smoczynski, 858-292-6455

   e) North City Pure Water Facility and North City Pure Water Pump Station, Anthony Van, 858-292-6492

f) North City Pure Water Pipeline, Fabiola Amarillas, 619-533-5437

g) Metro Biosolids Center Improvement, Lubna Arikat, 858-292-6419

2-14.3 Coordination. To the "WHITEBOOK", ADD the following:

2. Other adjacent City projects are scheduled for construction for the same time period in the vicinity of the **Morena Pump Station**. See **Appendix F** for the approximate location. Coordinate the Work with the adjacent projects as listed below:

a) Morena Conveyance South, Juan Elli Bermudo, 858-614-5802

b) Midcoast Corridor Transit Project, Brett Stephens 619-504-3016

c) San Diego River Bridge Double Track Project, Brett Stephens 619-504-3016

d) Alvarado 2nd Pipeline Extension, Jericho Gallardo, 619-533-7523

e) Pacific Beach Pipeline, Roberto Vejar-Parra, 619-533-5402

f) Morena Improvements 1, Elham Lotfi, 619-533-5212

g) SDG&E Morena Pump Station Overhead Relocation Project, Andy Renger 619-764-1835.

2-15 TECHNICAL STUDIES AND DATA. To the "WHITEBOOK", ADD the following:

3. In preparation of the Contract Documents, the designer has relied upon the following reports of explorations and tests at the Work Site:

a) Inspection Report Asbestos Lead and Universal Waste for Humane Society dated July 13, 2018

b) Final Pothole Report (108) Dated Sept 25, 2017

4. The reports listed above are available for review by contacting the Contract Specialist or visiting:

https://drive.google.com/drive/folders/1K-Zl6NJ5nD3KRU0xUvTvdkJBLO8JnNYs?usp=sharing

2-16 CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM. To the "WHITEBOOK", item 1, DELETE in its entirety.

SECTION 3 – CHANGES IN WORK

3-2.2.1 General. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. Unit Bid prices shall not be subject to adjustment regardless of quantity used, or if none is used, for the following Bid items:

a) imported backfill

b) shoring

c) water services

d) house connection sewers

e) water pollution control items

2. Upon discovery and prior to the Work, you shall notify the Resident Engineer if there is a change in Bid item quantity that increases the total Contract Price by 5% or $100,000 or more, whichever is less.

3-3.2.3 Markup. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. Work paid under Allowance Bid items for permits, governmental fees, or direct payments specified in the Contract Documents shall not be subject to any markups.

2. The allowance for overhead and profit shall not exceed the values listed in the table below:

Component	**Overhead**	**Profit**
Labor	10%	10%
Material	10%	5%
Equipment	10%	5%

3. Markups for materials shall be applied to the actual cost of the material before applying the sales tax.

4. When a Subcontractor is performing Extra Work, the allowance for overhead and profit shall be applied to the labor, materials, and equipment costs of the Subcontractor as follows:

   a) Regardless of the number of Subcontractor tasks for Extra Work, you may only apply 10% for the first $50,000 of the Subcontractor's portion of accumulated total cost then 5% for any remaining costs.

      You shall not apply 10% to any costs after the first $50,000 of accumulated total costs from performing Extra Work.

   b) If the accumulated costs of single or subsequent tasks exceed the $50,000 threshold, you shall instead only apply 5% to any amounts in excess of the $50,000.

   c) Regardless of the number of hierarchical tiers of Subcontractors, you may only markup a Subcontractor's Work once.

3-5 **DISPUTED WORK.** To the "GREENBOOK" and "WHITEBOOK", DELETE all sections in their entirety and SUBSTITUTE with the following:

3-5 DISPUTED WORK.

1. If you and the City are unable to reach agreement, the Resident Engineer may direct you to proceed with the Disputed Work. Payment shall be as later determined by 3-2, 3-3, mediation or arbitration, as agreed by you and the City, or as fixed in a court of law.

2. Although not to be construed as proceeding under 3-3, you shall keep and furnish records of Disputed Work to the Resident Engineer in accordance with 3-3.

3-5.1 **Claims.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

ADD:

3-5.1 Claims.

1. A Claim is a written demand by you that seeks an adjustment in the Contract Price, Contract Time, or other relief associated with a dispute arising under or relating to the Contract, including a breach of any provision thereof. A voucher, invoice, or other routine request for payment is not a Claim.

2. A Claim shall conform to these specifications and may be considered after the City has previously denied a request by you for a Change Order seeking the demanded relief.

3. You shall submit a Claim to the Engineer if a dispute occurs that arises from or relates to the Contract. The Claim shall seek all relief to which you assert you are entitled as a result of the event(s) giving rise to the dispute. Your failure to process a Claim in accordance with these specifications shall constitute a waiver of all relief associated with the dispute. Claims are subject to 6-11, "Right to Audit".

4. You shall continue to perform the Services and Work and shall maintain the Schedule during any dispute proceedings. The Engineer will continue to make payments for undisputed Services and Work.

5. The City's Claims process specified herein shall not relieve you of your statutory obligations to present claims prior to any action under the California Government Code.

3-5.1.1 Initiation of Claim.

1. You shall promptly, but no later than 30 Calendar Days after the event(s) giving rise to the Claim, deliver the Claim to the Engineer.

2. You shall not process a Claim unless the Engineer has previously denied a request by you for a Change Order that sought the relief to be pursued in the claim.

3-5.1.1.1 Claim Certification Submittal.

1. If your Claim seeks an increase in the Contract Price, the Contract Time, or both, submit with the Claim an affidavit certifying the following:

    a) The Claim is made in good faith and covers all costs and delays to which you are entitled as a result of the event(s) giving rise to the Claim.

    b) The amount claimed accurately reflects the adjustments in the Contract Price, the Contract Time, or both to which you believe you are entitled.

    c) All supporting costs and pricing data are current, accurate, and complete to the best of your knowledge. The cost breakdown per item of Work shall be supplied.

    d) You shall ensure that the affidavit is executed by an official who has the authority to legally bind you.

3-5.1.2 Initial Determination.

1. The Engineer will respond in writing to your Claim within 30 Calendar Days of receipt of the Claim.

3-5.1.3 Settlement Meeting.

1. If you disagree with the Initial Determination, you shall request a Settlement Meeting within 30 Calendar Days. Upon receipt of this request, the Engineer will schedule the Settlement Meeting within 15 Working Days.

3-5.1.4 City's Final Determination.

1. If a settle agreement is not reached, the City shall make a written Final Determination within 10 Working Days after the Settlement Meeting.

2. If you disagree with the City's Final Determination, notify the Engineer in writing of your objection within 15 Working Days after receipt of the written determination in accordance with 3-5.2.1.4, "DRB Traditional Dispute Meeting".

    Failure to give notice of objection of the Final Determination within the 15 Working Day period shall waive your right to pursue the Claim.

3-5.2 Dispute Resolution Process. To the WHITEBOOK**,** DELETE in its entirety and SUBSITUTE with the following:

1. A mandatory Dispute Resolution Board process shall be established in accordance with 3-5.2.1, "Dispute Resolution Board (DRB)" prior to the mandatory mediation as described in 3-5.2.2, "Mandatory Non-binding Mediation".

3-5.2.1 Dispute Resolution Board (DRB).

1. The DRB is a 3-member board that you and the City establish prior to beginning work.

3-5.2.1.1 DRB Member Selection. Within 45 Working Days of Contract approval, you and the City shall select DRB members and establish the DRB using the following procedure:

1. You and the City each nominates a DRB member candidate who is on the City's approved list. For the list of approved member candidates, go to the City's Division of Construction website.

2. If you or the City nominates someone who is not on that list, the candidate shall:

   a) Be knowledgeable in the type of construction and contract documents anticipated by the Contract.

   b) Have completed training by the Dispute Resolution Board Foundation.

   c) Have no prior direct involvement on this Contract.

   d) Have no financial interest in the Contract or with the parties, subcontractors, suppliers, consultants, or associated legal or business services within 6 months before award and during the Contract, except for payments for City DRA or DRB services, or payments for retirement or pensions from either party not tied to, dependent on, or affected by the net worth of the party.

3. You and the City shall request a disclosure statement from each nominated DRB member candidate and must each furnish it to the other party. The statement shall include:

   a) Resume of the candidate's experience.

   b) Declaration statement that describes past, present, anticipated, and planned professional or personal relationships with each of the following:

      i. Parties involved in the Contract

      ii. Parties' principals

      iii. Parties' counsel

      iv. Associated subcontractors and suppliers

4. You and the City are allowed:

   a) One-time objection to the other's candidate without stating a reason.

   b) Objection to any of the other's subsequent candidates based on a specific breach of the candidate's responsibilities or qualifications under items 1 and 3 of this section.

5. If you or the City objects to the other's candidate, the party whose candidate was objected to must nominate another DRB candidate within 15 Working Days.

6. The 1st candidate from a party that receives no objection becomes that party's DRB member.

7. You and the City each provide written notification to your selected DRB member.

8. Within 15 Working Days of their notifications, the selected DRB members recommend to you and the City the 3rd DRB member candidate and provide that candidate's disclosure statement.

9. Within 15 Working Days of the recommendation, you and the City must each notify the first 2 DRB members whether you approve or disapprove of the recommended 3rd DRB member candidate.

10. If the 2 DRB members cannot agree on the 3rd DRB candidate, they will submit a list of candidates to you and the City for final selection and approval.

11. If the 2 DRB members do not recommend a 3rd DRB candidate within 15 Working Days of notification of their selections, or if you and the City do not agree on the 3rd DRB member candidate within 15 Working Days of the recommendation, or if you and the City do not agree on any of the candidates on the list provided by the first 2 selected DRB members, you and the City each must select 3 candidates from the current list of arbitrators certified by the Public Works Contract Arbitration Committee established by Pub Cont Code § 10245 et seq. who will be willing to serve as a DRB member. The first 2 selected DRB members must select the 3rd member in a blind draw of these 6 candidates.

12. The 3 DRB members then decide which of the three will act as the DRB chairman. If you and the City do not agree with the selected chairman, the 3rd member will act as the DRB chairman.

3-5.2.1.2 DRB Member Replacement.

1. The service of a DRB member may end at any time with a notice of at least 15 Working Days if any of the following occurs:

    a) A member resigns

    b) The City replaces its selected member

    c) You replace your selected member

    d) The City's and your selected members replace the 3rd member

2. Either you or the City replace any member for failing to comply with the required employment or financial disclosure conditions of DRB membership as described in the Contract and in the Dispute Resolution Board Agreement form.

3. Replacing any DRB member shall be accomplished by written notification to the DRB and the other party with substantiation for replacing the member.

4. A replacement DRB member is selected the same way as the original DRB member. Selecting a replacement must start upon determination of the need for a replacement and must be completed within 15 Working Days. The Dispute Resolution Board Agreement form shall be amended to reflect the change to the DRB.

3-5.2.1.3 DRB Progress Meetings.

1. You and the City shall periodically meet with the DRB and visit the job site so the DRB members can keep abreast of construction activities and develop familiarity with the work in progress.

2. The progress meetings shall occur at the start of the project and at least once every 4 months after that.

3. Both parties shall attend each progress meeting.

4. You and the City may agree to waive scheduled progress meetings when the only work remaining is plant establishment.

3-5.2.1.4 DRB Traditional Dispute Meeting.

1. If you disagree with the City's Final Determination, notify the Engineer and DRB in writing of your objection within 15 Working Days after receipt of the determination.

2. A DRB dispute meeting shall be held no sooner than 30 Calendar Days and no later than 60 Calendar Days after the DRB receives your written notice unless you and the City otherwise agree.

3. At least 15 Calendar Days before the scheduled dispute meeting, each party shall furnish the DRB documentation that supports its position and any additional information requested by the DRB.

4. If the DRB requests additional information within 10 Calendar Days after the dispute meeting, the party receiving the request shall furnish this information within 10 Calendar Days of receiving the request.

5. The DRB shall provide a written recommendation report within 30 Calendar Days of the dispute meeting unless you and the City agree to allow more time.

6. Within 10 Calendar Days of receiving the DRB's recommendation report, either you or the City may request clarification of any part of the report. Only one request for clarification from each party is allowed per dispute.

7. Within 30 Calendar Days after receiving the DRB's recommendation, each party shall furnish a written response to the DRB indicating acceptance or rejection of the recommendation. If a party rejects the recommendation and has new information that supports its position, the party may request reconsideration. The reconsideration request shall be made within 30 Calendar Days after receiving the DRB's recommendation. Only one request for reconsideration from each party is allowed per dispute.

8. If you reject the DRB's recommendation, notify the Resident Engineer and DRB in writing of your objection within 15 Working Days after receipt of the DRB's recommendation and file a "Request for Mediation" in accordance with 3-5.2.2, "Mandatory Non-binding Mediation".

3-5.2.2 Mandatory Non-binding Mediation.

1. If a dispute arises out of or relates to the Contract, or the breach thereof, and if said dispute cannot be settled through contract provisions provided for the Dispute Resolution Board process, claim settlement, or negotiations, the parties agree to first endeavor to settle the dispute in an amicable manner, using mandatory mediation under the Construction Industry Mediation Rules of the American Arbitration Association or any other neutral organization agreed upon before having recourse in a court of law.

3-5.2.2.1 Mandatory Mediation Costs.

1. The expenses of witnesses for either side shall be paid by the party producing such witnesses. All other expenses of the mediation, including required traveling and other expenses of the mediator shall be borne equally by the parties.

3-5.2.2.2 Selection of Mediator. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. A single mediator, knowledgeable in construction aspects and acceptable to both parties, shall be used to mediate the dispute.

2. To initiate mediation, the initiating party shall serve a Request for Mediation at the American Arbitration Association (AAA) on the opposing party.

3. If AAA is used, the initiating party shall concurrently file with AAA a "Request for Mediation" along with the appropriate fees, a copy of requested mediators marked in preference order, and a preference for available dates.

4. If AAA is selected to coordinate the mediation (Administrator), within 10 Working Days from the receipt of the initiating party's Request for Mediation, the opposing party shall file the following:

    a) A copy of the list of the preferred mediators listed in preference order after striking any mediators to which they have any objection.

b) A preference for available dates.

c) Appropriate fees.

5. If the parties cannot agree on a mediator, then each party shall select a mediator and those mediators shall select the neutral third party to mediate the matter.

3-5.2.2.3 Conduct of Mediation Sessions.

1. Mediation hearings shall be conducted in an informal manner and discovery shall not be allowed.

2. Discussions, statements, and/or admissions shall be confidential to the proceedings and shall not be used for any other purpose as it relates to the party's legal position. The parties may agree to exchange any information they deem necessary.

3. Both parties shall have an authorized representative attend the mediation. Each representative shall have the authority to recommend entering into a settlement. Either party may have attorney(s), witnesses, or expert(s) present. Either party may request a list of witnesses and notifications of whether attorney(s) shall be present.

4. Any resulting agreements from mediation shall be documented in writing. Mediation results and documentation, by themselves, shall be "non-binding" and inadmissible for any purpose in any legal proceeding, unless such admission is otherwise agreed upon in writing by both parties. Mediators shall not be subject to any subpoena or liability and their actions shall not be subject to discovery.

3-5.2.2.4 Mandatory Assistance.

1. If a third-party dispute, litigation, or both arises out of or relates in any way to the Services provided under the Contract, upon the City's request, you shall agree to assist in resolving the dispute or litigation. Your assistance includes, but is not limited to the following:

a) Providing professional consultations.

b) Attending mediations, arbitrations, depositions, trials, or any event related to the dispute resolution and litigation.

3-5.2.2.5 Compensation for Mandatory Assistance.

1. The City will reimburse you for reasonable fees and expenses incurred by you for any required assistance rendered in accordance with 3-5.1.5, "Mandatory Assistance" as Extra Work.

2. The Engineer will determine whether these fees and expenses were necessary due to your conduct or failure to act.

3. If the Engineer determines that the basis of the dispute or litigation in which these fees and expenses were incurred were the result of your conduct or your failure to

act in part or in whole, you shall reimburse the City for any payments made for these fees and expenses.

4. Reimbursement may be through any legal means necessary, including the City's withholding of your payment.

3-5.2.3 Payment.

1. Pay each DRB member $2,000 per day for DRB's participation at each on-site meeting

   On-site meetings include:

   a) Initial project meeting

   b) Scheduled progress meetings for a project with a DRB

   c) Dispute meetings

2. This payment includes full compensation for on-site time, travel expenses, transportation, lodging, travel time, and incidentals for each day or portion thereof that the DRB member is at a DRB meeting.

3. Before a DRB member spends any time reviewing plans and specifications, evaluating positions, preparing recommendations, or performs any other off- site DRB-related tasks, you and the City shall agree to pay for the tasks. Pay the DRB member $200 per hour for these tasks. This payment includes full compensation for incidentals such as expenses for telephone, fax, and computer services.

4. The City shall reimburse you for 1/2 of the invoiced costs to the DRB and 1/2 of the costs of any technical services agreed to. Submit a change order bill and associated invoices with the original supporting documents in the form of a canceled check or bank statement to receive reimbursement. Do not add mark-ups to the change order bill.

5. The City will not pay for any DRB-related work performed after Contract acceptance.

6. The City will not pay your cost of preparing for and attending a dispute resolution meeting.

7. The CONTRACTOR shall make direct payments to each DRB member for their participation in authorized meetings and approved hourly rate charges, from invoices submitted by each DRB member, and technical services.

   DRB members may submit invoices to the CONTRACTOR for partial payment for work performed and services rendered for their preapproved participation in authorized meetings. The invoices shall be in a format approved by the parties and accompanied by a general description of activities performed during that

billing period. Payment for hourly fees, at the agreed rate, shall not be paid to a DRB member until the amount and extent of those fees are approved by the CITY and the CONTRACTOR.

3-5.3 Forum of Litigation.

1. It is the express intention that all legal actions and proceedings related to the Contract or Agreement with the City or to any rights or any relationship between the parties arising therefrom shall be solely and exclusively initiated and maintained in courts of the State of California for the County of San Diego.

ADD:

3-5.4 Pre-judgment Interest.

1. The parties stipulate that if a judgment is entered against a party for breaching this Contract, the pre-judgment interest shall be two percent (2%) per annum.

SECTION 4 - CONTROL OF MATERIALS

ADD:

4-1.1.1 American Iron and Steel (AIS).

1. The Consolidated Appropriations Act, 2014, includes an "American Iron and Steel (AIS)" requirement in section 436 that requires this project, funded via the Clean Water State Revolving Loan Fund (CWSRF) to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system.

2. You acknowledge to and for the benefit of the City of San Diego and the State Water Resource Control Board that you understand the Work under this Contract is being funded with monies made available by the Clean Water State Revolving Fund that have statutory requirements commonly known as "American Iron and Steel" that requires all of the iron and steel products used for construction to be produced in the United States including iron and steel products to be provided by you. You hereby warrant to and for the benefit of the City and the State that:

   a) You have reviewed and understand the American Iron and Steel Requirement,

   b) All of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement with required certification (for Sample Certification Letter, refer to **Appendix G** unless a waiver of the requirement is approved, and;

   c) You will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a

waiver of the American Iron and Steel Requirement, as may be requested by the City or the State.

3. The additional information below is being provided for reference and guidance to ensure that you comply with all requirements set forth by the CWSRF Loans:

   a) Refer to the following EPA website:

http://www.epa.gov/cwsrf/state-revolving-fund-american-iron-and-steel-ais-requirement

   b) The United States Environmental Protection Agency's Memorandum dated March 20, 2014 entitled, "Implementation of American Iron and Steel Provisions of P.L. 113-76, Consolidated Appropriations Act, 2014":

https://www.epa.gov/sites/production/files/2015-09/documents/ais-final-guidance-3-20-14.pdf

4. Your failure to comply with this provision shall permit the City or State to recover damages against you for any loss, expense, or cost (including without limitation attorney's fees) incurred by the City or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the City). Although you have no direct contractual privity with the State, as a lender to the City for the funding of this project, you and the City agree that the State is a third-party beneficiary and neither this provision (nor any other provision of this Contract necessary to give this provision force or effect) shall be amended or waived without the prior written consent of the State.

5. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or the EPA to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Purchaser or the EPA resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the EPA or any damages owed to the EPA by the Purchaser). While the Contractor has no direct contractual privity with the EPA, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the EPA is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the EPA

4-1.3.1 **General.** To the "WHITEBOOK", ADD the following:

3. Steel pipe in sizes larger than 18 inches shall require inspection at the source of production.

4. City lab staff or a qualified inspection agency shall witness all welding, lining, coating, and testing.

5. All parts of production (including but not limited to product fabrication, welding, testing, lining, and coating of straight pieces and specials) shall be performed or produced in the United States.

6. Welding and all testing shall be performed by certified welders and testing staff with credentials traceable in the United States.

4-1.3.2 **Inspection by the Agency.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

a. The City will provide inspection and testing laboratory services within the continental United States within a 200-mile radius of the geographical limits of the City.

4-1.3.3 **Inspection of Items Not Locally Produced.** To the "WHITEBOOK", DELETE in its entirety.

ADD:

4-1.3.3 **Inspection of Items Not Locally Produced.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. When you intend to purchase specialty pipe and related materials from sources located more than 200 miles (321.9 km) outside the geographical limits of the City, a qualified Third party independent inspection firm provided by the City's Construction Management team will be engaged to inspect materials, equipment, or process.

2. You shall be responsible for coordination with that firm and the pipe fabricator in order to schedule inspection of the full fabrication process and obtain all necessary approvals. No pipe or related materials shall be shipped nor shall any processing, fabrication or treatment of such pipe and materials be done without proper inspection by City's designated Lab staff or the approved agent of said Third party independent inspection firm. Approval by City Lab or said agent shall not relieve you of responsibility for complying with the requirements of the Contract Documents.

4-1.3.5 **Special Inspection**. To the "WHITEBOOK", ADD the following:

5. No special inspection shall be performed by the Contractor. The Contractor is not required to pay for special inspection unless due to circumstances detailed in DIV 01, Section 01 45 33.

4-1.3.6 **Preapproved Materials.** To the "WHITEBOOK", ADD the following:

3. You shall submit in writing a list of all products to be incorporated in the Work that are on the AML.

4-1.6 **Trade Names or Equals.** To the "WHITEBOOK", ADD the following:

11. You shall submit your list of proposed substitutions for an "equal" item **no later than 5 Working Days after the determination of the Apparent Low Bidder** and on the City's Product Submittal Form available at:

https://www.sandiego.gov/ecp/edocref/

SECTION 5 – UTILITIES

5-1.1 **General.** To the "WHITEBOOK", ADD the following:

1. **90 Calendar Days** prior to any paving work, you shall notify the utility owner to provide them adequate time to adjust their utility box frame and cover to finish grade.

5-2 **PROTECTION.** To the "WHITEBOOK", item 2, ADD the following:

g) Refer to **Appendix L** for more information on the protection of AMI devices.

5-6 **COOPERATION.** To the "GREENBOOK", ADD the following:

1. Notify SDG&E at least 10 Working Days prior to excavating within 10 feet of SDG&E Underground High Voltage Transmission Power Lines (69 KV and higher). No mechanical excavation within 10' of SDGE underground high voltage power lines.

2. SDG&E will be relocating power poles on Sherman and Custer Streets during the first 30 days of the Contract time.

SECTION 6 - PROSECUTION, PROGRESS AND ACCEPTANCE OF WORK

6-1.1 **Construction Schedule.** To the "WHITEBOOK", items 5, 9, 20, and 22, DELETE in their entirety and SUBSTITUTE with the following:

5. Monthly progress payments are contingent upon the submittal of an updated Schedule to the Engineer. The Engineer may refuse to process the whole or part of any monthly payment if you refuse or fail to provide an acceptable schedule.

9. Inclusive to the Contract Time, include 15 Working Days to the Schedule for the generation of the Punchlist. You shall Work diligently to complete all Punchlist items within 30 Working Days after the Engineer provides the Punchlist.

20. The **120 Calendar Days** for the Plant Establishment Period is included in the stipulated Contract Time. Time and shall begin with the acceptance of installation of the vegetation plan in accordance with Section 801-6, "MAINTENANCE AND PLANT ESTABLISHMENT".

22. Submit an updated cash flow forecast with every pay request (for each Project ID or WBS number provided in the Contract) showing periodic and cumulative

construction billing amounts for the duration of the Contract Time. If there has been any Extra Work since the last update, include only the approved amounts.

i. Refer to the Sample City Invoice materials in Appendix D – Sample City Invoice with Cash Flow Forecast and use the format shown.

ii. See also the "Cash Flow Forecast Example" at the location below:

https://www.sandiego.gov/ecp/edocref/

6-1.2 **Commencement of the Work.** To the "WHITEBOOK" DELETE in its entirety and SUBSTITUTE with the following:

1. Unless specified otherwise, you shall start construction within 5 Working Days after NTP and shall diligently prosecute the Work to completion within the Contract Time. Do not start any construction activities at the Site until the Pre-construction meeting is held and until the NTP has been issued by the Engineer.

2. Upon your written request, the Engineer may delay the issuance of the NTP as described in the following:

   a) Up to 5 Working Days from the Pre-construction meeting.

3. For areas that do not require engineered TCP on D-sheets, you may at any time after the Pre-construction meeting obtain a TCP Permit via Working Drawings or the City's over the counter process and start the Work. If you decide to commence the construction Work before the completion of the D-sheet TCPs, you shall forfeit the 60 Working Days specified here. The D-sheet TCP shall be done concurrently, and no additional time shall be granted.

4. For paving Work, coordinate the Work to facilitate the installation and protection of the new curb ramps and associated concrete Work prior to commencing the asphalt overlay operations. Do not start the Work at a specific location until all layouts and measurements are agreed upon by you and the Engineer.

6-1.6 **Excusable Delays.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. If a delay in the Work occurs and affects Work activities, delays may either be Excusable Compensable Delays or Excusable Non-Compensable Delays.

ADD:

6-1.6.1 **Excusable Compensable Delays.**

1. If an Excusable Delay meets the requirements of 6-6.2, "Extensions of Time", then the City shall compensate for the following circumstances:

   a) The City's failure or inability to make available any portion of the entire Site in accordance with the requirements of the Schedule.

b) The City's failure or inability to obtain necessary zoning changes, variances, code changes, permits or approvals from any governmental authority, or failure to obtain any street or alley vacations required for the performance of the Work, except to the extent due to your fault or neglect as determined by the Engineer.

c) Delays resulting from the acts or omissions of Separate Contractors, except to the extent Separate Contractors perform their work properly and in accordance with the Schedule.

d) Differing or concealed site conditions that could not reasonably have been anticipated at the time of Bid.

e) Delays resulting from the existence or discovery of hazardous materials or waste on the Site not brought in by you and not included in the Contract.

f) Delays resulting from any changes made to any City of San Diego Municipal Code after the date of execution of the Contract.

g) Delays due to the City's acts or omissions and those within the City's control.

h) Delays requested by the City.

ADD:

6-1.6.2 Excusable Non-Compensable Delays.

1. The City shall only issue an extension of time for Excusable Delays that meet the requirements of 6-6.2, "Extensions of Time" for the following circumstances:

   a) Delays resulting from Force Majeure.

   b) Delays caused by weather.

   c) Delays caused by changes to County, State, or Federal law.

   d) Delays caused by State or County Health Department orders in response to COVID-19

   e) Contractor shall schedule for work stoppages for twelve (12) working days per calendar year to accommodate special events. These events include but are not limited to the following; Rock and Roll Marathon (June), Kaiser Permanente Half Marathon (November), Susan G. Komen Race for the Cure (November), and additionally during large trolley usage events such as Comic Con, Opening Day for Padres. These twelve (12) working days will not be considered compensable delays pursuant to this Section 6-1.6.2. The City shall give the Contractor 30 days written notice of the event occurring.

6-2.2 **Work Restrictions.** The item below is in reference to the Morena Pump Station Drawings **40421-D:**

1. Contractor shall provide flagged vehicular access to the MTS Trolley overflow lot located on Friar's Road during trolley operational hours.

ADD:

6-2.2.1 **Payment.**

1. The payment for complying with the work restrictions shall be included in the Contract Price.

ADD:

6-2.3 **Work Plan for MTS.**

1. The Contractor shall provide a detailed Work Plan and Construction Phasing Plan submittal for review and approval from MTS to ensure the Contractor's proposed construction operations do not impede MTS operational requirements, provide protection of MTS right of way space, and provide protection of the Trolley tracks during construction. The Work Plan and Construction Phasing Plan submittal shall be provided prior to beginning any work within the MTS right of way and shall include the following elements at a minimum:

    a. Project purpose for work where pipeline crosses the railway as indicated on Civil Drawing C-16 (40421-40-D).

    b. Project scope for work pertaining to the installation of the Brine pipeline crossing the MTS trolley right of way.

    c. Construction phasing plan and schedule including description of the required phasing for all work to allow for coordination of trolley track operations.

    d. Description of Contractor's means and methods for pipeline installation.

    e. Description of Contractor's equipment proposed for pipeline installation.

    f. Description of any excavation (boring, potholing, digging, etc.) with locations and depths identified.

    g. Description of any excavation backfill.

    h. Description of any potential noise, dust or other impacts from work/equipment.

    i. Traffic control plan, if applicable.

    j. Community outreach plan, if applicable.

    k. Description of how Contractor will access the MTS Right-of-Way.

    l. Description of any environmental issues and permits obtained.

    m. Any on-track/railroad movement must include a specific work plan that details the equipment that will be used by the Contractor on the railroad

track, the on-track movement that will take place, and the qualifications of all personnel that will work on, in-between or near the equipment. The personnel qualifications must include the last twelve (12) months of all applicable training records and certifications.

n. Contractor shall also prepare and submit an Erosion and Sediment Control Plan (ESCP) for the work within the MTS right of way. Approval and issuance of permit by MTS is contingent upon submittal and approval of ESCP.

o. The payment for complying with the Work Plan, training requirements, compensation to MTS for providing flagmen, and all permit requirements shall be included in the "Influent, Diversion & Overflow Sewers" bid item. You shall not be entitled to any additional costs for the Work.

ADD:

6-2.4 Schedule Milestones.

1. Milestone 1 - Intermediate Substantial Completion – Completion of all requirements defined herein for Intermediate Substantial Completion.

2. Milestone 2 - Substantial Completion – Occurs after the completion of the Integration Period and upon completing the prerequisites for substantial completion.

3. Milestone 3 - Final Completion – After successful completion of substantial completion requirements, and all aspects of the Contract Closeout have been satisfactorily completed.

ADD:

6-3.2.1.1 Environmental Document.

1. The City of San Diego has prepared an Environmental Impact Report/Environmental Impact Statement (EIR/EIS), Proj. No. SCH#2106081016/PS #499621 for Pure Water Phase 1, which includes the Morena Pump Station. This document may be obtained at the following web link,

https://www.sandiego.gov/public-utilities/sustainability/pure-water-sd/reports

In addition, Pure Water Phase 1 has obtained the Environmental Documents listed below that the Contractor shall comply with**:**

PURE WATER ENVIRONMENTAL DOCUMENTS
Site Development Permit
Record of Decision
Air Pollution Control District Permit
Army Corps of Engineers 408 Permit

These documents can be obtained at the following link:

https://drive.google.com/drive/folders/1zoTpwKkjrVSnmRARWe6rSKIHOlvVoo11?

2. Compliance with the City's environmental documents shall be included in the Contract Price.

6-3.2.2 **Archaeological and Native American Monitoring Program.** To the "WHITEBOOK", ADD the following:

4. The City will retain a qualified archaeologist for this Contract. You shall coordinate your activities and Schedule with the activities and schedules of the archaeologist monitor. Notify the Engineer before noon of the Working Day before monitoring is required. See 2-11, "INSPECTION" for details.

6-3.2.3 **Paleontological Monitoring Program.** To the "WHITEBOOK", ADD the following:

3. The City will retain a qualified paleontologist for this Contract. You shall coordinate your activities and Schedule with the activities and schedules of the paleontologist monitor. Notify the Engineer before noon of the Working Day before monitoring is required. See 2-11, "INSPECTION" for details.

6-3.2.4 **Payment.** To the "WHITEBOOK", ADD the following:

All costs required for meeting the requirements in the aforementioned Pure Water Environmental Documents in section 6-3.2.1.1 above shall be included in the contract cost.

6-6.2 **Extensions of Time.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. The Contract Time shall not be modified except by Change Order.

2. You shall notify the City in writing within **1 Working Day** after the occurrence and discovery of an event that impacts the Project Schedule.

    a) If you believe this event requires a Change Order, you shall submit a written Change Order request with a report to the City that explains the request for Change Order within **5 Working Days**. The Change Order request must include supporting data, a general description of the discovery, the basis for extension, and the estimated length of extension. The City may grant an extension of time, in writing, for the Change Order request if you require more time to gather and analyze data.

3. The Engineer shall not grant an extension of Contract Time in accordance with 6-1.6, "Excusable Delays" unless you demonstrate, through an analysis of the critical path, the following:

    a) The event causing the delay impacted the activities along the Project's critical path.

b) The increases in the time to perform all or part of the Project beyond the Contract Time arose from unforeseeable causes beyond your control and without your fault or negligence and that all project float has been used.

4. Any modifications to the Contract Time will be incorporated into the weekly document that the Engineer issues that stipulates the Contract Time. If you do not agree with this document, submit to the Engineer for review a written protest supporting your objections to the document within **30 Calendar Days** after receipt of the statement. Your failure to file a timely protest shall constitute your acceptance of the Engineer's weekly document.

   a) Your protest will be considered a claim for time extension and shall be subject to 3-5.1, "Claims".

6-6.4 **Written Notice and Report.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. Your failure to notify the Resident Engineer within **1 Working Day** OR provide a Change Order request in accordance with 6-6.2, "Extensions of Time" within **5 Working Days** after the event will be considered grounds for refusal by the City to consider such request if your failure to notify prejudices the City in responding to the event.

6-7.1 **General.** To the "WHITEBOOK", item 3, ADD the following:

1. 30 Days for full depth asphalt final mill and resurfacing work required per SDG-107.

2. Where shutdowns of 16 inch and larger pipes are required, there is a shutdown moratorium from May until October. Plan and schedule Work accordingly. No additional payment or Working Days will be granted for delays due to the moratorium.

6-8.1 **Completion.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. You shall submit a written assertion that the Work has been completed and is ready for Owner Acceptance. If, in the Engineer's judgment, the Work has been completed in accordance with the Contract Documents, the Engineer will set forth in writing the date the Work was completed. This will be the date that you are relieved from responsibility to protect and maintain the Work and to which liquidated damages will be computed.

2. For additional requirements related to Closeout items, refer to Technical Specifications, Section 01 77 00 "Closeout Procedures"

6-8.1.1 Requirements Before Requesting a Walk-through. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

6-8.1.1 Requirements Before Requesting Intermediate Substantial Completion.

1. The following items are required prior to requesting a Substantial Completion:

   a) Remove temporary facilities from the Site.

   b) Thoroughly cleaning the Site and removing all mark outs and construction staking.

   c) Provide completed and signed Red-lines in accordance with 2-5.4 "Redlines and Record Documents".

   d) Provide all material and equipment maintenance and operation instructions and/or manuals.

   e) Provide all tools which are permanent parts of the equipment installed in the Project.

   f) Provide and properly identify all keys for construction and all keys for permanent Work.

   g) Provide all final Special Inspection reports required by the applicable building Code.

   h) Provide all items specified to be supplied as extra stock. Wrap, seal, or place in a container all items as necessary to allow for storage by the City for future use. Verify the specified quantities.

   i) Ensure that all specified EOCP and certified wage rate documentations covering the Contract Time have been submitted.

   j) Provide the spare parts for the proposed irrigation system as specified in the Special Provisions.

   k) If the Work includes sewer and storm drain installations, the inspection shall include televising in accordance with 306-18, "VIDEO INSPECTION".

   l) If the Work includes a Plant Establishment Period, Work in accordance with 801-6, "MAINTENANCE AND PLANT ESTABLISHMENT" shall be completed prior to requesting Substantial Completion, unless approved otherwise by the Owner.

   m) Notify the Engineer to arrange a final inspection of permanent BMPs installed.

6-8.1.2 **Walk-through and Punchlist Procedure.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. You shall notify the Engineer 15 Working Days in advance of date of anticipated Substantial Completion to allow time for Engineer to schedule a Walk-through. After you complete the requirements in 6-8.1.1, "Requirements Before Requesting Substantial Completion" and when you consider that the Work is Substantially Complete, you will notify the Engineer in writing that the Project is Substantially Complete. The Engineer will review your request and determine if the Project is ready for a Walk-through, by verifying whether you have completed all items as required by 6-8.1.1, "Requirements Before Requesting Substantial Completion". Within 7 Working Days, the City will either reject your request of a Walk-through in writing or schedule a Walk-through inspection. The Engineer shall facilitate the Walk-through.

2. The following documents shall be provided at the time of your Walk-through request: As-Built markup, Plans, specifications, technical data such as submittals and equipment manuals, draft final payment, warranties, material certifications, bonds, guarantees, maintenance service agreements, and maintenance and operating manuals.

3. Written warranties, except manufacturer's standard printed warranties, shall be on a letterhead addressed to you. Warranties shall be submitted in the format described in this section, modified as approved by the City, to suit the conditions pertaining to the warranty. Lack of submitting these items will delay start of Walk-through.

4. The Engineer will provide you with the Punchlist within 15 Working Days after the date of the Walk-through. The City shall not provide a preliminary Punchlist.

5. If the Engineer finds that the Project is not Substantially Complete as defined herein, the Engineer will terminate the Walk-through and notify you in writing.

6. If, at any time during the Engineer's evaluation of the corrective Work required by the Punchlist, the Engineer discovers that additional corrective Work is required, the Engineer may include that corrective Work in the Punchlist.

7. You shall remain solely responsible for the Project Site until the Project is completely operational, all Punchlist items have been corrected, and all operation and maintenance manuals have been accepted by the City.

8. The Engineer shall meet with you within 5 Working Days of notification that all Punchlist items are corrected. You shall complete the Punchlist within 30 Working Days and Working Days will continue to be counted until Acceptance of the Project.

6-8.2 **Acceptance.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. You shall provide the completed, signed, and stamped DS-563 to the Engineer prior to Acceptance.

2. You shall deliver the final As-builts and final billing prior to Acceptance.

3. You shall assemble and deliver to the Engineer a Final Summary Report and Affidavit of Disposal prior to Acceptance.

4. Acceptance shall occur after all of the requirements contained in the Contract Documents have been fulfilled. If, in the Engineer's judgment, you have fully performed the Contract, the Engineer will recommend to the City Engineer that your performance of the Contract be accepted. You shall receive notification of Acceptance in writing from the Owner and counting of working days shall cease and Warranty begins.

5. Retention can be released 35 Calendar Days after NOC. Submit your request for retention to the Resident Engineer and they will mail to you a "Release of Claims" form which shall be completed and returned before the retention will be released.

6-8.3 **Warranty.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. You shall warranty and repair all defective materials and workmanship for a period of 1 year. This call back warranty period shall start on the date the Work was accepted by the City unless the City has Beneficial Use or takes Occupancy of the portions of the project earlier (excluding water, sewer, and storm drain projects).

2. You shall warranty the Work free from all latent defects for 10 years and patent defects for a period of 4 years.

3. The warranty period for specific items covered under manufacturers' or suppliers' warranties shall commence on the date they are placed into service at the direction of the Engineer in writing.

4. All express warranties from Subcontractors, manufacturers', or Suppliers', of any tier, for the materials furnished and Work performed shall be assigned, in writing, to the City, and shall be delivered to the Engineer prior to the Acceptance of your performance of the Contract.

5. Replace or repair defective materials and workmanship in a manner satisfactory to the Engineer after notice to do so from the Engineer and within the time specified in the notice. If you fail to make such replacements or repairs within the time specified in the notice, the City may perform the replacement or repairs at your expense. If you fail to reimburse the City for the actual costs, your Surety shall be liable for the cost

6. Items that shall be warrantied free from defective workmanship and materials for a period longer than 1 year are as follows:

Specified Item	Minimum Warranty Period
Detectable Warning Tile Construction	3 Years of Manufacturer's Warranty
All Work Under SECTION 500 – PIPELINE REHABILITATION	3 Years
Fiber Optic Interconnect Cables	2 Years
Luminaires*	10 Years of Manufacturer's Warranty
LED Signal Modules	3 Years of Manufacturer's Warranty
Field Devices Associated with 700-6.3, "Adaptive Control Note"	See 700-6.3.9, "Warranty"

* Provide documentation verifying that the induction luminaire models being offered for the Project are covered by the 10-year warranty.

7. If, during the warranty period, any item of the Work is found to be Defective Work, you shall correct it promptly after receipt of written notice from the City to do so. The warranty period shall be extended with respect to portions of the Work corrected as part of the warranty requirements.

6-9 LIQUIDATED DAMAGES. To the "WHITEBOOK", ADD the following:

3. Contractor and Owner recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in Contract Times in the Scope of Work. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), the Contractor shall pay the following amounts for each Milestone for each day that expires after the time specified herein until the Work is substantially complete.

Milestone No.	Milestone Description	Required Completion Date or Working Days	Amount of Liquidated Damages
Milestone 1	Intermediate Substantial Completion	750 days after Notice to Proceed	$9,500/day
Milestone 2	Substantial Completion	895 days after Notice to Proceed	$1,000/day
Milestone 3	Final Completion	925 days after Notice to Proceed	$1,000/day

SECTION 7 - RESPONSIBILITIES OF THE CONTRACTOR

7-2 LABOR.

ADD

7-2.5 **Project Labor Agreement.** The Contractor and all subcontractors agree to be bound by the Project Labor Agreement (which is attached as Attachment I and incorporated by this reference) by submitting a Letter of Consent to the City's Labor Coordinator. The Contractor shall submit its Letter of Consent as a condition of award and all subcontractors shall submit their Letter of Consent before commencing any Work on the Project.

7.3 **INSURANCE.** To the "GREENBOOK", DELETE in its entirety.

ADD:

7-4 OWNER-CONTROLLED INSURANCE PROGRAM.

7-4.1 General Requirements.

1. The City has implemented an Owner-Controlled Insurance Program (OCIP) for its Pure Water Projects. In this OCIP, the City furnishes Workers' Compensation, General, Excess, Pollution Liability and Builder's Risk insurance associated with construction of the Work. Insurance furnished under the OCIP covers the City, the Contractor, and the Contractor's subcontractors of all tiers with exceptions stated below. As detailed in Section 7-4.17 and 7-4.18, Contractor and subcontractors still provide some insurance coverage under the OCIP.

2. Bidders, as well as their subcontractors with a subcontract amount of greater than one half of one percent of the Contractors bid amount, shall exclude from bids the costs of insurance for risks covered under the OCIP.

3. Bidders, as well as their subcontractors with a subcontract amount of greater than one half of one percent, shall determine the OCIP coverage credit by utilizing the OCIP Credit Worksheets attached herein under **Section 6. Certifications and Forms**.

4. OCIP enrollment is mandatory for contractors/subcontractors with contracts valued at $10,000 or greater or onsite labor of three days or more. For contracts under $10,000 in value, should there be any potential for additive change orders thereby increasing the contract value to $10,000 or greater, the contractor/subcontractor must enroll in the OCIP.

5. Bidders, as well as all of their subcontractors, with a subcontract amount of greater than one half of one percent of the Contractors bid amount, shall complete OCIP credit worksheets provided as part of the bid documents attached herein. Bidders shall submit, as well as OCIP credit worksheets obtained from all their subcontractors, the OCIP credit worksheets two business days after bid opening. **Failure to comply with OCIP credit worksheet requirements shall render the bid non-responsive and ineligible for award.**

6. Contractor shall still maintain minimum insurance outside of OCIP as defined in Section 7-4.17

7. OCIP related manuals mentioned in Section 7-4 and 7-10 can be downloaded from the following link:

https://drive.google.com/drive/folders/15LysB00Xje0FkIB3AGrS3PuFZQQBgME

7-4.2 OCIP Definitions.

1. The following definitions apply to the OCIP program:

a) Claim – A covered loss asserted under the OCIP insuring policy(s).

b) OCIP Deductible Assessment – The amount the Enrolled Contractor is responsible for paying as its contribution for settlement of any loss that is chargeable to the Contractor, or its subcontractors. The deductible shall be paid in a proportional amount between the Contractor and subcontractor, as determined by responsibility of the party causing the loss, by the OCIP insurance carrier.

c) Enrolled Contractors – The Contractor and any Subcontractor who have submitted all necessary enrollment information and have received confirmation letter, as well as certificates of insurance evidencing OCIP coverage as issued from the OCIP administrator. Enrollment date shall be established by the date on the certificate of insurance.

d) Excluded Parties: - The following parties shall not be enrolled in the OCIP:

1. Heavy or structural demolition utilizing wrecking balls or explosives

2. Hazardous materials remediation, removal or transport companies and their consultants.

3. Architects, surveyors, engineers, soil testing engineers and their respective consultants.

4. Vendors, suppliers, fabricators, materials dealers, truckers, haulers, drivers and others who merely transport, pickup, deliver, or carry materials, personnel, parts or other equipment to and from the Job Site.

5. Any parties or entities not specifically designated by the City at its sole discretion, even if otherwise eligible.

6. Subcontractors work with a value of less than $10,000, unless their work extends to be greater than three days of work or more

e) Insured Party - Contractor, the Contractor's subcontractors, officers, employees and agents, the City and the City's officers, employees, contractors and agents as enrolled in the OCIP, except any Uninsured Party.

f) OCIP Administrator - The person or insurance broker firm designated by the City with responsibility for administration of the OCIP, including claims.

g) OCIP Coverage – the insurance coverages generally described in Sections 7-4.3, through 7-4.10 of this Section and set forth more fully in the policies of insurance or forms of policies of insurance on file with the City's Public Utilities Department.

h) Uninsured Party - Any person, partnership, corporation, or other business entity performing work under the Contract that is not an Insured Party under the OCIP.

7-4.3 OCIP Insurance Provided By The City.

1. Before commencement of the work, the City will obtain OCIP insurance coverage. Insured Parties will be enrolled in the OCIP according to the policies of OCIP insurance coverage.

2. The Contractor and the Contractor's subcontractors, officers, employees and agents, except for Excluded Parties as defined in Section 7-4.2 (d), will be Insured Parties with OCIP Coverage solely as to risks at the job site.

3. The City assumes no obligations to provide insurance other than OCIP Coverage.

4. The City does not warrant or represent that the OCIP Coverages constitute an insurance portfolio that adequately addresses all of the Contractor's risks under the contract documents. Nothing in this Section shall be construed to relieve the Contractor of any risk or obligation under the contract documents.

5. The OCIP Coverages are set forth in full in the respective policy forms and are on file with the City's Public Utilities Department. Nothing in this section is intended to alter or amend any provision of the OCIP Coverage policies. In the event of an actual conflict between the descriptions of coverage contained in this Section and the coverage provided under the policies, the provisions of the policies shall govern.

7-4.4 Information To Be Provided By Successful Bidder After Contract Award.

1. Within 15 working days from the mailing date of the Notice of Intent to Award of Contract, the successful bidder shall complete and return to the OCIP Administrator the "OCIP Insurance Enrollment Form," and provide such other information as the Project Manager or OCIP insurance carriers deem necessary. Each subcontractor shall complete the OCIP Insurance Enrollment Form and return such forms to the successful bidder for submission with, and attachment to, its form.

2. Each subcontractor shall complete the OCIP Insurance Enrollment Forms and submit to the successful bidder for submission to the OCIP Administrator not less than two weeks before the date they are scheduled to begin work. Failure to submit the information within the time required may delay the subcontractor's ability to commence work.

3. Contractor shall ensure that each subcontractor on the Work site for whom OCIP coverage is provided has received confirmation of such coverage from the OCIP Administrator before commencement of the subcontractor's work.

4. The City will review the OCIP documents submitted by the Contractor within 15 working days of their submittal. Any deficiencies noted shall be corrected by the Contractor within five working days of its receipt of the returned documents. The City will endeavor to issue a Limited Notice to Proceed within 60 working days of the mailing date of the Notice of Award however, failure to complete and return the documents identified in this paragraph within the time provided may delay the City's issuance of the Limited Notice to Proceed, or result in forfeiture of the successful bidder's bid bond and award of contract to the next lowest bidder.

7-4.5 OCIP Workers' Compensation Insurance and Employers Liability.

1. Coverage for workers' compensation insurance will comply with statutory limits of the workers' compensation laws of the State of California, with Coverage B - Employer's Liability, to limits of not less than one million dollars ($1,000,000) each accident, one million dollars ($1,000,000) each employee for bodily injury by disease, and one million dollars ($1,000,000) policy limit for bodily injury by disease covering operations of the insured parties at the Work site. Coverage under the Broad Form All States extension is also included. This insurance is primary for all occurrences at the jobsite only.

   a) Named Insured: Contractor and subcontractors of all tiers Enrolled in OCIP

   b) Insurer: Zurich

   c) A.M. Best Rating: AXV

   d) Policy Term: Per Effective Date of each Enrolled Contractor, as defined above, to the earliest of each Enrolled Contractor Work completion, or at 12:01 AM, 7/21/25

   e) Policy Form: Per CA statutory requirements

7-4.6 OCIP General and Excess Liability Insurance.

1. General and Excess liability will be provided under Commercial General Liability insurance policy(s) and covering the insured parties in connection with the performance of the work at the jobsite, that includes hazards of operations (including explosion, collapse, and underground coverage), elevators, independent contractors, employees as additional insureds, completed operations with a ten (10) year extended discovery period after substantial completion of the work, contractual liability coverage (for contracts related to the work), personal injury liability coverage,

and excess Employer's Liability coverage for claims arising out of the work hereunder, for personal injury, bodily injury, and property damage, in policies of insurance such that the total available limits to all insureds combined will not be less than one hundred million dollars ($150,000,000) combined single limits for each occurrence and aggregates, as applicable.

a) Named Insured: City, Contractor and subcontractors of tiers Enrolled in OCIP.

b) Insurer: HDI

c) A.M. Best Rating: AXV

d) Policy Term: July 21, 2019 to July 21, 2025, Plus 10 years Completed Operation Coverage

e) Policy Form: Occurrence

f) Limits: General Liability

Coverage	Limit
Per Occurrence	$2,000,000
Personal & Advertising Injury Limit	$2,000,000
General Annual Aggregate*	$4,000,000
Completed Operations Term Aggregate**	$4,000,000

NOTE: * All aggregate limits reinstate annually.
** 10 year Completed Operations has single aggregate

EXCESS LIABILITY

i. Coverage: Follow form excess liability (terms and conditions, exclusions, etc.) of the underlying Commercial General Liability and Employers Liability policy wording.

ii. Named Insured: City, Contractor and subcontractors of tiers Enrolled in OCIP.

iii. Insurer(s): See Below

iv. A.M. Best Rating: AXV

v. Policy Term: 7/21/19 to 7/21/25

vi. Policy Form: Follow - Form

vii. Limits: Layered to $154M.

Layer No.	Insurer	Policy Number	Shared Limit by all Enrolled Contractors	Cumulative Limits
1	AWAC		$10M excess $2M/$4M	$12M Each Occurrence $14M Aggregate
2	CHUBB		$15M excess $27M/$29M	$27M Each Occurrence $29M Aggregate
3	Liberty		$25M excess $27M/$29M	$52M Each Occurrence $54M Aggregate
4	Great American		$50M excess $52M/$54M	$102M Each Occurrence $104M Aggregate
5	Zurich		$50M excess $102M/$104M	$152M Each Occurrence $154M Aggregate

7-4.7 Contractors Pollution Liability.

Contractor's pollution liability shall include contractual liability coverage for liability arising out of cleanup, removal, storage, or handling of hazardous or toxic chemicals, materials, substances or any other pollutants resultant from the worksite.

1. Named Insured: City, Contractor and subcontractors of tiers Enrolled in OCIP.
2. Insurer: Ironshore
3. A.M. Best Rating: AXV
4. Policy Term: July 21, 2019 to July 21, 2025
5. Policy Form: Occurrence
6. Limits: $50,000,000 per occurrence and Aggregate

7-4.8 OCIP Deductibles – General/ Excess and Pollution Liability.

1. Notwithstanding the actual policy deductibles per occurrence, the Contractor shall be liable for a $15,000 (fifteen thousand) dollar deductible for each occurrence, to the extent losses payable are attributable to the Contractor's acts or omissions or the acts or omissions of Contractor's officers, employees, subcontractors or agents, or Uninsured Parties providing equipment, materials, supplies or services for the Work. The Contractor's deductible shall encompass the costs of investigation and defense, including court costs and attorneys' fees.

2. Any deductible amount will be invoiced to the Contractor by separate billing. If not paid within 30 calendar days of notice, the amount will be withheld from the next progress payment. Any payment of a deductible amount per occurrence by the Contractor shall not be compensable to Contractor by the City.

3. Each claim, without regard to the amount claimed, shall be reported by the Contractor to the Project Manager, OCIP administrator and the insurance company. The insurance company will adjust the claim on behalf of the Insured Parties. Insurance company will determine if there is proportional responsibility for the loss between the contractor and subcontractor, and such determination will provide the basis for payment of the deductible between the contractor and subcontractor.

7-4.9 OCIP Builder's Risk Insurance.

1. OCIP Coverage for builder's risk will provide coverage on an all-risk basis, including coverage against fire, flood, lightning, wind damage, hail, explosion, collapse, offsite storage and in-transit, and installation risks of equipment to be installed as part of the work. Earthquake coverage is not included. The policies for such insurance will be secured and maintained by the City in a form and amount consistent with such coverage commonly purchased for large construction projects. The Contractor's coverage for Builder's Risk shall be $94 million per occurrence with no aggregate.

2. Coverage shall include materials, supplies, and equipment that are intended for specific installation in the work while such materials, supplies, and equipment are located at the jobsite, in transit, or while temporarily located away from the Work site for the purpose of repair, adjustment, or storage at the risk of one of the insured parties.

3. Except as otherwise provided in Subsection 7-4.9 (2), this insurance will not include coverage for tools or clothing of workers, or Contractor's equipment.

4. The Builder's Risk policy will be endorsed waiving the carrier's rights of recovery under subrogation against the other Insured Parties.

7-4.10 OCIP Builders Risk Deductibles.

1. Notwithstanding the actual policy deductible, the Contractor shall be liable for the first $25,000 (twenty-five thousand) of loss for each occurrence. $50,000 (fifty thousand) for contracts over $100M (one hundred million). Flood/Water damage and LEG3 deductible is $50,000 (fifty thousand) The Contractor may insure deductible risk at the Contractor's discretion and cost.

2. Each claim without regard to the amount claimed shall be reported by the Contractor to the OCIP Administrator and the insurance company. The insurance company will adjust the claim on behalf of the Insured Parties. Insurance company will determine if there is proportional responsibility for the loss between the contractor and subcontractor, and such determination will provide the basis for payment of the deductible between the contractor and subcontractor.

3. Payments by the insurer for all losses covered under the All Risk Builder's Risk policy will be made to the City. The City will make the proceeds from the Builder's Risk policy covered losses available to the Contractor for rebuilding work damaged by covered perils.

7-4.11 No Waiver Of Contract Obligations.

1. Nothing contained herein or in any document referenced herein shall relieve, limit, or be construed to relieve or limit the Contractor from any liability or obligations otherwise imposed by the contract documents.

7-4.12 Change Orders.

1. Change orders shall include the removal of OCIP provided insurance costs from the Contractors costs associated with the change order. Contractor shall specifically identify the OCIP insurance costs associated with the change order.

2. Contractor is solely responsible for ensuring that its subcontractors remove the cost of OCIP insurance coverage associated with the change order.

7-4.13 The City's Right To Audit OCIP

The Contractor hereby warrants to the City the accuracy of the information provided on the OCIP Insurance Enrollment Form and OCIP Credit Worksheets, and agrees that the City, its officers, agents, insurance carriers, and the OCIP Administrator may audit the records of the Contractor and its subcontractors to confirm the accuracy of information provided, including the accuracy of all estimated payrolls, and to ascertain any effect on insurance resulting from changes in the work. The audit will be held during the Contractor's normal business hours at the office of the Contractor or at another mutually agreeable location. This provision is supplemental to 2015 Whitebook Section 6-11, "Right to Audit".

The City shall be entitled to credits in OCIP insurance premiums that may accrue as a result of the audit. The Contractor shall also be entitled to any credits as a result of the audit for any OCIP premiums paid in excess of their OCIP Credit Worksheets.

1. The Contractor shall maintain or cause to be maintained sufficient records as may be necessary to audit its compliance and its subcontractors' compliance with the requirements of the OCIP.

7-4.14 Assignment.

1. The Contractor and each of its subcontractors shall assign to the City all return premiums, premium refunds, dividends, and other monies due in connection with the insurance provided by the City. The Contractor and its subcontractors shall execute such other further documentation as may be required by the City to effect this assignment.

7-4.15 OCIP Claims.

1. The Contractor, its subcontractors, and uninsured parties shall assist the City, its agents, and the OCIP Administrator and shall provide the utmost cooperation in the adjustment of claims arising out of the operations conducted under, or in connection with, the work and shall cooperate with the City's insurance carriers in claims and

demands that arise out of the work and that the insurance carriers are called upon to adjust or resist.

2. The Contractor and its subcontractors shall make every effort to provide modified work for injured workers who have been placed on modified duty status as a result of a Workers' Compensation injury or illness covered under this OCIP.

7-4.16 Limit Of OCIP Coverages

1. The City does not warrant or represent that the OCIP coverages constitute an insurance portfolio that adequately addresses the risk faced by the Contractor or its subcontractors. The Contractors and its subcontractors shall satisfy themselves as to the existence, extent, and adequacy of the OCIP coverages before the commencement of work under the Contract.

2. The OCIP coverages referred to above are set forth in full in the respective policy forms, and the foregoing descriptions of such policies are not intended to be complete, or to alter or amend any provision of the actual policies. In the event of an actual conflict between the foregoing descriptions of policies with such instruments, the provisions of the insurance policies shall govern.

7-4.17 Contractor Provided Insurance That Is Not Covered By The OCIP Insurance.

1. The OCIP does not provide the insurance policies for auto liability coverage and aircraft liability coverage. In addition, the City requires that any excluded party under OCIP who is performing work to have the required insurance listed in this section. The Contractor shall procure and maintain during the period of performance of this Contract and for 12 months following completion, insurance from insurance companies authorized to do business in the State of California, as set forth in this Section. These policies shall be primary insurance as to the City so that any other coverage held by the City shall not contribute to any loss under the Contractor's insurance. Coverage may be provided by a combination of primary and excess insurance policies, provided all insurers meet the requirements of this Section.

2. The Contractor shall obtain and maintain insurance following insurance coverages in the amounts as follows:

3. General Commercial Liability -- $5,000,000 for any excluded party, any subcontractor who fails or losses enrollment in the OCIP. Coverage at least as broad as ISO form CG 00 01 10 01 or its equivalent, with no exclusion endorsements.

4. Automobile Liability -- $5,000,000 Coverage at least as broad as ISO form CA 00 01 10 01, for "any auto," including owned, non-owned and hired vehicles

5. Aircraft Liability: If aircraft is used by the Contractor, its subcontractors, or anyone else on their behalf, the Contractor or its subcontractor shall maintain or cause the operator of the aircraft to maintain aircraft public liability insurance insuring passengers and the general public against personal injury, bodily injury, or property damage arising from aircraft owned, used, operated or hired in connection with the

work by the Contractor, subcontractor, or anyone else in limits of not less than ten million dollars ($10,000,000) combined single limit for each occurrence, for each aircraft.

6. Workers' compensation and employer's liability: Coverage shall comply with the laws of the State of California, but an employer's liability limit of less than $1,000,000 is not permitted. The Contractor may satisfy this requirement by proof of an approved self-insurance program under California law.

7. Any insurance policy utilizing a self-insured retention is subject to approval by the City. Contractor shall be solely responsible for the payment of any self-insured retention, however, any self-insured retention policy obtained by either the contractor, or any tier of sub-contractor, shall be endorsed to provide that the self-insured retention may be satisfied by either the named, additional insured, or City covered under the policy.

8. The insurance policies shall be endorsed as follows:

   a) For general commercial liability and automobile insurance, as well as excess or umbrella insurance covering risks within the scope of that type insurance, the City, its Council Members, officers, employees and agents are included as additional insureds with regard to liability and defense of suits or claims arising from the operations, products and activities performed by or on behalf of the Named Insured. The Contractor's insurance applies separately to each insured, including insureds added pursuant to this paragraph, against whom claim is made or suit is brought except with respect to the policy limits of liability. The inclusion of any person or entity as an insured shall not affect any right which the person or entity would have as a claimant if not so included. Any failure of the named insured to comply with reporting provisions of the policy or breaches or violations of warranties shall not affect coverage provided to the insureds added pursuant to this paragraph. The additional insured endorsement shall provide coverage at least as broad as ISO form CG 20 10 11 01 and CG 20 37 10 01

   b) The Contractor's insurance shall be primary. Any other insurance or self-insurance available to the City or persons stated in paragraph (1) shall be in excess of and shall not contribute to the Contractor's insurance.

   c) The Contractor's insurance shall not be canceled or materially reduced in coverage except after 30 days prior written notice has been given to the City, except 10 days' notice shall be allowed for non-payment of premium.

   d) The workers' compensation and employer's liability insurance, and any property insurance shall be endorsed to include a waiver by the insurer all rights of subrogation against the City and other persons specified in paragraph (1) for losses paid under the terms of the insurance policy. Any of the Contractor's off-site insurance requirements shall not have the provision of naming the City as loss payee.

9. Unless otherwise specified by supplemental condition, the insurance shall be provided by an acceptable insurance provider, as determined by the City, which satisfies the following minimum requirements: An insurance carrier authorized to do business in California and maintaining an agent for process within the state. Such insurance carrier shall maintain a current A.M. Best rating classification of "A- (A minus)" or better and a financial size of $50 million to $100 million (Class VII) or better, or a Lloyds of London program provided by syndicates of Lloyds of London and other London insurance carriers, providing all participants are qualified to do business in California and the policy provides for an agent for process in the state and the program assures a financial capability at least equal to the required classification and size for authorized insurers. Workers' compensation and employer's liability insurance may be provided the California State Compensation Fund.

10. Certificates of insurance and endorsements shall be provided by the Contractor and approved by the City before execution of the Contract.

7-4.18 Subcontractors Proof Of Insurability Requirement Under OCIP.

1. As a requirement of the OCIP Program, all subcontractors shall demonstrate insurability to the satisfaction of the OCIP Administrator as follows:

   (1) Commercial General Liability - $1,000,000

   (2) Automobile Liability - $1,000,000

   (3) Workers' Compensation and employer's liability – as required by California law with employer's liability of not less than $1,000,000

2. The Contractor shall be responsible for obtaining proof of insurability from its subcontractors and providing the information to the OCIP Administrator, as well as for assuring that all its subcontractors comply with the requirements of the OCIP Program.

7-4.19 Notices, Costs, And Losses – OCIP.

1. Before the date on which the Contractor or any subcontractor begins performance of its part of the work, the Contractor shall cause to be furnished to the OCIP Administrator certificates of insurance for insurance required to be maintained by the Contractor and its subcontractors as provided herein. The Contractor shall not be allowed and shall not allow subcontractors on the jobsite for the performance of work until appropriate certificates of insurance are issued by the OCIP Administrator.

2. The City will pay the cost of the OCIP insurance premiums for the insurance described above as being provided by the City, and the City will receive or pay, as the case may be, all adjustments in such costs, whether by way of dividends or otherwise. All enrolled Contractors, and Subcontractors, shall assign to the City all adjustments, premium discounts, dividends, costs or other monies due for the OCIP insurer(s).

3. The cost of losses sustained because of clauses that specify the Contractor deductible amounts in any of the insurance policies furnished by the City shall be paid by the Contractor. If the City-provided OCIP policies described in Sections 7-4.6., 7-4.7 and 7-4.9 have deductible amounts greater than the Contractor-deductible amounts, such excess amounts will be paid by the City provided that the Contractor shall be responsible for losses greater than OCIP policy limits.

4. Require its subcontractors to waive the rights of recovery in the same manner as waived in the employees, and Contractors rendering services at the Work site, the Contractor, other Project contractors, and their subcontractors regardless of tier.

7-4.20 Contractor Obligations Under OCIP.

1. The Contractor shall:

   a) Provide OCIP Coverage enrollment information as required by the City. Furnish to the OCIP Administrator and the insurance carriers all information and documentation that the OCIP Administrator may require from time to time in connection with the issuance of policies under this Contract, in such form and substance as the OCIP Administrator may prescribe.

   b) Furnish to the OCIP Administrator monthly payroll reports on the form provided by OCIP Administrator, and payroll records as required.

   c) Segregate their respective reports relating to the work for which OCIP coverage is herein provided from their records relating to other work for which such coverage is not provided.

   d) Promptly comply with the policy requirements of the OCIP insurance carriers as submitted through the Project Manager.

2. The Contractor shall not violate or knowingly permit any subcontractor to violate any conditions of the policies of insurance provided by the City under the terms of the Contract and shall at all times satisfy the requirements of the insurance companies issuing them.

3. The Contractor shall assure that all OCIP requirements imposed upon and to be performed by the Contractor shall likewise be imposed upon, assumed, and performed by each of its subcontractors and uninsured parties with whom it or its subcontractors have a contractual relationship.

4. The Contractor shall furnish each bidding and negotiating subcontractor, vendor, supplier, material dealer, or other person or business entity that may provide goods or services in connection with the work a copy of this Section describing the insurance requirements for the Contractor and its subcontractors shall require each to impose the same requirement in their subcontracting and procurement procedures.

5. If the Contractor or any of its subcontractors should fail to comply with the requirements of this Section, the City may withhold payments due to the Contractor or suspend the work until such time as the Contractor and its subcontractors have performed such obligations to the reasonable satisfaction of the Project Manager.

6. The Contractor shall include in the bid price the cost of complying with the OCIP as herein described.

7. Failure of the Contractor to enroll any sub-contractor of any tier in the OCIP, or to allow any sub-contractor to begin work on-site without proof of enrollment, shall constitute a breach of the OCIP insurance requirements. As such, all work performed by the sub-contractor, or any accident or injury as a result of the sub-contractor's activity, shall be considered an uninsured risk under the OCIP coverage. No OCIP insurance coverage of any line of insurance described in this document, shall extend coverage to the conditions described above.

7-4.21 OCIP Insurance Manual.

1. The OCIP Administrator will provide an OCIP Insurance Manual that will describe procedures relevant to the OCIP to the Contractor. The Contractor and its subcontractors are required to comply with the procedures therein described.

7-4.22 Alternative Insurance.

1. In the event the City is unable to furnish, or after commencement of work elects not to furnish or to continue to furnish the OCIP coverage herein described, and upon 30 days written notice from the City, the Contractor shall secure insurance as required under the Section 7-4.17 with limits as specified below (2). The Contractor shall be allowed a change order for additional costs of insurance that were excluded from the bid as required by this Supplemental Condition.

2. The coverage limits for insurance required pursuant to paragraph (a), and also for coverage not provided by OCIP Coverage such as automobile liability, shall be as follows:

   (1) Commercial General Liability -- $25,000,000 annual aggregate renewal

   (2) Contractors Pollution Liability - $5,000,000 annual aggregate

   (3) Automobile Liability -- $5,000,000

   (4) Workers' Compensation and employer's liability - as required by California law with employer's liability of not less than $1,000,000

   (5) Builder's Risk – Contract Value

   (6) Aircraft Liability: If aircraft is used by the Contractor, its subcontractors, or anyone else on their behalf, the Contractor or its subcontractor shall maintain or cause the operator of the aircraft to maintain aircraft public liability insurance insuring passengers and the general public against

personal injury, bodily injury, or property damage arising from aircraft owned, used, operated or hired in connection with the work by the Contractor, subcontractor, or anyone else in limits of not less than $10,000,000 combined single limit for each occurrence, for each aircraft.

7-4.23 Accident Reports and Claims.

1. Contractor shall immediately report (as soon as feasible, but not more than 24 hours after occurrence) to the City any accident or other occurrence causing injury to persons or property during the performance of this Contract. If required by the City's Risk Management Department, the report shall be made in writing and shall include, at a minimum:

   a) the names, addresses, and telephone numbers of the persons involved,

   b) the names, addresses and telephone numbers of any known witnesses,

   c) the date, time and description of the accident or other occurrence.

2. All claims for damages, losses, expenses and other costs, received by the Contractor or the City, arising out of or resulting from or in connection with the performance of the Work shall be acknowledged by the Contractor by sending written notice to the claimant within 10 days of the Contractor's receipt of the claim. The written notice shall either:

   a) confirm the Contractor's responsibility for damages and losses, and intent to pay or settle claim directly with the claimant; or

   b) confirm the Contractor's responsibility for prompt investigation and processing of the claim, including identifying the Contractor's insurance carrier and claims adjuster, describing the Contractor's or insurance carrier's procedure for investigating and processing of the claim, and providing a name and telephone number for contacting the representative of the Contractor. A copy of the written notice of claim shall be delivered to the Project Manager. Should the Contractor state his intent to pay or settle the claim directly with the claimant, payment or settlement shall be made within 45 working days of receipt of the claim. Claims to be submitted to the Contractor's insurance carrier shall be forwarded to the insurance carrier within 30 calendar days of receipt of the claim. Failure by the Contractor to send the written notice of claim, or to notify the Project Manager of any claim, shall be cause for the City to withhold payments to the Contractor.

3. The City shall have full authority to compromise or otherwise settle any claim related to the Contract at any time. The City will notify the Contractor of the receipt of any third-party claim arising from or relating to the Work within 14 working days of the receipt of the claim by the City. The City shall be entitled to recover its reasonable costs incurred in providing the Contractor timely notification of third-

party claims. Neither this Section nor the City's failure to give notice shall limit the City's ability to compromise or settle any claim.

7-4.24 Additional Insurance Provisions.

1. Nothing in Section 7-4 shall be construed to limit or qualify the liabilities and obligations otherwise assumed by the Contractor pursuant to this Contract, including but not limited to the provisions relating to indemnity and warranty.

2. The City may require the Contractor to provide complete copies of all insurance policies required by Section 7-4.

3. If at any time, the Contractor fails to maintain in full force any insurance required by the Contract, the City may acquire the necessary insurance for the Contractor and deduct the cost thereof from any payment due the Contractor.

PURE Program OCIP – Insurance Coverage by Project Segment Summary

Project Name: **Morena Pump Station**

Owner Controlled Insurance Program Insurance coverage provided for Contractor

Type	Limit	Deductible
General Liability	$150M	$15K
Automobile Liability**	N/A	N/A
Workers Compensation	CA Statutory - $1M employers Liability	N/A
Pollution Liability*	$50M	
Builders Risk***	Contract Value	$25K

*Indicates shared limit among all Pure projects, per project limit applies

**N/A indicates not provided by OCIP coverage

*** AOP deductible per occurrence with no aggregate – deductible limit for Flood/Water damage and LEG3 is $50K

Contractor/Sub-Contractor Insurance Requirements by type of insurance and limits still required under OCIP

Contractor	Limit	Self-Insured Retention
General Liability	$5M	Needs Approval
Automobile Liability	$5M	Needs Approval
Workers Compensation	CA Statutory - $1M employers Liability	
Pollution Liability*	N/A	N/A
Builders Risk*	N/A	N/A
Sub-Contractor	**Limit**	**Self-Insured Retention**
General Liability	$1M	Needs Approval
Automobile Liability	$1M	Needs Approval
Workers Compensation	CA Statutory - $1M employers Liability	
Pollution Liability*	N/A	N/A
Builders Risk*	N/A	N/A

* Coverage provided by OCIP

Contractor Insurance Required if OCIP is unavailable at commencement of work or cancelled after construction has begun

Type	Limit	Self-Insured Retention
General Liability	$25M	Needs Approval
Automobile Liability	$5M	
Workers Compensation	CA Statutory - $1M employers Liability	
Pollution Liability	$5M	
Builders Risk	Contract Value	Needs Approval

General Notes – Pure Water OCIP Coverage Morena Pump Station

1) Contractor obligation for payment of the deductible under the OCIP coverage is triggered by insurance carrier acceptance of claim.
2) At issuance of the Notice to Proceed, the shared OCIP coverage limits remain at 100% of the values stated above.

Notes: OCIP will utilize a per-occurrence deductible program. If Contractor utilizes Self-Insured retention insurance, it will require approval of the self-insurance retention amount the contractor declares.

7-5.3 **Payment.** To the "WHITEBOOK", DELETE item 2, and SUBSTITUTE with the following:

2. An allowance Bid Item has been provided to cover the cost of securing permits and associated fees.

ADD:

7-6 **THE CONTRACTORS REPRESENTATIVE.** To the "GREENBOOK", ADD the following:

1. Both the representative and alternative representative shall be employees of the Contractor and shall not be assigned to a Subcontractor unless otherwise approved by the City in writing.

7-8.1 **General.** To the "WHITEBOOK", ADD the following:

2. You shall provide a PM-10 certified self-loading motorized street sweeper equipped with a functional water spray system for this project.

3. You shall sweep all paved areas within the Work site and all paved haul routes as specified below:

   a) Every working day.

   b) As directed by the Engineer.

   If these requirements would require you to sweep on a Holiday or Weekend, then you shall sweep the next available Working Day prior to that Holiday or Weekend.

7-8.6.1.13 **Annual Reports and Annual Fee.** To the "WHITEBOOK", item 2, DELETE in its entirety and SUBSTITUTE with the following:

3. You shall pay the Annual Fee to the State Water Board within 30 Calendar Days of the Invoice Date. Your failure to pay within this timeframe shall result in a Notice of Violation (NOV) and the forwarding of the invoice to a Collections agency by the State.

7-8.6.2.10 **BMP Inspection, Maintenance, and Repair.** To the "WHITEBOOK", ADD the following:

5. Maintenance activities shall be documented by the QSP or QSD in the Construction BMP Maintenance Log for projects subject to SWPPP requirements. See **Appendix N - SWPPP Construction BMP Maintenance Log**.

7-8.6.3.7 **Payment.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. The payment for SWPPP Development, SWPPP Implementation, and compliance with the requirements of the CGP and these specifications shall be included in the Bid items for "SWPPP Development" and "SWPPP Implementation". The payment for the pertinent required trainings and certifications shall be included in these Bid items.

2. The payment for the permit to obtain coverage under the Construction General Permit shall be made under the Allowance Bid item for "SWPPP Permit Fee".

3. You shall submit a Schedule of Values in accordance with 7-2.1 "Schedule of Values (SOV)". The SOV shall itemize the Work further, as applicable, as follows:

   a) Development and Amendment of PRDs.

   b) Good Site Management "Housekeeping" BMPs.

   c) Non-Storm Water Management.

   d) Erosion Control.

   e) Sediment Control.

   f) Run-on and Runoff Management.

   g) BMP Inspection, Maintenance, Repair, and Construction BMP Maintenance Log.

   h) Development and Implementation of CSMP.

   i) Annual Report.

   j) Notice of Termination.

   k) Development and Implementation of Sampling and Analysis Portion of CSMP.

   l) Development and Implementation of Monitoring and Reporting Program.

   m) Street Sweeping.

   n) Development and Implementation of Rain Event Action Plan (for Risk Level SWPPPs).

   o) Development and Implementation of Active Treatment System (Risk Level 3 only).

   p) When specified, Post Construction Requirements (such as Inlet Markers).

4. For private projects, disregard references to the measurement and payment and refer to the permit conditions for additional requirements

7-8.6.5 Payment. DELETE in its entirety and SUBSTITUTE with the following**:**

7-8.6.5 Drinking Water Discharges Requirements.

1. All discharge related to the project of water used for testing an acceptance of new water mains to the storm drain shall comply with the State Water Resources Control Board, ORDER WQ 2014-0194-DWQ, STATEWIDE GENERAL NPDES PERMIT FOR DRINKING WATER SYSTEMS DISCHARGES found at the State Boards website at the following location:

   https://www.waterboards.ca.gov/water_issues/programs/npdes/docs/drinkingwater/final_statewide_wqo2014_0194_dwq.pdf

All monitoring, sampling and reporting for compliance with the Order must be completed by a QSP.

a) BMPs shall be in place prior to the start of discharge. At a minimum, you shall:

   i. Sweep the gutter and street in the flow path

   ii. Provide inlet protection at all inlets receiving discharge

   iii. Provide dechlorination

   iv. Implement sediment and erosion control measures such as diffusers, check dams, flow controls, etc.

b) Monitoring and Samples.

   i. As required by the Order, you shall monitor, sample and report all discharges to the storm drain. You shall record the results for each discharge event on the City's Drinking Water Discharge Monitoring form included **as Appendix H, Monthly Drinking Water Discharge Monitoring Form.** Submit completed forms to the Engineer at the end of every month.

   ii. Notifications: You shall notify the RWQCB at and Transportation and Storm Water Department prior to the start of any large volume discharge (greater than 1 acre-foot volume). You shall notify The County of San Diego, Department of Environmental Health (DEH) at (858) 495-5579 prior to the start of discharges 100,000 gallons or more within ¼ mile of the ocean or bay coastline.

   iii. Sampling and reporting requirements are outlined in the Order.

      - For Superchlorinated discharges, at a minimum, you shall sample chlorine, turbidity and pH the first 10 minute of discharge, the first 60 minutes of discharge and last 10 minutes of discharge and provide an estimate of the total volume of water discharged.

      - For Large Volume discharges (or discharges greater than 1 acre-foot in total volume), at a minimum, you shall sample chlorine and turbidity pH the first 10 minute of discharge, the first 60 minutes of discharge and last 10 minutes of discharge and provide an estimate of the total volume of water discharged.

      - For discharges that are not superchlorinated and are under 1 acre-foot in total volume, at a minimum, you shall provide an estimate of the total volume of water discharged.

iv. Effluent limits:

- Field measurement of 0.1 mg/L chlorine or more is an exceedance of the Order.
- Visual estimates of 20 NTU or more for surface water and 225 NTU or more for ocean is an exceedance the City's Basin Plan.
- Field measurements for pH outside the range of 6.5 to 8.5 is an exceedance of the City's Basin Plan.

v. Receiving water monitoring: if an exceedance is observed, the discharge shall be stopped immediately, BMPs must be adjusted until discharge is no longer exceeding limits. The QSP shall monitor receiving waters for adverse effects to water quality. If any adverse effect to water quality is observed, the RE and RWQCB shall be notified immediately. The QSP shall document the point of confluence between the discharge and receiving water with photographs.

c) Areas of Special Biological Significance (ASBS).

i. Non-storm water discharges including drinking water discharges to Areas of Special Biological Significance (ASBS) are prohibited. These are ocean areas requiring protection of species or biological communities to the extent that alteration of natural water quality is undesirable and are classified as a subset of State Water Quality Protection Areas. Non-storm water discharges shall be located outside of the designated areas to ensure maintenance of natural water quality conditions in these areas.

ii. A map showing ASBS locations can be found in the Storm Water Standards Manual Part 2 Appendix A. The areas in the San Diego Region include: La Jolla (ASBS #29), Scripps (ASBS #31), and La Jolla Shores watershed boundaries.

2. If prior approval is obtained to discharge to the sewer system, you shall discharge the water used for testing and acceptance of new water mains to the sewer system in accordance with the Contract Documents as shown on the batch discharge Plans. You shall submit to the Engineer a "Request for Batch Discharge Authorization to Discharge Potable Pipe Flushing Water to Sewer" form. The request form is found on the City website at the following location:

https://www.sandiego.gov/sites/default/files/pipe_flush_batch_disch_0.pdf

a) When discharging to the sewer system has been approved, you shall use a totalizer flow meter to record the total volume discharged to sewer and

shall submit to the Engineer a log of actual discharged water quantities, dates, and locations. Failure to report this information to the Engineer is a violation of the authorization for discharge to the sanitary sewer. Within five (5) Working Days of the discharge, the Engineer shall receive and report actual total flows to the sanitary sewer to the Public Utilities Department (PUD), Industrial Wastewater Control Program (IWCP).

b) If the discharge to the sewer system is not approved, you shall discharge the water used for the testing of new mains to surface waters, storm drain inlets, or to other approved sources and you shall comply with 7-8.6.5, "Drinking Water Discharges Requirements". All discharge activities related to the project shall comply with the State Water Resources Control Board, ORDER WQ 2014-0194-DWQ, STATEWIDE GENERAL NPDES PERMIT FOR DRINKING WATER SYSTEMS DISCHARGES as referenced by:

http://www.waterboards.ca.gov/water_issues/programs/npdes/docs/drinkingwater/final_statewide_wqo2014_0194_dwq.pdf

ADD:

7-8.6.5.1 Payment.

1. The payment for complying with the requirements of drinking water systems discharge to the storm drain shall be included in the contract price.

2. The payment for complying with the discharge requirements for discharges to sewer system shall be included in the contract price.

7-8.6.6.9 Payment. To the WHITEBOOK, DELETE in its entirety and SUBSTITUTE with the following**:**

1. The payment for preparing a Community Health and Safety Plan shall be paid in accordance with 7-22.20, "Payment".

2. The Allowance Bid item for "Dewatering Permit and Discharge Fees" shall cover actual costs of permit fees.

3. The payment for dewatering hazardous contaminated water shall be included in the lump sum Bid item for "Shoring, Bracing and Dewatering of Non- Hazardous and Hazardous Contaminated Groundwater" and shall include furnishing, setting up, removal and operating all equipment necessary to treat and discharge the hazardous contaminated groundwater including but not limited to any costs related to obtaining permits except the actual permit fee. All sewer discharge fees shall be paid by the contractor and included in the lump sum Bid item for "Shoring, Bracing and Dewatering of Non- Hazardous and Hazardous Contaminated Groundwater".

4. The payment for the handling and disposal of the hazardous contamination shall be in accordance with F7-22 20, "Payment".

5. Submit supporting invoices and a Schedule of Values for the Lump Sum Bid item for "Shoring, Bracing and Dewatering of Non Hazardous and Hazardous Contaminated Groundwater" in accordance with 9-2.1, "Schedule of Values (SOV)". The SOV shall itemize the Work to show the following:

   a) All costs associated with handling contaminated groundwater specified in 7-8.6.6.6, "Dewatering System", and 7-8.6.6.8 "Hazardous Waste Operations and Emergency Response (HAZWOPER) Certificate".

   b) All costs associated with equipment used for dewatering hazardous contaminated groundwater, including costs for mobilization and demobilization.

   c) All rental and operating costs for equipment used for dewatering contaminated groundwater.

6. The Contractor shall assume a dewatering system capacity of twice the dewatering flow rate identified in the Geotechnical Documents.

7-10.4.1 **General.** To the "WHITEBOOK" and "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following.

7-10.4.1 **General.**

ADD:

7-10.4.1.1 **Safety, Sanitation, Medical, and Drug and Alcohol Requirements.**

a) The Contractor shall have ultimate responsibility for the health and safety of its employees. These specifications shall not be construed to limit the Contractors liability nor to assume that the City, its employees, agents, or designates shall assume any of the Contractors liability associated with its safety performance.

b) The Contractor shall promptly and fully carry out the safety, sanitary, and medical requirements as stated in the contract documents and as may from time to time be prescribed by the Engineer, to the end that proper work shall be done, and the safety and health of the employees and of the public are preserved and safeguarded. In case such regulations and orders are not observed by the Contractor, they may be enforced by the Engineer at the Contractor's expense. The Contractor shall summarily dismiss and shall not again engage, except with the written consent of the Engineer, any employee or subcontractor who knowingly and willingly violates the safety, sanitary, or medical requirements. Such discharge shall not be the basis of any claim for compensation or damages from the Contractor against the City, its OCIP Insurance, or any of its officers, employees, consultants or agents.

c) Appropriate first aid facilities and supplies shall be kept at the site of the Work, and the Contractor shall provide and maintain all measures required by the

Construction Safety Orders issued by the Division of Industrial Safety of the State of California.

d) The Contractor shall prohibit the use or possession of intoxicating liquors or controlled substance at the jobsite or in any vehicle or equipment used in performance of the Work. This prohibition shall not apply to use or possession of prescription or non-prescription medication in accordance with prescribed directions.

e) Employ a "competent person" as defined by Cal OSHA. The "competent person" shall monitor, educate, and facilitate safety related jobsite activities. This individual shall be on the jobsite during all work hours identified in Section 6.7, Paragraph (b), or as authorized in writing by the Engineer.

f) When trenching, place your name and emergency telephone number adjacent to the Work at intervals and locations approved by the Engineer. The method of marking shall be approved by the Engineer.

g) The City shall not assume any role in determining the adequacy of the Contractors Safety and Health Plan.

7-10.4.1.2 Contractor's Safety and Health Representatives.

a) The Contractor shall provide a qualified and experienced full-time, on-site Safety Professional to serve as their Safety and Health Representative. Qualifications shall include at least 10 years of construction related safety experience as the lead site safety representative (only duty) and experience in developing and implementing accident prevention programs for construction projects. If the Contractors Safety and Health Representative has less than 10 years construction related safety experience, or equivalent level of education and experience, the Contractors Safety and Health Representative must be approved by The City of San Diego. This individual shall be assigned only to this project and whose sole duty is monitoring and supervising the Contractor's and Subcontractors' Safety, Health, and Environmental Program, and who shall be on-site when any work is in progress. In the event the Contractor's Safety Representative gives notice of separation of employment or is transferred from the Contractor's work site, the Contractor shall ensure that the incumbent Safety Representative remains on site for a minimum of two weeks after giving notice, and that the Contractor's replacement Safety Representative receives a minimum of two weeks safety orientation on the construction site before being allowed to assume the full duties as the Contractor's Safety Representative. This requirement may be waived upon written approval by the City. The Contractor's Safety and Health Representative shall support and Implement the OCIP Safety Program, or its equivalent and shall coordinate and require the Contractor's and Subcontractor's foremen to participate in the OCIP Program and conduct and submit the required audits as described in the Safety Programs section of the OCIP Construction Safety Procedures Manual. In the event the Contractor fails to comply with the above safety professional requirements, the

Engineer shall obtain the services of a Safety Professional, and charge all costs associated with the services to the Contractor.

b) The Contractor's safety and health representatives shall be responsible for, and have the authority to, direct the required safety and health programs, correct unsafe conditions and unsafe practices, and stop work in areas containing unsafe conditions or practices until such unsafe conditions or practices are correct.

c) The Contractor's safety and health representatives shall be charged with the responsibility of daily on-site safety and health coordination and inspections and shall record the results of the inspections and corrective actions, if any, on a report form provided by the City.

d) The weekly report shall be submitted to the Engineer not later than the first working day following the workweek covered by the report.

e) Contractor's Safety and Health representatives shall participate in weekly progress meetings and report out on safety conditions at the worksite.

7-10.4.1.3 Submittals.

1. Submit, within 30 days of the Notice of Award and before execution of the Contract or at a later time as directed by the Engineer a Project-specific safety and health program conforming to the OCIP Construction Safety Procedures Manual and applicable laws and regulations that includes the following:

2. A Project-specific Injury and Illness Prevention Program covering work performed by or for the Contractor at the site.

3. The resume of qualification and experience for the Contractor's on-site safety representative responsible for safety and health.

4. A written Hazard Communication Program covering work performed by or for the Contractor at the site.

5. Optional – Dependent upon Worksite Assessment] A written Emergency Action and Fire Protection Plan and a written Fire Prevention Plan covering work performed by or for the Contractor at the site. The Contractor shall have the Fire Protection Plan reviewed and approved by the jurisdictional fire protection agency. The Contractor's Fire Protection Plan shall include:

    a) Dedication of an on-site 2,000 gallon or greater water truck fitted with a one- and one-half inch fire hose that shall have the ability to access all on-site construction operations.

    b. Fire watch on-site during construction operations. This role may be filled by the Contractor's safety representative.

    c) Contractor shall check in daily with CAL FIRE for an update on fire conditions and to determine if any fire restrictions have been ordered. This information shall be included on the Contractor's Daily Report to the Engineer.

d) Contractor shall cease brush clearing, cutting, or chipping operations when a red flag fire day is declared by the jurisdictional fire agency.

e) Contractor shall have tailgate meetings daily to communicate fire conditions and fire prevention measures necessary for the daily work.

6. A written hazard safety analysis of the project conditions. The Contractor shall perform a comprehensive site analysis before commencement of work to determine any existing hazards and shall abate these hazards or inform the Engineer and all affected employees of these hazards and how to protect themselves from them.

7. In addition to the reports that the Contractor is required to file under the provisions of California Workers' Compensation law and other applicable laws, submit a report to the Engineer on or before the 10th day of each month giving:

   1. The total force employed on the contract in workdays during the previous calendar month.

   2. The number and character of all accidents resulting in loss of time, medical treatment and first aid treatment.

   3. Any other information or classification of employee injuries incurred on the Project and disabilities resulting there from that may be required by the Engineer.

8. Obtain and keep copies of the Material Safety Data Sheets of all hazardous materials brought to and stored at the site.

7-10.4.1.4 Emergency Procedures.

a) Designate responsible personnel to make emergency calls. Should an emergency occur, the Contractor shall:

   1. Immediately secure the area and implement the Emergency Action Plan. Preserve the site for investigation until released by OSHA, the Engineer or OCIP Insurance Provider.

   2. Notify the Construction Management Team or another representative previously designated by the Engineer in writing.

b) Provide information regarding the emergency to the appropriate authorities and authorized City representatives only. Questions from others including the press and media shall be referred to the Engineer.

   a) Emergency procedures shall ensure that the Contractor's Safety Representative or the most qualified senior supervisor present takes charge and directs the handling of the emergency. The Contractor shall ensure proper handling of all Subcontractor related emergencies per the Contractor’s and OCIP Emergency Procedures.

b) All Incidents, whether causing injury, environmental impacts or unauthorized property damage or not, shall be investigated by the Contractor and documented on forms provided by the OCIP and as required by the OCIP Construction Procedures Safety Manual. Instruct and require supervisors that, except for rescue or other emergency measures, the Incident site shall be secured until investigation has been completed and the scene has been released by both the Contractor and the Engineer, and as appropriate, the insurance company/OSHA.

c) Injuries which require medical attention shall be reported to the Engineer or Construction Management Team immediately after summoning medical help and securing the scene to prevent further injury. Injuries which meet the Cal/OSHA, Title 8 requirement as reportable shall also be reported to Cal/OSHA immediately. The Contractor shall investigate and generate a report which identifies the root causes and corrective actions for all accidents and incidents. This report shall be on the OCIP Incident form or an equivalent form approved by the Engineer. The Construction Management Team will also investigate all accidents and incidents to identify means to prevent further occurrences

d) For incidents that caused or had the potential to cause injury or significant losses, the Engineer or Construction Management Team may request a post Incident review. In such cases, he Contractor, Subcontractor, or other entity shall send an appropriate Manager to present the facts of the incident and provide information how future similar incidents will be prevented.

e) Immediately notify the Engineer or OCIP Safety Manager of any unabated hazardous conditions and take action to guard or control access to these conditions until correction has been accomplished. Notify the Engineer of any property or equipment found at the work site that is not under the Contractor's control. However, it shall be the Contractor's responsibility to take necessary precautions to prevent injury to persons or damage to property from such hazardous conditions until corrected by the responsible party

7-10.4.1.5 Safety and Health.

Have and implement a written site-specific IIPP and Code of Safe Work Practices covering site work to be performed under the contract.

1. If not a part of the IIPP, the following procedures shall also be implemented:

   a) Stress the importance of, and conduct a thorough hazard safety analysis at the start of the project.

   b) Participate to develop and ensure all key staff are aware of the project hazards and keep staff informed of existing and developing safety hazards.

c) Encourage all suppliers to visit the project site to assess hazards before the delivery of materials.

2. Foremen and superintendents shall provide written Job Task Analysis for all tasks. The JTA shall include all hazards that might be encountered while performing the task and methods for assuring that each employee will be protected from the hazard.

3. Utilize supervisory and craft employees to conduct and document a jobsite Safety Survey each week. Each survey shall include subcontractor activities. Utilize the results of each survey to inform Contractor and Subcontractor employees and other affected jobsite individuals of hazards on the job and how to protect themselves from these identified hazards. Survey shall be submitted to the Engineer for review and comment. Identify upcoming jobs and associated hazards and notify affected employees and individuals.

4. Before authorization or start of construction, the Contractor shall prepare a Spill Prevention and Contingency Plan for review and approval of the appropriate jurisdictional agency and all construction crew members shall be trained in the requirements of the Spill Prevention and Contingency Plan. The Plan will include information on storage of hazardous materials, emergency response procedures, employee training requirements, fire safety, first-aid procedures, hazardous materials release containment/control procedures, and release reporting requirements. The Contractor shall integrate this SP&CP into the IIPP.

5. All persons shall be required to wear American National Standards Institute approved hard hats while at the Work site; no bump caps will be permitted. Each employee's hard hat shall identify the employee's name and employer. Steel toed shoes shall be worn when in active construction zone. Safety vest or equivalent shall be worn in addition to hard hat when in active construction zone.

6. When sufficient time is available, notify the City in advance of safety inspections by Cal/OSHA, the fire department, or other governmental agencies. When regulatory agencies arrive on-site for unannounced inspections, the Contractor shall immediately inform the Engineer and the Construction Management Team and shall escort the inspector(s) for the entire duration of their time on-site. When the Engineer is not present during a safety inspection, immediately report to the Engineer that an inspection has taken place, and describe any violations, or citations, and the Contractor's abatement actions or salient events arising from the inspection.

7. The Contractor shall be responsible to ensure compliance with the specific policies and procedures established in the OCIP Construction Safety Procedures Manual. To ensure Contractor and Subcontractor compliance with the IIPP's and applicable laws, contractor specifications, and the Owner Controlled Insurance Program, the Engineer or Construction Management Team Representative will use the [TBD Schedule Driven Safety Program] and the [TBD Managing Safety Performance] or

equivalent Program as approved by the Engineer to gauge the Contractor's compliance and adherence to its site-specific IIPP and applicable laws and regulations. Such monitoring and audits by the Construction Management Team or the Engineer will not relieve the Contractor of any safety and health obligations.

8. Eating and drinking shall not be permitted in areas containing hazardous materials.

9. Equipment shall be maintained in a proper state of operation as per the manufacturer's specifications. Equipment service records will be maintained and be available for inspection to ensure compliance.

10. Reduce harmful combustion engine emissions to the greatest extent feasible by conducting preventive maintenance on construction equipment and, whenever possible, limit equipment idling time by such means as turning engines off while vehicles are in loading and unloading queues; use clean and low sulfur fuels and use electric motors to drive conveyor belts, pumps, compressors, and other equipment.

11. All personnel shall wear appropriate Personal Protective Equipment in accordance with the Contractor's IIPP, regulatory requirements, and the OCIP Construction Safety Procedures Manual. All personnel in active construction areas shall be required to wear approved hard hats, eye protection, safety vests with reflective stripes, steel toed work shoes, long pants, and shirts with sleeves. Gloves, hearing protection, and additional eye protection may be required as appropriate.

12. No asbestos- or PCB-containing materials shall be used.

13. At the beginning of the Project, the Contractor shall post at the entrance to the construction site a sign of size and wording approved by the Engineer listing the general rules, regulations, attire, and PPE requirements.

7-10.4.1.6 Safety and Health Training.

1. The Contractor's safety and health representatives shall conduct training classes before commencement of the Work and on a monthly basis, or more often if needed, on safety and health, emergency procedures, first aid, fire prevention, and other areas applicable to the Work. The Contractor may seek input from the Engineer.

7-10.4.1.7 First Aid.

1. The Contractor is responsible to provide initial emergency care for all personnel on site, including City and Construction Management Team personnel and to notify Emergency Responders by calling 911 when required. The contractor is also responsible to arrange for transportation of sick or injured persons off the job site when other than emergency transport is appropriate.

7-10.4.2.1 General. To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

ADD:

7-10.4.2.1 Regulatory Requirements.

1. Have copies of the following at the Work site. The required information shall be made available to the Construction Management Team and the Engineer for review upon request:
    1. A complete copy of the California Code of Regulations, Title 8.
    2. Material Safety Data Sheets for all hazardous materials being used or stored at the site.
    3. Permits required for the Work.
    4. All records and information required by the Construction Safety Procedures Manual.

ADD:

7-10.6.2.1 Project Identification Sign, ADD the following:

1. The State Revolving Fund requires that the Contractor place (1) temporary sign at least four (4) feet tall by eight (8) feet wide made of three-fourths (3/4) inch thick exterior grade plywood or other approved material in a prominent location approved by the Engineer. The Contractor shall fabricate, properly mount and maintain both signs. The image cast on the sign should be resistant and protected from weathering. The signs should be mounted firmly and securely at the two sites with proper footing and post, as approved by the Resident Engineer. The Contractor is responsible for maintaining the signs in a manner approved by the Resident Engineer and will remove and dispose of upon completion. The sign shall include the full colored image that will be provided on a CD, at the pre-construction meeting.

   The cost to fabricate, properly mount and maintain project signs shall be included in the contract price.

   See Attachment D, Funding Agency Provisions, Section 1.9 Signage for signs to be mounted in the project site.

7-13.4 Contractor Standards and Pledge of Compliance. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. The Contract is subject to City's Municipal Code §22.3004 as amended 10/29/13 by ordinance O-20316.

2. You shall complete a Pledge of Compliance attesting under penalty of perjury that you complied with the requirements of this section.

3. You shall ensure that all Subcontractors complete a Pledge of Compliance attesting under penalty of perjury that they complied with the requirements of this section.

4. You shall require in each subcontract that the Subcontractor shall abide by the provisions of the City's Municipal Code §22.3004. A sample provision is as follows:

"Compliance with San Diego Municipal Code §22.3004. The Subcontractor acknowledges that it is familiar with the requirements of San Diego Municipal Code §22.3004 ("Contractor Standards") and agrees to comply with requirements of that section. The Subcontractor further agrees to complete the Pledge of Compliance, incorporated herein by reference."

ADD:

7-13.8 Equal Pay Ordinance.

1. You shall comply with the Equal Pay Ordinance (EPO) codified in the San Diego Municipal Code (SDMC) in section 22.4801 through 22.4809, unless compliance is not required based on an exception listed in SDMC section 22.4804.

2. You shall require all of your Subcontractors to certify compliance with the EPO in their written subcontracts.

3. You shall post a notice informing your employees of their rights under the EPO in the workplace or job site.

4. By signing this Contract with the City of San Diego, you acknowledge the EPO requirements and pledge ongoing compliance with the requirements of SDMC Division 48, section 22.4801 et seq., throughout the duration of this Contract.

7-16 COMMUNITY OUTREACH. To the "WHITEBOOK", DELETE in its entirety and SUBSITITUTE with the following:

7-16.1 General.

1. To ensure consistency with the City's community outreach plan for the project, the City shall work with you to inform the public (which includes, but shall not be limited to, property owners, renters, homeowners, business owners, business patrons, recreational users, and other community members and stakeholders) of construction impacts, including when, where, and how long the impacts will last. Your efforts to mitigate construction impacts by communicating with the public require close coordination and cooperation with the City. Community outreach will be led by the Owner's Outreach team and supported by the Contractor.

2. You shall perform the community outreach activities required throughout the Contract Time. You shall assign a staff member from your construction team who shall perform the required community outreach services as a point of contact for the Owner's Outreach team and Construction Manager/Resident Engineer.

3. You shall closely coordinate with the Owner's Outreach team and work with the businesses, institutions, residents, and property owners impacted by the Project.

4. Your example duties include working with the Owner's Outreach team to notify businesses, institutions, and residents of the commencement of construction activities not less than five (5) days in advance, coordinating access for vehicular and pedestrian traffic to businesses, institutions, and residences impacted by the Project, reporting activities at all Project progress meetings scheduled by the Engineer, attending the Project Pre-construction meeting, attending up to eight (8) community meetings, attending one-on-one meetings with businesses and stakeholders as needed, participating in facility tours as needed, and supporting responses to community questions and complaints related to your activities.

5. Members of your team shall participate in outreach meetings, including an initial orientation meeting (superintendent and foremen), led by the City and Owner's Outreach team to discuss expectations for and participation in outreach tasks throughout the Contract Time. The superintendent shall participate in subsequent outreach meetings on a quarterly basis following the initial orientation.

6. The assigned staff member responsible for performing required community outreach services shall maintain an outreach materials kit provided and updated by the Owner's Outreach team.

7. You shall execute the Information Security Policy (ISP) Acknowledgement Form - For Non-City Employees within 15 Days of the award of the Contract if any of the following apply:

    a) Your contact information is made available on any outreach materials.

    b) Contractor will be the primary point of contact to resolve project related inquiries and complaints.

8. Electronic Communication.

    a) All inquiries and complaints shall be sent to the Owner's Outreach team to be logged in to the City's internal public contact tracking system within 24 hours of receipt of inquiries and complaints.

    b) Any updates or a resolution of inquiries and complaints shall be sent to the Owner's Outreach team to be documented in the City's internal public contact tracking system within 24 hours.

    c) Copies of email communications shall be saved individually on to the City's internal public contact tracking system in an Outlook Message Format (*.msg).

    d) All graphics, photos, and other electronic files associated with inquiries and/or complaints shall be provided to the Owner's Outreach team to be

saved into the individual records, located within the City's internal public contact tracking system.

7-16.1.1 Quality Assurance.

1. During the course of community outreach, you shall ensure that the character of all persons that conduct community outreach (distributing door hangers, attending community meetings, interacting with the public, etc.) on your behalf shall:

   a) Have the ability to speak and comprehend English and/or English and Spanish, as appropriate for the community or public they are informing.

   b) Possess and display easily verifiable and readable personal identification that identifies the person as your employee.

   c) Have the interpersonal skills to effectively, professionally, and tactfully represent you, the project, and the City to the public.

7-16.1.2 Submittals.

1. All public notifications and outreach materials will be prepared by the Owner's Outreach team and shall be delivered/distributed by you. After distributing, you shall submit verification of delivery and any copies of returned notices to the Owner's Outreach team. Submit a PDF copy of the approved letters and notices to the Owner's Outreach team.

2. You shall provide the required information to the Owner's Outreach team for the creation and distribution of newsletters, e-newsletters, website updates, etc., for a project including: a written update on the progress of Work, 3-week look-ahead schedules, contact names and phone numbers, and any other information which may be of interest to the public for this purpose.

3. You shall identify and summarize communications (via phone, in person, and email) with the public within 24 hours of receipt, even if your response to the individual is still incomplete, to the Owner's Outreach team for inclusion in the City's internal public contact tracking system. You shall submit copies of all written, electronic, and verbal communications and conversations with the public to the Owner's Outreach team for reporting to the City's internal public contact tracking system.

7-16.2 Community Outreach Services.

7-16.2.1 Public Notice by Contractor.

1. Post Project Identification Signs in accordance with 7-10.6.2, "Project Identification Sign".

2. No less than 5 Working Days in advance of Project construction activities and utility service interruptions, you shall notify all critical facilities, businesses, institutions, property owners, residents, or any other impacted stakeholders within a minimum 300-foot (90 m) radius of the Project. Verbal and written notifications shall be sent

to critical facilities (including but not limited to police stations, fire stations, hospitals, and schools). A copy of written notifications sent to any critical facility shall also be sent to the Resident Engineer. You shall keep records of the people contacted, along with the dates of notification, and shall provide the record to the Engineer upon request. You shall identify all other critical facilities that need to be notified.

3. Distribute public notices in the form of door hangers using the City's format to all occupants and/or property owners along streets:

    a. Where Work is to be performed at least five (5) Days before starting construction or survey activities or impacting the community as approved by the Resident Engineer.

    b. Additional notifications (five (5) Days in advance and on the day of impact) shall be distributed to properties where driveways will be closed for any period of time or where there will be a water shut-off for a period of time.

    c. Within five (5) Days of the completion of your construction activities where Work was performed, Contractor shall distribute public notices in the form of door hangers, which outlines the anticipated dates of road repairs and specifies between Asphalt Resurfacing or Slurry Seal.

    d. Notifications for street resurfacing shall be distributed no less than 48 hours in advance and no more than 72 hours in advance.

4. Leave the door hanger notices on or at the front door of each dwelling and apartment unit and at each tenant of commercial buildings abutting each of the street block segments. Where the front doors of apartment units are inaccessible, distribute the door hanger notices to the apartment manager or security officer.

5. Door Hanger Material: Contractor shall use Blanks/USA brand, Item Number DHJ5B6WH, 1¼ inch Holes (removed), 2-up Jumbo Door Hanger in Bristol White, or approved equal.

6. Mailed Notice Material: Contractor shall use Cougar by Domtar, Item Number 2834, or approved equal.

7. For all Work on private property, contact each owner and occupant individually a minimum of 15 Days prior to the Work. If the Work has been delayed, re-notify owners and occupants of the new Work schedule, as directed by the Resident Engineer. All contacts shall be documented and provided to the Owner's Outreach team to ensure inclusion in the City's internal public contact tracking system.

8. A sample of public notices is included in the Contract **Appendix K.**

7-16.2.2 Communications with the Public.

1. Coordinate access for vehicular and pedestrian traffic to businesses, institutions, and residences impacted by the Project.

2. Contractor shall provide updates on construction impacts to the Resident Engineer and the Owner's Outreach team. Contractor shall notify the Resident Engineer in advance about time-sensitive construction impacts and may be required to distribute construction impact notices to the public on short notice.

3. Contractor shall incorporate community outreach activities related to construction impacts in the baseline schedule and update the Resident Engineer and the Owner's Outreach team with each week's submittal of the Three-Week Look Ahead Schedule.

4. At the request of the Resident Engineer or the Owner's outreach team, Contractor shall attend and participate in project briefings at community meetings and one-on-one meetings with businesses and/or stakeholders.

5. Contractor shall coordinate with the Resident Engineer and Owner's Outreach team on all responses and actions taken to address public inquiries and complaints within the 24 hours that they are received.

7-16.2.3 Communications with Media.

1. The City may allow members of the media access to its construction site(s) on a case-by-case basis only.

2. Occasionally, uninvited members of the media may show up at construction Sites. Members of the media (including, but not limited to newspapers, magazines, radio, television, bloggers, and videographers) do not have the legal right to be in the construction Site without the City's permission.

3. In the event that media representatives arrive near or on the construction Site(s), Contractor shall keep the media representative off the Site(s) in a courteous and professional manner until a Public Information Officer is available to meet them at an approved location.

4. Contractor shall report all visits from members of the media to the Resident Engineer and the Owner's Outreach team as quickly as possible so that the City's Public Information Officer can be contacted and can meet with the members of the media at the construction Site(s).

5. If the City allows members of the media to access a construction Site, Contractor shall allow the City to escort the media representatives while they are on the construction Site and shall ensure their safety.

6. Contractor shall require media representatives to sign in and out of the Site Visitor Log and to use personal protective equipment.

7. Contractor have a right to speak to members of the media about your company and its role on the project. All other questions shall be referred to the City.

7-16.3 Project Webcams.

1. Provide and maintain two (2) pole mounted high definition web cameras at locations identified by the City to allow users to remotely view the project on a secure connection.

2. Manufacturer: Work Zone Cam 877-966-3101 www.workzonecam.com or equal.

3. Requirements:

   a. Thermostatically controlled enclosure with heater and blower.

   b. Powder coated aluminum housing with stainless steel fittings for padlocks

   c. Impact resistant viewing window

   d. Two UL rated compression glands, gas spring lid, adjustable camera sled

   e. Canon digital SLR camera with 12.2 megapixel images (4272x2828 pixels), APS-C Imager or approved equal

   f. Angle of view: wide 63 degrees horizontal – 44-degree vertical, full zoom 22 degree horizontal – 15 degree vertical

   g. EF-S 18mm-55mm f/3.5-5.6 Image Stabilization lens

   h. Compression: JPEG/RAW

   i. Auto Features: ISO speed, metering mode, white balance, and focus

   j. 4GB onboard storage

   k. 120VAC or 12 VDC Solar Power with battery sufficient for minimum 48 hours of overcast weather

   l. Communications: 10base-T/100base-TX Ethernet, IP Addressing: Dynamic or Static

   m. Wireless cellular modem EVDO REV.A full duplex transceiver with GPS and exterior outdoor antenna

4. Online Web Interface: The Web Camera will function via a web-based interface to allow the viewing of all High Definition still images captured and stored from any location without internet access.

5. The Online Web Interface shall include:

   a. City logo and project name

   b. Multiple tabs option for accession multiple cameras from one page

   c. Digital Pan, Tilt, and Zoom capability within a High Definition image

   d. Easy navigation with intuitive image calendar control

e. Automated image geotagging with camera location

f. Downloadable up-to-date high-quality time-lapse movies with embed code for adding the time-lapse to websites

g. Image Comparison Tool for overlaying two images from different dates and times for comparison

h. Share Image Tool for saving and emailing

i. Local weather data

j. Google Maps integration of GPS data showing camera location

k. The system shall capture and upload images every 30 minutes, 24 hours per day

l. The System Vendor will maintain images on their servers for reference available at all times during the life of the project. All images will be protected on secure fully redundant servers at multiple locations owned and operated by the System Vendor.

6. In coordination with the City, the System Vendor shall provide an embed code or web interface link with Contractor's project details for unlimited public or private access.

7. The Contractor shall provide a fixed pole (minimum 40 feet height and three inches minimum diameter) as per System Vendor's instruction. The Contractor shall supply all equipment required for safe and secure access to the camera location, including building access, bucket truck and/or lift, for technicians performing installation and maintenance services.

8. Contractor shall pay for cellular service for both cameras until Final Completion of the Work. City will pay for website services and shall have full control over content and security.

9. Following completion of the project, Contractor shall turn over cameras, poles and other related equipment to the City.

7-16.4 Payment.

1. The payment for these community outreach services shall be included in the Contract Price.

7-17 NEWSLETTER. To the "WHITEBOOK" DELETE in its entirety**.**

7-20 ELECTRONIC COMMUNICATION. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. PM Web shall be used on this Contract as described in Technical Specification Section 01 33 22.

2. You shall post all communications addressed to the Engineer concerning construction including RFIs, submittals, daily logs, and transmittals through PM Web. Review and act on all communications addressed to Contractor in PM Web. A user's guide to PM Web will be provided at the Pre-construction meeting and demonstration will be provided.

3. You shall comply with Section 2-16 for items related to "Contractor Registration and Electronic Reporting System".

4. You shall comply with Section 7-2.3 for items related to "Payroll Records".

7-21.1 **General.** To the "WHITEBOOK", item 3, DELETE in its entirety and SUBSTITUTE with the following:

5. During the construction phase of projects, the minimum waste management reduction goal is 90% of the inert material (a material not subject to decomposition such as concrete, asphalt, brick, rock, block, dirt, metal, glass, and etc.) and 65% of the remaining project waste. You shall provide appropriate documentation, including a Waste Management Form attached as an appendix, and evidence of recycling and reuse of materials to meet the waste reduction goals specified.

7-21.9 **Payment.** To the "WHITEBOOK", item 1, DELETE in its entirety and SUBSTITUTE with the following:

1. Payment for bid item "Demolition of Site and Structures" is in accordance with technical specification section 01 29 00.

7-22.1 **General.** To the "WHITEBOOK", item 10, DELETE in its entirety and SUBSTITUTE with the following:

10. You shall ensure that construction staff have the required Hazardous Waste Operations and Emergency Response (HAZWOPER) certification for construction activities that have encountered flammable liquids or other hazardous substances. Construction staff shall include: City Engineers, City Laboratory Technicians, and City staff that perform onsite inspections.

    a) If your Work encounters flammable liquids or other hazardous substances, you shall be responsible for scheduling training for all construction staff to attend and for submitting verification to the Engineer that construction staff have the required HAZWOPER certification prior to continuing that Work in that area. You shall maintain the HAZWOPER certifications annually until the construction activities triggering the requirement is complete, as approved by the Resident Engineer.

    b) You shall be responsible for implementing, training, and submitting verification to the Engineer that construction staff have the required HAZWOPER certification before the Notice to Proceed (NTP) has been issued.

SECTION 8 - FACILITIES FOR AGENCY PERSONNEL

8-2 FIELD OFFICE FACILITIES. To the "WHITEBOOK", ADD the following:

8-2.5 Owner Representative Field Office.

A. General:

1. Separate from Contractor's field office, Contractor shall provide field offices, equipment, services and utilities specified herein for the Owner's Representative and the Engineer at the project site. Alternatives to the modular trailer configuration and criteria described herein may be proposed by the Contractor, provided that the alternatives meet the requirements outlined below. Alternatives will need to be reviewed and approved by the Owner's Representative. Potential alternatives include commercial or industrial office space.

2. Unless released earlier by the Owner's Representative in writing, said field office(s) shall be maintained in full operation at the site with all utilities connected and operable until the Notice of Completion has been executed or recorded. Upon execution or recordation of the Notice of Completion, or upon early release of the field office(s) by the Owner's Representative, the Contractor shall remove the field office(s) within 14 days from said date, and shall restore the site occupied by said field office(s).

B. Office Facilities:

1. General: The Contractor shall provide all necessary electrical utility service connection and trailer wiring, plumbing with hot and cold water, toilet and lavatory fixtures, air conditioning and heating equipment, and shall furnish all necessary light, heat, water, and janitorial services in connection with all field offices specified herein, for the duration of the Work.

2. Field office: The Contractor shall provide and maintain for the exclusive use of the Owner's Representative and the Engineer one separate, well lighted, field office trailer with the following:

a. The area of said field office shall not be less than 2880 (48'x60') square feet, including toilet facilities. The Contractor shall provide all furnishings, services, and equipment specified herein.

b. The office shall have a minimum of four outside doors with security locks and 10 keys provided. Lockable exterior door bars shall be provided. Railed landings and railed stairs shall be provided at each door. An 8-foot full trailer width deck at the main entrance of the trailer shall be provided with rails and ADA compliant handicap access ramp.

c. Trailer shall have a minimum of fifteen exterior windows. Windows shall be equipped with security guard screens and interior blinds.

d. Contractor shall provide a sign on the main entrance door reading Construction Manager, letter height 4 inches minimum.

e. The field office trailer will have a minimum of 6 offices (to be confirmed via approved floor plan submittal), two toilet rooms, one 15' x 48' conference room and a common area with sink and counter space and electrical outlets.

f. A minimum of four (4) 110-v ac duplex electric convenience outlets shall be provided in each individual office and four (4) in the conference room. Additional duplex outlets shall be evenly distributed around the common area. Each desk location shall have at least one duplex outlet. The electric distribution panel(s) shall be of sufficient size to provide uninterrupted service. Should sizing of panels be found inadequate Contractor shall, at no additional cost, increase the circuits and wiring to provide uninterrupted service. A dedicated 20-amp circuit shall be provided for the copy machine.

g. Three Ethernet outlets shall be provided in each office and shall be spaced throughout the common area and the conference room. Contractor shall provide all Ethernet cabling.

h. Contractor shall provide a preliminary layout of the field office trailer for approval by the Owner's Representative prior to fabrication of the trailer.

C. Field Office Furnishings:

1. The Contractor shall provide the following listed items in new condition or as approved by the Owner's Representative for the field office:

a. 15 each - Standard 30 x 60-inch desks

b. 1 each - Plan table 36 x 72-inch top; 36-inches high

c. 15 each – File cabinets, legal size, 4-5 drawer, with suspension racks

d. 30 each - Office chairs, standard arm rest type, adjustable, swivel, tilt-back with casters.

e. 15 each - Waste baskets.

f. Clothes Rack: Two

g. 1 each – Reverse osmosis/cartridge filter water dispenser unit (supplying both hot and cold water) with continuous supply of paper cups.

h. 12 each - Book case, 30 x 72 x 12 inches

i. 18 each - Stackable chairs, cushion type

j. 15 each - Conference tables, 30" x 60"

k. 1 each - First aid kit.

l. 4 each - Fire extinguishers,

m. 4 each - Marker board, 2' x 4'

n. 3 each – Marker board, 4' x 8'

o. Provide and install 55-inch Samsung Smart TV or equal

p. 1 each – Refrigerator/freezer, 21.7 cu ft minimum capacity

q. 1 each – Microwave oven

r. 1 each - Office copy machine. The copy machine shall be a Xerox VersaLink Model C7120 with the two-tray option and the Integrated Office Finisher or approved equal with full maintenance support. Toner shall also be provided with two spare toner cartridges with the copier at all times. The Contractor shall set up the copy machine so that it can perform its full range of features such as copy, print, scan, e-mail, and send/receive fax. The Contractor shall obtain and pay for a service contract with a local representative of the dealer or manufacturer for on-site service and repair within 24 hours.

D. Field Office Services:

1. The field office shall be provided with sufficient lighting to provide not less than 60-foot-candles at desk top height. Lighting shall be provided over the entrance doors.

2. Plumbing shall be connected to the sanitary sewer. A continuous supply of toilet paper and paper towels shall be furnished.

3. Two (2) times a week (Tuesday and Thursday) janitorial services shall be performed after working hours each day. Offices shall be swept, dusted, waste receptacles emptied, and all debris properly disposed of. Toilet facilities shall be sanitized and cleaned. Supplies shall be replenished, as required, of paper towels, paper cups, hand soap, toilet paper, and first-aid kit.

4. Provide and Install Electrical power service. Monthly power bill shall be paid by the Contractor.

E. Contractor shall pay for all permits and connection fees associated with the trailer installation.

F. Execution:

1. Make available for Construction Manager's use prior to start of the Work at Site or within 30 Days of the Notice to Proceed, whichever comes first. Field Office shall remain on Site through Notice of Completion. Contractor shall also demobilize trailer facilities.

2. Provide minimum 100 square feet of gravel or crushed rock base, minimum depth of 4 inches, at each entrance. Provide gravel or crushed rock base, minimum depth of 4-inches, for parking area suitable for fifteen vehicles.

3. Locate where directed by Construction Manager; level, block, tie down (seismic restraint), skirt, provide stairways, ADA accessible ramp, 8- foot-wide decking at entrance for the entire width of the trailer and relocate when necessary and approved. Construct on proper foundations and provide proper surface drainage and connections for utility services.

4. Raise grade under field office, as necessary, to elevation adequate to avoid flooding.

5. Provide sanitary facilities in compliance with state and local health authorities.

6. Exterior Door Keys: Furnish two sets of keys.

7. Telephone:

a. Provide and install Voice over Internet Protocol (VOIP) phones for the number of incoming lines equal to that specified.

b. Provide and install appropriate jacks; locate as directed by Construction Manager.

G. Computer:

1. Provide and install four HP Inspiron Desktop Model # I3470-3903BLK-PUS with 24- inch Dell Monitors Model # S2419NX) or approved equal, including required connecting cables and plugs.

H. Local Area Network (LAN):

a. Provide Ethernet network prewired in compliance with EIA/TIA 568B.

b. LAN shall be designed and installed by personnel experienced in similar LAN systems.

l. Telecommunications:

a. Site/Room Requirements:

1) Provide and install a 4' × 4' × ¾" fire-rated plywood backboard

2) Provide and install a 120V AC dedicated outlet on a dedicated 15Amp circuit breaker. Single standard 3 prong 120V AC, 15Amp dedicated receptacle. Within 5' of equipment mount

3) Provide and install new #6 ground wire bonded to an MGN (except in CA) or UFER Ground terminated to a grounding bus bar 2" Sleeve(s).

4) Backboard shall be mounted to wall with proper drywall anchors and not just screws

5) Active equipment shall not be installed within 3' of electrical panels

6) Active equipment shall not be installed within 3' of water sources (sinks, wash basins)

7) All equipment shall be installed in accordance with all ADA code (leaving 36'' open fare way).

8) Provide and install two (2), 5-15P outlets on 120-volt, 15-amp circuits. Within three feet of the network racks

9) Provide and install all labor, materials and equipment to connect to the City's SANNET fiber network.

b. Network Cabling Requirements:

1) Provide and install fourteen (14) network wall plates with two (2) data jacks per wall plate for a total twenty-eight (28) data jacks.

2) All data jacks shall be clearly and professionally labeled with matching labels at the faceplate and at the patch panel. Naming convention shall be based upon the matrix attached. Handwritten labels are not acceptable.

3) All data jacks shall be home runs from the faceplate to a Category 6 patch panel to the nearest IDF.

4) Cabling between the wall jack to the patch panel shall be plenum rated cable where required by code. The Category 6 cables shall be "Blue" in color. Use T568A wiring pattern terminating into Keystone Jack, Category 6, 110 type, 90 degree at the wall jack. The wall jack shall match the color of the faceplate.

5) The cabling between the wall plate and the patch panel, the cabling will terminate into the patch panel using a T568A wiring pattern into a Keystone Jack, Category 6, 110 type, 90 degree at the patch panel. The keystone shall match the color of the patch panel.

6) All data jacks shall be tested and certified. The vendor will provide a complete testing report for all data jacks.

7) Install one (1), 48-port Category 6 Patch Panel. Each patch panel will be a 2U, 48-port Category 6 Patch Panel.

8) Install a Wall mounted cabinet. Rack Size - 19". Height (Rack Units) - 12U. Dimensions (WxDxH) - 25.1 in x 23.6 in x 17.7 in.

c. Network a printer of quality and capabilities equal, or similar, to the following with contracted for immediate site services:

1) Sharp MX 4070V B&W and Color Networked capable of 11X17 printing and network accessible, or

2) Multi-Function Device (MFD): Provide a Konica Minolta BizHub C350 or C351 capable of color printing, 11X17 printing, scan to email and fax capabilities.

d. The contractor shall provide an Internet, T1 line or greater. The internet circuit shall be provided for the duration of the project to the CM with an Ethernet handoff. Provide a public routable IP address scheme with a subnet mask of /29 for routable addresses. The Contractor shall provide LAN Line telephone service and voicemail and will perform maintenance including move, add, and changes for the duration of the project. Each network component and UPS device will carry the stated maintenance types until thirty (30) days after Final Acceptance. Contractor also shall provide wired/wireless router.

e. Contractor shall provide all consumable supplies necessary for complete operation of the equipment specified under this section shall be furnished by Contractor until thirty (30) days after Final Acceptance. These supplies include, but are not limited to, ink and toner cartridges, plain paper, first-aid supplies, and fire extinguishers and certifications.

f. Provide appropriate jacks, wiring, and equipment required for a complete telecommunications system.

g. Arrange and provide for telecommunication service for use during construction. Pay costs of installation, maintenance, and monthly service of internet connection.

h. Maintain in good repair and appearance, and provide weekly cleaning service and replenishment, as required, of paper towels, paper cups, hand soap, toilet paper, first-aid kit supplies, and bottled water.

8-2.5.1 **Payment.** The payment for Field Office Facilities shall be included in the Lump Sum bid item "Field Office" and shall comply with all requirements discussed in supplementary provisions section 8-2.5.

SECTION 9 - MEASUREMENT AND PAYMENT

9-2 **Lump Sum Work.** To the "GREENBOOK" ADD the following:

Bid items and their scope are specified in the plans, contract documents and technical specification Section 01 29 00.

9-3.1 **General.** To the "GREENBOOK", paragraph (9), DELETE in its entirety and SUBSTITUTE with the following:

If, within the time fixed by law, a properly executed notice to stop payment is filed with the City, due to your failure to pay for labor or materials used in the Work, all money due for such labor or materials will be withheld from payment in accordance with applicable laws.

To the "WHITEBOOK", ADD the following:

3. As provided in §7105 of the California Public Contract Code, if the Contract is not financed by revenue bonds, you are not responsible for the cost of repairing or restoring damage to the Project when damage was proximately caused by an act of God, in excess of 5% of the Contract Price, if the following occur:

   a) The Project damaged was built in accordance with the Contract requirements.

b) There are no insurance requirements in the Contract for the damages.

4. The payment for Potholing for Shoring Limits shall be included in the Lump Sum bid item "Potholing for Shoring Limits".

9-3.2 **Partial and Final Payment.** To the "GREENBOOK", paragraph (3), DELETE in its entirety and SUBSTITUTE with the following:

Upon commencement of the Work, an escrow account shall be established in a financial institution chosen by you and approved by the City**.** Documentation for an escrow payment shall have an escrow agreement signed by you, the City, and the escrow agent. From each progress payment, 5% will be deducted and deposited by the City into the escrow account. Upon completion of the Contract, the City will notify the Escrow agent in writing to release the funds to you. Only the designated representative of the City shall sign the request for the release of Escrow funds.

To the "WHITEBOOK", item 1, DELETE in its entirety and SUBSTITUTE with the following:

2. The Final Payment, which is the release of Retention, shall be paid to you after you have successfully submitted the following required documents:

a) An affidavit that payrolls and bills for materials, equipment, and other indebtedness connected with the Work for which the City or the City's property might be responsible for or encumbered by.

b) A certificate evidencing that insurances required by the Contract Documents shall remain in force after Final Payment is currently in effect and shall not be canceled or allowed to expire until at least a 30 Calendar Days prior written notice has been given to the Engineer.

c) Consent of Surety to Final Payment.

d) If required by the Engineer, other data establishing payment or satisfaction of obligations such as receipts, releases and waivers of liens, claims, and security interests or encumbrances arising out of the Contract Documents. If a Subcontractor refuses to furnish a release or waiver required by the City, you may furnish a bond satisfactory to the Engineer to indemnify the City against such lien.

e) If required in the Contract Documents, the successful completion and submittal of the required reports such as construction demolition, waste recycling, and hydrostatic discharge reports.

f) Required EOCP Final Summary Report in accordance with Section 12, "Contract Records and Reports", record drawings, operations manuals, test reports, warranty documentation, and UL labels shall be submitted before requesting the release of retention.

g) Acceptance of the completed Project by the asset owning Department.

To the "WHITEBOOK", ADD the following:

2. Submit an invoice for payment after you successfully complete the required documents and the City will pay the invoice within 30 Calendar Days. The City will pay 6% annually for late retention payments.

9-3.2.1 **Application for Progress Payment.** To the "WHITEBOOK", item 3, DELETE in its entirety and SUBSTITUTE with the following:

3. The City shall not pay progress or partial payments until you submit to the Engineer an acceptable updated Schedule. It is solely your responsibility to prepare and submit the Schedule updates

9-3.2.2 **Amount of Progress Payments.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. The City will pay interest at rate 6% annually for late progress payments.

2. Progress payments will be considered "late" if the following occur:

   a) The City does not pay the contractor within 30 Calendar Days from receipt of an undisputed and properly submitted invoice. A properly submitted payment invoice means that the City has approved for payment the entire invoice amount or if the Resident Engineer has not disputed any portion of the application within 7 Calendar Days of the date of submission.

   b) The application for payment does not require signing of a Contract Change Order.

3. The Engineer may withhold payment for any of the following reasons:

   a) Defective or incomplete Work.

b) Not providing an updated and accurate Cost Loaded Construction Schedule in accordance with 6-1.1, "Construction Schedule".

c) Stop notices, wage orders, or other withholdings required by Applicable Law. Your failure to comply with 7-2.3, "Payroll Records" and the Contractor Registration and Electronic Reporting System requirements of the Contract Documents.

4. The Engineer may back charge the contract for any of the following reasons:

a) Defective or incorrect Work not remedied.

b) Damage to City property or a third party's property that was caused by you.

c) Liquidated Damages.

9-3.2.3 **Waiver of Claims at Final Payment.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. Your acceptance of Final Payment constitutes a waiver of affirmative Claims by you, except those previously made in writing and identified as unsettled at the time of Final Payment.

9-3.2.4 **Withholding of Payment and Back Charge.** To the "WHITEBOOK", DELETE in its entirety.

9-3.4.1 **Payment:** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. Payment for mobilization work shall be dispersed for payment as described in the Technical Specifications Div 01, Section 01 29 00 from the "Mobilization" Bid item and shall not exceed 2% of the Contract Price. If the Bid item for "Mobilization" exceeds 2% of the Contract Price, any such differential amounts up to the bid amount, shall be paid as a part of the Final Payment.

9-3.5 **Field Orders.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. If the cumulative total of Field Order items of Work does not exceed the "Field Orders" Bid Item, the City shall pay those Field Orders as shown below:

TABLE 9-3.5

FIELD ORDER LIMITS

Contract Price	Maximum Field Order Work Amount
Less than $100,001	$2,500
$100,001 to $1,000,000	$5,000

Contract Price	Maximum Field Order Work Amount
$1,000,001 to $5,000,000	$10,000
$5,000,001 to $15,000,000	$20,000
$15,000,001 to $30,000,000	$40,000
Greater than $30,000,000	$50,000

2. Field Order items of Work for contracts greater than $15,000,000 will require additional approvals from the City prior to its approval by the Resident Engineer.

3. The City will issue a Field Order only after the City's acceptance of the cost of the field order amount.

4. Field Orders shall not be used to add scope or to include extensions of time related to changes in work.

5. If in the event there is a change related to the critical path on the project which necessitates an extension of time and the change amount is within the Field Order limits shown on Table 9-3.5, then a Field Order can be issued to compensate you for the approved costs. Any extensions of time associated with the change shall be included in a subsequent Change Order and no additional compensation shall be granted as part of the change order for the extension of time.

6. The unused portions of Field Orders Bid item shall revert to the City upon Acceptance.

SECTION 203- BITUMINOUS MATERIALS

203-6.3.1 General. To the "WHITEBOOK", ADD the following:

3. Asphalt concrete for Job Mix Formula (JMF) and Mix Designs shall be Type III and shall not exceed 15% RAP.

SECTION 209 – PRESSURE PIPE

209-1.1.1 Pressure Pipe. To the "WHITEBOOK", ADD the following:

2. PVC products, specifically type C900 and C905, as manufactured or distributed by J-M Manufacturing Company or JM Eagle shall not be used on the Contract for pressurized pipe.

4. Refer to AWWA C900-16 for all references to AWWA C905.

SECTION 217 – BEDDING AND BACKFILL MATERIALS

217-2.2 Stones, Boulders, and Broken Concrete. To the "GREENBOOK", Table 217-2.2, DELETE in its entirety and SUBSTITUTE with the following:

TABLE 217-2.2

Zone	Zone Limits	Maximum Size (greatest dimension)	Backfill Requirements in Addition to 217-2.1
Street or Surface Zone	From ground surface to 12" (300 mm) below pavement subgrade or ground surface	2.5" (63 mm)	As required by the Plans or Special Provisions.
Street or Surface Zone Backfill of Tunnels beneath Concrete Flatwork		Sand	Sand equivalent of not less than 30.
Trench Zone	From 12" (300 mm) below pavement subgrade or ground surface to 12" (300 mm) above top of pipe or box	6" (150 mm)	
Deep Trench Zone (Trenches 3' (0.9 m) wide or wider)	From 60" (1.5 m) below finished surface to 12" (300 mm) above top of pipe or box	Rocks up to 12" (300 mm) excavated from trench may be placed as backfill	
Pipe Zone	From 12" (300 mm) above top of pipe or box to 6" (150 mm) below bottom of pipe or box exterior	2.5" (63 mm)	Sand equivalent of not less than 30 or a coefficient of permeability greater than 1-½ inches/hour (35 mm per hour).
Overexcavation	Backfill more than 6" (150 mm) below bottom of pipe or box exterior	6" (150 mm)	Sand equivalent of not less than 30 or a coefficient of permeability greater than 1-½ inches/hour (35 mm per hour). Trench backfill slurry (100-E-100) per 201-1 may also be used.

SECTION 302 – ROADWAY SURFACING

302-3 PREPARATORY REPAIR WORK. To the "WHITEBOOK", ADD the following:

13. Asphalt concrete shall be Type III and shall not exceed 15% RAP in accordance with 203-6.3.1, "General".

302-4.5 Scheduling, Public Convenience and Traffic Control. To the "GREENBOOK", paragraphs (1) and (2), DELETE in its entirety and SUBSTITUTE with the following:

1. In addition to the requirements of Part 6, you shall comply with the following:

    a) At least 5 Working Days prior to commencing the Work, you shall submit your proposed Schedule to the Engineer for approval.

    b) Based upon the approved schedule, you shall notify residents and businesses of the Work and post temporary "No Parking" signs 72 hours in advance.

    c) Requests for changes in the approved Schedule shall be submitted to the Engineer for approval at least 3 Working Days before the street is scheduled to be sealed.

302-5.9 Measurement and Payment. To the "WHITEBOOK", item 2, DELETE in its entirety.

SECTION 303 – CONCRETE AND MASONRY CONSTRUCTION

303-5.1.1 General. To the "WHITEBOOK", ADD the following:

7. For the purposes of this section, the terms "walk" and "access ramp" shall be synonymous with "sidewalk" and "curb ramp and pedestrian ramp", respectively.

303-5.10.2 Payment. To the "WHITEBOOK", ADD the following:

4. The payment for completely removing and replacing the existing concrete spandrel of a cross gutter associated with curb ramp installations, in accordance with SDG-131 - General Curb Ramp Notes, and as identified on the Plans, shall be included in the payment for the curb ramp. No additional costs shall be incurred when separate Bid items for cross gutters has been provided.

5. The payment for completely removing and replacing the existing concrete alley apron associated with curb ramp installations, in accordance with SDG-131 - General Curb Ramp Notes, and as identified on the Plans, shall be included in the payment for the Curb Ramp installation. No additional costs shall be incurred when separate Bid items for alley aprons has been provided

SECTION 306 – OPEN TRENCH CONDUIT CONSTRUCTION

306-2.8 Advance Preparation before Connecting to Existing Pipelines. To the "GREENBOOK", ADD the following:

Prior to making any connections to existing pipes for relocation of conflicting utilities, the Contractor shall coordinate with City staff to coordinate connection activities. Contractor to verify that the existing conditions are adequate for the proposed relocation drawings prior to ordering materials or laying any pipe or conduit.

306-3.4 Minimum and Maximum Pipe Zone Trench Width. To the "GREENBOOK", ADD the following:

Where pipe trench width or depth shown on the drawing is not wide or deep enough to accommodate welding procedures, Contractor shall widen or deepen trench as needed at the joint to accomplish the work.

306-6.5.1 General. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. For PVC water pipes:

    a) Bedding material shall:

        i. Either be sand, crushed aggregate, or native free-draining granular material.

        ii. 100% of the bedding material shall pass the no. 4 sieve and shall have an expansion when saturated with water of not more than 0.5%.

        iii. Have a sand equivalent of SE 50. SE 30 or higher may be substituted for SE 50 as bedding material if all of the following requirements are met:

            - The top of the pipe and haunch areas are mechanically compacted by means of tamping, vibrating roller, or other mechanical tamper.
            - Equipment is of size and type approved by the Engineer.
            - 90% relative compaction or better is achieved.

    b) When jetting, care shall be exercised to avoid floating of the pipe.

2. PVC sewer pipes shall be bedded in 3/8 inch (9.5 mm) or 1/2 inch (12.5 mm) crushed rock in accordance with 200-1.2, "Crushed Rock and Rock Dust". Crushed rock for PVC sewer pipes may contain recycled Portland Cement Concrete and shall

conform to gradation requirements for 3/8-inch or1/2 inch nominal size as shown in Table 200-1.2.1 (A).

3. Storm drains and all types of non-PVC sewer mains shall be bedded in 3/4 inch (19 mm) crushed rock in accordance with 200-1.2, "Crushed Rock and Rock Dust". Crushed rock for storm drains may contain recycled Portland Cement Concrete and shall conform to gradation requirements for 3/4-inch nominal size as shown in Table 200-1.2.1 (A). Bedding shall be placed to a depth of 4 inches (101.6 mm) below the outside diameter of the pipe or 1 inch (25.4 mm) below the bell of the pipe, whichever is greater.

306-7.8.2.1 **General.** To the "WHITEBOOK", item 2, DELETE in its entirety and SUBSTITUTE with the following:

2. Pressure testing of pipe and fittings at the lowest elevation shall be performed at 150% of the specified test pressure and no less than 100% of the specified test pressure at the highest elevation.

   a) Specified test pressure for Class 235 pipe shall be 150 psi and is tested at 225 psi.

   b) Specified test pressure for Class 305 pipe shall be 200 psi and is tested at 300 psi.

306-8.8 **Valves, Hydrants, and Appurtenances.** To the "WHITEBOOK", ADD the following:

Access structures shall be constructed in accordance with the Plans, Reference Specifications and Standard Drawing SDW 103, "Access Manhole".

306-8.3.3 **Acceptance.** To the "GREENBOOK", ADD the following:

Where carrier pipe is installed within a casing, carrier pipe shall be tested and accepted prior to placement of grout between carrier pipe and casing.

306-8.9.2.3 **Allowable Leakage.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. For prefabricated pressure pipe testing requirements, refer to prefabricated gravity pipe pressure testing requirements in 306-7.8.2, "Pressure Testing and Leakage Inspection".

306-8.9.2.4 **Test Procedure.** To the "GREENBOOK", ADD the following:

Surge pressure shall be used as the Specified test pressure for all pipe, see drawings for specific surge pressure at any given location.

306-13.2 **Permanent Resurfacing.** To the "WHITEBOOK", DELETE in its entirety and REPLACE with the following:

1. Contractor shall resurface trenches per SDG-107, including "T-cap" paving (1 ½" deep trench grind, including a minimum of 6" additional width each side of the existing trench), replace-in-kind any damaged existing facilities including, but not limited to; striping, traffic loops, traffic signals, and trolley mast arms.

2. Contractor shall be responsible for removal and replacement of all permanent paving damaged due to exposition, repair, and replacement of any pipe which has failed testing at no cost to the City. Contractor shall not be entitled to any additional Working Days or contract extension due to delays resulting from removal and replacement of permanent paving due to test failure.

306-13.2.1 **Payment.**

All permanent resurfacing work including mobilization, demobilization and other items associated with resurfacing activities shall be included in the bid item "Influent, Diversion & Overflow Sewers".

306-15.1 **General.** To the "WHITEBOOK", DELETE in its entirety.

ADD:

306-15.1 **General.** To the "GREENBOOK", paragraph (1), sub-item "d", DELETE in its entirety and SUBSTITUTE with the following:

d) the excavations of the trench and disposal of excess excavation.

To the "GREENBOOK", paragraph (1), ADD the following:

n) trench shoring and plans, excluding engineered shoring and engineered shoring plans.

To the "GREENBOOK", paragraph (2), DELETE in its entirety and SUBSTITUTE with the following:

No separate or additional payment shall be made for additional bedding or a higher strength of pipe necessitated by you exceeding the maximum trench width, unless a bid item has been provided.

306-15.2 **Shoring and Bracing.** To the "WHITEBOOK", ADD the following:

2. Payment for shoring and bracing will be included in bid item "Shoring, Bracing and Dewatering of Non- Hazardous and Hazardous Contaminated Groundwater" as specified in specification section 01 29 00.

306-19.2 **Pipe Separations.** To the "WHITEBOOK", item 1, subsection "a", DELETE in its entirety and SUBSTITUTE with the following:

a) You shall notify the Engineer immediately if:

i. 1 foot (0.3 m) vertical separation as measured from the outside of pipe wall to the outside of pipe wall between sewer and water mains cannot be maintained.

ii. 10 feet (3.0 m) horizontal separation as measured from the outside of pipe wall to the outside of pipe wall between sewer and water mains cannot be maintained.

iii. 6 inches (152.4 mm) vertical separation as measured from the outside of pipe wall to the outside of pipe wall between utilities other than sewer and water mains cannot be maintained.

iv. 3 feet (0.9 m) or more of cover over the top of the water main cannot be maintained.

v. 5 feet (1.5 m) or more of cover over the top of the recycled water main cannot be maintained.

SECTION 600 - ACCESS

ADD:

600-1 **GENERAL.** To the "WHITEBOOK", item 5, DELETE in its entirety and SUBSTITUTE with the following:

5. If the City's crews are unable to provide the citizens with the mandated services due to your failure to comply with these specifications, you shall collect trash, recyclables, and yard waste on the City's schedule and deliver to the City's designated locations. If you fail to perform this Work, you shall incur additional costs for the City to reschedule pick up of an area.

SECTION 601- TEMPORARY TRAFFIC CONTROL FOR CONSTRUCTION AND MAINTENANCE WORK ZONES

601-3.5.1 **General.** To the "WHITEBOOK", paragraph 3, DELETE in its entirety and SUBSTITUTE with the following:

Temporary "No Parking" and "No Stopping" signs shall be installed 72 hours before enforcement. Temporary "No Parking" and "No Stopping" signs shall be installed and removed as specified in the Special Provisions. Signs shall indicate specific days, dates, and times of restrictions. If violations occur, call Police Dispatch 619-531-2000 to enforce the Tow-Away notice.

601-3.6.4 **Barricades.** To the "WHITEBOOK", to item 4, ADD the following:

4) You shall place "OPEN TRENCH" signs (C27(CA)) on Type 3 Barricade within the construction Work zone, ahead of any Work areas with open trenches that are greater than 3 inches in depth, in accordance with California MUTCD SECTION 6F.103 (CA). The barricades shall be placed in a continuous manner and shall prevent pedestrian, vehicular, and biker access to the open trench area.

601-6 **PAYMENT.** To the "WHITEBOOK", item 5 subitem d, DELETE and SUBSITITUTE with the following:

d) The Contractor shall expect to be required no more than five (5) PCMS on-site at one time, as directed by the City, and shall be paid via the Bid item for "Portable Changeable Message Signs," for signs in use. All other costs associated with placing, operating, programming, maintaining, repairing, replacing, transporting from location to location, and removing each PCMS shall be included in this bid item. The quantity, as provided in the bid list, accounts for five (5) PCMS multiplied by thirty-six (36) months for a total quantity of one hundred and eighty (180) months. The Contractor shall be compensated each month by applying the unit cost to each PCMS used in that month.

SECTION 700 – MATERIALS

700-5.1 **(86-5.01) Vehicle Detectors.** To the "WHITEBOOK", item 1, DELETE in its entirety and SUBSTITUTE with the following:

9. Loop wire shall be Type 2. Loop detector lead-in cable shall be Type "B". Slots shall be filled with elastomeric sealant, epoxy sealant, or hot-melt rubberized asphalt sealant, except asphaltic emulsion loop sealant and cold tar loop sealant are acceptable if the pavement surface will receive an asphaltic concrete overlay.

SECTION 802 - NATIVE HABITAT PROTECTION, INSTALLATION, MAINTENANCE, AND MONITORING

802-2.1 **Project Biologist.** To the "WHITEBOOK", ADD the following:

5. The City will retain a qualified Project Biologist to perform biological monitoring work for this Contract. You shall coordinate your activities and Schedule with the activities and schedules of the Project Biologist.

SECTION 900 – MATERIALS

900-2.3 **Payment.** To the "WHITEBOOK", item 3, DELETE in its entirety and SUBSTITUTE with the following:

3. The payment for furnishing materials for your connection, cut and plug, and cut-in Work shall cover all necessary materials (fittings and hardware, excluding valves and pipes), delivery, and unloading. The payment shall be included within the Bid item of the Work involved and no separate payment for furnishing those materials shall be made. The payment for furnishing valve and pipe materials for your connection, cut and plug, and cut-in Work shall be included in the Bid item for "Morena Pump Station".

901-1.1 **General.** To the "WHITEBOOK", item 2, DELETE in its entirety and SUBSTITUTE with the following:

2. The Engineer will coordinate all interactions between you and the City Water Operations Division, the City Water Quality Laboratory, and other City organizations. Upon your request, the Engineer shall notify the City's Public Utilities Department's staff as noted below which shall be required at least 20 Working Days prior to the beginning of Work that involves shutting down pipelines, high-lining, cutting and plugging of, or making connection to the existing water mains.

    a) Transmission Mains (16 inches and larger) – Jesus Ramos (619-527-7438)

    b) Distribution Mains (less than 16 inches) – (619-527-7539)

    c) Water Facilities – Tatyana Fikhman (619-527-7465) and Jesus Ramos (619-527-7438)

901-2.2.1 **General.** To the "WHITEBOOK", item 5, DELETE in its entirety and SUBSTITUTE with the following:

5. The Engineer will coordinate all interactions between you and the City Water Operations Division, the City Water Quality Laboratory, and other City organizations. Upon your request, the Engineer shall notify the City's Public Utilities

Department as noted below which shall be required at least 20 Working Days prior to the beginning of Work that involves shutting down pipelines, high-lining, cutting and plugging of, or making connection to the existing water mains.

a) Transmission Mains (16 inches and larger) – Jesus Ramos (619-527-7438)

b) Distribution Mains (less than 16 inches) – (619-527-7539)

c) Water Facilities – Tatyana Fikhman (619-527-7465) and Jesus Ramos (619-527-7438)

901-1.1.2.2 Start-up Procedures. To the "WHITEBOOK", item 2, subsection "j", DELETE in its entirety and SUBSTITUTE with the following:

j) In the event that the high-line piping system fails to pass the required bacteriological testing, you will be expected to help investigate and perform corrective actions if warranted by the findings and you shall re-flush and re-disinfect the lines for re-testing at no additional cost to the City. Disposal of chlorinated water for retesting shall be in accordance with the City standards and regulations. Indiscriminate disposal of chlorinated water shall not be permitted.

901-2.2.4 Preparation for Connection. To the "WHITEBOOK", item 7 and 8, DELETE in its entirety and SUBSTITUTE with the following:

7. Upon receiving notification of a shutdown date by City Water Operations Division for your planned connection, you shall trench and steel plate the pit(s) necessary to make the connection(s) prior to the start of the scheduled shutdown to facilitate an expedient connection to the existing main. Shutdown of the water main and connection shall be completed within the timeline agreed upon and as specified by City Water Operations staff so that water is restored in accordance with the shutdown notification and as needed for operation of the water system.

8. If you anticipate connection operations exceed the time as identified in the notification, causes health and safety risks, or disrupts water services to the consumers, you shall notify the Engineer and the City's Station 38 at (619) 527-7500 as soon as possible for assistance to provide potable water and temporary high-lines to restore water to the affected consumers.

To the "WHITEBOOK", ADD the following:

12. After the connection operation (for mains or services), you shall request the Engineer notify City Water Laboratory take water samples for bacteriological tests in accordance with Section 7 of the AWWA C651. If the test does not pass, you will be expected to help investigate and perform corrective actions if warranted by the findings.

13. Bacteriological Testing (Bac-T) sample results are valid only for 14 Calendar Days from the date the results are first made available. If any system is not placed into service within the 14 Calendar Days, then bacteriological testing shall be reinitiated.

901-2.3.4.1 Quality Control. To the "WHITEBOOK", item 3, DELETE in its entirety and SUBSTITUTE with the following:

3. After the cut and plug operation, the water main and its appurtenances shall be disinfected, and field tested by you in accordance with the latest edition of AWWA C651. You shall also request the Engineer to notify the City Water Laboratory to take water samples for bacteriological tests in accordance with Section 7 of the AWWA C651. If the test does not pass, you will be expected to help investigate and perform corrective actions if warranted by the findings.

901-2.5 Payment. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. Your Work for connecting to the existing system (cut-in or tie-in Work), excluding new main interconnections between various phases, shall be paid under the Bid items for the connection (cut-in or tie-in Work) and shall include the following:

    a) Trenching, furnishing, and installing all materials and labor to complete the Work, including up to 10 feet of new water pipe

    b) Potholing

    c) Protecting the water main while performing the Work

    d) Coordinating your Work with the City Forces

    e) Coordinating with the community (community outreach)

    f) Traffic control and construction BMPs

    g) Pavement Restoration

2. Cut and plug Work of the existing system by you shall be included in the Bid item for "Morena Pump Station" and shall include coordination of Work with City Forces, any scheduling impact costs, community outreach, furnishing and installing of materials, and traffic control. Potholing and protecting the water main while performing the Work shall be included in this payment.

3. Traffic control saw cutting the trench area, trench caps, and other spot repairs in the vicinity of the disturbed area at each restored connection shall be included in the square foot Bid item for "Pavement Restoration for Final Connection". Asphalt overlay and slurry seal Work shall be paid for under separate Bid items.

4. Interconnections between various phases of newly installed watermains shall be included in the associated pipeline bid items.

PART 10

EQUAL OPPORTUNITY CONTRACTING PROGRAM (EOCP)

SECTION A – GENERAL REQUIREMENTS

4.1 **Nondiscrimination in Contracting Ordinance.** To the "WHITEBOOK", subsection 4.1.1, paragraph (2), sentence (1), DELETE in its entirety and SUBSTITUTE with the following:

You shall not discriminate on the basis of race, gender, gender expression, gender identity, religion, national origin, ethnicity, sexual orientation, age, or disability in the solicitation, selection, hiring, or treatment of subcontractors, vendors, or suppliers.

12. **CONTRACT RECORDS AND REPORTS.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. You shall maintain records of all subcontracts and invoices from your Subcontractors and Suppliers for work on this project. Records shall show name, telephone number including area code, and business address of each Subcontractor, Supplier, and joint venture partner, and the total amount actually paid to each firm. Project relevant records, regardless of tier, may be periodically reviewed by the City.

2. You shall retain all records, books, papers, and documents pertinent to the Contract for a period of not less than 5 years after Notice of Completion and allow access to said records by the City's authorized representatives.

3. You shall submit the following reports using the City's web-based contract compliance (Prism® portal):

    a) **Monthly Payment.** You shall submit Monthly Payment Reporting by the 10th day of the subsequent month. Incomplete and/or delinquent reporting may cause payment delays, non-payment of invoices, or both.

4. The records maintained under item 1, described above, shall be consolidated into a Final Summary Report, certified as correct by an authorized representative of the Contractor. The Final Summary Report shall include all subcontracting activities and be sent to the Engineer prior to Acceptance. Failure to comply may result in assessment of liquidated damages or withholding of retention. The City will review and verify 100% of subcontract participation reported in the Final Summary Report

prior to approval and release of final retention to you. In the event your Subcontractors are owed money for completed Work, the City may authorize payment to subcontractor via a joint check from the withheld retention.

END OF SUPPLEMENTARY SPECIAL PROVISIONS (SSP)

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SECTION 01 12 00
PARTNERING

PART 1 GENERAL

1.1 PARTNERING

A. The Owner intends to encourage the foundation of a cohesive partnership with the Contractor. This partnership will be structured to draw on the strengths of each organization to identify and achieve reciprocal goals. The general objectives are effective and efficient contract performance to achieve completion within budget, on schedule, and in accordance with the intent of the Contract Documents.

B. Project partnering recognizes that the Owner, Contractor, Construction Manager and Engineer all hold in common the goal of successful completion of this Project, including the following specific goals:

1. Construction of a facility that meets the project performance standards as defined in the Specifications.
2. Completion of the project on schedule in order to correctly interface with other concurrent and related projects and provide operational success of the MPS and the other Pure Water Program Projects.
3. Conformance to budgetary requirements and limitations.
4. Promote organizational efficiency for all parties.

C. In addition, it is recognized that safety, liability limitation, avoidance of litigation, reputation, good will, and other factors are of significant importance to all parties involved in the Project.

D. Through partnering, the four parties will agree among themselves regarding the primary goals for the Project and the methods that will be used to accomplish them. This will require development of a cooperative open relationship among the Contractor, Owner, Construction Manager, and Engineer. The parties will mutually develop a communication framework and a conflict resolution system to be used throughout the Project.

E. Partnering will include an initial 8-hour workshop in which the basic requirements for the partnering relationship will be established. The following persons will be expected to attend the workshop, at a minimum.

1. Contractor:
   a. Project Sponsor (Principal-in-Charge).
   b. Project Manager.
   c. Safety Representative.
   d. Startup Manager.
   e. Superintendents.
   f. Subcontractors.
   g. Key Manufacturers.

2. Owner:
    a. Director of Utility Services (Principal).
    b. Manager of Technical Services.
    c. Project Manager.
    d. Construction Manager.
3. Construction Manager:
    a. Principals.
    b. Construction Manager.
    c. Project Coordinator.
    d. Startup Manager.
    e. Resident Engineers.
    f. Inspectors.
4. Engineer:
    a. Principals.
    b. Project Manager.
    c. Resident Engineer.

F. The partnering workshop will be conducted by an independent partnering facilitator within 30 days of the limited Notice to Proceed at a time and date agreed upon by all parties and at a neutral location away from each entity's home office and/or field facilities. The facilitator will prepare the workshop agenda after conducting telephone interviews with key individuals from each party to assess their needs and concerns.

G. Additional partnering sessions will be held quarterly on an as needed basis, and will include an 8-hour workshop, with the same attendees as the initial partnering workshop. The purpose of these follow-up sessions will be to confirm the relationship and assure the partnering effort continues to be successful throughout the Project.

H. A partnering facilitator will be employed by the Owner who will help establish and monitor the partnering relationship. Payment and Partnering shall be per Section 2-13.1 of the Whitebook.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 GENERAL

1.1 WORK REQUIRED OF THIS SECTION

A. Payment for the various items of the Bid Schedule, as further specified herein, shall include all compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor and services, operations, and incidentals appurtenant to the items of Work being described here and within the plans, specifications, and Contract Documents, as necessary to complete the various items of the Work all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of permits and cost of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the California Division of Industrial Safety and the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). No separate payment will be made for any item that is not specifically set forth in the Bid Schedule, and all costs therefore shall be included in the Contract Price.

B. Work shall include all electrical, mechanical, HVAC, plumbing, instrumentation and control, structural, coatings, and architectural work required to support each Bid Item.

1.2 SUBMITTALS

A. Informational Submittals:

1. Schedule of Values: Submit on Schedule of EstimatedProgress Payments:
   a. Submit with initially acceptable Schedule of Values.
   b. Submit adjustments thereto with Application for Payment.
2. Application for Payment: Submit on Owner's form.
3. Final Application for Payment.

1.3 SCHEDULE OF VALUES

A. Prepare a separate Schedule of Values for each schedule of the Work under the Agreement.

B. Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.

C. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.

D. Lump Sum Work:

1. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.
   a. Include item(s) for monthly progress schedule update.
2. Break down by Division 02 through 49 for each Project facility.

E. An unbalanced or front-end loaded schedule will not be acceptable.

F. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.

G. Submit Schedule of Values on a USB Flash Drive in a spreadsheet format compatible with latest version of MS Excel.

1.4 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

A. Show estimated payment requests throughout Contract Times aggregating initial Contract Price.

B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

1.5 ALLOWANCES

A. Allowances will be administered in accordance with the Contract requirements and as described below under 1.14 Bid Items.

B. Submit, with application for payment, invoice showing the date of purchase, labor costs, expenses, and the total price for all allowance items.

C. Allowances shall be paid based on actual work performed up to the amount listed in the Bid Schedule. The Owner shall authorize the use of the cash allowances on an as needed basis.

D. Allowances are further described as:

1. Permits & fees
2. Dewatering Hazardous Contaminated Water
3. Equipment Setup for Hazardous Dewatering
4. Dewatering Permit for Discharge Fees
5. SWPPP Permit Fee
6. Dispute Resolution Board
7. Field Orders
8. Security Systems.

1.6 APPLICATION FOR PAYMENT

A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.

B. Use detailed Application for Payment Form provided by Owner.

C. Provide separate form for each schedule as applicable.

D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.

E. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.

F. Preparation:

1. Round values to nearest dollar.
2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Engineer.

1.7 MEASUREMENT—GENERAL

A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.

B. Whenever pay quantities of material are determined by weight, weigh material on scales furnished by Contractor and certified accurate by state agency responsible. Obtain weight or load slip from weigher and deliver to Owner's representative at point of delivery of material.

C. If material is shipped by rail, car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff and provided further that car weights will not be acceptable for material to be passed through mixing plants.

D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by Engineer. Each vehicle shall bear a plainly legible identification mark.

E. Haul materials that are specified for measurement by the cubic yard measured in the vehicle in transport vehicles of such type and size that actual contents may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its water level capacity. Load vehicles to at least their water level capacity. Loads hauled in vehicles not meeting above requirements or loads of a quantity less than the capacity of the vehicle, measured after being leveled off as above provided, will be subject to rejection, and no compensation will be allowed for such material.

F. Quantities Based on Profile Elevations: Existing ground profiles shown on Drawings were taken from a topographic map drawn with contour intervals of 1 foot with supplementary spot elevations to nearest half foot.

G. Quantities will be based on ground profiles shown. Field surveys will not be made to confirm accuracy of elevations shown.

H. Where measurement of quantities depends on elevation of existing ground, elevations obtained during construction will be compared with those shown on Drawings. Variations of 1 foot or less will be ignored, and profiles shown on Drawings will be used for determining quantities.

I. Units of measure shown on Bid Form shall be as follows, unless specified otherwise.

Item	Method of Measurement
AC	Acre—Field Measure by Engineer
CY	Cubic Yard—Field Measure by Engineer within limits specified or shown
CY-VM	Cubic Yard—Measured in Vehicle by Volume
EA	Each—Field Count by Engineer
GAL	Gallon—Field Measure by Engineer
HR	Hour
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure by Engineer
MFBM	Thousand Foot Board Measure—[Delivery Invoice] [Field
SF	Square Foot
SY	Square Yard
TON	Ton—Weight Measure by Scale (2,000 pounds)

1.8 PAYMENT - GENERAL

A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

B. Payment for the various items of the Bid Schedule, as further specified herein, shall include all compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor and services, operations, and incidentals appurtenant to items of Work being described here and within the plans, specifications, and Contract Documents, as necessary to complete the various items of the Work all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of permits and cost of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the California Division of Industrial Safety and the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). No separate payment will be made for any item that is not specifically set forth in the Bid Schedule, and all costs therefore shall be included in the contract price.

C. Payment for Procured Equipment:

1. Payment for procured equipment is divided into two types of equipment: Major Equipment as identified in Attachment 1 List if Major Equipment, and all other procured equipment. Major Equipment will be paid according to the following milestones:
    a. Purchase Order = 5%. An executed purchase order must accompany the payment request.
    b. Submittal Acceptance = 5%. Approval of the equipment submittal is required prior to payment of this amount.
    c. Fabrication = 65%. Fabrication, including factory testing, may be paid in part provided adequate documentation is presented and accepted at the monthly Schedule Preview Meeting.
    d. Delivery = 10%. Proof of onsite delivery (or proper handling of stored materials) must accompany the payment request.
    e. Pre-Operational Checkouts/Installation Certification = 10%. Proof of Installation Certification by the Manufacturer must accompany the payment request.
    f. Operational Checkouts/Performance Verification = 5%. Documentation of successful operational checkouts/performance verification must be provided.
    g. The sum of items listed above shall not exceed the documented quotation amount or invoice amount.
2. All other equipment (i.e., non-Major Equipment) will be paid upon submittal and acceptance of the required documents, including:

a. Paid invoices and proof of payment for materials on hand.
b. Proof of proper storage or stored materials.
c. Quantity verification (load tickets, etc.).
d. Any required certifications.

1.9 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by Owner.
6. Material remaining on hand after completion of Work.

1.10 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to Engineer.

B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.11 PARTIAL PAYMENT FOR UNDELIVERED, PROJECT-SPECIFIC MANUFACTURED OR FABRICATED EQUIPMENT

A. Notwithstanding above provisions, partial payments for undelivered (not yet delivered to Site or not stored in the vicinity of Site) products specifically manufactured for this Project, excluding off the shelf or catalog items, will be made for products listed below when all following conditions exist:

1. Partial payment request is supported by written acknowledgment from Suppliers that invoice requirements have been met.
2. Equipment is adequately insured, maintained, stored, and protected by appropriate security measures.
3. Each equipment item is clearly marked and segregated from other items to permit inventory and accountability.
4. Authorization has been provided for access to storage Site for Engineer and Owner.
5. Equipment meets applicable Specifications of these Contract Documents.

B. Payment of 15 percent of manufacturer's quoted price for undelivered, Project-specific manufactured equipment will be made following Shop Drawing approval. Thereafter, monthly payments will be made based on progress of fabrication as determined by Engineer, but in no case will total of payments prior to delivery exceed 75 percent of manufacturer's quoted price.

C. Failure of Contractor to continue compliance with above requirements shall give cause for Owner to withhold payments made for such equipment from future partial payments.

1.12 RETENTION

A. The Owner shall retain a percentage of each progress payment in accordance with Section 9-3 Partial and Final Payment, Supplementary Special Provisions of the Contract Documents. The retained amount is available for the protection and payment of the person(s), mechanics, subcontractors, or materialmen who perform labor upon the Contract or Work thereunder, and the persons who supply such person(s), or subcontractors with components and supplies for carrying on such Work.

B. Pursuant to Section 22300 of the Public Contract Code of the State of California, the Contractor has the option, at its expense, to deposit securities with an Escrow Agent as a substitute for retention earnings required to be withheld by the City. Securities eligible for such substitution are bank or savings and loans certificates of deposit or such securities which are eligible for investment pursuant to Government Code Section 16430. As to any such security or securities so substituted for monies withheld, the Contractor shall be the beneficial owner of same and shall receive any interest thereon. Such security shall, at the request and expense of the Contractor, be deposited with the City or with a State or Federally Chartered bank as the escrow agent who shall pay such monies to the Contractor upon notification by the City that payment can be made. Such notification will be given at the expiration of 35 days from the date of acceptance of the work, or as prescribed by law, provided however, that there will be a continued retention of the necessary securities to cover such amounts as are required by law to be withheld by properly executed and filed notices to stop payment, or as may be authorized by the Contract to be further retained.

1.13 PHASE FUNDING

A. See Attachment B of contract documents.

1.14 BID ITEMS

A. MOBILIZATION – LUMP SUM

1. No measurement shall be made for this item.

2. Payment for this item shall be made as a Lump Sum amount named in the Bid Schedule in accordance with Specification 9-3.4.1.

B. BONDS (PAYMENT & PERFORMANCE) – LUMP SUM

1. No measurement shall be made for this item.

2. Payment for this item shall be made as a Lump Sum amount named in the Bid Schedule in accordance with Specification 2-4.1.

C. FIELD OFFICE – LUMP SUM

1. No measurement shall be made for this item.
2. Payment for this item shall be made as a Lump Sum amount named in the Bid Schedule in accordance with Specification 8-2.5.1.

D. SURFACE IMPROVEMENTS – LUMP SUM

1. No measurement shall be made for this item.

2. Payment for this item shall be made as a Lump Sum amount named in the Bid Schedule and as described as all surface improvements identified in the plans and specifications within the Public Right-of-Ways of Sherman and Custer Streets. All work shall be performed per Whitebook and per City Standards.

E. TRAFFIC CONTROL – LUMP SUM

1. No measurement shall be made for this item.

2. Payment for this item shall be made as a Lump Sum amount named in the Bid Schedule in accordance with Specification 601-6.

F. STONE COLUMNS – LUMP SUM

1. No measurement shall be made for this item.

2. Payment for this item shall be made as a Lump Sum amount named in the Bid Schedule and as described in Specification 31 45 19.

G. DEMOLITION OF SITE AND STRUCTURES – LUMP SUM

1. No measurement shall be made for this item.

2. Payment for construction and demolition waste management shall include all items discussed in Section 7-21 including but not limited to preparation of Waste Management Form, site storage and hauling of construction and demolition waste, disposal of construction and demolition waste, and any items covered in Specification 02 41 00 Demolition.

H. INFLUENT, DIVERSION & OVERFLOW SEWERS – LUMP SUM

1. No measurement shall be made for this item.

2. Payment is made for this item for the construction of all influent, diversion and overflow sewers including but not limited to, trenchless construction, open-cut pipe installation, junction structures, diversion structures, angle structures, brine line, connections, fiber optic conduit, fiber optic cable, gates, coatings, soil improvements, relocation of existing waterlines and all other appurtenant work necessary, temporary paving, resurfacing, lane striping, replacement of damaged traffic loops, replacement of damaged railroad signals all in accordance with the special provisions, plans, and associated technical specifications. Payment under this bid item shall be made as a Lump Sum price named in the Bid Schedule.

I. SHORING, BRACING AND DEWATERING OF NON HAZARDOUS AND HAZARDOUS CONTAMINATED GROUNDWATER – LUMP SUM

1. No measurement shall be made for this item.

2. Payment for this item shall be made as a Lump Sum amount named in the Bid Schedule in accordance with Specifications 7-8.6.6, 306-4, 31 23 19.01 and 31-50-00.

J. ABANDON EXISTING 66-INCH SEWER – LINEAL FOOT

1. Measurement for this item shall be made per lineal foot of pipe abandoned in accordance with Civil Drawing 40421-50-D.

2. Payment for this item shall be made per unit price per lineal foot in accordance with Specification 306-3.3.3.

K. HANDLING AND DISPOSAL OF NON-FRIABLE ASBESTOS MATERIAL – LINEAL FOOT

1. Measurement for this item shall be made per lineal foot of pipe removed and properly disposed.

2. Payment for this item shall be made per unit price per lineal foot of removed and properly disposed pipe in accordance with Specification 306.3.3.4.5

L. MORENA PUMP STATION – LUMP SUM

1. No measurement shall be made for this item.

2. Payment is made for this item for the construction of the Morena Pump Station. This item shall include a complete and operational sewer lift station and all other appurtenant work necessary including control systems, all in accordance with the special provisions, plans, and associated technical specifications. Payment under this bid item shall be made as a Lump Sum price named in the Bid Schedule.

M. PERMITS AND FEES – ALLOWANCE

1. No measurement shall be made for this item.

2. Payment is made for this item from the allowance for Permit and Fees paid by the Contractor to the City and other agencies in order to obtain and pull the permits associated with the Morena Pump Station. Payment for this item shall be made for actual fees paid from the allowance amount named in the Bid Schedule. Incidental costs shall be included in the contract price.

N. PREPARATION OF HAZARDOUS WASTE MANAGEMENTPLAN AND REPORTING – LUMP SUM

1. No measurement shall be made for this item.

2. Payment for this item shall be made as a Lump Sum amount named in the Bid Schedule in accordance with Specification 7-22.20.

O. MONITORING OF CONTAMINATED SOIL – PER HOUR

1. Measurement shall be made for this item in accordance with Specification 7-22.20.

2. Payment for this item shall be made for this item in accordance with Specification 7-22.20.

P. TESTING, SAMPLING, SITE STORAGE, HANDLING OF PETROLEUM CONTAMINATED SOIL – PER TON

1. Measurement shall be made for this item in accordance with Specification 7-22.20.

2. Payment for this item shall be made for this item in accordance with Specification 7-22.20.

Q. LOADING, TRANSPORTATION, AND DISPOSAL OF PETROLEUM CONTAMINATED SOIL – PER TON

1. Measurement shall be made for this item in accordance with Specification 7-22.20.

2. Payment for this item shall be made for this item in accordance to Specification 7-22.20.

R. DEWATERING PERMIT AND DISCHARGE FEES - ALLOWANCE

1. No measurement shall be made for this item.

2. Payment is made for this item from the allowance for Dewatering Permit for Discharge Fees paid by the Contractor to the City for disposal of dewatering discharges to the sanitary sewer system. Payment for this item shall be made for actual fees paid from the allowance amount named in the Bid Schedule. Incidental costs shall be included in the contract price.

S. SWPPP DEVELOPMENT – LUMP SUM

1. Measurement shall be made for this item in accordance with Specification 7-8.6.3.7.

2. Payment for this item shall be made for this item in accordance with Specification 7-8.6.3.7.

T. SWPPP IMPLEMENTATION – LUMP SUM

1. Measurement shall be made for this item in accordance with Specification 7-8.6.3.7.

2. Payment for this item shall be made for this item in accordance with Specification 7-8.6.3.7.

U. SWPPP PERMIT FEE -ALLOWANCE

1. Measurement shall be made for this item in accordance with Specification 7-8.6.3.7.

2. Payment for this item shall be made for this item in accordance with Specification 7-8.6.3.7.

V. SUSPENSION OF WORK - RESOURCES – PER DAY

1. Measurement shall be made for this item in accordance with Specification 6-3.2.2.1.

2. Payment for this item shall be made in accordance with Specification 6-3.2.2.1.

W. SEWER BYPASS AND PUMPING PLAN (DIVERSION PLAN) – LUMP SUM

1. Measurement shall be made for this item in accordance with Specification 7-8.5.4.
2. Payment for this item shall be made in accordance with Specification 7-8.5.4. Work shall be inclusive of Specifications 7-8.5.4 and 01 50 25.

X. FIELD ORDERS – ALLOWANCE

1. No measurement shall be made for this item.

2. Payment is made for this item as an allowance towards field orders and contingencies that may occur during the course of the Work within the scope. Payment for this item shall be made as negotiated from the allowance amount named in the Bid Schedule. Field Order limits shall conform to Attachment E Supplementary Special Provisions 9-3.5.

Y. SECURITY SYSTEMS – ALLOWANCE

1. No measurement shall be made for this Item.

2. Payment is made for this item from the allowance for the installation of the security system to be installed at the Morena Pump Station including security cameras, security panel, door access pads, intrusion switches as shown in the Security Plans and specified in the Security Specification Sections. Security Plans and Specifications will be provided to the awarded contractor upon the execution of the nondisclosure agreement Appendix T, "Nondisclosure Agreement – Security Measures for the Morena Pump Station" and the final price will be negotiated with the Contractor at that time. Payment of this negotiated price will be covered from the allowance set aside in Bid Item.

Z. PORTABLE CHANGEABLE MESSAGE SIGNS (EOC TYPE 1)

1. Measurement shall be made for this item in accordance with Specification 601-6 from the Supplementary Special Provisions.

2. Payment for this item shall be made in accordance with Specification 601-6 from the Supplementary Special Provisions.

AA. DISPUTE RESOLUTION BOARD – ALLOWANCE

1. Measurement shall be made for this item in accordance with Specification 3-5.2.3.

2. Payment for this item shall be made for this item in accordance to Specification 3-5.2.3.

BB. INTEGRATION PERIOD SUPPORT – LUMP SUM

1. No measurement shall be made for this item.

2. Payment for this item shall be made as a Lump Sum amount named in the Bid Schedule in accordance with Specification 01 91 14 TESTING, INTEGRATION AND STARTUP.

CC. POTHOLING FOR SHORING – LUMP SUM

1. No measurement shall be made for this item.

2. Payment for this item shall be made as a Lump Sum amount named in Bid Schedule. Payment will be upon completion and results delivery to Engineer of investigative core samples at the contractors proposed southern shoring limit for the following items:
   a. Launching shaft at station 19+28.58 of Drawing 40421-31-D
   b. Receiving Shaft at station 10+43.10 of Drawing 40421-31-D

3. The core samples shall advance 2 borings to a total depth of 30 feet or refusal with a small truck mounted geo-probe or approved equal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The rate of progress and the time of completion of the work are of the essence for this contract. The work shall be executed with such progress as required to prevent any delay to this contract and to other projects or contractors working at the site. Compliance includes, but is not limited to, meeting contract milestone dates, compliance to scheduling submittals, working within any constraints and completion of all contract work within the allotted time.

B. The work specified in this section includes the preparation, submittal, and acceptance of a Baseline Schedule, construction progress schedules, schedule updates, recovery schedules, Time Impact Analysis (TIA) and revisions to the construction progress schedule. The construction schedule shall conform to the time provisions specified in the special provisions of the contract documents and the requirements of all other specified work sequence constraints set forth in the contract documents.

C. The Contractor shall prepare and submit a Baseline Construction Schedule in accordance with the requirements of this section. By preparing and submitting the Baseline Construction Schedule and monthly schedule updates, the Contractor represents that it can and intends to safely execute the contracted work and all portions thereof including all activities of subcontractors, equipment vendors, and suppliers including submittals and re-submittals within the specified times and constraints. The Contractor also represents that the bid price covers all costs associated with the execution of the Work in accordance with the construction schedule and contract documents.

D. This specification includes the cost loaded schedule requirements, consistent with the PAYMENT PROCEDURES Section 01 29 00, which shall form the basis for the pay application report and all monthly payment requests. These referenced sections shall be correlated and linked when preparing the monthly progress payment. The Schedule of Values shall be generated from the Oracle Primavera P6 current accepted schedule.

E. The City will review the schedule, and any updates or revisions, and any other schedule data for conformance to the Contract. Review and acceptance of the Baseline Construction Schedule and associated documents does not relieve the contractor of responsibility for the feasibility of the schedule, performance of any omitted work and completion of the work and milestones within the contract time.

1.2 DEFINITIONS

A. ACTIVITY: A discrete work element of a project that can be identified for planning, scheduling, and controlling the construction project. Activities included in a construction schedule consume time and resources.

B. PREDECESSOR ACTIVITY: An activity that precedes another activity in thenetwork.

C. SUCCESSOR ACTIVITY: An activity that follows another activity in the network.

D. CODE OF ACCOUNTS: A unique lettering or numbering system in which letters or numbers are assigned to each unique component of the work breakdown structure.

E. HARD LOGIC: Relationships with mandatory dependencies where the nature of the work itself dictates the order in which the activities should be performed. Construction of the walls before starting painting work is an example of mandatory dependency.

F. SOFT LOGIC: Also known as Discretionary Dependencies or Preferential Logic. Preferential logic that controls the critical path using constraints and lags will not be allowed.

G. HARD CONSTRAINTS: Override logical relationships and thereby prevent activities from being scheduled according to the logic. Hard Constraints include Mandatory Start, Mandatory Finish, Start On and Finish On.

H. CRITICAL PATH METHOD (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of the Project.

I. CRITICAL ACTIVITIES: Activities on the critical path. To avoid project delays, work must start and finish on the planned early start and finish dates.

J. CRITICAL PATH: The longest connected chain of interdependent activities through the network schedule that establishes the maximum overall project duration or completion. There can only be one critical path for a project duration or a project milestone.

K. NEAR CRITICAL PATH: The Near Critical Path shall be defined as the “longestpath” plus 15 working days total float.

L. FLOAT:

1. The measure of leeway in starting and completing an activity. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.

2. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date or contract milestone.

M. FRAGNET: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

N. WORK AREA: An area of construction, a separate facility, or a similar significant construction element.

O. CONTRACT MILESTONE: An activity or event that must be completed by a specific date and to which liquidated damages may apply. Contract start and completion dates are considered Contract Milestones.

P. NETWORK DIAGRAM: A graphic diagram of a network schedule, showing activities and activity relationships.

Q. SCHEDULE OF VALUES: A realistic statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment. The Schedule of Values should be produced from P6 and match the Cost Loading in the Schedule.

R. COST-LOADING: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total contract amount, unless otherwise approved by the City.

S. RESOURCE LOADING: The allocation of manpower necessary for the completion of an activity as scheduled.

T. WORK BREAKDOWN STRUCTURE (WBS): The WBS is a hierarchical structure of the Work to be performed under the contract.

U. CALENDAR DAY: All days in a calendar year including weekends and holidays. Contract duration is measured in calendar days against contract milestones.

V. PACING: An intentional slowing of work activities during a delay, or alleged delay, to project completion.

W. INSTALLED MAJOR EQUIPMENT: All major equipment installed as part of the final constructed facility. See PAYMENT PROCEDURES Section 01 29 00 for definition of Major Equipment.

X. CONSTRUCTION EQUIPMENT: All equipment utilized by the contractor to construct the facility but is not a part of the final constructed facility.

Y. BLACKOUT CALENDAR: An activity calendar that applies the non-work option in Primavera P6 Activity Calendars to create non-working days, weeks, and/or months when work is restricted from occurring. The City requires the use of blackout calendars for restricted activities rather than adjusted logic and durations.

13 SCHEDULER QUALIFICATIONS

A. The Contractor shall employ or retain the services of a full-time, onsite Senior Project Scheduler who shall have verifiable experience in construction work sequencing, productivity, and scheduling as well as preparing and maintaining detailed construction schedules using the most current version of Oracle Primavera P6 software. Contractor's scheduler shall have experience on projects similar in size and total construction cost. Within seven (7) calendar days after Notice to Proceed, the Contractor shall submit to the City Representative for review and acceptance, in accordance with the SUBMITTAL PROCEDURES Section 01 33 00 and the WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT Section 01 33 22, the Project Scheduler's resume, including personal references from at least two (2) owner-representatives familiar with the Project Scheduler's work on previous water or wastewater treatment projects. The City reserves the right to reject the proposed scheduler based on the lack of qualifications as defined in this section. The Contractor's scheduler shall attend all schedule related meetings, including progress meetings, job walks when necessary to verify schedule progress, schedule review meetings and special meetings pertaining to scheduling of the Work. This person, along with the Contractor's management team, is expected to work closely with the City Representative to deliver acceptable products outlined in this section and comply with the Reports requirements of this section.

B. If the Senior Construction Scheduler leaves the employment or retainage of the Contractor, the Contractor will be required to notify the City Representative in advance of the intended departure and fulfill the requirements of this subsection within thirty (30) calendar days of the departure of the Contractor's Senior Construction Scheduler. The City reserves the right to disapprove any candidate proposed for the Project. The City reserves the right to remove any member of the Contractor scheduling staff that is, in the City's opinion, not performing scheduling work in accordance with the scheduling requirements.

1.4 SCHEDULING CONFERENCES

A. PRE-CONSTRUCTION SCHEDULING CONFERENCE:

1. Within thirty (30) calendar days after Notice to Proceed, the City Representative shall schedule and conduct a pre-construction scheduling conference to commence development of the required construction schedule. Attendance by the Contractor's Senior Construction Scheduler is mandatory. At the meeting, the requirements of this section will be reviewed with the Contractor; the Contractor shall present their proposed methodology for the Baseline Construction Schedule, sequence of operations, and resource and cost/quantity loading methodology. The Contractor shall submit to the City Representative a written copy of its proposed WBS structure at this meeting. The City shall review the WBS structure within ten (10) calendar days after submission by the Contractor. The Contractor shall make all modifications to the proposed WBS structure that are requested by the City. The WBS shall be correlated with the Contractor's Schedule of Values and the cost loaded schedule. The Senior Scheduler shall develop other activity codes and values needed to comply with the reporting requirements listed herewith, subject to acceptance by the City. The Contractor shall bring to the Pre-Construction Scheduling Conference the Network Logic Diagram used in bid preparation. This will be used as a basis of discussion for the construction plan.

1.5 FLOAT

A. Pursuant to the float sharing requirements of the Contract, use of float suppression techniques such as preferential sequencing, special lead/lag logic restraints, hard constraints, Start on or After and Start on or Before constraints, adding and/or removing working or non-working days from an accepted activity calendar, extended activity durations, or imposed dates, shall be cause for rejection of the Baseline Construction Schedule and any revisions or updates. The use of float time disclosed or implied using alternative float suppression techniques shall be shared as directed by the City.

B. Float time is not for the exclusive use or benefit of either the City or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and the contract completion date. Contractor's use of float shall be pre-approved by the City prior to use.

C. No time extensions will be granted nor delay damages paid unless a City-caused delay occurs which impacts the Project's critical path and the Contractor has complied with all related contract requirements. Other delays will be evaluated by the Contractor for concurrency to issues and be included as part of the Contractor's analysis.

D. Submittal of an early completion schedule shall not provide a basis for the Contractor to claim an excusable delay for any time earlier than the contract completion date. Any early completion schedule shall be approved by a contract change order.

1.6 LOGIC AND LEVEL OF DETAIL

A. The project schedule shall include activities of sufficient detail to accurately represent and clearly convey the Contractor's feasible plan for the timely completion of the full scope of the work. Activities performed on site shall have maximum durations of 20 days and a value of $50,000. The Contractor shall be responsible for developing the logic of the Baseline Schedule and for updating the logic each month to accurately reflect the progress of the work to date and the Contractor's current plan for the timely completion of the work. The schedule logic for each activity shall be constructed by determining which activities must be completed before any subsequent activity can start, which activities can occur simultaneously with the predecessor activity, which activities cannot start until another activity is complete, and the impact of all resource limitations on activity sequencing, activity durations, and activity dates. Every activity, except the project start and finish milestones, shall have a minimum of one predecessor and one successor. All paths through the project schedule shall proceed in the direction representing the progression of time; start to finish logic is disallowed. Activity lags shall not have a negative value. The use of lags shall be kept to a minimum and shall be subject to acceptance by the City. Redundant ties to preceding activities in a sequential series of activities will not be permitted.

B. The activity descriptions shall be specific and discrete such that it cannot be confused with any other activity description. For example, "Form Concrete Wall" is too broad; there must be a description of the unique location of the wall. Similarly, activities that are discrete should not be combined.

C. Finish to start logical relationships shall be predominantly used for schedule activities. The use of logical relationships with negative lags will not be allowed in the baseline schedule, in proposed revised schedules, or in the monthly updates.

D. Milestones. Separately identify each Project milestone, conforming to the scheduling requirements as set forth in the Contract Documents, and assign a "finish no later than" constraint date. For Completion Deadlines, the activity description shall reference the appropriate Contract clause.

E. No unspecified milestone constraints, other constraints, Float suppression techniques, or use of Project activity durations, logic ties, and/or sequences deemed unreasonable by the City, will be used in the Project Schedule.

F. Any schedule showing an early completion date must show the time between the scheduled completion date(s) and the applicable Completion Deadline(s) as Float.

1.7 SCHEDULE SOFTWARE SETTINGS AND RESTRICTIONS

A. Contractor shall use the most current version of Oracle Primavera P6 software to produce the contract schedules and reports as specified herein. In accordance with the SUBMITTAL PROCEDURES Section (01 33 00), the Contractor shall submit all schedules and associated documentation directly into the City-furnished, web-based, document control system in accordance with the WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT Section (01 33 22). The schedule files shall be submitted in Primavera's Proprietary Exchange (XER) format until such time as Primavera recommends transferring to their Extensible Markup Language (XML) format. Reports shall be in Adobe Portable Document Format (PDF).

B. ACTIVITY CONSTRAINTS:

1. Date/time constraint(s), other than those required by the contract, will not be allowed unless accepted by the City. Identify any constraints proposed and provide an explanation of the purpose of the constraint in the Narrative Report. Any finish constraints for City required milestones must use a 'Finish on or Before' type designation and have logic ties. Start on or After and Start on or Before constraints are discouraged. All Start on or After and Start on or Before constraints are subject to approval by the City representative. No hard constraints, which include Start on, Finish on, Mandatory Start, and Mandatory Finish, are allowed. The contractor shall not use any manual date entries that override schedule driven dates based on duration and network logic.

C. LAGS:

1. Lags will not be used when the creation of an activity will perform the same function (e.g., concrete cure time), instead an activity representing the gap between the completion of one activity and the start of another will describe the time gap.

D. DEFAULT PROGRESS DATA DISALLOWED:

1. Actual Start and Actual Finish dates on the CPM schedule shall match the dates provided from Contractor Quality Control Production Reports, Contractor daily reports and other contemporaneous project documentation.

E. SOFTWARE SETTINGS:

1. Schedule calculations and Out-of-Sequence progress (if applicable) shall behandled through Retained Logic, not Progress Override. All activity durations and float values will be shown in days. Activity progress will be shown using Remaining Duration. Default activity type set to "Task Dependent." User preference settings shall be set to hours with the show unit label box checked and zero decimal places. The "Durations Format" shall be set to days with the show durations label box checked, and zero decimal places.

2. The critical path shall be calculated by selecting the Longest Path as opposed to Total Float.

F. Activities unless otherwise approved will be “physical percent complete” type. Duration percent complete will only be used on City-related activities such as submittal reviews.

G. Duration Type shall be set to Fixed Duration and Units.

H. The "Automatically Level resources when scheduling" box shall not be checked. All schedule submittals, and schedule related data of any kind, shall not be resource leveled and shall be the basis for rejection if submitted with resource leveling.

I. The project critical path shall be displayed using both the ‘Critical’ and ‘Longest Path’ filters in P6.

1.8 COST LOADING

A. The activities contained within the schedules shall be cost loaded, and they shall equal the Contract Total Price with Sub-Totals that match the Schedule of Values within the PAYMENT PROCEDURES Section 01 29 00. Contractor is required to cost load the construction schedule using price per unit. Equipment shall include installed and construction equipment specified as price of equipment that is worth over $100,000. For example, the labor unit would be $ per hour; the material unit would be material cost per unit installed. The non-labor resources shall be used exclusively on activities containing equipment. Equipment shall include installed and construction equipment specified as price of equipment. The resource coding and name shall distinguish between installed and construction equipment. An example of price per unit cost loading is shown below:

1. One (1) labor unit = $1of labor

2. Material unit of $1 for 1 unit

3. Equipment unit of $1 for 1 unit

B. Procured items, including installed equipment, should be budgeted as part of separate procurement activities such that the installation activity is not started when the procured material is onsite and installation has not begun. Refer to the PAYMENT PROCEDURES Section 01 29 00 for more details. O&M and Training activities shall be their own cost-loaded schedule activities. Project record documentation (as-builts) shall also be a separate cost-loaded schedule activity.

C. Overhead and profit shall be prorated evenly on all cost loaded activities. Alternatively, overhead may be treated as a Level of Effort activity or activities. The Contractor shall not unbalance the activity cost loading, nor shall the Contractor utilize Resource Leveling as a technique for extending activity durations. The approved Schedule of Values, as generated from the Cost Loading becomes the basis for the Payment Application.

D. Every construction activity that contains labor shall be cost loaded.

E. Fabricate and Deliver activities shall be cost loaded to cover the material or equipment costs. The Fabrication activities shall utilize a material or equipment resource.

F. Commissioning activities shall be cost loaded using a labor resource.

G. The cost loading and progress payments for long lead procurement items will be discussed at the pre-construction scheduling conference.

H. Once the Schedule of Values is accepted with the Baseline Construction Schedule, requests for changes to the Baseline Schedule of Values will not be approved unless approved in writing by the City Representative.

I. The Contractor shall submit with the Baseline Schedule the detailed budget documents reflecting the costs used as the basis of the cost loading contained therein.

J. In Oracle Primavera P6, for actual monthly costs to store correctly, the Contractor must setup the financial period to equal the first and last date of the calendar month, regardless of the actual monthly cutoff date. Financial periods cannot bridge 2 months and must equal the full month. Financial dates table will be provided at the Preliminary Schedule meeting.

K. Work Restrictions in Supplementary Special Provision 6-2.2 indicating activities that cannot be performed during specific periods of time due to operational or other City requirements shall be accommodated in the Baseline and Progress Schedules using blackout calendars. These Blackout Calendars must be developed incorporating the specific durations when work cannot be performed, according to the terms of each work restriction, and applied to the applicable activities. These Blackout Calendars will prevent work from extending into these restricted periods by shifting it until after the completion of the restriction.

1.9 RESOURCE LOADING

A. Schedules shall include resource loading, also known as manpower loading, showing at a minimum, the composite crew, the classification (e.g., foreman, journeyman, etc.) of the individual craftsman comprising the crew, materials or equipment associated with each construction and commissioning activity shown on the schedule, plus any other information required by the City. Manpower shall be expressed as manhours.

B. Manpower resources shall be listed in the Resource Library of the Primavera Software and the Contractor shall assign manpower resource loading by trade for each work activity of the schedule.

C. The Contractor warrants that it will allocate resources and costs based upon Early Date curves and Late Date curves as well as all area between these two curves. The Contractor also warrants that the cost of performing the work, based upon both curves, is included within its bid price.

D. The Contractor shall submit with the Baseline Schedule the detailed budget documents reflecting labor hours used as the basis of the resource loading contained therein. The budget documents used to resource load the Baseline Construction Schedule shall be based upon the escrowed bid documents and reconcile thereto.

E. Work performed by the prime contractor and all subcontractors with a contract value greater than or equal to two (2) percent of the Prime Contract Value shall use the following resources:

1. Labor
2. Materials
3. Installed Major Equipment (refer to Section 1.02 Definitions)
4. Construction Equipment (refer to Section 1.02 Definitions)
5. Manhours

F. The Prime Contractor, and each of the subcontractors with a contract value greater than or equal to two (2) percent of the Prime Contract Value, shall create separate Labor, Material and Nonlabor (Equipment) resources for the Prime Contractor and each subcontractor. The resources shall be titled with the name and/or trade of the Prime Contractor and subcontractors and shall match the responsibility activity code assigned to each activity.

1.10 ACTIVITY CALENDARS

A. All calendars shall be given specific project names and defined clearly in Oracle Primavera P6. For example, "MPS Standard 5-day with Holidays," "MPS 6-day with Holidays," Calendars for different trades if used, should be specified. All calendars and activity coding within the schedule shall be "Global" rather than "Project" level and shall have a unique prefix of the City contract number.

B. The Contractor shall utilize Blackout Calendars and apply the calendars to activities that may be impacted by the work restrictions stated in Section 6-2.2 of the Supplementary Special Provisions.

PART 2 - PRODUCTS

2.1 180-DAY SCHEDULE

A. Within thirty (30) calendar days after Notice to Proceed, the Contractor shall submit to the City the Preliminary Construction Schedule for all work in the first One Hundred Eighty (180) calendar days following NTP, as well as a general approach for the remainder of the Work.

B. Within sixty (60) days after Notice to Proceed, the Contractor shall submit to the Preliminary Construction Schedule cost and resource loaded. The remaining portion of the work may be summary activities assigned to the Contractor's planned baseline WBS structure and shall be cost-loaded to equal the full contract amount.

C. The City Representative, Contractor and its Senior Project Scheduler shall meet within fourteen calendar days (14) of the submittal of the One Hundred Eighty (180) calendar day Construction Schedule to review and make any necessary adjustments or revisions. The Contractor shall submit the revised One Hundred Eighty (180) calendar day Construction Schedule within fourteen (14) calendar days after receiving comments. Such re-submittal shall be reviewed by the City Representative within seven calendar days (7) of receiving such re-submittal. The One Hundred Eighty (180) calendar day Construction Schedule, when revised, will represent the Contractor's planned means, methods, and sequences for performance of the Work required in the One Hundred Eighty (180) calendar days following NTP and is to be incorporated as the first One Hundred Eighty (180) days of the Contractor's Baseline Construction Schedule. The One Hundred Eighty (180) day schedule will include, but not be limited to work tasks that will or may be critical to performance within the Contract Time including, but not limited to, the following:

1. Planning.
2. Mobilization.
3. Key shop drawing and sample submittals.
4. Fabrication and delivery of key and long-lead procurement elements.
5. Contractor and Subcontractor Activities
6. Activities for the City, other contractors, utility providers, tenants, or other third parties.
7. Specific phasing as required by Contract.
8. Summary activities for the remaining duration of the contract.

D. The 180-day schedule shall be cost loaded as described in the Cost Loading Section of this specification.

E. The Contractor shall include a Schedule Narrative with the 180-Day Schedule submittal.

2.2 BASELINE CONSTRUCTION SCHEDULE

A. The Baseline Construction Schedule shall be constructed to show sequence and duration of the activities the Contractor proposes to carry out the Work. The schedule shall be resource (manpower) and cost loaded and should indicate any restrictions on the availability of work areas. The Contractor shall utilize the Baseline Construction Schedule in planning, scheduling, coordinating, and performing the work under the Contract (including all activities of Subcontractors, equipment vendors, and Suppliers). The Baseline Construction Schedule is the basis of the Schedule of Values and 4-week look-ahead schedules. The approved 180-Day Schedule shall be incorporated into the Baseline Schedule without any changes or progress. The Baseline Schedule shall demonstrate the feasibility of the Contractor's Civil and Concrete plans. Among other elements, this plan shall demonstrate the ability to meet concrete pour, cure and strip requirements including restrictions on adjacent pours, the ability of the crane and concrete pumping equipment to reach all areas of the concrete work, and a logical plan for completing and exiting the work. The plan shall demonstrate all work including Mechanical and Electrical work and Commissioning phases.

B. Within one hundred eighty (180) days after Notice to Proceed, the Contractor shall submit the Baseline Construction Schedule to the City, including a written narrative to further explain the plan as set forth in its CPM logic network and schedule. The Contractor shall schedule a workshop prior to submittal of the Baseline Construction Schedule to present the schedule plan. Within 5 workings days from Baseline Schedule submittal, the Contractor shall conduct a Baseline Schedule presentation describing the schedule in detail and the Contractor's means & methods for construction. The City Representative shall accept or reject, in writing, the Contractor's Baseline Schedule within thirty (30) Calendar Days after receipt of all required information. If rejected, the Contractor shall make necessary modification to the Baseline Schedule and resubmit to the City within fourteen (14) Calendar Days. The City Representative shall accept or reject, in writing, the revised Baseline Construction Schedule within 14 calendar days of resubmittal. Once accepted, the Baseline Construction Schedule shall be used for monitoring and evaluating Contract performance, including, but not limited to progress, progress payments, changes, and delays.

C. The Baseline Construction Schedule will be the Performance Measurement Baseline (PMB) for the project. This requires that the PMB will be maintained with any structural schedule changes in the Current schedule. This includes expansion and contraction in WBS and/or activities, detailing out summary cost items, and anything else that makes the PMB non-measurable.

D. There shall be at least one continuous Critical Path in the Baseline Schedule, using the longest path definition that starts at the earliest occurring schedule activity in the network (i.e., NTP1) and ends at the latest occurring schedule activity in the network. No more than 20 percent of the activities may be critical or near critical. The Near Critical path shall be defined as within 15 working days of the critical path. If 20% of the activities become critical, present a plan to reduce the number of near-Critical Path activities to the client.

E. The Baseline Construction Schedule shall demonstrate the final level of detail for each activity and shall contain the required relationships completely identified and the durations of each activity correctly depicted. The Baseline Construction Schedule shall be developed as follows:

1. The Baseline Construction Schedule shall contain no contract changes or delays which may have been incurred during the interim schedule development period. These changes will be entered at the first update after the baseline schedule has been accepted and a change to the contract time or duration was made via an approved change order.

2. The Baseline Construction Schedule submitted for review and acceptance by the City shall contain no status and the data date shall be the contract notice to proceed date.

3. The Baseline Construction Schedule shall clearly indicate the longest critical path of activities from notice to proceed to the contract completion date or contract milestone.

4. The Baseline Construction Schedule will contain all cost information assigned to each of the specific activities at the final level of detail. Every construction activity that contains labor, construction equipment or permanent equipment shall be cost and resource loaded to permit initial generation of a cash flow curve and resource curve.

F. The Baseline Schedule shall include summary activities and milestones for startup as defined in Part 1.5 of Section 01 91 14 TESTING, INTEGRATION AND STARTUP. The detailed Startup Schedule will be submitted and updated separately as described in Section 01 91 14 TESTING, INTEGRATION AND STARTUP, with links to the accepted Baseline Schedule summary activities and milestones for startup. 100 working days prior to the start of Pre-Commissioning, the Contractor shall submit detailed Startup Schedule which will link to the accepted Baseline Schedule summary activities and milestones for startup.

G. The Comments made by the City Representative on the Baseline Construction Schedule, during review, will not relieve the Contractor from compliance with requirements of the Contract Documents. To the extent that there are any conflicts between the accepted schedule and the requirements of the Contract Documents, the Contract Documents shall govern. The Baseline Schedule shall show the sequence and interdependence of activities required for complete performance of the Work, beginning with the date of the Contractor's Notice to Proceed date and concluding with the Contract Completion.

H. The Baseline Construction Schedule shall reflect the Contractor's true plans for progressing and performing the work. The Contractor shall be responsible for the means, methods, and duration and certifies that the schedule duration and contract period is achievable and Contractor's estimate/bid, and/or budgets, are based upon sequences shown in the schedule.

I. The Baseline Schedule shall provide the Contractor and the City with a tool to monitor and follow the progress of all phases of the Work. The Baseline Schedule submitted to the City shall comply with all limits imposed by the Scope of Work, with all contractually specified intermediate milestone and completion dates, and with all constraints, restraints or sequences included in the Contract. The Contractor shall obtain subcontractor written concurrence with its Baseline Construction Schedule for all subcontracts with a contract value of 2 percent or greater of the prime contract value.

J. The Baseline Construction Schedule shall incorporate and include:

1. Appropriate administrative activities and contract specified review periods (including the City and third parties) for all and phases and components of work.

2. Required cost, resource and activity codes.

3. Project milestones dates and overall construction activities and project completion dates.

4. Project budget, schedule of values and the cost basis for progress payments.

5. Commissioning activities.

6. Punch list and final completion activities.

K. Failure to include in the schedule any element of Work required for performance of Contract shall not excuse Contractor from completing all Work required within applicable time constraints, notwithstanding the City's acceptance of Contractor's Baseline Construction Schedule.

L. Nothing in these requirements shall be deemed to negate or diminish Contractor's authority and responsibility to plan and schedule Work as required, subject to requirements of Contract Documents.

M. No construction activity shall be more than 20 working days duration. Exceptions may be approved by the City.

N. SUBMITTAL REVIEW TIME:

1. Include in the schedule the review times indicated in the SUBMITTAL PROCEDURES Section 01 33 00. Coordinate submittal review times in contractor's baseline construction schedule with submittal schedule. The schedule shall include a schedule activity for all submittals required by these specifications. Rejected submissions will require the contractor to add activities that start a second submission and review process.

23 SCHEDULE NAMING REQUIREMENTS

A. To assist the City in consolidating the schedules from all the projects, a standard naming convention has been adopted. The Project name in P6 and the schedule file name should be the same as the following example:

MPS Baseline 01 Dec18 DD123118

Where:

MPS = the code for the project, in this case Morena Pump Station
Baseline = the type of schedule submittal, which can also be Update, Recovery or Time Impact Analysis
01 = the submittal number or version
Dec18 = the month and year of the schedule submittal
DD = the Data Date, in this example Dec 31, 2018

The exported P6 data (XER) file shall use the same name as the Schedule ID

2.4 ACTIVITY CODES

A. The project schedule shall utilize the following activity codes and code values. Unless otherwise specified, a value for each code shall be assigned to each activity. In the event it is unclear which code value assignment should be made for an activity, the City Representative will make the final decision. The Project ID (City Contract Number) shall be the prefix for all Activity Codes. All District-required Activity Codes should be global. Final configuration will be presented at the Pre-Construction scheduling meeting.

Activity Code	Description
(Project ID) Phase	Phase of Work, Examples include Submit, Review & Approve, Fabrication, Deliver, Mobilization, Construction, Commissioning etc.
(Project ID) Work Area	Assign Area code to activities based upon the work area in which the activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew, from working in more than one work area at a time due to restraints on resources of space. Examples of Area code include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings. Activities shall not have more than one Area code. Not all activities are required to be work area coded.
(Project ID) Responsibility	Assign a Responsibility code to all activities indicating who is responsible for performing the activity. Examples include Electrical, Mechanical, Plumbing, Fire Protection, the City, General Contractor Etc. Responsibility code may be named to the company performing the work.
(Project ID) System	Assign System code to the group of activities that comprise a system that will be Commissioned during the commissioning phase. Examples of a System are: Chemical Treatment System, Sprinkler System, HRSG System, SCADA System, Switchgear etc.

Activity Code	Description
(Project ID) CSI	All procurement and submittal activities shall be assigned a 6 digit CSI code identifying Submittals, Purchase Orders, Fabrication and Delivery activities. The City uses CSI's Master Format 50 numbering system.
(Project ID) Cost ID	All cost loaded activities shall be assigned a cost code for the purpose of categorizing costs into accounts.
(Project ID) Change Orders	The Contractor shall use a City-provided change order code structure containing the change order number and a description of the change order.
CITY Project Code	The Contractor shall add the City's Project code to all activities. For MPS, for example, use the Code Value of "MPS" with a Description of "Morena Pump Station (MPS)"
(Project ID) 180-Day Schedule	Assign an activity code to all activities to be reviewed and approved as part of the 180-Day Schedule, which includes all activities within the 180-day window
(Project ID) Major Equipment	Assign an activity code to all activities related to procurement of Major Equipment as defined in the Definitions and Terms found in the PAYMENT PROCEDURES Section (01 29 00)
CITY Access Requests	Assign an AR Code to all access request activities.
(Project ID) Milestones	The Contractor shall add a Milestones code to all milestones in the schedule.
(Project ID) Weather Sensitivity	Code (WS or NWS). Assign Category of Work Code to all Activities based upon Weather Sensitive Installation or Non-Weather Sensitive Installation.

2.5 ACTIVITY ID

A. Every Activity ID in the baseline and updated schedules shall be preceded by a 3 or 4 letter prefix code followed by a dash. All suffix coding to the right of the dash is at the discretion of the Contractor. The prefix code for the Morena Pump Station project is '**MPS-**'.

B. If for any reason an Activity ID is deleted or removed from the schedule, it may not be reused for another activity. Similarly, once the baseline construction schedule is accepted, activity descriptions may not be changed without the permission of the City Representative.

2.6 SCHEDULE SUBMITTALS

A. In accordance with the SUBMITTAL PROCEDURES Section 01 33 00 and the WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT Section 01 33 22, submit all required schedule submittals in the following format:

1. One (1) electronic copy of the Oracle Primavera P6 XER file including all project layouts.

2. One (1) PDF copy of all reports, bar-charts, time-scaled diagrams, histograms, s-curves and narrative.

B. VARIANCE REPORT:

1. With each updated schedule submission, provide a computer-generated Log Report listing all changes made between the previous schedule and current updated schedule. Identify the name of the previous schedule and name of the current schedule being compared showing all changes to the Schedule. This report will as a minimum show changes for: Added & Deleted Activities, Original Durations, Calendars, Descriptions, Constraints (added, deleted or changed), Added/Deleted Resources, Costs, Added/Deleted Relationships, Changed Relationship Lags, a Critical Path Analysis, Float Analysis, Open Ended Activity Analysis. A narrative shall be included in the variance report stating the reason for the changes listed above.

C. CPM REPORTS: Concurrent with the CPM schedule, submit in PDF format the reports listed below. The specific format of the required reports will be discussed at the Preconstruction Scheduling Conference.

1. Critical Path Gantt Chart as further described in Section 2.02.A

2. Critical and Near Critical Path Gantt Chart as further described in Section 2.02.A

3. Activity ID Report: List of all activities sorted by activity number.

4. Activity Schedule Bar-chart: Sorted by phase, area, start and finish.

5. Logic Report: List of preceding and succeeding activities for all activities, sorted by phase, area, start and finish.

6. Total Float Report: List of all activities sorted by phase in descending order of total float, then descending finish.

7. Schedule of Values Report generated from the Oracle Primavera P6 schedule grouped by the Cost ID activity code and filtered by "budgeted total cost is not equal to $0." Sort by Activity ID with the following columns:

    a. Activity ID

    b. Activity Name

    c. Remaining Duration
    d. Start

    e. Finish

    f. Cost Percent Complete

    g. Physical Percent Complete

    h. Previous Physical Percent Complete

    i. Budgeted Total Cost

    j. Actual Total Cost

    k. Actual This Period Total Cost

    l. Previous Applications Total Cost

    m. Remaining Total Cost

    n. At Completion Total Cost

8. PROJECT CASH FLOW S-CURVE: Show the monthly budgeted costs, actual costs and estimate at completion. Include cash curves for early and late start and finish dates.

9. MANPOWER HISTOGRAMS: Showing project overall labor hours per month and trade labor hours per month (carpenters, masons, electricians, laborers, foremen, etc.)

10. MATERIAL AND EQUIPMENT STATUS REPORT: Showing the status of materials and equipment stored on-site and materials and equipment stored in bonded warehouse(s).

2.7 BASELINE NARRATIVE

A. The Contractor shall provide a written narrative accompanying the electronic version of the Contractor's Baseline Schedule submission. This narrative shall explain the Contractor's approach for meeting all milestones and project completion dates. It shall also include a clear description of the critical path activities from beginning to end and describe anticipated crew sizes, production rate and anticipated problems of major activities along the critical path.

B. In the written narrative, the contractor shall include the basis and assumptions used to develop the Contractor's Baseline Schedule. The contractor shall include crew sizes, equipment requirements, and anticipated delivery dates; restraints; critical path activities; activities requiring overtime or additional shifts; activities that contain time contingencies for impacts to be expected from normal rainfall; holidays and other non-work days; potential problem areas; permits; coordination required with the City and third party agencies; and long lead delivery items requiring more than 60 calendar days from order to delivery. The narrative shall also include a description of winterization activities necessary for work to continue through normally inclement weather periods.

2.8 PAYMENTS DURING THE 180 DAY AND BASELINE SCHEDULE PROCESSING

A. The City will only process the Contractor's payment applications for Mobilization, Bonds and Insurance prior to the acceptance of the 180-Day Schedule. The accepted 180-Day Schedule shall be the basis for progress payment request until the duration of the 180-Day Schedule is exceeded, at which time the Contractor shall have an accepted Baseline Schedule in effect. Should the Contractor not have an accepted Baseline Schedule at the end of the 180-Day Schedule duration, the City will be unable to process payments until a Baseline schedule is accepted and statused. This paragraph remains in effect in addition to any payment deductions or withholds determined per paragraph 3.04.

B. The City places a high value on the timely acceptance of the 180-Day and Baseline Schedules, and their usefulness to the City diminishes with late acceptance of these schedules. Accordingly, for every month that acceptance of the 180-Day Schedule is delayed beyond 95 calendar days after NTP, the payment amount for the 180-Day Schedule, as specified in the PAYMENTS PROCEDURES Section 01 29 00, will be reduced by 10% of the specified amount. For every month beyond 180 calendar days after NTP that an accepted Baseline Schedule is delayed, the payment amount for the Baseline Schedule, as specified in the PAYMENTS PROCEDURES Section 01 29 00, will be reduced by 10% of the specified amount.

2.9 SCHEDULE UPDATE PROCESS AND PAYMENTS

A. Contractor to monthly update the approved Baseline Schedule to reflect the current status of the Project. The update shall include all information available and status of the Project as of the cut-off date established in the Preliminary Schedule Meeting. All Monthly Progress Schedules shall incorporate all schedule Revisions and changes previously approved by the City.

B. Each Monthly Progress Schedule shall reflect all as-built activities performed as of the effective data date of the update schedule. The Monthly Progress Schedule shall include the period from the last update to the effective data date and for the remainder of the Project. The current period's activities shall be reported as they actually took place. In the updated schedule, Contractor shall indicate the actual dates that activities were started, completed, or split. Ongoing activities shall have an indication of the percent complete based on the amount of actual work performed, and the estimated remaining duration to complete such activities.

C. Contractor shall certify that the progress shown on the schedule update accurately represents Work completed through the cutoff date of the Submittal.

D. If Work was performed out of sequence, implement changes to the schedule so that it correctly reflects the actual sequence of work. In the case of repairing logic for Work performed out of sequence, the City may consider the use of negative lags. Any such schedule corrections for out of sequence work shall be considered a Revision, and Contractor shall obtain written approval from the City prior to implementing those revisions to the Monthly Progress Schedule or any other type of schedule.

E. The physical percentage completion status (and remaining duration) of activities shall be statused in the schedule Updates and the Monthly Progress Schedule independently from the status of the dollar amount assigned to the activity for cost (price) and progress payment purposes. For example, the status of an activity can be 50% complete (based on time of performance) and may have a remaining duration of 5 days of the original 10-day duration, but the cost assigned to that activity may have a different completion status, and the earned dollars could be more or less than 50% of the at-completion dollars assigned to that activity. Contractor shall set up the scheduling software to calculate the physical completion status of each activity related to time separately from the statusing of the value of dollars earned for progress payment purposes.

F. The earned-to-date dollar amount must reflect the value of the work completed (which may not be directly proportional to the activity remaining duration or physical completion status), and consideration must be given to: 1) materials stored at the site or off site, but not incorporated into the work when payment prerequisites are met by Contractor, 2) reductions for non-compliant work, 3) reductions for failure to provide material testing or required certifications, 4) reductions for other reasons described by the Contract Documents, 5) when the value of the work remaining is naturally disproportionate to the performance time remaining. When the physical percentage complete of an activity is disproportionate to the earned-to-date dollar amount, the reasons for the variance shall be described in a Log field as part of the Monthly Progress Schedule data, and those Log field notations shall be displayed as a column in the APPLICATION FOR PAYMENT DETAIL.

G. In addition to what is required for a schedule Update of work progress, the submission shall include a separate tabular report of all schedule activities that are cost loaded, and shall include the at-completion Total Cost, the proposed earned-this-period Cost amount, and the proposed earned-to-date Cost. The format and group subtotaling of the cost and payment accounting tabular report shall be submitted for review and acceptance by the City prior to the first Monthly Progress Schedule submission, and the City can request and Contractor shall implement revisions to the formatting and data displayed in the tabular report at any time thereafter to better serve the City's cost accounting system. The tabular report shall serve as the line item detail of the earned-to-date dollars assigned to each activity through the schedule's data date, will be referred to as the APPLICATION FOR PAYMENT DETAIL document, and once approved by the City, will be an attachment to the Contractor SUMMARY OF TASKS submitted by Contractor as part of the monthly INVOICE AND INVOICE CERTIFICATE package.

H. Two days prior to the Monthly Progress Schedule data date, submit draft Monthly Progress Schedule for review by the City. Review will be done during a meeting to go over the claimed amounts. During the meeting the City Representative will respond to Contractor's estimated earned-to-date dollar amounts, and any variances between Contractor's proposed earned-to-date dollars and the City's estimate will be discussed and resolved. A marked up copy of the tabular report of the resolution of any variances will be copied for each party. Those changes to the draft Monthly Progress Schedule earned-to-date dollars will be made to the schedule before the Monthly Progress Schedule is formally submitted. If follow-up is required to further a discussion or to present proof in order to resolve the earned-to-date dollar amount for an activity, it shall occur within two working days after the Meeting, and a resolution shall be reached before formal submission of the Monthly Progress Schedule. If there is a disagreement between City's and Contractor's estimated earned-to-date dollar amounts, Contractor shall use the City's earned-to-date figure.

I. If at any time, Contractor or the City discovers an at-completion dollar amount (budget) assigned to an activity that is unreasonable or incorrect, either party can request that an adjustment be made. Such proposed adjustment shall be presented at the next Weekly Progress Meeting and discussed and treated like any other proposed schedule revision. Adjustments to the at-completion dollar amount for any activity will naturally require an equal adjustment to another activity such that the total Contract value does not change. Any proposed Revision to the at-completion dollar amount for any activity must be accepted by the City in writing prior to the change being made to the Monthly Progress Schedule. Contractor will maintain and make available to the City a record of all approved revisions to at-completion dollar amounts that displays each approved revision, and the adjustments to all activities affected by a revision.

J. Contractor's monthly payment applications shall not be accepted and processed for payment by the City Representative without Baseline Schedule progress updates submitted in the time and manner required by this specification which accurately reflect the allowable costs due under the Contract Documents and are accepted by the City. Should the Baseline Schedule progress updates not be accepted due to the Contractor's failure to address all City provided comments, payment withholds and deducts will be applied as specified in paragraph 3.04 of this section.

K. Please see the PAYMENT PROCEDURES Section 01 29 00 for the Schedule of Values approval process and coordination with invoice payment.

L. The Schedule Update Submittal shall include:

1. A detailed Gantt chart showing all activities organized by Work Breakdown Structure. The activity columns shall include Activity ID, Activity Name, Original Duration, Remaining Duration, Duration Percent Complete, Physical Percent Complete, Start, Finish, and Total Float. The critical path shall be clearly shown.

2. A Critical Path Gantt chart showing Longest Path grouped by WBS to level 1 only. The activity columns shall include Activity ID, Activity Name, Remaining Duration, Start, Finish, and Total Float. The critical path and relationship lines (logic) shall be clearly shown and based upon the critical and longest path.

3. A Critical and Near Critical Path Gantt using the "calculate multiple float paths" option in P6 with the "display multiple float paths ending with activity" set to each of the contract milestones. Set the number of float paths to thirty (30). Group the report by "Float Path" and filter for float value 15 days from the float value showing on each contract milestone. The activity columns on the tabular data portion of the schedule shall include Activity ID, Activity Name, Remaining Duration, Start, Finish, and Total Float. The critical path and relationship lines (logic) shall be clearly shown.

4. A Schedule Variance Report shall be submitted comparing the current schedule submittal with the previously accepted schedule. Display the baseline project bars and milestones in the Gantt Chart. Include the following categories:

    a. Activity ID

    b. Activity Name

    c. Original Duration

    d. BL Project Duration

    e. Variance – BL Project Duration

    f. Start

    g. Finish

    h. BL Project Start

    i. BL Project Finish

    j. Variance – BL Project Finish Date

5. Schedule of Values Report generated from the Oracle Primavera P6 schedule grouped by the Cost ID activity code and filtered by "budgeted total cost is not equal to $0." Sort by Activity ID with the following columns:

    a. Activity ID

    b. Activity Name

    c. Remaining Duration

    d. Start

    e. Finish

    f. Cost Percent Complete

    g. Physical Percent Complete

    h. Previous Physical Percent Complete

i. Budgeted Total Cost

j. Actual Total Cost

k. Actual This Period Total Cost

l. Previous Applications Total Cost

m. Remaining Total Cost

n. At Completion Total Cost

6. A Cashflow curve plotting actual invoicing against Baseline forecast cashflow and the update forecast to project completion. The cashflow shall include Show the monthly budgeted costs, actual costs and estimate at completion. Include cash curves for early and late start and finish dates.

7. A manpower histogram plotting actual labor hours against Baseline forecast labor hours over the entire project.

8. Material and Equipment Histograms: Showing the status of materials and equipment stored on-site and materials and equipment stored in bonded warehouse(s).

9. Construction Equipment Histograms: Show project overall equipment count per month by major equipment category count per month (cranes, excavators, etc.).

M. All changes to Schedule Updates must be accepted by the City Representative. If the Contractor desires to make a change to the current accepted Progress Update Schedule, the Contractor shall request permission from the City in writing, stating the reasons for the change as well as the specifics, such as revisions to activities, logic, durations, calendars, etc. Pending changes will be discussed at the Monthly Schedule Review (two days prior to last Friday) where the City may authorize their inclusion in the schedule without any determination of merit or responsibility.

N. Out of sequence logic must be corrected before the Progress Update Schedule is submitted.

O. Pending Changes shall have a City assigned Potential Change (PC) number. The Contractor shall incorporate PC activities into the schedule as Level of Effort (LOE) activities, with a zero-dollar value cost, in the update period in which the Contractor knew, or should have known of the change. The LOE shall be linked to the impacted base contract schedule activities. The change activity shall not be cost loaded until an agreement is reached between the Contractor and City as to cost. Should the PC impact the critical path, the Contractor shall submit a Time Impact Analysis (TIA) per the TIA provisions of these specifications. Upon acceptance of a TIA by the City Representative, the Contractor shall incorporate the detailed TIA schedule activities into the next Schedule Update retaining the original LOE activity. All Potential Change Activities shall be assigned a WBS and coding structure to distinguish said activities from base contract schedule activities. Upon PCs being incorporated into a Contract Change Order (CCO), the Contractor shall assign a WBS and Activity Code for each CCO, with its subset of PC numbers, with the sum cost loading of said PC activities equal to the value of the CCO. The sum of the base contract activities shall total the original contract value. The sum of the change activities shall total CCOs issued to date, plus remaining PCs pending CCO. In the case of deductive change, the base contract activity shall be broken into two activities with the same logic ties consisting of the original activity with the remaining base contract amount and second activity with the amount to be deducted, the sum of the two totaling the originally scheduled value. Add an offsetting deduct (negative cost) as a PC change activity. The deduct amount activity on the base contract section shall have the successor logic removed, with a "deduct" note in parenthesis added to the end of the activity description. The deduct activity shall remain open until the actual deduct activity in the change section is statused as complete upon the CCO being issued. Upon the CCO being issued, both activities shall be statused with the CCO issue date.

P. Failure to include in the schedule any element of Work required for performance of Contract shall not excuse Contractor from completing all Work required within applicable time constraints, notwithstanding the City's acceptance of Contractor's Construction Schedule.

Q. Contractor shall address City review comments and resubmit within 7 Calendar Days from receipt of review comments. Should the Contractor fail to timely incorporate the City schedule review comments prior to the due date for the next month's update, the Contractor shall proceed with the update and the outstanding schedule review comments from the prior month will be included in the current schedule update's review comments. The Contractor is responsible for including the City schedule review comments into all affected schedules.

R. Schedule updates forecasting contract milestones 30 or more days late are subject to rejection.

2.10 NARRATIVE PROGRESS REPORTS

A. A Cost Activity Report shall be prepared and submitted with each progress payment. The cost information shall be updated by activity and summarized for each month. The sum of all monthly costs shall be equal to the contract amount plus approved change orders.

B. The Narrative Report shall be submitted with the monthly progress update and include:

1. The Contractor's transmittal letter.
2. Schedule report indicating each activity on the CPM Schedule that has been:
    a. Completed during this reporting period.
    b. In progress during this reporting period.
3. Scheduled for the next reporting period.
4. Analysis, by critical path. (Note: critical path is longest path as described above.)
    a. A listing of the current critical path.
    b. Progress made on critical path activities in current CPM schedule
    c. Explanations for any lack of Work on critical path activities planned to be performed during the last month.
    d. Impact on other activities, milestones, and completion dates.
5. Current and anticipated delays:
    a. Cause of the delay.
    b. Corrective action and schedule adjustments taken or to be taken to correct the delay.
    c. Impact of the delay on other activities, milestones, and completion dates.
    d. Recommendations for recovery of the delays.
6. Any change in construction sequence, logic changes, relationship changes, or duration changes and the rationale associated with each change for City review and acceptance.
7. Any corrective actions taken by the Contractor to address delays or potential delays
8. Value of materials and equipment properly stored at the site but not yet incorporated in the Work.
9. Identify interface items of work with another contract or with existing facilities or where third-party action or coordination is required.

10. Pending issues and status of other items such as:

    a. Permits.

    b. Contract modifications.

    c. Time extension requests.

    d. Long-lead procurement items.

11. Contract complete date status.

12. Ahead of schedule and number of days.

13. Behind schedule and number of days.

14. Summary of project status including cumulative information to date, variance, and forecast at completion.

15. Other project or scheduling concerns.

2.11 WEEKLY 4-WEEK LOOK-AHEAD SCHEDULE

A. The weekly bar chart "Four Week Look-Ahead Schedule" submittal shall comply with the following requirements:

1. Be produced using the latest version of Oracle Primavera P6 software and generated from the latest Monthly Schedule Update.

2. Updated weekly with a Monday Data Date.

3. The filter for the bar chart will be all activities that have started but not finished, plus all activities with a start or finish within minus 1 week and plus 4 weeks. Total float and the critical path shall clearly be shown.

4. Submit as a printed bar chart on 11-inch by 17-inch paper 24 hours prior to the weekly project meeting.

5. Identify any shutdowns/cutovers that may potentially impact stakeholders.

6. Be prepared to discuss the status of activities on the Four Week Look Ahead Schedule, including any key issues or delays at the weekly project meetings. The Contractor's Superintendent in charge of the work areas in the schedule shall review and sign off on the Four Week Look Ahead Schedule. The Superintendent shall be prepared to review the activities in the Four Week Look Ahead Schedule and discuss any foreseeable issues.

7. The Contractor may provide supplemental detail to elaborate on any schedule activity and must clearly represent this supplement detail as supplemental task information separate from the Oracle Primavera P6 generated schedule. The Contractor shall not in any way change the Activity ID and description in the schedule. For each activity on the Four Week Rolling Schedule, the Contractor shall list the corresponding schedule activity identification number from the current Monthly Progress Schedule Update.

2.12 RECOVERY SCHEDULE

A. When a periodic update indicates the project completion, or any intermediate contract milestone, is 1 to 15 days behind the current accepted schedule, the City reserves the right to request a recovery schedule. If the work falls more than 15 days behind the current accepted schedule, the Contractor is required to submit a Recovery Schedule taking steps necessary to improve progress at no additional cost to the City.

Recovery schedules may be submitted independently or included in the next Monthly Progress Update. Indicate changes to working hours per shift, labor per shift, shifts per working day, working days per week, or amount of construction equipment, or any combination of foregoing, sufficiently to achieve the contractual milestones in accordance with the current Contract requirements. If the Contractor chooses to include the recovery schedule with the next Monthly Progress Update, the City Representative may reject the Monthly Progress Update or require revisions to be made to the recovery schedule before the Monthly Progress Schedule is accepted. Recovery Schedules shall be prepared by the Contractor regardless of the underlying cause for the delay and responsibility for the time.

B. The Recovery Schedule shall have the same data date as the submitted Monthly Progress Schedule, and the data prior to the data date shall be the same in both. Concurrent with the submittal of the Monthly Progress Schedule for review by the City, Contractor shall submit the proposed Recovery Schedule. The Submittal shall also include a written, narrative format document detailing proposed changes to the Project Schedule and including reasons for the changes. This narrative document shall include at a minimum, the following:

1. Detailed description of the changes in the means and methods that Contractor intends to implement to recover from schedule delay; such as additional design staff, additional construction crews, additional equipment, extended working hours, additional shifts per day, or other means;
2. Detailed description of proposed changes in work activity sequences that will permit previously scheduled sequential work to be performed concurrently, or other scheduling changes, which will result in recovery of the schedule delay;
3. Identification of changes to specific activity original durations;
4. Identification of changes to activity relationships and/or schedule logic;
5. Identification of activities that have been added, deleted, or modified; and/or
6. Identification of changes to the Project Schedule's Critical Path.

2.13 TIME IMPACT ANALYSIS (TIA)

A. When the Contractor asserts it has been or will be delayed, and as a result is requesting a time extension, the Contractor shall notify the City Representative of a potential delay and prepare and submit a TIA within fourteen (14) calendar days after the impact is known or should have been known.

B. The TIA shall be submitted separately and based upon the current accepted schedule with a data date closest to and prior to the date when the Contractor knew, or should have known, of the impact. The current accepted schedule can be the Initial 180 Day Schedule, Baseline Schedule, or Monthly Schedule Update.

C. If the Contractor is submitting time related costs of any kind and/or is requesting time due to a schedule delay, the submittal of a TIA is required.

D. The Contractor shall submit to the City a written TIA illustrating the influence of each change or delay on any specified intermediate milestone date and the current projected completion date. Each TIA shall include a CPM schedule network (fragnet) indicating all necessary added activities, logic, duration and demonstrating how the Contractor proposes to incorporate the change or delay into the Schedule and any additional supporting evidence that the City deems necessary.

E. The TIA submittal shall include a PDF fragnet comparing the current accepted schedule against the Contractor's claimed delay, showing the impact on the critical path. The fragnet must show all impacts leading up and including the contract milestones.

F. The TIA shall include a narrative addressing entitlement including a description of the scope of the change as well as addressing compliance with all contract requirements for requesting a time extension. The schedule narrative at a minimum shall address the chronology of events (impact activities), compliance with notice requirements, schedule update used as the basis of analysis (or baseline schedule if applicable), critical path, identification of CPM schedule activities impacted, logic ties between impact activities and CPM schedule activities, fragnet, concurrency, and compensability if applicable.

G. The Contractor shall submit one (1) electronic copy of the Oracle Primavera P6 schedule files in XER format, PDF copies of the fragments, and the narrative. Each TIA should be identified with a discrete ID number and description.

H. Should the Contractor fail to request time and submit a contract compliant TIA per these specifications, the Contractor will have irrevocably waived its contract right to a time extension and time-related costs and will be responsible for all costs associated with mitigating said delay to complete the work within the contract time.

I. Contractor shall not be entitled to any time or compensation for potential delays, or delays, which:

1. Can be avoided by re-sequencing work activities;

2. Applying additional resources;

3. Do not delay the project completion date or a project milestone; or

4. Result from any method used to sequester float.

J. Pacing is defined as an intentional slowing of work activities during a delay, or alleged delay, to project completion. Absent contemporaneous notice of intent to pace, including the contractor's rational to pace and the City's concurrence, pacing of work activities will be construed as a concurrent delay for the purposes of assessing time extensions and delay costs."

K. The Contractor shall incorporate City review comments and resubmit the TIA within 7 calendar days of receiving them.

L. Upon acceptance of the TIA by the City Representative, the Contractor shall incorporate the TIA fragnet into the next monthly progress schedule update.

PART 3 - WEATHER

3.1 ANTICIPATED WEATHER DAYS

A. TIME ALLOWANCE FOR INCLEMENT WEATHER:

1. Time allowance for inclement weather: "Inclement weather" is a lost workday, caused by inclement weather conditions, and is defined as a day in which the Contractor's workforce cannot work 50 percent or more of the day thereby resulting in a delay to the critical path. The number of inclement weather days will be reflected in a schedule activity titled "Inclement Weather". The Contractor shall allow thirteen (13) working days per year within the Baseline Construction Schedule for inclement weather, the unused portion shall be considered as Float to be used by either party. The inclement weather activity's successor shall be the Substantial Completion milestone. The predecessor activities shall be the last project activities that occur before Substantial Completion. The Contractor shall notify the Resident Project Representative in writing when a lost workday has occurred due to inclement weather in accordance with the Baseline Construction Schedule update requirements. Any delays beyond the thirteen (13) working days per year shall not entitle the Contractor to any additional compensation. The sole remedy of the Contractor shall be to seek a non-compensable extension of time.

3.2 WEATHER CALENDAR AND ACCOUNTING OF DAYS

A. The accounting of weather days shall occur once monthly corresponding to the Monthly Schedule Update. The City granted non-working days affecting the critical path attributable to weather shall be accounted for in the Weekly Statement of Contract Time, as prepared by the City, independent of the weather allowance. City granted weather days shall be added to the schedule monthly as a one work day Non-work days in the calendars with an actual date equal to the non-working day as reflected in the Weekly Statement of Contract Time. A monthly reconciliation will occur between the inclement weather allowance and actual weather impact, as reflected in the Weekly Statement of Contract Time. Should the Contractor meet all contract requirements for demonstrating unavoidable delay, the Contractor shall be granted a time extension for weather impact days, beyond the weather allowance days for the same time period, for activities on the critical path.

B. No contract time adjustment shall be made if actual non-working days attributable to weather affecting the critical path DOES NOT exceed the allowance. Unused weather allowance shall become project float.

3.3 COMPLIANCE AND FAILURE TO SUBMIT TIMELY SCHEDULES

A. Because the City places a high value on the importance and use of project scheduling information as a management tool in achieving the completion of Work as planned, the City will deduct ten percent (10%) of the monthly Progress Payment, but not more than three percent (3%) of the contract value, for failure by the Contractor to submit accepted Baseline Schedules or the monthly Progress Update Schedules as required by these specifications. These deductions shall apply should the Contractor fail to address within the specified time frame schedule review comments, TIA review comments, recovery schedule requirements, and address any other requirements of these specifications and/or the City. These deductions are cumulative and will be made for each and every month that the Contractor fails to provide the required information. The Progress Update Schedules and narratives shall be accurate, reflect actual events on the project, and meet all requirements of these specifications. If the Contractor does not correct the deficiency by providing an acceptable schedule within the specified time frame from receiving the City's review comments, the deduction will become permanent via a deductive change order.

PART 4 -- PROJECT RECORD SCHEDULE

4.1 FINAL PROGRESS SCHEDULE

A. The last monthly update of the project schedule shall be the project record (as-built) schedule. The project record schedule shall accurately show the completion of all work required by the contract and shall have a data date equivalent to the day after the actual date of the Contract Completion milestone. All project schedule activities shall be statused at one hundred percent (100%) complete and have actual start and actual finish dates. The project budgeted cost reflected in the project record schedule shall be the contract price, inclusive of all adjustments due to executed change orders. The project record schedule submittal shall meet all monthly update requirements and include an actual cost statement. The City's acceptance of the project record schedule shall be a condition precedent to acceptance of the contract by the City's Board of Directors and to the release of final payment and bonds by the City.

B. This schedule submission shall be accompanied by a certification, signed by an officer of the company and the Contractor's Project Manager and Project Scheduler, stating "To the best of our knowledge, the enclosed final update of the Construction Progress Schedule accurately reflects the actual start and completion dates and logical relationships of all activities contained herein and represents an accurate depiction of the way in which the project was constructed."

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 DEFINITIONS

A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.

B. Deferred Submittal: Information submitted by Contractor for portions of design that are to be submitted to permitting agency for approval prior to installation of that portion of the Work, along with Engineer's review documentation that submittal has been found to be in general conformance with Project's design.

C. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.2 PROCEDURES

A. Direct submittals as described in Section 01 33 22, Web Based Construction Document Management, unless specified otherwise.

1. Via Construction Manager.

B. Electronic Submittals: Submittals shall, unless specifically accepted, be made in electronic format.

1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
3. PDF files shall be set to open "Bookmarks and Page" view. Magnification shall be set to "fit page".
4. Add general information to each PDF file, including title, subject, author, and keywords.
5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
6. Submit new electronic files for each resubmittal.
7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
8. Owner will reject submittal that is not electronically submitted, unless specifically accepted.

9. Provide Construction Manager with authorization to reproduce and distribute each file as many times as necessary for Project documentation. Provide file password if security settings are used.
10. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference and shall be as required by Section 01 33 22, Web Based Construction Document Management.

C. Transmittal of Submittal:

1. Contractor shall:
   a. Review each submittal and check for compliance with Contract Documents.
   b. Stamp each submittal with uniform approval stamp before submitting to Construction Manager.
      1) Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
      2) Construction Manager will not review submittals that do not bear Contractor's approval stamp and will return them without action.
2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form in format approved by Construction Manager.
3. Identify each submittal with the following:
   a. Numbering and Tracking System:
      1) Sequentially number each submittal.
      2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
   b. Specification section and paragraph to which submittal applies.
   c. Project title and Owner's project number.
   d. Date of transmittal.
   e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.
5. All submittals shall be in the English language.

D. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.
2. Package submittal information by individual specification section. Do not combine different specification sections together in submittal package, unless otherwise directed in specification.
3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
4. Index with labeled tab dividers in orderly manner.
5. Submit all text in the English language.

E. Timeliness: Schedule and submit in accordance Schedule of Submittals, and requirements of individual specification sections.

F. Processing Time:

1. Time for review shall commence on Construction Manager's receipt of submittal.
2. Construction Manager will act upon Contractor's submittal and transmit response to Contractor not later than 20 working days after receipt, unless otherwise specified.
3. Allow 30 working days for the review of deferred submittals by the Agency Having Jurisdiction (AHJ) after approval by the Design Engineer.
4. Resubmittals will be subject to same review time.
5. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.

G. Resubmittals: Clearly identify each correction or change made.

H. Incomplete Submittals:

1. Construction Manager will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
2. When any of the following are missing, submittal will be deemed incomplete:
   a. Contractor's review stamp; completed and signed.
   b. Transmittal of Contractor's Submittal; completed and signed.
   c. Insufficient number of copies.

I. Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped "Not Subject to Review."
2. Construction Manager will keep one copy and return submittal to Contractor.

J. Approved Materials List (AML):

1. See Section 4-1.3.6, "Preapproved Material" in The WHITEBOOK and as amended in the SSP for submittal requirements of materials in the City's AML.

K. Working Drawings:

1. Submit Working Drawings listed in TABLE 2-5.3.2 of The WHITEBOOK in accordance with the requirements of The WHITEBOOK and The GREENBOOK.

L. Products and Manufacturers: All products and manufacturers listed may be substituted with an approved equal

1.3 ACTION SUBMITTALS

A. Prepare and submit Action Submittals required by individual specification sections.

B. Shop Drawings:

1. Copies: Five copies of closed submittals as required under Section 01 33 22, Web Based Construction Document Management.
2. Identify and Indicate:
   a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
   b. Equipment and Component Title: Identical to title shown on Drawings.
   c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
   d. Project-specific information drawn accurately to scale.
3. Manufacturer's standard schematic drawings and diagrams as follows:
   a. Modify to delete information that is not applicable to the Work.
   b. Supplement standard information to provide information specifically applicable to the Work.
4. Product Data: Provide as specified in individual specifications.
5. Deferred Submittal: See Drawings for list of deferred submittals.
   a. Contractor-design drawings and product data related to permanent construction.
      1) Written and graphic information.
      2) Drawings.
      3) Cut sheets.
      4) Data sheets.
      5) Action item submittals requested in individual specification section.
   b. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit required supporting data and drawings for review and acceptance by Engineer. Documentation of review and approval provided on Engineer's comment form, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.
6. Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.

C. Samples:

1. Copies: Two, unless otherwise specified in individual specifications.

2. Preparation:
    a. Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
        1) Manufacturer name.
        2) Model number.
        3) Material.
        4) Sample source.
3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
4. Full-size Samples:
    a. Size as indicated in individual specification section.
    b. Prepared from same materials to be used for the Work.
    c. Cured and finished in manner specified.
    d. Physically identical with product proposed for use.

D. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute as noted:

1. Approved:
    a. Contractor may incorporate product(s) or implement Work covered by submittal.
    b. Distribution: Electronic.
        1) One copy of closed submittal furnished to the Construction Manager.
2. Approved as Noted:
    a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
    b. Distribution: Electronic.
3. Partial Approval, Resubmit as Noted:
    a. Make corrections or obtain missing portions, and resubmit.
    b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
    c. Distribution: Electronic.
4. Revise and Resubmit:
    a. Contractor may not incorporate product(s) or implement Work covered by submittal.
    b. Distribution: Electronic.

E. Trade Names or Equals

1. All proprietary materials, equipment and manufacturers identified in the Technicals are intended to establish the type, function, and quality required. Where one (1) or more proprietary name is provided, "or approved equal" shall also be included in that list. Submittals for trade name equals shall follow the procedures identified in Section 4-1.6 of the Whitebook.
2. All "equal" products as stated in the Technicals shall mean "approved equal" products.

1.4 INFORMATIONAL SUBMITTALS

A. General:

1. Copies: Electronic.
2. Refer to individual specification sections for specific submittal requirements.
3. Construction Manager will review each submittal. If submittal meets conditions of the Contract, Construction Manager will forward copy to appropriate parties. If Construction Manager determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Construction Manager will provide review comments to Contractor, and require that submittal be corrected and resubmitted.

B. Equipment Procured Overseas: Within 60 Calendar Days of Notice to Proceed, submit a list of equipment that will require overseas shipping for project delivery. List shall include the value of shipped items.

C. Certificates:

1. General:
   a. Provide notarized statement that includes signature of entity responsible for preparing certification.
   b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual specification section.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual specification sections.
6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
7. Manufacturer's Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers' Field Services.

D. Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.

E. Contractor-design Data (related to temporary construction):

1. Written and graphic information.
2. List of assumptions.
3. List of performance and design criteria.
4. Summary of loads or load diagram, if applicable.
5. Calculations.
6. List of applicable codes and regulations.
7. Name and version of software.

8. Information requested in individual specification section.

F. Deferred Submittals: See Drawings for list of deferred submittals.

1. Contractor-design data related to permanent construction:
   a. List of assumptions.
   b. List of performance and design criteria.
   c. Summary of loads or load diagram, if applicable.
   d. Calculations.
   e. List of applicable codes and regulations.
   f. Name and version of design software.
   g. Factory test results.
   h. Informational submittals requested in individual specification section.
2. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit calculations and test results of Contractor-designed components for review by Engineer. Documentation of review and indication of compliance with general design intent and project criteria provided on Engineer's comment form as meets conditions of the Contract, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.

G. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual specification section.

H. Operation and Maintenance Data: As required in Section 01 78 23, Operation and Maintenance Data.

I. Payment:

1. Application for Payment: In accordance with Section 01 29 00, Payment Procedures.
2. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.
3. **Schedule of Estimated Progress Payments: In accordance with Section 01 29 00, Payment Procedures.**

J. Quality Control Documentation: As required in Section 01 45 16.13, Contractor Quality Control.

K. Schedules:

1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
   a. Show for each, at a minimum, the following:
      1) Specification section number.
      2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
      3) Estimated date of submission to Construction Manager, including reviewing and processing time.

b. On a monthly basis, submit updated Schedule of Submittals to Construction Manager if changes have occurred or resubmittals are required.

2. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.

L. Special Guarantee: Supplier's written guarantee as required in individual specification sections.

M. Statement of Qualification:

1. Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.
   Submittals Required by Laws, Regulations, and Governing Agencies:
   a. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
   b. Transmit to Construction Manager for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

N. Submittals Required by Laws, Regulations, and Governing Agencies:

1. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

O. Test, Evaluation, and Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.
2. Factory:
   a. Identification of product and specification section, type of inspection or test with referenced standard or code.
   b. Date of test, Project title and number, and name and signature of authorized person.
   c. Test results.
   d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
   e. Provide interpretation of test results, when requested by Construction Manager.
   f. Other items as identified in individual specification sections.
3. Field:
   a. As a minimum, include the following:
      1) Project title and number.
      2) Date and time.

3) Record of temperature and weather conditions.
4) Identification of product and specification section.
5) Type and location of test, Sample, or inspection, including referenced standard or code.
6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
8) Provide interpretation of test results, when requested by Construction Manager.
9) Other items as identified in individual specification sections.

P. Testing and Startup Data: In accordance with Section 01 91 14, Testing, Integration, and Startup.

Q. Training Data: In accordance with Section 01 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 22
WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT

PART 1 GENERAL

1.1 SUMMARY

A. The Owner, Construction Manager, Engineer, and Contractor shall utilize PMWeb (PMWeb is a registered trademark of PMWeb, Inc.), for submission of all data and documents (unless specified otherwise herein) throughout the duration of the Contract.

1. PMWeb is a web-based electronic media site.
2. PMWeb is paid for by the Owner.
3. PMWeb will be made available to all Contractor's personnel, subcontractor personnel, suppliers, consultants, Construction Manager, and Engineer.
4. The joint use of this system is to facilitate electronic exchange of information, automation of key processes, and overall management of Construction Phase Documentation.
5. PMWeb shall be the primary official means of project information submission and management.

B. User Access Limitations: The Construction Manager will initially manage the Contractor's access to PMWeb by allowing access and assigning user profiles to accepted Contractor personnel. User profiles will define levels of access into the system; determine assigned function based authorizations and user privileges. Subcontractors and suppliers will be given access to PMWeb by and through the Contractor. Entry of information exchanged and transferred between the Contractor and its subcontractors and suppliers on PMWeb shall be the responsibility of the Contractor.

C. Joint Ownership of Data: Data entered in a collaborative mode (entered with the intent to share as determined by permissions and workflows within the PMWeb system) by the Owner, Construction Manager, Engineer, and Contractor will be jointly owned.

D. Automated System Notification and Audit Log Tracking: Review comments made (or lack thereof) by the Owner on Contractor submitted documentation shall not relieve the Contractor from compliance with requirements of the Contract Documents. The Contractor is responsible for managing, tracking, and documenting the Work to comply with the requirements of the Contract Documents. Owner's acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation of the Contractor's submitted information.

E. Submittals:

1. See Section 01 33 00, Submittal Procedures.
2. Preconstruction Submittals List of Contractor's key PMWeb personnel. Include descriptions of key personnel's roles and responsibilities for this Project. Contractor should also identify their organizations administrator on the list.

F. Computer Requirements:

1. The Contractor shall use computer hardware and software that meets the requirements of the PMWeb system as required to access and utilize PMWeb. As recommendations are modified by PMWeb, the Contractor will upgrade their system(s) to meet or exceed the recommendations. Upgrading of the Contractor's computer systems will not be justification for a cost or time modification to the Contract.
2. The Contractor shall ensure that connectivity to the PMWeb system is accomplished through DSL, cable, T-1 or wireless communications systems. The minimum bandwidth requirements for using the system is 128kb/s. It is recommended a faster connection be used when uploading pictures and files into the system.
3. PMWeb currently supports Mozilla's Firefox, Google Chrome, and Apple's Safari web browsers for accessing the application.

G. Contractor Responsibility:

1. The Contractor shall be responsible for the validity of their information placed in PMWeb and for the abilities of their personnel.
2. Accepted users shall be knowledgeable in the use of computers, including Internet Browsers, email programs, CAD drawing applications, and Adobe Portable Document Format (PDF) document distribution program.
3. The Contractor shall utilize the existing forms in PMWeb to the maximum extent possible. If a form does not exist in PMWeb the Contractor must include a form of their own or provided by the Construction Manager as an attachment to a submittal.
4. Adobe PDF documents will be created through electronic conversion rather than optically scanned whenever possible. The Contractor is responsible for the training of their personnel in the use of PMWeb (outside what is provided by the Owner) and the other programs indicated above as needed.

H. Connectivity Problems: Provide a list of Contractor's key PMWeb personnel for the Construction Manager's acceptance. Contractor is responsible for adding and removing users from the system. The Construction Manager reserves the right to perform a security check on all potential users. The Contractor will be allowed to add additional personnel and subcontractors to PMWeb after clearance by security check.

I. Training:

1. The Owner has arranged and paid for training to be provided to the Contractor.
2. Training consists of web-based seminars in conjunction with a conference call.
3. Contractor shall arrange and pay for the facilities and hardware/software required to facilitate their own training.

PART 2 PRODUCTS

2.1 DESCRIPTION

A. PMWeb project management application (no "or-equal").

PART 3 EXECUTION

3.1 PMWEB UTILIZATION

A. PMWeb shall be utilized in connection with all document and information management required by these Contract Documents.

3.2 SUBMITTALS

A. Shop Drawings:

1. Shop Drawing and design data documents shall be submitted PDF attachments to the PMWeb submittal work flow process and form. Examples of Shop Drawings include, but are not limited to:
   a. Standard manufacturer installation drawings.
   b. Drawings prepared to illustrate portions of the work designed or developed by the Contractor.
   c. Steel fabrication, piece, and erection drawings.

B. See Section 01 33 00, Submittal Procedures.

3.3 PRODUCT DATA

A. Product catalog data and manufacturer's instructions shall be submitted as PDF attachments to the PMWeb submittal work flow process and form. Examples of product data include, but are not limited to:

1. Manufacturer's printed literature.
2. Preprinted product specification data and installation instructions.

3.4 ADMINISTRATIVE OR INFORMATIONAL SUBMITTALS

A. All correspondence and preconstruction submittals shall be submitted using PMWeb. Examples of administrative submittals include, but are not limited to:

1. Permits.
2. Requests for substitutions (RFS).
3. List of contact personnel.
4. Requests for Information (RFI).

B. Network Analysis Schedules and associated reports and updates. Each schedule submittal specified in these Contract Documents shall be submitted as a native backed-up file (.PRX or .STX) of the scheduling program being used. The schedule shall also be posted as a PDF file in the format specified in these Contract Documents.

C. Plans for safety, demolition, environmental protection, and similar activities.

D. Quality Control Plan(s), Testing Plan and Log, Quality Control Reports, Production Reports, Quality Control Specialist Reports, Preparatory Phase Checklist, Initial Phase Checklist, Field Test reports, Summary reports, Rework Items List, etc.

E. Meeting minutes for quality control meetings, progress meetings, pre-installation meetings, etc.

F. Any general correspondence submitted.

G. Project Photos: Project photos shall be posted monthly to PMWeb.

3.5 COMPLIANCE SUBMITTALS

A. Test reports, certificates, and manufacture field report submittals shall be submitted on PMWeb as PDF attachments. Examples of compliance submittals include, but are not limited to:

1. Field test reports.
2. Quality Control certifications.
3. Manufacturer's documentation and certifications for quality of products and materials provided.

3.6 RECORD AND CLOSEOUT SUBMITTALS

A. Operation and maintenance data and closeout submittals shall be submitted on PMWeb as PDF documents during the approval and review stage as specified, with actual set of documents submitted for final. Examples of record submittals include, but are not limited to:

1. Operation and Maintenance Manuals: Final documents shall be submitted as specified.

2. Extra materials, spare stock, etc., submittal forms shall indicate when actual materials are submitted.

3.7 FINANCIAL SUBMITTALS

A. Schedule of Value, Pay Estimates, and Change Request Proposals shall be submitted on PMWeb. Supporting material for Pay Estimates and Change Requests shall be submitted on PMWeb as PDF attachments. Examples of compliance submittals include, but are not limited to:

1. Contractor's Schedule of Values.
2. Contractor's Monthly Progress Payment Requests.
3. Contract Change proposals requested by the Owner.

3.8 SUBMITTAL PAPER COPIES

A. Contractor shall deliver bound and tabbed paper copies of every closed submittal to the Construction Manager within 1 week of the Construction Manager closing a submittal with any disposition as follows:

1. Each copy shall have the closed PMWeb cover page including the disposition and any comments.
2. Final copies of submittals returned with comments, but not requiring resubmittal shall incorporate revisions per the Engineer's comments.
3. Number of Paper Copies:
   a. Final O&M Manuals: Three copies as specified in the Section 01 78 23, Operation and Maintenance Data.
   b. All Other Submittals: Five copies as specified in Section 01 33 00, Submittal Procedures.
   c. For submittals with attachments over 30 megabytes in size, provide one CD of the submittal for each required paper copy.

END OF SECTION

SECTION 01 43 33
MANUFACTURERS' FIELD SERVICES

PART 1 GENERAL

1.1 DEFINITIONS

A. Person-Day: One person for 8 hours within regular Contractor working hours.

1.2 SUBMITTALS

A. Informational Submittals:

1. Training Schedule: Submit, in accordance with requirements of this Specification, not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.
2. Lesson Plan: Submit, in accordance with requirements of this Specification, proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.
3. Training Session Recordings: Furnish Owner with two complete sets of recordings fully indexed and cataloged with printed label stating session and date recorded.

1.3 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual specification section.

B. Representative subject to acceptance by Owner, Construction Manager, and Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

A. Furnish manufacturers' services, when required by an individual specification section, to meet the requirements of this section.

B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, time required to perform specified services shall be considered incidental.

C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.

D. Determine, before scheduling services, that conditions necessary to allow successful testing have been met.

E. Only those days of service approved by Construction Manager will be credited to fulfill specified minimum services.

F. When specified in individual specification sections, manufacturer's onsite services shall include:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
3. Providing, on a daily basis, copies of manufacturers' representatives field notes and data to Engineer and Construction Manager.
4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Construction Manager.
5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer's products and systems.
6. Assistance during functional and performance testing, and facility startup and evaluation.
7. Training of Owner's personnel in the operation and maintenance of respective product as required.

3.2 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

A. A Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by equipment manufacturer's representative.

B. Such form shall certify signing party is a duly authorized representative of manufacturer, is empowered by manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to ensure equipment is complete and operational.

3.3 TRAINING

A. General:

1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.

2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Section 01 78 23, Operation and Maintenance Data.
3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

B. Training Schedule:

1. List specified equipment and systems that require training services and show:
   a. Respective manufacturer.
   b. Estimated dates for installation completion.
   c. Estimated training dates.
2. Allow for multiple sessions when several shifts are involved.
3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
4. Coordinate with Section 01 32 00, Construction Progress Documentation, and Section 01 91 14, Testing, Integration, and Facility Startup.

C. Lesson Plan:

1. When manufacturer or vendor training of Owner personnel is specified, prepare a lesson plan for each required course containing the following minimum information:
   a. Title and objectives.
   b. Recommended attendees (such as, managers, engineers, operators, maintenance).
   c. Course description, outline of course content, and estimated class duration.
   d. Format (such as, lecture, self-study, demonstration, hands-on).
   e. Instruction materials and equipment requirements.
   f. Resumes of instructors providing training.

D. Pre-Startup Training:

1. Coordinate training sessions with Owner's operating personnel and manufacturers' representatives and with submission of operation and maintenance manuals in accordance with Section 01 78 23, Operation and Maintenance Data.
2. Complete at least 14 days prior to beginning of facility startup.

E. Post-startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

F. Recording of Training Sessions:

1. Furnish video recording of pre-startup and post-startup instruction sessions, including manufacturers' representatives' hands-on equipment instruction and classroom sessions.
2. Video training materials shall be produced by a qualified, professional video production company.
3. Use DVD format suitable for playback on standard equipment available commercially in the United States. Blu-ray® DVD format is not acceptable without Construction Manager's prior approval.
4. DVD may contain multiple training sessions. If multiple training sessions included on a DVD, provide with on-screen menu for playback selection.

3.4 SUPPLEMENT

A. The supplement listed below, following "End of Section," is part of this Specification.

1. Manufacturer's Certificate of Proper Installation.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER_____ EQPT SERIAL NO: _____

EQPT TAG NO:_____ EQPT/SYSTEM:_____

PROJECT NO:_____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

☐ Installed in accordance with Manufacturer's recommendations.

☐ Inspected, checked, and adjusted.

☐ Serviced with proper initial lubricants.

☐ Electrical and mechanical connections meet quality and safety standards.

☐ All applicable safety equipment has been properly installed.

☐ Functional tests.

☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments: _____

_____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate their equipment and (iii) authorized to make recommendations required to ensure equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date:_____, 20___

Manufacturer:_____

By Manufacturer's Authorized Representative: _____

(Authorized Signature)

SECTION 01 45 16.13
CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
   b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.2 DEFINITIONS

A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

1.3 SUBMITTALS

A. Informational Submittals:

1. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
2. CQC Report: Submit, weekly, an original and one copy in report form.

1.4 OWNER'S QUALITY ASSURANCE

A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.

B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:

1. Relieve Contractor of responsibility for providing adequate quality control measures.
2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance.
3. Constitute or imply acceptance.
4. Affect the continuing rights of Owner after acceptance of the completed Work.

C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.

D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Construction Manager.

E. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.

B. Maintain complete inspection records and make them available at all times to Owner and Construction Manager.

C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.2 COORDINATION MEETING

A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Construction Manager and Owner to discuss the quality control system.

B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor's management and control with the Owner's Quality Assurance.

C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

3.3 QUALITY CONTROL ORGANIZATION

A. CQC System Manager:

1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
2. CQC System Manager may not perform other duties on the Project.
3. CQC System Manager shall have construction experience on similar type Work.
4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
5. CQC System Manager shall be onsite during construction; periods of absence may not exceed 2 weeks at any one time.
6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.

B. CQC Staff:

1. Designate a CQC staff, available at the Site at all times during progress, with complete authority to take any action necessary to ensure compliance with the Contract. CQC staff members shall be subject to acceptance by Construction Manager.
2. CQC staff shall take direction from CQC System Manager in matters pertaining to QC.
3. CQC staff must be of sufficient size to ensure adequate QC coverage of Work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities.
4. The actual strength of the CQC staff may vary during any specific Work period to cover the needs of the Project. Add additional staff when necessary for a proper CQC organization.

C. Organizational Changes: Obtain Construction Manager's acceptance before replacing any member of the CQC staff. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

3.4 QUALITY CONTROL PHASING

A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:

1. Preparatory Phase:
   a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.

b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.

c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.

d. Perform prior to beginning Work on each definable feature of Work:

1) Review applicable Contract Specifications.
2) Review applicable Contract Drawings.
3) Verify that all materials and/or equipment have been tested, submitted, and approved.
4) Verify that provisions have been made to provide required control inspection and testing.
5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
7) Review the appropriate activity hazard analysis to verify safety requirements are met.
8) Review procedures for constructing the Work, including repetitive deficiencies.
9) Document construction tolerances and workmanship standards for that phase of the Work.
10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Construction Manager.

2. Initial Phase:

a. Accomplish at the beginning of a definable feature of Work:

1) Notify Owner at least 48 hours in advance of beginning the initial phase.

2) Perform prior to beginning Work on each definable feature of Work:

a) Review minutes of the preparatory meeting.
b) Check preliminary Work to verify compliance with Contract requirements.
c) Verify required control inspection and testing.
d) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Comparison with sample panels is appropriate.
e) Resolve all differences.

f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

3) Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3. Follow-up Phase:
   a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.
   b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.
   c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.
4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.5 CONTRACTOR QUALITY CONTROL PLAN

A. General:
1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
2. An interim plan for the first 30 days of operation will be considered.
3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.

B. Content:

1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:

a. Organization: Description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three-phase control system (see Paragraph QC Phasing) for all aspects of the Work specified.
b. CQC Staff: The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
c. Letters of Authority: A copy of a letter to the CQC System Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop Work which is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to Owner.
d. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.
e. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.
f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
g. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.

C. Acceptance of Plans: Acceptance of the Contractor's basic and addendum CQC plans is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Owner reserves the right to require Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.

D. Notification of Changes: After acceptance of the CQC plan, Contractor shall notify Construction Manager, in writing, a minimum of 7 calendar days prior to any proposed change. Proposed changes are subject to acceptance by Construction Manager.

3.6 CONTRACTOR QUALITY CONTROL REPORT

A. As a minimum, prepare a CQC report for every 7 calendar days. Account for all days throughout the life of the Contract. Reports shall be signed and dated by CQC System Manager. Include copies of test reports and copies of reports prepared by QC staff.

B. Maintain current records of quality control operations, activities, and tests performed, including the Work of subcontractors and suppliers.

C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items, including but not limited to the following:

1. Status of Noncompliances issued by the Construction Manager.
2. Contractor/subcontractor and their areas of responsibility.
3. Operating plant/equipment with hours worked, idle, or down for repair.
4. Work performed today, giving location, description, and by whom. When a network schedule is used, identify each phase of Work performed each day by activity number.
5. Test and/or control activities performed with results and references to specifications/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
6. Material received with statement as to its acceptability and storage.
7. Identify submittals reviewed, with Contract reference, by whom, and action taken.
8. Offsite surveillance activities, including actions taken.
9. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
10. List instructions given/received and conflicts in Drawings and/or Specifications.
11. Contractor's verification statement.
12. Indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered.
13. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in file work and workmanship comply with the Contract.

3.7 SUBMITTAL QUALITY CONTROL

A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures. The CQC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements. Owner will furnish copies of test report forms upon request by Contractor. Contractor may use other forms as approved.

3.8 TESTING QUALITY CONTROL

A. Testing Procedure:

1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Perform the following activities and record the following data:
   a. Verify testing procedures comply with contract requirements.
   b. Verify facilities and testing equipment are available and comply with testing standards.
   c. Check test instrument calibration data against certified standards.
   d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
   e. Documentation:
      1) Record results of all tests taken, both passing and failing, on the CQC report for the date taken.
      2) Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.
      3) Actual test reports may be submitted later, if approved by Construction Manager, with a reference to the test number and date taken.
      4) Provide directly to Construction Manager an information copy of tests performed by an offsite or commercial test facility. Test results shall be signed by an engineer registered in the state where the tests are performed.

      5) Failure to submit timely test reports, as stated, may result in nonpayment for related Work performed and disapproval of the test facility for this Contract.

B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

3.9 COMPLETION INSPECTION

A. CQC System Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.

B. Punchlist:

1. CQC System Manager shall develop a punch list of items which do not conform to the Contract requirements.
2. Include punch list in the CQC report, indicating the estimated date by which the deficiencies will be corrected.
3. CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

END OF SECTION

SECTION 01 45 33
SPECIAL INSPECTION, OBSERVATION, AND TESTING

PART 1 GENERAL

1.1 SUMMARY

A. This section covers requirements for Special Inspection, Observation, and Testing required in accordance with Chapter 17 of the 2016 CBC and is in addition to and supplements requirements included in the Special Inspection Program shown on Drawings.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
2. International Code Council (ICC):
   a. California Building Code (CBC).
   b. Evaluation Service (ICC-ES) Reports and Legacy Reports.

1.3 DEFINITIONS

A. Agencies and Personnel:

1. Agency Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.
2. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.
3. Registered Design Professional in Responsible Charge: An individual who is registered or licensed to practice their respective design profession as defined by statutory requirements of professional registration laws of state or jurisdiction in which Project is to be constructed.
4. Special Inspector: Qualified person employed by Owner who will demonstrate competence to the satisfaction of AHJ for inspection of a particular type of construction or operation requiring Special Inspection.

B. Special Inspection Program: Detailed written procedure contained on Drawings establishing systems and components subject to Special Inspection, Observation, and Testing during construction, type and frequency of testing, extent and duration of Special Inspection, and reports to be completed and distributed by Special Inspector.

C. Special Inspection:

1. Special Inspection: Inspection required of materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved Contract Documents and referenced standards.
2. Special Inspection, Continuous: Full-time observation of work requiring Special Inspection by an approved Special Inspector who is present in area where the Work is being performed.
3. Special Inspection, Periodic: Part-time or intermittent observation of the Work requiring Special Inspection by an approved Special Inspector who is present in area where the Work has been or is being performed, and at completion of the Work.

D. Structural Systems and Components:

1. Diaphragm: Component of structural lateral load resisting system consisting of roof, floor, or other membrane or bracing system acting to transfer lateral forces to vertical resisting elements of structure.
2. Drag Strut or Collector: Component of structural lateral load resisting system consisting of diaphragm or shear wall element that collects and transfers diaphragm shear forces to vertical force-resisting elements or distributes forces within diaphragm or shear wall.
3. Seismic-Force-Resisting System: That part of structural lateral load resisting system that has been considered in the design to provide required resistance to seismic forces identified on Drawings.
4. Shear Wall: Component of structural lateral load resisting system consisting of a wall designed to resist lateral forces parallel to plane of the wall. Unless noted otherwise on Drawings, load-bearing walls with direct in-plane connections to roof and floors shall be considered to be shear walls.
5. Wind Force Resisting System: That part of the structural system that has been considered in the design to provide required resistance to wind forces identified on Drawings.

E. Nonstructural Components:

1. Architectural Component Supports: Structural members or assemblies of members which transmit loads and forces from architectural systems or components to structure, including braces, frames, struts, and attachments.

2. Electrical Component Supports: Structural members or assemblies which transmit loads and forces from electrical equipment to structure, including braces, frames, legs, pedestals, and tethers, as well as elements forged or cast as part of component for anchorage.
3. Mechanical and Plumbing Component Supports: Structural members or assemblies which transmit loads and forces from mechanical or plumbing equipment to structure, including braces, frames, skirts, legs, saddles, pedestals, snubbers, and tethers, as well as elements forged or cast as part of component for anchorage.

F. Professional Observation:

1. Does not include or waive responsibility for required Special Inspection or inspections by building official.
2. Requirements are indicated in Special Inspection Program provided on Drawings.
3. Geotechnical Observation: Visual observation of selected subgrade bearing surfaces and installation of deep foundation elements by a registered design professional for general conformance to Contract Documents.
4. Structural Observation: Visual observation of structural system(s) by a registered design professional for general conformance to Contract Documents.

1.4 SUBMITTALS

A. Informational Submittals:

1. Contractor's Statement of Responsibility: Form shall be completed by entity responsible for construction of main wind-force-resisting systems, main seismic-force-resisting systems, wind-resisting components, and seismic-resisting components listed in Special Inspection Program on Drawings.
2. Fabricator's Certificate of Compliance: Form shall be completed by entity responsible for shop fabrication of structural load-bearing members and assemblies. Refer to Article Supplements located at end of section.

1.5 SPECIAL INSPECTION PROGRAM REQUIREMENTS

A. Designated Systems for Inspection:

1. Seismic-force-resisting systems designated under CBC Section 1705 and subject to Special Inspection: None required.
2. Wind-force-resisting systems designated under CBC Section 1705: None required.
3. Architectural, Plumbing, Mechanical, and Electrical Components subject to Special Inspection under CBC Section 1705.12.5 and 1705.12.6 for Seismic Resistance: As listed in Special Inspection Program on Drawings.

B. Special Inspection Program:

1. As included in Drawings and in support of building permit application, Project-specific requirements were prepared by Registered Design Professional in Responsible Charge. The following identifies elements of inspection, observation, and testing program to be followed in construction of the Work:
    a. Designated seismic systems and wind-force-resisting systems and components that are subject to Special Inspection and Structural Observation for lateral load resistance.
    b. Special Inspection and testing required by CBC Section 1705 and other applicable sections and referenced standards therein.
    c. Type and frequency of Special Inspection required.
    d. Type and frequency of testing required.
    e. Required frequency and distribution of testing and Special Inspection reports to be distributed by Special Inspector to Engineer, Contractor, building official, and Owner.
    f. Geotechnical Observation to be Performed: Required frequency and distribution of Geotechnical Observation reports by registered design professional to Contractor, building official, and Owner**.**
    g. Structural Observations to be Performed: Required frequency and distribution of Structural Observation reports by registered design professional to Contractor, building official, and Owner.

C. Special Inspection and associated testing of shop fabrication and field construction will be performed by an approved accredited independent agency or by Authority Having Jurisdiction's (AHJ) approved, qualified inspection staff. Owner or Owner's Registered Design Professional in Responsible Charge will secure and pay for services of agency to perform Special Inspection and associated testing.

D. Code required Special Inspection with associated testing and Professional Observation, as provided in Special Inspection Program on Drawings and further provided in this section, is for benefit of Owner and does not:
    1. Relieve Contractor of responsibility for providing adequate quality control measures.
    2. Relieve Contractor of responsibility for damage to or loss of material before acceptance.
    3. Constitute or imply acceptance.
    4. Affect continuing rights of Owner after acceptance of completed Work.

E. The presence or absence of code required Special Inspector and Professional Observer does not relieve Contractor from Contract requirements.

F. Contractor is responsible for additional costs associated with Special Inspection and Testing and Observation when Work is not ready at time identified by Contractor and Special Inspectors and Professional Observer are onsite, but not able to provide contracted services.

G. Contractor is responsible for associated costs for additional Special Inspection and Testing and Professional Observation by Special Inspectors and Professional Observers required because of rejection of materials of in place Work that cannot be made compliant to Contract Document without additional inspections and observation and testing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. Requirements of the Special Inspection Program are provided by the Owner. All other testing and inspections, unless noted otherwise, are provided by Contractor.

B. Provide access to shop or Site for Special Inspection and Testing and Professional Observation requirements.

C. Notify Engineer in advance of required Special Inspection and Professional Observation no later than 48 hours prior to date of Special Inspection and Professional Observation.

D. Provide access for Special Inspector to construction documents.

E. Retain special inspection records on-site to be readily available for review.

F. Cooperate with Special Inspector and provide safe access to the Work to be inspected.

G. Submit Fabricator's Certificates of Compliance for approved fabricators.

H. Provide reasonable auxiliary services as requested by the Special Inspector. Auxiliary services required include, but not limited to:

1. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests to assist the Special Inspector in performing test/inspections.
2. Providing storage space for the Special Inspector’s exclusive use, such as for storing and curing concrete test samples and delivery of samples to testing laboratories.
3. Providing the Special Inspector with access to all approved submittals.
4. Providing security and protection of samples and test equipment at the Project Site.
5. Provide samples of materials to be tested in required quantities.

I. When required by Registered Design Professional in Responsible Charge, provide access for plumbing, mechanical and electrical component inspections for those items requiring certification.

J. Materials and systems shall be inspected during placement where Continuous Special Inspection is required.

K. Where Periodic Special Inspection is indicated in the Special Inspection Program:

1. Schedule inspections for a combination of during and at completion of their placement.
2. Schedule periodically inspected Work (inspected during and after its placement) so that corrections can be completed and re-inspected before Work is inaccessible.
3. Sampling a portion of the Work is not allowed. Schedules shall provide for inspection of all Work requiring periodic inspection.

3.2 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this specification:

1. Contractor's Statement of Responsibility.
2. Fabricator's Certificate of Compliance.

END OF SECTION

CONTRACTOR'S STATEMENT OF RESPONSIBILITY

_____
(Project)

_____
(Name of Contracting Company)

_____
(Business Address)

(_____)_____ (_____)_____
(Telephone) (Fax)

I, (We) hereby certify that I am (we are) aware of the Special Inspection and Testing, Professional Observation, and component certification requirements contained in Contract Documents for this Project for seismic force-resisting systems, and for components including architectural, mechanical, and electrical components, as listed in Special Inspection Program on Drawings**,** and that:

1. Control of this Work will be exercised to obtain conformance with Contract Documents approved by building official.

2. Procedures within the Contractor's organization to be used for exercising control of the Work, method and frequency of reporting, and distribution of reports required under Special Inspection Program for Project are attached to this statement.

3. I, (We) will provide 48-hour notification to Engineer and approved inspection agency as required for structural tests and Special Inspection for Project.

4. The following person is hereby identified as exercising control over requirements of this section for the Work designated above:

Name: _____

Qualifications: _____

_____

_____

(Print name and official title of person signing this form)

Signed by: _____

Date: _____

Project Name: _____

FABRICATOR'S CERTIFICATE OF COMPLIANCE

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2.5 of 2016 CBC must submit Fabricator's Certificate of Compliance at the completion of fabrication.

_____

(Project)

_____

(Fabricator's Name)

_____

(Business Address)

_____

(Certification or Approval Agency)

_____

(Certification Number)

_____

(Date of Last Audit or Approval)

Description of structural members and assemblies that have been fabricated:

_____

_____

_____

_____

_____

I hereby certify that items described above were fabricated in strict accordance with approved construction documents.

_____

(Name and Title) type or print

_____

(Signature and Date)

Attach copies of fabricator's certification or building code evaluation service report and fabricator's quality control manual.

SECTION 01 50 25
SEWER BYPASS PUMPING

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to provide temporary sewage bypass pumping throughout the construction phase of the project and until all project improvements are constructed and accepted by the City.

1 Contractor shall construct and maintain all temporary bypass sewers and be responsible for all bypass pumping of sewage that is necessary to prevent backing up of sewage and allow appropriate conditions for proper inspection, rehabilitation, testing or drainage during force main rehabilitation, replacement of pumps, or reconnections to existing sewers. The Contractor shall immediately remove and dispose of all offensive matter spilled during the bypass pumping at his own expense. The Contractor shall also be responsible for paying any fines imposed from spills or overflows that occur as a result of the bypass pumping operations.

2 Contractor shall provide a complete redundant bypass pumping system, including intake and discharge conduit, and other equipment necessary to provide continuous wastewater flow and prevent the backing up of sewage in the case of emergencies at all times.

3. Noise levels shall be in accordance with the City's noise ordinance. The Contractor shall be responsible for providing all noise control measures and equipment to meet the City ordinance requirements at no additional cost to the City.

4. Contractor shall provide all necessary equipment to provide odor control facilities during bypass pumping and to ensure that no odor complaints are received by the City from surrounding businesses and residents. The Contractor shall be responsible for obtaining and securing any required permits needed for odor control systems and standby generators with the San Diego APCD at no additional cost to the City.

1.2 SUBMITTALS

A. The design, installation, and operation of the temporary pumping system shall be the sole responsibility of the Contractor. The Contractor shall employ the services of a subcontractor who can demonstrate, to the Engineer extensive experience in design, installation, and operation of temporary bypass pumping systems.

B. The Contractor shall prepare a specific, detailed description of the proposed pumping system (Bypass Pumping Plan). The Bypass Pumping Plan shall be submitted for review and approval by the Engineer prior to the mobilization of any of the equipment included in the Bypass Pumping Plan. The Bypass Pumping Plan shall outline all

provisions and precautions to be taken by the Contractor regarding handling of existing wastewater flows. The Bypass Pumping Plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials, and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of the access and bypass pumping locations for damage due to the discharge flows, and compliance with the requirements and permit conditions specified herein. No Construction shall begin until all provisions and requirements have been reviewed and accepted by the Engineer. The plan shall include but not limited to the following details:

1. Staging areas for pumps.

2. Sewer plugging method and types of plugs.

3. Size and location of manholes or access points for suction and discharge hose or piping.

4. Size of pipeline or conveyance system to be bypassed.

5. Number, size, material, location and method of installation of suction piping.

6. Number, size, material, location and method of installation of discharge piping.

7. Bypass pump sizes, capacities, and number of each size to be provided on- site including all primary, secondary, and spare pumping units.

8. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump, operating range shall be submitted).

9. Downstream discharge plan.

10. Method of protecting discharge manholes or structures from erosion and damage.

11. Thrust and restraint block sizes and locations. Provide the details necessary to demonstrate the integrity of all suction and discharge piping including piping and fittings associated with all primary and secondary pumping units.

12. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill.

13. Method of noise control for each pump and any additional equipment that is included in the Bypass Pumping Plan to maintain specified noise levels.

14. Any temporary pipe supports and anchoring requirements.

16. Calculations for selection of bypass pumping pipe size.

17. Schedule for installation of and maintenance of bypass pumping lines.

18. Plan indicating location of bypass pumping pipe locations.

18. A detailed Emergency Response Plan (ERP)for adverse weather and flooding for various phases of the Work. The ERP shall be prepared in collaboration with the City's O&M staff to ensure that the plan is acceptable to the City. The Contractor is responsible for conducting any workshops with City staff to complete the emergency response plan.

20. The Contractor shall provide continuous 24-hour monitoring of all equipment required for the bypass pumping operation, including motors, hoses, pipes, valves, generators, etc. The contractor shall provide continuous 24-hours a day qualified personnel in operation and maintenance of bypass pumping systems on site throughout the duration of any bypass work. The Contractor shall submit list of monitoring personnel and their qualifications for review and approval by the City. The Contractor shall maintain in good working condition all valves, gauges, meters associated with bypass system and shall replace any defective monitoring devices within 24 hours.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 BYPASS PUMPING

A. The Contractor shall supply pumps, conduits, power, and other equipment to divert the flow of sewage from existing gravity influent sewer to the existing force mains. The bypass system shall be of capacity to handle the wastewater flows in the table located at the end of this section. It is the intent of these Specifications to require the Contractor to establish adequate bypass pumping as required regardless of the flow condition.

B. All bypass pumping piping for force main materials, shall be HDPE and conform to the following requirements:

1. All polyethylene (HDPE) pipes shall meet the requirements of ASTM F714. DR rating of the pipe shall be sufficient to withstand the pressure and leakage test outlined below.

2. HDPE Pipe shall be furnished in standard laying lengths not exceeding 50 feet.

3. Joining system: The HDPE pipe shall be joined with butt, heat fusion joints. All joints shall be made in strict compliance with the manufacturer's recommendations and ASTM 2657. Where required, flange connections, mechanical joint connections and butt connections using bolted mechanical couplers shall be provided from a pipe stub with a polyethylene and steel stiffener. Flanged connections shall be provided from a pipe stub and a steel back-up flange. Quick connect couplings will not be permitted on HDPE bypass piping.

4. HDPE fittings shall be fully pressure rated to match the pipe DR pressure rating. All fittings shall be molded or fabricated by the same manufacturer as the pipe. HDPE fittings shall be joined using butt, heat fusion and/or electro- fusion. Adhesives and solvent cements shall not be permitted.

C. The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to the actual operation. The pressure and leakage test shall be conducted at one-and-a-half times the maximum pressure the system will experience based on the approved Bypass Pumping Plan for a period of two hours. No leakage is permitted during this test. The Engineer will be given 72 hours' notice prior to testing. In addition, the Contractor shall demonstrate that the pumping system is in good working order and is sufficiently sized to successfully handle the range of minimum to peak dry weather flows identified in the flow data in this specification by performing a test run for a period of 72 hours prior to beginning the Work.

D. Each bypass pumping operation shall include the components and systems to accomplish the bypass in accordance with these Specifications.

E. The Contractor shall provide on-site manual oversight of all bypass pumping operations 24 hours per day, 7 days per week when the bypass pumping system is in operation.

F. The Contractor shall be required to repair, at his own expense, any damage to public or private property caused by his operations.

G. Should damage of any kind occur to the existing sewers, the Contractor shall, at his own expense make repairs to the satisfaction of the Engineer.

H. The Contractor shall immediately notify the governing authority should a sanitary sewer overflow (SSO) occur and take the necessary action to clean up and disinfect the spillage to the satisfaction of the Authority and/or other governmental agency. If sewage is spilled onto public or private property, the Contractor shall wash down, clean up, and disinfect the spillage to the satisfaction of the property owner, Authority, and/or other governmental agency.

I. The Contractor shall not be permitted to overflow, bypass, pump or by any other means convey drainage to any land, street, storm drain or water course.

J. The Contractor shall cease bypass pumping operations and return flows to the new and/or existing sewer when directed by the Owner. During bypassing, no wastewater shall

be leaked, dumped, or spilled in or onto any area outside the existing wastewater system. When bypass operations are complete, all bypass piping shall be flushed with fresh water and drained into the wastewater system prior to disassembly.

K. Contractor must take care to prevent damage to existing structures. Discharge piping to gravity sewer systems shall be designed in such a manner as to prevent discharge from contacting manhole walls or benching and full discharge shall go into downstream pipe with as minimal turbulence as possible. Contractor is responsible for any damage to manholes. It may be necessary to remove the manhole cone to provide sufficient space for the bypass piping. If this is required, the Contractor shall be responsible for any damage to existing manhole components.

L. The Contractor shall establish adequate bypass pumping adherent to the conditions above and anticipate severe weather conditions and increases in peak flows during rain events. Available flow and capacity data for Contractor's use in sizing equipment is as follows. Bypass pumps shall be sized with an additional 1.5 safety factor applied to the peak dry weather flows (PDWF) listed below, or a complete redundant bypass pumping system shall be provided as indicated in Section 1.1.

Table 1 presents the wastewater flows for the existing trunk sewers that were provided by the City on June 16, 2017 based on recordings of existing flows from June to September of 2014. The Contractor shall request from the City updated flow data prior to start of construction of the project and prior to conducting any bypass pumping.

Table 1 – Existing Influent Sewer Wastewater Flows

	(NMVI) 78-inch	(MBI) 72-inch	(MBTS) 33-inch (1)	(EMBTS) 60-inch	TOTAL
	Q, (mgd)	Q, (mgd)	Q, (mgd)	Q, (mgd)	Q, (mgd)
Per 2014 Flow Meter Data					
Min DWF	11.4	14.4	0.5	3.9	32.7
ADWF	27.3	22.7	1.7	9.1	60.9
PDWF	36.7	31.6	2.6	12	78.9

(1) The existing 33-inch MBTS connects to the 72-inch MBI upstream of proposed Diversion Structures 1 and 2.

LEGEND:

NMVI – North Mission Valley Interceptor
MBI – Morena Blvd Interceptor
MBTS – Morena Blvd Trunk Sewer EMBTS
– East Mission Bay Trunk Sewer

Drawing C-05 provides an overview of the arrangement of the existing influent sewers along with their associated record drawings. It also shows the existing 66-inch Abandoned

Sewer that extends from the rail road tracks on the west side of the proposed Morena Pump Station to the east where it connects to the City's 108-inch North Metro Interceptor (NMI).

The abandoned 66-inch sewer has existing diversion structures that enables diversion of sewer flows from the MBI and MBTS (See Record Drawings 30507 -D). The estimated maximum flow that can be diverted through the 66-inch is 50 mgd. If the Contractor intends to utilize the existing 66-inch sewer for any sewer diversion, then this needs to be coordinated with the City. If the Contractor plans on utilize the 66-inch for sewer diversion, then the Contractor needs to investigate the condition of the existing diversion and the 66- inch sewer. This will require visual inspection of structures, slide gates, and CCTV of the existing 66-inch sewer. The Contractor would be required to provide a report to the City documenting the inspection work. The report should identify in detail any repairs intended to be made by the Contractor to any of the existing facilities and the costs associated with these repairs. The cost for sewer bypass pumping should be included in the Contractor base bid and there should not be any additional costs to the City outside of the required repairs identified by the Contractor.

The Contractor should note that sections of the existing 66-inch sewer will need to be removed and abandoned to construct the new facilities including the pump station and the 30-inch brine line. The Contractor should take all of these factors into consideration as part of his/her construction sequencing plan for the project.

For the construction of Diversion Structure No. 3 along the North Mission Valley Interceptor (NMVI), the Contractor may want to bypass flow from the 78-inch NMVI to the existing 66-inch existing sewer, which diverts flow to the 72-inch Morena Blvd Trunk Sewer. As-built drawings for the existing 78-inch NMVI is in drawings 27256-D that can be obtained. These drawings show the location of existing sewer manholes along the 78- inch NMVI that may be used for bypass pumping.

Similar to the potential bypass bumping from the west to the east described above, the Contractor shall take into consideration that sections of the existing 66-inch sewer will have to be removed to construct new facilities. The Contractor should take all of these factors into consideration as part of his/her construction sequencing plan for the project.

M. The 24-hour monitoring staff shall be properly trained, experienced, and mechanically qualified such that they can quickly and effectively address any potential emergency and non-emergency situations associated with the pumps and bypass pumping system that must remain in operation for an extended period.

3.2 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this specification:

- Diversion Scenarios

END OF SECTION

Potential Construction Sequencing Plan

Pump Station Dewatering Activities

JS Shaft	**MT JS to DS2**	**MT JS to DS3 66" & 48"**	**MT JS to MPS**	**MT 30" Brine from Custer to Friars**	**JS1 & Angle Structures**

DS1	**DS2**	**DS3**	**Angle Structure Adjacent to DS3**

Diversion Scenario 1	**Diversion Scenario 2**	**Diversion Scenario 3**	**Diversion Scenario 4**	**Diversion Scenario 5**

Traffic Control Scenario 1	**Traffic Control Scenario 2**	**Traffic Control Scenario 3**	**Friars Road Open**

Abbreviations

DS – Diversion Structure

JS – Junction Structure

MT – Microtunnel

MPS – Morena Pump Station

NMVI – North Mission Valley Interceptor

Diversion Scenario (Background/Existing)

Abbreviations:
Ex.- Existing
EMBTS- East Mission Bay Trunk Sewer
IE- Invert Elevation
MBTS- Morena Boulevard Trunk Sewer
MBI- Morena Boulevard Interceptor
MGD: Million Gallons per Day
MH- Manhole
MPS- Morena Pump Station
NMI- North Metro Interceptor
NMVI- North Mission Valley Interceptor
PDWF- Peak Dry Weather Flow
PWWF- Peak Wet Weather Flow

Additional Notes:
1. All flowrates shown in MGD
2. 66" pipe not currently in use
3. Capacity of the 66" pipe is 40 MGD
4. The available capacity of the 108" NMI is constrained at Pump Station 2 (existing, downstream). MBI connects with NMI upstream of Pump Station 2, downstream from this schematic. The additional capacities shown below consider flowrates at existing conditions. NMI has the capacity to divert 64 MGD of flow from MBI & MBTS. Consequently, dewatering into one of these pipes will decrease the additional available capacity of the other pipe.

Disclaimers:
1. Schematic is drawn disproportionately for clarity.
2. _____

PDWF: 19.6
PWWF: 32.0

MH

60"

60" EMBTS

Additional Capacity Available:
21.4 PDWF
9.0 PWWF

MBTS

PDWF: 2.9
PWWF: 6.2

72" MBI

PDWF: 42.0
PWWF: 78.2

IE: -4.33'

Ex. Diversion Structure

72"

72" MBI & MBTS

Additional Capacity Available:
53.3 PDWF
9.0 PWWF

66"

MPS Site

66"

Friars Rd

Ex. Diversion Structure

66"

Abandoned

IE: -1.48'

Ex. Brick and Mortar Plug

IE: -4.6'

Ex. NMI Junction Structure

78" NMVI

PDWF: 40.0
PWWF: 73.5

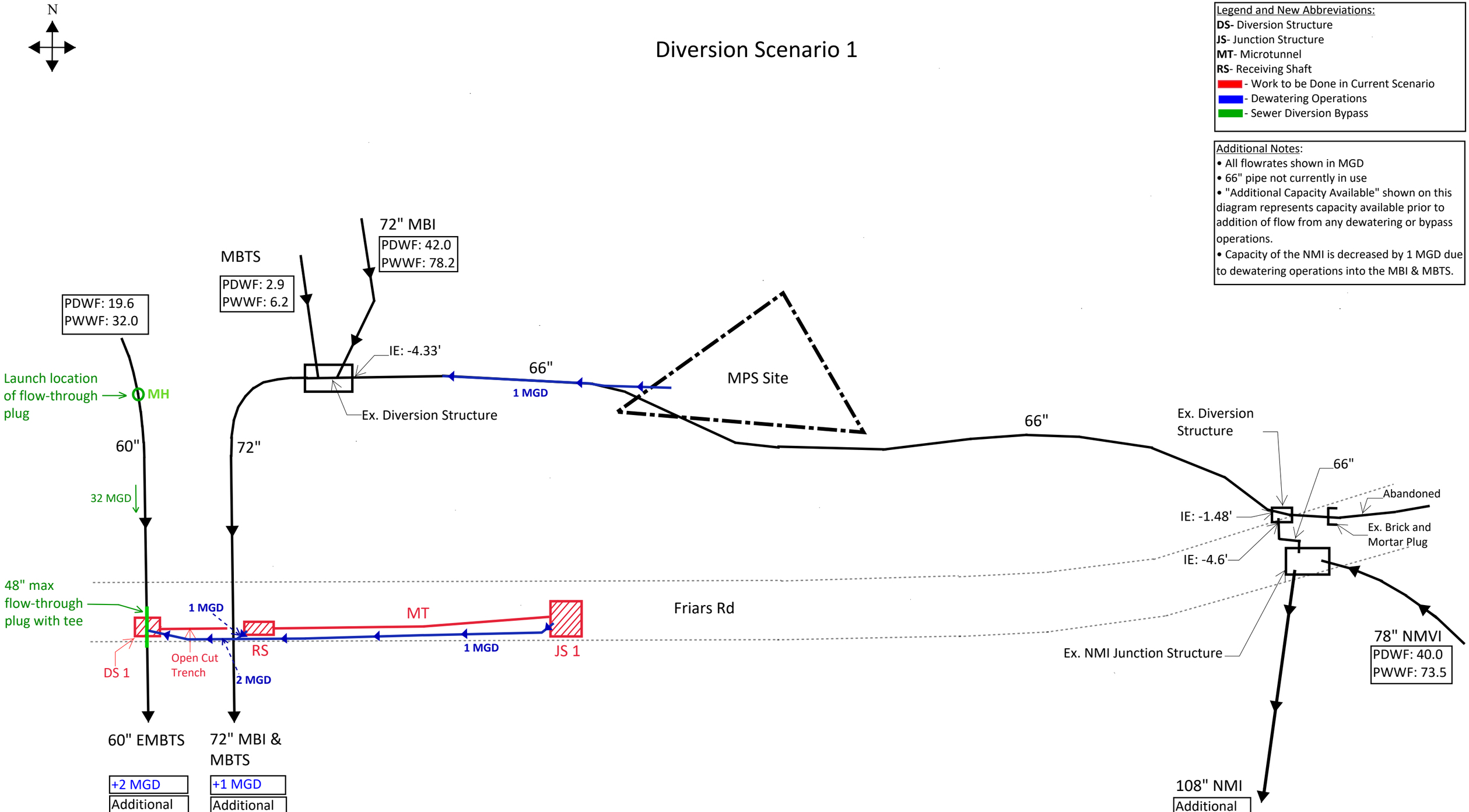
108" NMI

Additional Capacity Available:
40.0 PDWF*
20.0 PWWF*
*See Note 4 above

Diversion Scenario 1

Legend and New Abbreviations:
DS- Diversion Structure
JS- Junction Structure
MT- Microtunnel
RS- Receiving Shaft
- Work to be Done in Current Scenario
- Dewatering Operations
- Sewer Diversion Bypass

Additional Notes:
- All flowrates shown in MGD
- 66" pipe not currently in use
- "Additional Capacity Available" shown on this diagram represents capacity available prior to addition of flow from any dewatering or bypass operations.
- Capacity of the NMI is decreased by 1 MGD due to dewatering operations into the MBI & MBTS.



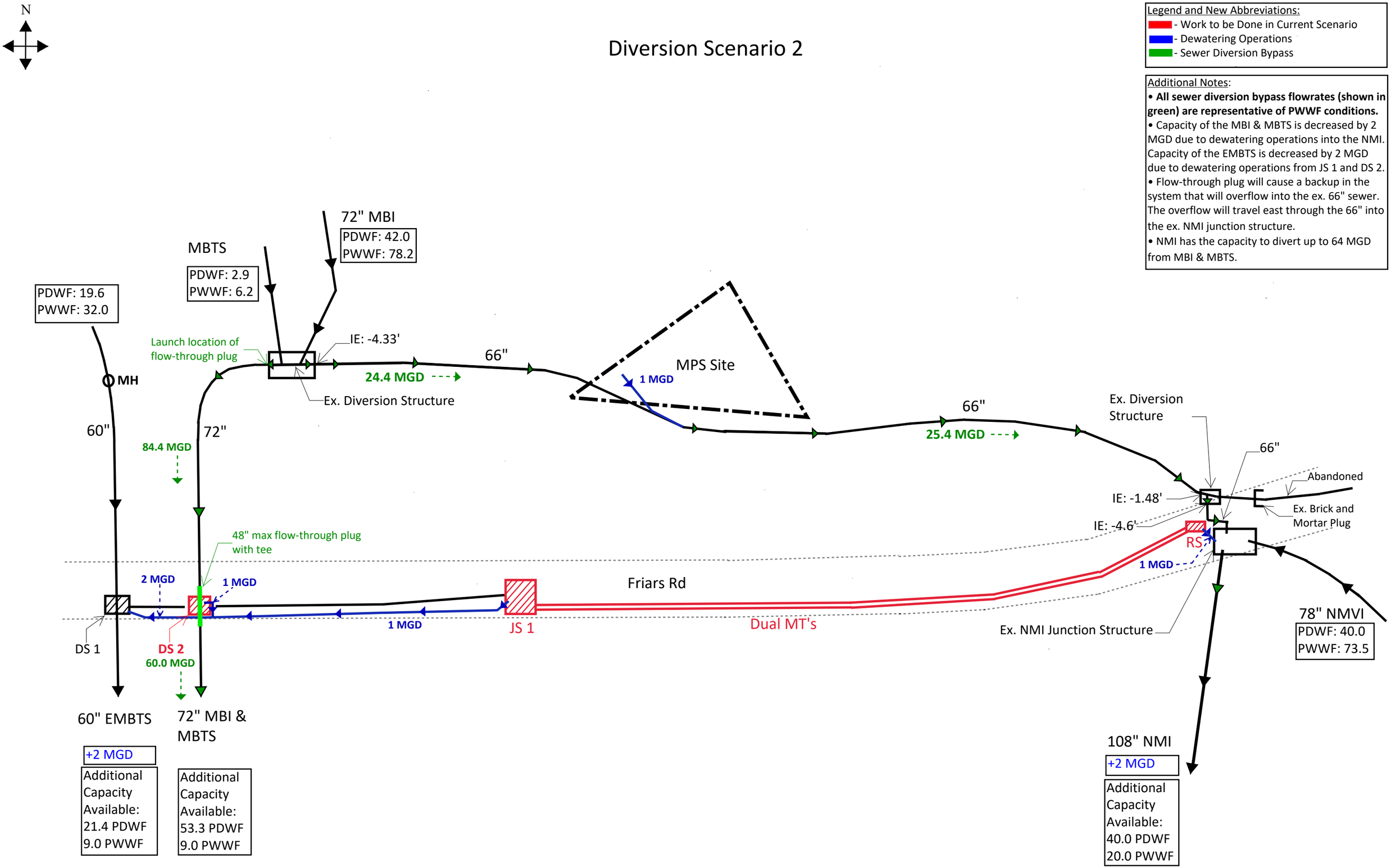
+2 MGD	+1 MGD
Additional Capacity Available: 21.4 PDWF 9.0 PWWF	Additional Capacity Available: 53.3 PDWF 9.0 PWWF

108" NMI
Additional Capacity Available: 40.0 PDWF 20.0 PWWF

Diversion Scenario 2

Legend and New Abbreviations:
- Work to be Done in Current Scenario
- Dewatering Operations
- Sewer Diversion Bypass

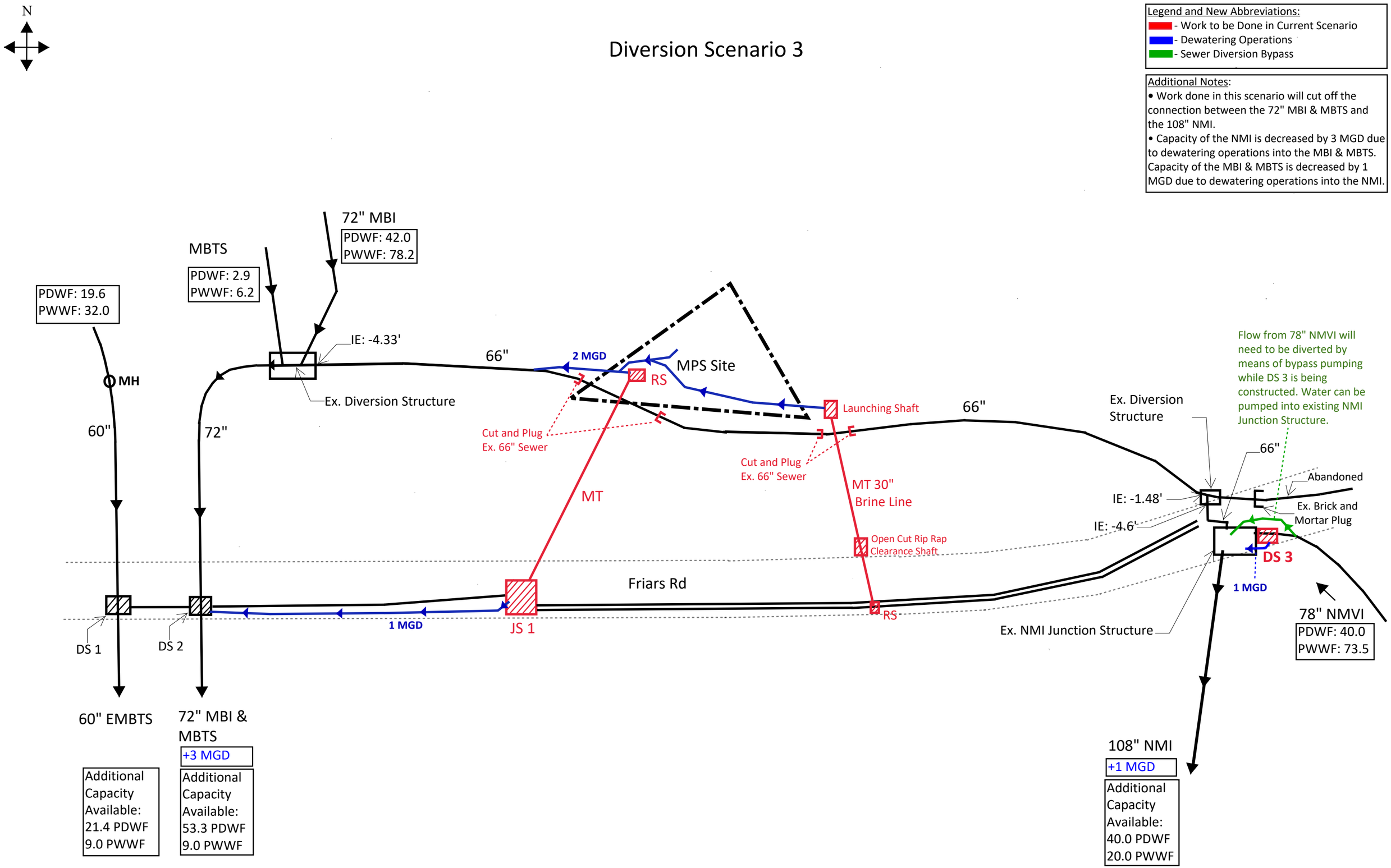
Additional Notes:
- **All sewer diversion bypass flowrates (shown in green) are representative of PWWF conditions.**
- Capacity of the MBI & MBTS is decreased by 2 MGD due to dewatering operations into the NMI. Capacity of the EMBTS is decreased by 2 MGD due to dewatering operations from JS 1 and DS 2.
- Flow-through plug will cause a backup in the system that will overflow into the ex. 66" sewer. The overflow will travel east through the 66" into the ex. NMI junction structure.
- NMI has the capacity to divert up to 64 MGD from MBI & MBTS.



Diversion Scenario 3

Legend and New Abbreviations:
- Work to be Done in Current Scenario
- Dewatering Operations
- Sewer Diversion Bypass

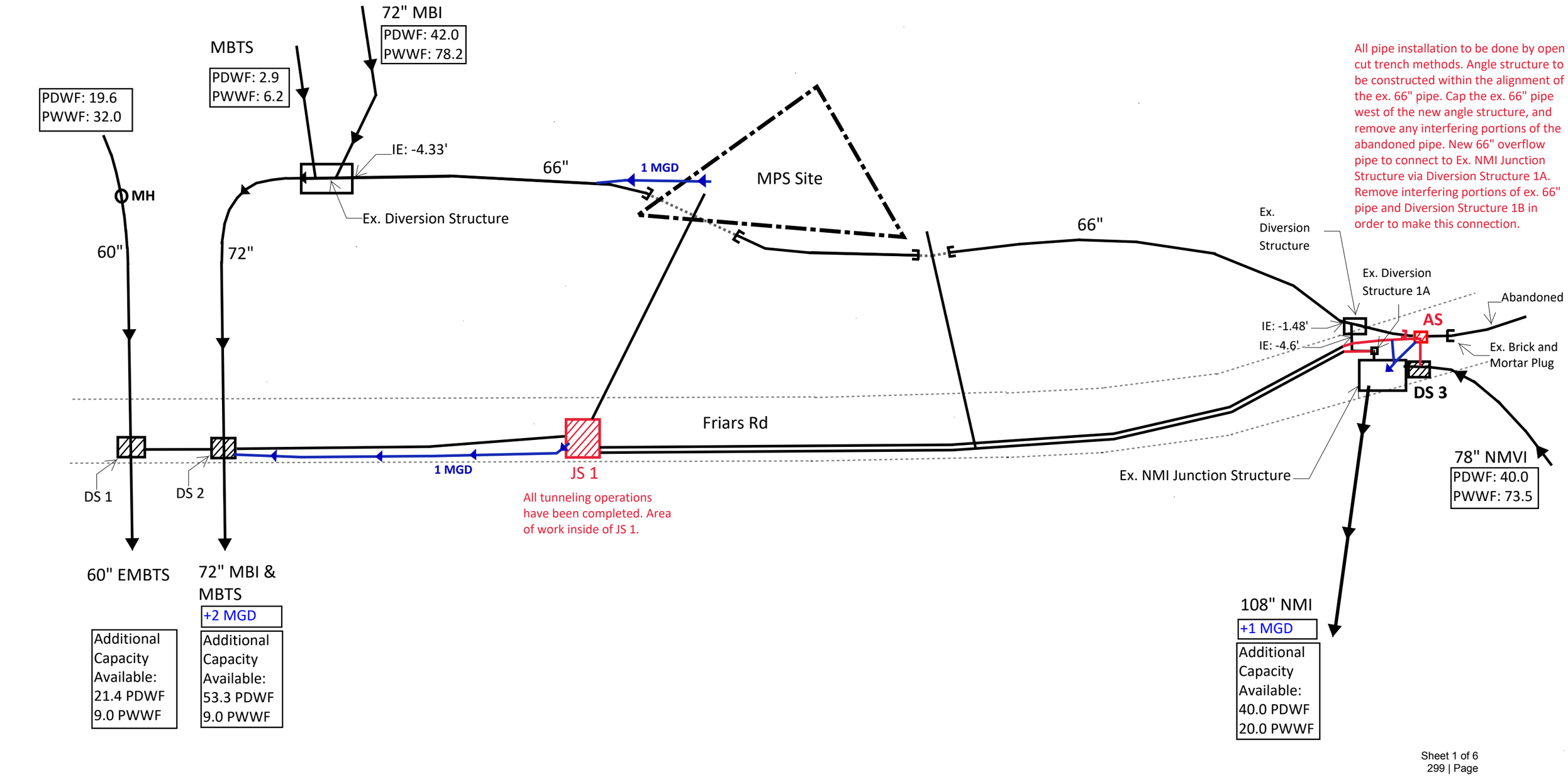
Additional Notes:
- Work done in this scenario will cut off the connection between the 72" MBI & MBTS and the 108" NMI.
- Capacity of the NMI is decreased by 3 MGD due to dewatering operations into the MBI & MBTS. Capacity of the MBI & MBTS is decreased by 1 MGD due to dewatering operations into the NMI.



Diversion Scenario 4

Legend and New Abbreviations:
AS - Angle Structure
- Work to be Done in Current Scenario
- Dewatering Operations
- Sewer Diversion Bypass

Additional Notes:
• Capacity of the NMI is decreased by 2 MGD due to dewatering operations into the MBI & MBTS. Capacity of the MBI & MBTS is decreased by 1 MGD due to dewatering operations into the NMI.



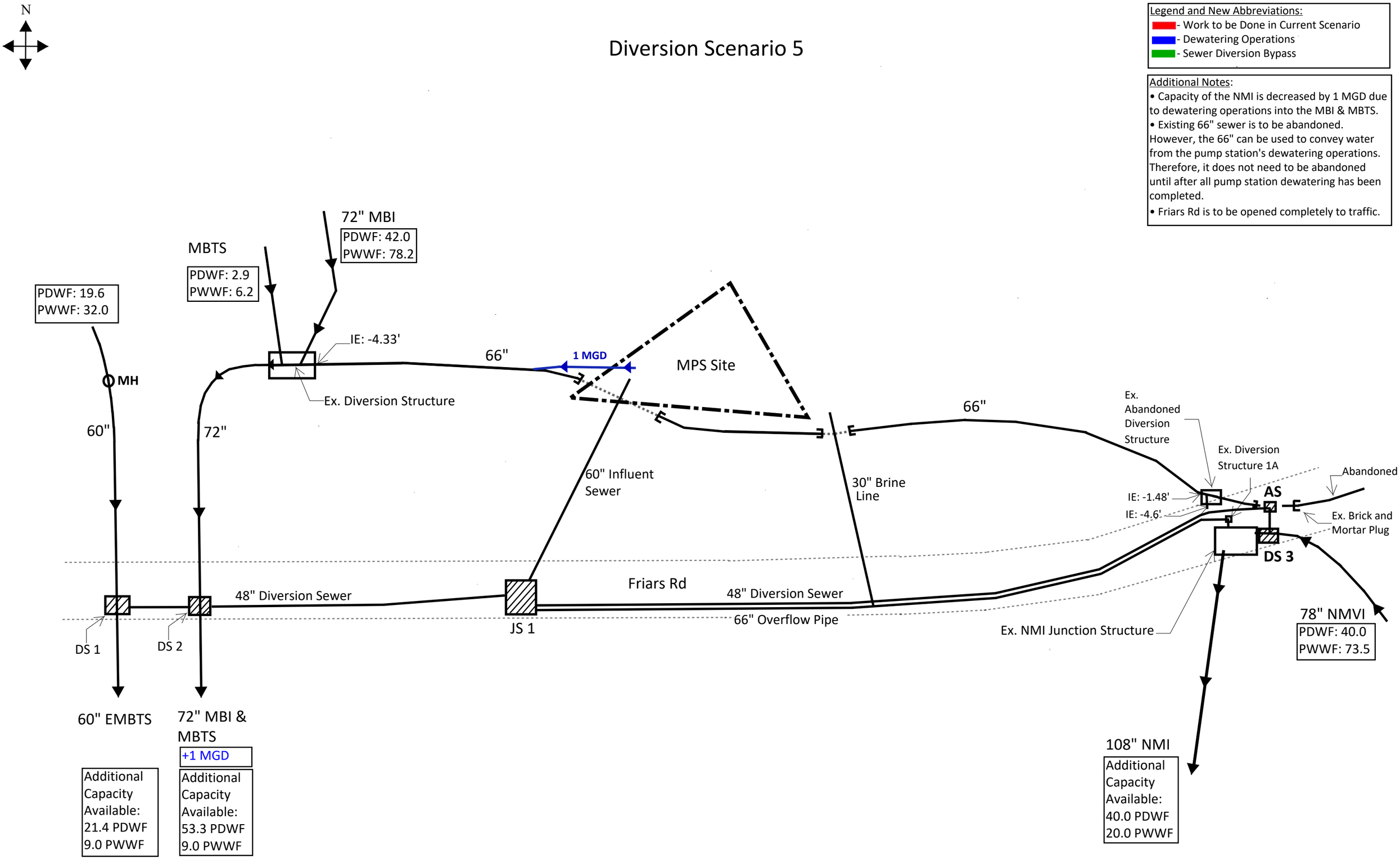
All tunneling operations have been completed. Area of work inside of JS 1.

All pipe installation to be done by open cut trench methods. Angle structure to be constructed within the alignment of the ex. 66" pipe. Cap the ex. 66" pipe west of the new angle structure, and remove any interfering portions of the abandoned pipe. New 66" overflow pipe to connect to Ex. NMI Junction Structure via Diversion Structure 1A. Remove interfering portions of ex. 66" pipe and Diversion Structure 1B in order to make this connection.

Diversion Scenario 5

Legend and New Abbreviations:
- Work to be Done in Current Scenario
- Dewatering Operations
- Sewer Diversion Bypass

Additional Notes:
- Capacity of the NMI is decreased by 1 MGD due to dewatering operations into the MBI & MBTS.
- Existing 66" sewer is to be abandoned. However, the 66" can be used to convey water from the pump station's dewatering operations. Therefore, it does not need to be abandoned until after all pump station dewatering has been completed.
- Friars Rd is to be opened completely to traffic.



SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.2 DESIGN REQUIREMENTS

A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of the 2016 California Building Code (CBC).

1.3 ENVIRONMENTAL REQUIREMENTS

A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 15 to 16 feet above sea level.

B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 50 degrees F to 100 degrees F.

1.4 PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by

name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.

C. Extra Materials, Special Tools, Test Equipment, and Expendables:

1. Furnish as required by individual Specifications.
2. Schedule:
   a. Ensure that shipment and delivery occur concurrent with shipment of associated equipment.
   b. Transfer to Owner shall occur immediately subsequent to Contractor's acceptance of equipment from Supplier.
3. Packaging and Shipment:
   a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
   b. Prominently displayed on each package, the following:
      1) Manufacturer's part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
      2) Applicable equipment description.
      3) Quantity of parts in package.
      4) Equipment manufacturer.

D. Request a minimum 7-day advance notice of shipment from manufacturer. Upon receipt of manufacturer's advance notice of shipment, promptly notify Construction Manager of anticipated date of equipment arrival.

E. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.5 DELIVERY AND INSPECTION

A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.

D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.6 HANDLING, STORAGE, AND PROTECTION

A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.

B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.

D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.

E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.

G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.

H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.

B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.

C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.

D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.

F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.

H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

I. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.

2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

J. Equipment Finish:

1. Provide manufacturer's standard finish and color, except where specific color is indicated.
2. If manufacturer has no standard color, provide equipment with gray finish as approved by Owner.

K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.

L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

M. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.2 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible; oil drains with bronze or stainless-steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.3 SOURCE QUALITY CONTROL

A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 30 days prior to scheduled test date, unless otherwise specified.

B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).

C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

3.2 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by entity supplying the product, material, or service, and submitted prior to shipment of product or material or execution of the services.

B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.

C. Such form shall certify proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.

D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.3 INSTALLATION

A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. No shimming between machined surfaces is allowed.

C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Repaint painted surfaces that are damaged prior to equipment acceptance.

E. Do not cut or notch any structural member or building surface without specific approval of Engineer.

F. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.

G. For material and equipment specifically indicated or specified to be reused in the Work:

1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.4 FIELD FINISHING

A. In accordance with Section 09 90 00, Painting and Coating, and individual Specification sections.

3.5 ADJUSTMENT AND CLEANING

A. Perform required adjustments, tests, operation checks, and other startup activities.

3.6 LUBRICANTS

A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

3.7 ANCHOR BOLTS

A. Provide anchor bolts as specified in the specification sections and in accordance with Section 05 50 00, Metal Fabrications.

3.8 SUPPLEMENTS

A. The supplement listed below, following "End of Section", is part of this specification.

1. Form: Manufacturer's Certificate of Compliance.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER: City of San Diego **PRODUCT, MATERIAL, OR SERVICE SUBMITTED:** _____

PROJECT NAME: Morena Pump Station and Conveyance System

PROJECT NO: _____

Comments: _____

_____

_____

_____

_____

_____

I hereby certify that the above-referenced product, material, or service called for by the Contract for the named Project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the Contract requirements, and are in the quantity shown.

Date of Execution: _____, 20___

Manufacturer: _____

Manufacturer's Authorized Representative *(print)*: _____

_____

(Authorized Signature)

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 SUBMITTALS

A. Informational Submittals:

1. Submit prior to application for final payment.
   a. Record Documents: As described in Section 01 33 00, Submittal Procedures and as required in General Conditions.
   b. Approved Shop Drawings and Samples: As described in Section 01 33 00, Submittal Procedures, Special bonds, Special Guarantees, and Service Agreements and as required in General Conditions.
   c. Consent of Surety to Final Payment: As required in General Conditions.
   d. Releases or Waivers of Liens and Claims: As required in General Conditions.
   e. Releases from Agreements.
   f. All documentation as required by all Funding Agencies.
   g. Final Application for Payment: Submit in accordance with procedures, requirements stated in Section 01 29 00, Payment Procedures and requirements stated in the General Conditions.
   h. Extra Materials: As required by individual specification sections.

1.2 RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
2. Accuracy of Records:
   a. Coordinate changes within record documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
   b. Purpose of Project record documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
3. Make entries within 24 hours after receipt of information that a change in the Work has occurred.

4. Prior to submitting each request for progress payment, request Engineer's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a deferral by Engineer to recommend whole or any part of Contractor's Application for Payment, either partial or final.

1.3 RELEASES FROM AGREEMENTS

A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.

B. In the event Contractor is unable to secure written releases:

1. Inform Owner of the reasons.
2. Owner or its representatives will examine the Site, and Owner will direct Contractor to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
3. Should Contractor refuse to perform this Work, Owner reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require Contractor to furnish a satisfactory bond in a sum to cover legal Claims for damages.
4. When Owner is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement or special easement, right is reserved to waive requirement for written release if: (i) Contractor's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that Contractor has failed to fulfill terms of side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. Promptly following commencement of Contract Times, secure from Owner at no cost to Contractor, one complete set of Contract Documents.
2. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.

3. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by Engineer.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
    a. Color Coding:
        1) Green when showing information deleted from Drawings.
        2) Red when showing information added to Drawings.
        3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by "cloud" drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
    a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
    b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
    c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
    d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
    e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and Engineer's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
    a. Clearly identify the item by accurate note such as "cast iron drain," "galv. water," and the like.

b. Show, by symbol or note, vertical location of item ("under slab," "in ceiling plenum," "exposed," and the like).
c. Make identification so descriptive that it may be related reliably to Specifications.

3.2 FINAL CLEANING

A. At completion of the Work or of a part thereof and immediately prior to Contractor's request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor's notice of completion, clean entire Site or parts thereof, as applicable.

1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to the Owner.
2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
4. Clean all windows.
5. Clean and wax wood, vinyl, or painted floors.
6. Broom clean exterior paved driveways and parking areas.
7. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
8. Rake clean all other surfaces.
9. Remove snow and ice from access to buildings.
10. Replace air-handling filters and clean ducts, blowers, and coils of ventilation units operated during construction.
11. Leave water courses, gutters, and ditches open and clean.

B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

3.3 SUBSTANTIAL COMPLETION

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Construction Manager in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Construction Manager issue a certificate of Substantial Completion.

B. Promptly after Contractor's notification, Owner, Contractor, and Construction Manager shall make an inspection of the Work to determine the status of completion. If Construction Manager does not consider the Work substantially complete, Construction Manager will notify Contractor in writing giving the reasons therefor.

C. If Construction Manager considers the Work substantially complete, Construction Manager will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Construction Manager as to any provisions of the certificate or attached list. If, after considering such objections, Construction Manager concludes that the Work is not substantially complete, Construction Manager will within 14 days after submission of the tentative certificate to Owner notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Construction Manager considers the Work substantially complete, Construction Manager will within said 14 days execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Construction Manager believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Construction Manager will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Construction Manager in writing prior to Construction Manager's issuing the definitive certificate of Substantial Completion, Construction Manager's aforesaid recommendation will be binding on Owner and Contractor until final payment.

3.4 FINAL INSPECTION

Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Construction Manager will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Detailed information for the preparation, submission, and Engineer's review of Operations and Maintenance (O&M) Data, as required by individual Specification sections.

1.2 DEFINITIONS

A. Preliminary Data: Initial and subsequent submissions for Engineer's review.

B. Final Data: Engineer-accepted data, submitted as specified herein.

C. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

1.3 SEQUENCING AND SCHEDULING

A. Equipment and System Data:

1. Preliminary Data:
   a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer.
   b. Submit prior to shipment date.
2. Final Data: Submit Instructional Manual Formatted data not less than 30 days prior to installation of equipment.

B. Materials and Finishes Data:

1. Preliminary Data: Submit at least 30 days prior to request for final inspection**.**
2. Final Data: Submit within 15 days after final inspection.
3. Record Data: Submit final Compilation Formatted and Electronic Media Formatted data prior to Substantial Completion of Project.

1.4 DATA FORMAT

A. Prepare preliminary and final data in the form of an instructional manual. Prepare final data on electronic media.

B. Instructional Manual Format:

1. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
2. Size: 8-1/2 inches by 11 inches, minimum.
3. Cover: Identify manual with typed or printed title "OPERATION AND MAINTENANCE DATA" and list:
    a. Project title.
    b. Designate applicable system, equipment, material, or finish.
    c. Identity of separate structure as applicable.
    d. Identify volume number if more than one volume.
    e. Identity of general subject matter covered in manual.
    f. Identity of equipment number and Specification section.
4. Spine:
    a. Project title.
    b. Identify volume number if more than one volume.
5. Title Page:
    a. Contractor name, address, and telephone number.
    b. Subcontractor, Supplier, installer, or maintenance contractor's name, address, and telephone number, as appropriate.
        1) Identify area of responsibility of each.
        2) Provide name and telephone number of a local source of supply for parts and replacement.
6. Table of Contents:
    a. Neatly typewritten and arranged in systematic order with consecutive page numbers.
    b. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
7. Paper: 20-pound minimum, white for typed pages.
8. Text: Manufacturer's printed data, or neatly typewritten.
9. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
10. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.

C. Data Compilation Format:

1. Compile all Engineer-accepted preliminary O&M data into a hard-copy, hard-bound set.
2. Each set shall consist of the following:
    a. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.

b. Cover: Identify each volume with typed or printed title "OPERATION AND MAINTENANCE DATA, VOLUME NO.____OF____", and list:
   1) Project title.
   2) Contractor's name, address, and telephone number.
   3) If entire volume covers equipment or system provided by one Supplier include the following:
      a) Identity of general subject matter covered in manual.
      b) Identity of equipment number and Specification section.

c. Provide each volume with title page and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.

d. Table of contents neatly typewritten, arranged in a systematic order:
   1) Include list of each product, indexed to content of each volume.
   2) Designate system or equipment for which it is intended.
   3) Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.

e. Section Dividers:
   1) Heavy, 80-pound cover weight, tabbed with numbered plastic index tabs.
   2) Fly-Leaf:
      a) For each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment.
      b) List with Each Product:
         (1) Name, address, and telephone number of Subcontractor, Supplier, installer, and maintenance contractor, as appropriate.
         (2) Identify area of responsibility of each.
         (3) Provide local source of supply for parts and replacement.
      c) Identity of separate structure as applicable.

f. Assemble and bind material, as much as possible, in same order as specified in the Contract Documents.

D. Electronic Media Format:

1. Portable Document Format (PDF):
   a. After all preliminary data has been found to be acceptable to Engineer, submit Operation and Maintenance data in PDF format on CD.

b. Files to be exact duplicates of Engineer-accepted preliminary data. Arrange by specification number and name.
c. Files to be fully functional and viewable in most recent version of Adobe Acrobat.

1.5 SUBMITTALS

A. Informational:

1. Data Outline: Submit two copies of a detailed outline of proposed organization and contents of Final Data prior to preparation of Preliminary Data.
2. Preliminary Data:
   a. Submit two copies for Engineer's review.
   b. If data meets conditions of the Contract:
      1) One copy will be returned to Contractor.
      2) One copy will be forwarded to Resident Project Representative.
      3) One copy will be retained in Engineer's file.
   c. If data does not meet conditions of the Contract:
      1) All copies will be returned to Contractor with Engineer's comments (on separate document) for revision.
      2) Engineer's comments will be retained in Engineer's file.
      3) Resubmit two copies revised in accordance with Engineer's comments.
3. Final Data: Submit two printed copies and an electronic copy in format specified herein.

1.6 DATA FOR EQUIPMENT AND SYSTEMS

A. Content for Each Unit (or Common Units) and System:

1. Product Data:
   a. Include only those sheets that are pertinent to specific product.
   b. Clearly annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information.
   c. Function, normal operating characteristics, and limiting conditions.
   d. Performance curves, engineering data, nameplate data, and tests.
   e. Complete nomenclature and commercial number of replaceable parts.

f. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
g. Spare parts ordering instructions.
h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).

2. As-installed, color-coded piping diagrams.
3. Charts of valve tag numbers, with the location and function of each valve.
4. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
   a. Format:
      1) Provide reinforced, punched, binder tab; bind in with text.
      2) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
      3) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
      4) Identify Specification section and product on Drawings and envelopes.
   b. Relations of component parts of equipment and systems.
   c. Control and flow diagrams.
   d. Coordinate drawings with Project record documents to assure correct illustration of completed installation.
5. Instructions and Procedures: Within text, as required to supplement product data.
   a. Format:
      1) Organize in consistent format under separate heading for each different procedure.
      2) Provide logical sequence of instructions for each procedure.
      3) Provide information sheet for Owner's personnel, including:
         a) Proper procedures in event of failure.
         b) Instances that might affect validity of guarantee or Bond.
   b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
   c. Operating Procedures:
      1) Startup, break-in, routine, and normal operating instructions.
      2) Test procedures and results of factory tests where required.
      3) Regulation, control, stopping, and emergency instructions.
      4) Description of operation sequence by control manufacturer.
      5) Shutdown instructions for both short and extended duration.
      6) Summer and winter operating instructions, as applicable.
      7) Safety precautions.
      8) Special operating instructions.

d. Maintenance and Overhaul Procedures:
    1) Routine maintenance.
    2) Guide to troubleshooting.
    3) Disassembly, removal, repair, reinstallation, and re-assembly.

6. Guarantee, Bond, and Service Agreement: In accordance with Section 01 77 00, Closeout Procedures.

B. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:
    a. Function, normal operating characteristics, and limiting conditions.
    b. Performance curves, engineering data, nameplate data, and tests.
    c. Complete nomenclature and commercial number of replaceable parts.
    d. Interconnection wiring diagrams, including control and lighting systems.
2. Circuit Directories of Panelboards:
3. Electrical service.
4. Control requirements and interfaces.
5. Communication requirements and interfaces.
6. List of electrical relay settings, and control and alarm contact settings.
7. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
8. As-installed control diagrams by control manufacturer.
9. Operating Procedures:
    a. Routine and normal operating instructions.
    b. Startup and shutdown sequences, normal and emergency.
    c. Safety precautions.
    d. Special operating instructions.
10. Maintenance Procedures:
    a. Routine maintenance.
    b. Guide to troubleshooting.
    c. Adjustment and checking.
    d. List of relay settings, control and alarm contact settings.
11. Manufacturer's printed operating and maintenance instructions.
12. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

C. Maintenance Summary:

1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
2. Format:
    a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
    b. Each Maintenance Summary may take as many pages as required.
    c. Use only 8-1/2-inch by 11-inch size paper.
    d. Complete using typewriter or electronic printing.
3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
    a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
    b. "Unit" is the unit of measure for ordering the part.
    c. "Quantity" is the number of units recommended.
    d. "Unit Cost" is the current purchase price.

1.7 DATA FOR MATERIALS AND FINISHES

A. Content for Architectural Products, Applied Materials, and Finishes:

1. Manufacturer's data, giving full information on products:
    a. Catalog number, size, and composition.
    b. Color and texture designations.
    c. Information required for reordering special-manufactured products.
2. Instructions for Care and Maintenance:
    a. Manufacturer's recommendation for types of cleaning agents and methods.
    b. Cautions against cleaning agents and methods that are detrimental to product.
    c. Recommended schedule for cleaning and maintenance.

B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer's data, giving full information on products:
    a. Applicable standards.
    b. Chemical composition.
    c. Details of installation.
2. Instructions for inspection, maintenance, and repair.

1.8 SUPPLEMENTS

A. The supplements listed below, following “End of Section”, are part of this Specification.

1. Forms: Maintenance Summary Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT:_____CONTRACT NO.:_____

1. EQUIPMENT ITEM_____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS)_____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE _____

   a. Name_____Telephone No. _____

   b. Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	**Frequency**	**Lubricant (If Applicable)**
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

8. LUBRICANT LIST

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER'S INVENTORY.

Part No.	Description	Unit	Quantity	Unit Cost
Note: Identify parts provided by this Contract with two asterisks.				

SECTION 01 88 15
ANCHORAGE, THRUST RESTRAIN, AND BRACING

PART 1 GENERAL

1.1 SUMMARY

A. This section covers requirements for anchorage, thrust restrain, and bracing of equipment, distribution systems, and other nonstructural components required in accordance with the ICC 2016 California Building Code (CBC), for seismic, wind, gravity, soil, and operational loads.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Institute of Steel Construction (AISC) 360, Specification for Structural Steel Buildings.
2. American Society of Civil Engineers (ASCE): ASCE 7, Minimum Design Loads for Buildings and Other Structures.
3. International Code Council (ICC): International Building Code (IBC).

1.3 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.

B. Designated Seismic System: Architectural, electrical, and mechanical system or their components for which component importance factor is greater than 1.0.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. General:

1. The CONTRACTOR shall be responsible for the design, installation, and testing of all anchorage, thrust restrain, and bracing systems.
2. Anchorage, thrust restrain, and bracing systems shall be designed by a qualified professional engineer registered in the State of California.

3. Design anchorage and bracing of architectural, mechanical, and electrical equipment, components and systems in accordance with this section, unless a design is specifically provided within Contract Documents or where exempted hereinafter.
4. Design attachments, braces, and anchors for equipment, components, and distribution systems to structure for gravity, seismic, wind, and operational loading.
5. Anchor and brace piping and ductwork, whether exempt or not exempt for this section, so that lateral or vertical displacement does not result in damage or failure to essential architectural, mechanical, or electrical equipment.
6. Architectural Components: Includes, but are not limited to, nonstructural walls and elements, partitions, cladding and veneer, access flooring, signs, cabinets, suspended ceilings, and glass in glazed curtain walls and partitions.
7. Provide supplementary framing where required to transfer anchorage and bracing loads to structure.
8. Adjust equipment pad sizes or provide additional anchorage confinement reinforcing to provide required anchorage capacities in concrete.
9. Design anchorage and bracing for:
    a. All architectural, electrical, and mechanical equipment and components, with the exception of mechanical and electrical components where all of the following apply:
        1) Ip = 1.0;
        2) Flexible connections are provided between the component and the associated ductwork, piping, and conduit; and either a) the component weighs 400 lb or less and has a center of mass located 4 ft or less above the adjacent floor level; or b) the component weighs 20 lb or less or, in the case of a distributed system, 5 lb/ft or less.
10. Design seismic anchorage and bracing for Designated Seismic Systems regardless of weight or mounting height.
    a. Component Importance Factor:
        1) Ip = 1.0, unless noted otherwise.
        2) Ip shall be taken as 1.5 if any of the following conditions apply:
            a) Component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems and egress stairways.
            b) Component contains hazardous materials.
            c) Component is in or attached to Risk Category IV structure and is needed for continued operation of facility or its failure could impair continued operation of facility.

11. For components exempted from design requirements of this section, provide bolted, welded, or otherwise positively fastened attachments to supporting structure.

B. Design Loads:

1. Gravity: Design anchorage and bracing for self-weight and superimposed loads on components and equipment.
2. Wind: Design anchorage and bracing for wind criteria provided on General Structural Notes on Drawings for exposed architectural components and exterior and wind-exposed mechanical and electrical equipment. Alternately, manufacturer certification may be provided for components such as roofing and flashing to verify attachments meet Project-specific design criteria.
3. Operational:
   a. For loading supplied by equipment manufacturer for CBC required load cases.
   b. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), water hammer, and other load-inducing conditions.
   c. Locate braces to minimize vibration to or movement of structure.
   d. For vibrating loads, use cast-in-place anchors meeting requirements of Section 05 50 00, Metal Fabrications.
4. Hydraulic: Design of anchorage for submerged gates and other mechanical equipment shall include hydrostatic and hydrodynamic loads determined in accordance with Section 15.7 of ASCE 7-10.
5. Seismic:
   a. In accordance with 2016 CBC, Section 1613, and Chapter 13 of ASCE 7.
   b. Design anchorage and bracing for design criteria listed on General Structural Notes on Drawings.
   c. Design anchorages for parts or elements of architectural, mechanical, and electrical systems in accordance with provisions of CBC and the following Site-specific seismic criteria, unless noted otherwise on Drawings:
      1) Site-Specific Spectral Response Coefficients:
         a) Short Period Mapped Maximum Considered Earthquake Acceleration, 5 Percent Damped: SS equals 1.291g.
         b) 1-Second Period Mapped Maximum Considered Earthquake Acceleration, 5 Percent Damped: S1 equals 0.500g.
      2) Short Period Design Spectral Response Acceleration, 5 Percent Damped: SDS equals 0.861g.

a) 1-Second Period Design Spectral Response Acceleration, 5 Percent Damped: SD1 equals 0.800g.

3) Site Class: D

4) Seismic Design Category (SDC): D, unless noted otherwise. Same as supporting structure's SDC, as shown on Drawings.

5) Risk Category: IV, unless noted otherwise. Anchorage and bracing shall be same as that for supporting structure as shown on Drawings.

d. Design forces for anchors in concrete or masonry shall be in accordance with ASCE 7, Section 13.4.2 as applicable for Project Seismic Design Category.

C. Seismic Design Requirements:

1. Nonstructural Components: Design as nonbuilding structures for components with weights greater than or equal to 25 percent of effective seismic weight of overall structure.
2. Analyze local region of body of nonstructural component for load transfer of anchorage attachment if component Ip = 1.5.
3. The following are exempt from requirements for provision of seismic anchorages and bracing, in addition to those items specifically exempted in ASCE 7, Part 13.5 for architectural components and Part 13.6 for electrical and mechanical equipment:
   a. Furniture, except storage cabinets and bookshelves over 6 feet tall.
   b. Temporary or movable equipment.
4. Provide support drawings and calculations for electrical distribution components if any of the following conditions apply:
   a. Conduit diameter is greater than 2.5-inch trade size.
   b. Total weight of bus duct, cable tray, or conduit supported by trapeze assemblies exceeds 10 pounds per foot.
   c. Supports are cantilevered up from floor.
   d. Supports include bracing to limit deflection and are constructed as rigid welded frames.
   e. Attachments utilize spot welds, plug welds, or minimum size welds as defined by AISC.
5. Other seismic design and detailing information identified in ASCE 7, Chapter 13, is required to be provided for new architectural, mechanical and electrical components, systems, or equipment.

1.5 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. List of architectural, mechanical, and electrical equipment requiring Contractor-designed anchorage and bracing, unless specifically exempted.
   b. Manufacturers' engineered seismic and non-seismic hardware product data.
   c. Attachment assemblies' drawings including seismic attachments; include connection hardware, braces, and anchors or anchor bolts for nonexempt components, equipment, and systems.
   d. Submittal will be rejected if proposed anchorage method would create excessive stress to supporting member. Revise anchorages and strengthen structural support to eliminate overstressed condition.

B. Informational Submittals:

1. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include CBC and Project-specific criteria as noted on General Structural Notes on Drawings, in addition to manufacturer's specific criteria used for design; sealed by a civil or structural engineer registered in the State of California.
2. Manufacturer's hardware installation requirements.

C. Deferred Submittals:

1. Submitted seismic anchorage drawings and calculations are identified as CBC deferred submittals and will be submitted to and must be accepted by AHJ prior to installation of component, equipment, or distribution system.
2. Submit deferred Action Submittals such as Shop Drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment or distribution system to be anchored to structure.

1.6 SOURCE QUALITY CONTROL

A. Contractor and supplier responsibilities to accommodate Owner-furnished shop fabrication related special inspections and testing are provided in Project's Statement of Special Inspections on Drawings, and Section 01 45 33, Special Inspection, Observation, and Testing.

B. Provide all other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

C. Provide Source Quality Control for welding and hot-dip galvanizing of anchors in accordance with Section 05 50 00, Metal Fabrications.

PART 2 PRODUCTS

2.1 GENERAL

A. Design and construct attachments and supports transferring seismic and non-seismic loads to structure of materials and products suitable for application and in accordance with design criteria shown on Drawings and nationally recognized standards.

B. Provide anchor bolts for anchorage of equipment to concrete or masonry in accordance with Section 05 50 00, Metal Fabrications. Provide anchor bolts of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.

C. Provide post-installed concrete and masonry anchors for anchorage of equipment to concrete or masonry in accordance with Section 05 05 19, Post-Installed Anchors. Provide post-installed anchors of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.

D. Do not use powder-actuated fasteners or sleeve anchors for seismic attachments and anchorage where resistance to tension loads is required. Do not use expansion anchors, other than undercut anchors, for non-vibration-isolated mechanical equipment rated over 10 horsepower.

PART 3 EXECUTION

3.1 GENERAL

A. Make attachments, bracing, and anchorage in such a manner that component lateral force is transferred to lateral force resisting system of structure through a complete load path.

B. Design, provide, and install overall seismic anchorage system to provide restraint in all directions, including vertical, for each component or system so anchored.

C. Provide snubbers in each horizontal direction and vertical restraints for components mounted on vibration isolation systems where required to resist overturning.

D. Provide piping anchorage that maintains design flexibility and expansion capabilities at flexible connections and expansion joints.

1. Piping and ductwork suspended more than 12 inches below supporting structure shall be braced for seismic effects to avoid significant bending of hangers and their attachments.

E. Anchor tall and narrow equipment such as motor control centers and telemetry equipment at base and within 12 inches from top of equipment, unless approved otherwise by Engineer.

F. Do not attach architectural, mechanical, or electrical components to more than one element of a building structure at a single restraint location where such elements may respond differently during a seismic event. Do not make such attachments across building expansion and contraction joints.

3.2 INSTALLATION

A. Do not install components or their anchorages or restraints prior to review and acceptance by Engineer and AHJ.

B. Notify Engineer upon completion of installation of seismic restraints.

3.3 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. In accordance with Section 05 50 00, Metal Fabrications and Section 05 05 19, Post-Installed Anchors**.**

B. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan on Drawings.

C. Provide any other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 01 91 14
TESTING, INTEGRATION, AND STARTUP

PART 1 GENERAL

1.1 STARTUP

A. The goal of startup is to verify proper performance and operation of the Facility.

B. Testing, integration, and startup are complex portions of the Work required for satisfactory completion and require thorough planning and proper execution.

C. See Attachment 1, Phase 1 Commissioning Model for the Morena Pump Station startup in the context of the overall Program integration and acceptance plan.

1.2 DEFINITIONS

A. Acceptance Testing: A contractually required, specific and measurable test, often with liquidated damages attached, to demonstrate a system or facility performs to its intended function (e.g. flow amounts, duration and quality criteria are met). A successor activity to Performance Testing. All major defects are resolved at this point.

B. Distributed Control System Provider (DCSP): Entity who is responsible for the development and programming of the Facility DCS.

C. Auxiliary Systems: Subsystems and systems selected by the Owner as critical to the operation and function of the Work. Auxiliary systems are more specifically identified in the Contract Documents.

D. Commissioning:

1. The disciplined and systematic process of assuring that all components, subsystems and systems of a constructed unit are designed, installed, tested and operated in conformance with the design intent, and functional intent and operational requirements of the Owner.
2. This includes:
    a. Proof testing of design intent using static check sheets, dynamic check sheets and defined procedures to ensure compliance with design drawings, data sheets and specifications.
    b. Achieving a smooth and safe transition from an inert state to a completely tested, clean, leak tight, operable and safe unit ready for startup and performance testing.
    c. All testing shown on Attachment 1 Commissioning Model.

E. Components: Individual items of equipment or portions of the Work that when combined with other components make up subsystems or systems. Components

may be minor items such as pressure gauges, or they may be significant items such as pump motors.

F. Contract Documents: Construction Contract, Specifications and Drawings.

G. Facility: The combined equipment and systems located to perform a specified function e.g. Morena Pump Station (MPS).

H. Factory Acceptance Testing (FAT): All testing required to be conducted at the fabricator's / manufacturer's / vendor's off-site locations, witnessed or unwitnessed. Includes all such testing, regardless of the specific descriptive title used for said testing in the Contract Documents.

I. Final Completion: Refer to the Contract Requirements and Supplementary Provisions

J. Functional Testing: A test of a given component, subsystem or system to confirm its operation meets specifications and Contract requirements. Often a prerequisite to Performance and Acceptance Testing.

K. Integration Period: This is the period occurring after Intermediate Substantial Completion and before Substantial Completion during which the MPS will be tested and operated as part of the overall Pure Water Program system, including the Morena Force Main and Brine/Centrate Pipeline, the NCPWF Influent Pump Station and Influent Conveyance, the NCWRP Expansion, the Metropolitan Biosolids Center Improvements, NCPWF and the North City Pure Water Pipeline, and Dechlorination Facilities.

L. Intermediate Substantial Completion: The time at which the Project's operating facilities or systems are sufficiently complete to send screened and oxygenated wastewater flows to the NCWRP. All functional tests that can be performed with potable water shall be complete and facilities shall be fully operable to allow for a flow increase to the NCWRP for 120 days. Refer to Attachment 1 for commissioning model planned. The Contractor shall support all activities within the Integration period as described in Section 01 91 14, Testing, Integration, and Startup. Refer to Contract requirements and Supplementary Provisions.

M. Joint Test Group (JTG): Workgroup consisting of personnel from the Engineer, Construction Manager, Owner, Contractor, and Subcontractors whose goal is to facilitate pre-startup and startup of the Facility. This work group shall also support the Integration Period testing as part of a larger work group from other Facilities.

N. Major Equipment Systems: Systems, subsystems, or major equipment components selected by the Owner as critical to the operation and function of the Work. Major equipment systems are more specifically identified in the Contract Documents.

O. Manufacturer's Installation Inspection: Preliminary inspection conducted by Manufacturer or Manufacturer's accepted representative to confirm proper installation of components, systems, and subsystems.

P. Mechanical/Electrical Functional Testing: Testing performed to confirm general performance of mechanical and electrical systems. Hydrostatic leak testing of pipes is an example. Electrical testing specified in Division 26, Electrical, shall be considered Mechanical/Electrical Functional Testing.

Q. Performance Test: A defined test of a system, systems or facility over a period of 7 days, unless otherwise specified, to demonstrate the system or facility is fully operational and meets all specifications, performance objectives and Contract requirements. Performance testing will be done with NCPWF influent (tertiary treated wastewater) pumped from the NCWRP, as defined with these Contract Documents.

R. Operational Readiness Test Part 1, See Section 40 90 00, Instrumentation and Control.

S. Operational Readiness Test Part 2, See Section 40 90 00, Instrumentation and Control.

T. Process Instrumentation and Control (PIC): Computer-based system whose purpose is to control and supervise the overall Facility operation. See Section 40 90 00, Instrumentation and Control.

U. Staging Site Demonstration: Startup phase during which the DCSP performs a FAT to test the proper communication and action of the DCSP-developed software system. This testing will be conducted offsite.

V. Startup: The act of starting or operating a component, subsystem or system and testing its functionality and performance against defined metrics.

W. Subsystems: A group of related equipment that performs a defined function and is an element of a larger system.

X. Substantial Completion: Upon satisfactory completion of the 30-Day Systemwide facility Acceptance Test, See Attachment 1 Phase 1 Commissioning Model. Refer to Contract requirements and Supplementary Provisions.

Y. Systems: A group of related components, equipment or subsystems that perform a defined function or set of functions within a facility.

Z. Training: Classroom and equipment area instruction by Manufacturer or Manufacturer accepted representative intended to educate the Owner on the proper operation and maintenance of components, systems, and subsystems.

AA. Unit Process: Portion of the facility that performs a specific process function, such as high purity oxygen, screening facilities.

BB. Beneficial Use: Utilization of a system, unit process, or facility by the Owner. Refer to Supplemental Special Provisions for further definition and extended warranty requirements for equipment placed into Beneficial Use.

1.3 SUBMITTALS

A. Action Submittals:

1. Startup Personnel Qualifications: The qualifications submittal for the Startup Manager and Project Integrator shall be provided at the Preconstruction Conference.
2. Startup Management Plan: Submitted within 60 days after Notice to Proceed.
3. Overall Facility Startup Plan.
4. Factory Acceptance Test Plans.
5. Acceptance Test Plans.
6. Startup Schedule:
   a. Schedule shall be a detailed Oracle Primavera P6 schedule linked to the milestones and key startup activities contained in the Construction Schedule as specified in Section 01 32 00 Construction Progress Documentation.
   b. The Startup Schedule shall include each phase of testing of for the systems defined herein.
   c. Schedule shall be submitted in both XER and PDF format and updated monthly.
   d. The detailed Startup Schedule shall be submitted no later than 6 months prior to the start of ORT Part 1 in the accepted Baseline Schedule, as specified in Section 01 32 00 Construction Progress Documentation.
7. Startup Results Submittal:
   a. Include the following:
      1) Final minutes from all JTG meetings.
      2) Results documentation from all Factory Acceptance Testing.
      3) Completed test plans (endorsed by Construction Manager and Contractor).
      4) Record of all Training:
         a) Training requests.
         b) Agendas.
         c) Sign in sheets.
         d) Handouts.
         e) Electronic copy of all training presentations.
      5) Record of all Manufacturer Services/Inspections.
      6) Record of all testing not covered above.

1.4 JOINT TEST GROUP (JTG)

A. Purpose:

1. The purpose of the JTG is to facilitate communication and collaboration between all parties required to successfully complete startup including but not limited to the following:
   a. Prepare test plans.
   b. Conduct testing.
   c. Oversee testing.
   d. Assign individual or multiple JTG personnel tasks associated with startup to be completed outside of the JTG workshops.

B. Personnel:

1. The following Owner personnel will participate in the JTG:
   a. Engineer.
   b. DCSP.
   c. Owner's Representatives:
      1) Construction representative.
      2) Operations representative.
   d. Construction Manager.
   e. Owner Startup Manager.
   f. Others as required.
2. The Contractor shall assign the following personnel to the JTG:
   a. Contractor Startup Manager.
   b. Project Integrator.
   c. Electrical Subcontractor Management Representative.

C. The JTG will participate in the following meetings:

1. Startup Preparation Workshops:
   a. Status of equipment submittals and startup plan for overall facility.
   b. Development of team.
   c. Frequency: Every 2 weeks.
   d. Duration: 4 hours minimum.
   e. Start Date: 4 weeks after Notice to Proceed.
2. Startup Planning Workshops:
   a. Preparation of test plans.
   b. Review of equipment shop drawings.
   c. Frequency: Every week.
   d. Duration: 8 hours minimum.
   e. Start Date: 6 months before anticipated commencement of functional testing.
3. Factory Acceptance Test Prep Workshops:
   a. Preparation of factory test plans.

b. Address scheduling.
c. Frequency: Once per required FAT.
d. Duration: 8 hours minimum.
e. Start Date: 2 months prior to anticipated FAT date.

4. Pre-Startup Execution Workshops:
   a. Finalize planning for startup activities.
   b. Finalize test plans.
   c. Address any supplier/manufacturer issues.
   d. Frequency: Every week.
   e. Duration: 8 hours minimum.
   f. Start Date: 1 month before anticipated commencement of functional testing.
5. Startup Execution Workshops:
   a. Current status of testing.
   b. Identification of specific needs.
   c. Identification and resolution of issues.
   d. Frequency: Daily.
   e. Duration: 4 hours minimum.
   f. Start Date: Commencement of functional testing, through completion of 30-Day Facility Acceptance Testing.

D. Authority:

1. The Construction Manager will be the final authority on all disputes. Construction Manager's authority is not intended to compromise or change the Contractor's rights and responsibilities as described elsewhere in these Contract Documents.
2. The JTG may not independently amend or change the Contract Documents. However, the Contract Documents may be amended or changed according to the Contract Documents, based on JTG recommendations approved by the Construction Manager.

E. Contractor Participation:

1. The Contractor is required to participate in all JTG meetings and shall dedicate the required time and personnel to complete tasks assigned by the JTG. This shall include, but not be limited to the development of all startup and testing plans identified as being required to be led by the Contractor.
2. The Contractor shall include, in his lump sum bid, all costs associated with onsite and offsite testing described in these Specifications including travel, subsistence, lodging, etc.

1.5 ORGANIZATION OF STARTUP PHASES

A. The following table summarizes the various phases of startup:

Description	Duration	Preceding Constraints	Comments
Submittals	As required to meet testing schedule		
Factory Acceptance Testing	As required to meet testing schedule	Approved submittals required prior to testing.	
Staging Site Demonstration	180 days	Delivery of DCS components to DCSP staging site. Completion of all FATs.	Done by DCSP
Mechanical/Electrical Functional Testing and Equipment Testing	As required to meet testing schedule for individual unit process	Complete all FATs. Complete equipment and piping installation. Approved submittals required prior to testing (including O&Ms).	Includes hydrostatic testing
PIC Operational Readiness Test Part 1	As required to meet testing schedule	Manufacturer's installation assistance and inspection. Completion of PICS Operational Readiness Test Part 1. Completion of staging site demonstration test and loading of application software. Approved submittals required prior to testing (including O&Ms).	

Description	Duration	Preceding Constraints	Comments
PIC Operational Readiness Test Part 2	As required to meet testing schedule	Completion of PICS Operational Readiness Test Part 1. Completion of staging site demonstration test and loading of application software. Approved submittals required prior to testing (including O&Ms).	
Functional and Performance Testing on Unit Processes	As required to meet testing schedule	Completion of PIC Operational Readiness Test Part 2. Approved submittals required prior to testing (including O&Ms).	See Attachment 1 for graphical presentation
Training	As specified	Completion of all functional and performance testing.	
Facility Commissioning	As required	Completion of Functional and Performance Testing of Unit Processes and Auxiliary Systems, and Pump Station, and Training.	
Integration Period Testing and Commissioning	120 days	Intermediate Substantial Completion. Interfacing Facilities Ready to Test.	Integrating the NCWRP, NCPWF, MPS, NCPWPS and MBC facilities

Description	Duration	Preceding Constraints	Comments
Facility Acceptance Test	30 days	Completion of commissioning of the unit processes. Manufacturer's CPI. Training. Approved submittals required prior to testing (including O&Ms).	

1.6 WORK RELATED TO THE FACILITY

A. During the period between Intermediate Substantial Completion and Substantial Completion, the Owner will conduct integration procedures associated with the Facility and its coordinated operation with NCWRP, NCPWF, NCPWPS including the Dechlorination Facility, and Metropolitan Biosolids Center, and systems being constructed by others, such as the communications and control interface and COMNET upgrade. This integration will generally consist of communications system verification and a verification that the facilities can operate as one overall system.

1.7 CONTRACTOR STARTUP PERSONNEL

A. Contractor shall provide personnel, both supervisory and from the applicable trades, who are experienced in startup, testing, and commissioning for the execution of the work described in these Contract Documents.

B. Startup Manager: Only assigned duties are those specifically related to planning and execution of startup activities in support of the Work. The Startup Manager shall have the necessary experience to fully understand all startup requirements and the authority to dedicate Contractor's resources as required to execute the Work.

1. The Contractor shall allocate the costs for the Startup Manager as a monthly allocation starting at the project limited NTP and terminating at Final Completion.
2. Once the Owner and Construction Manager accept the Startup Manager, the Contractor shall not change the Startup Manager throughout the full period

of performance of the Work, beginning after the limited NTP, without the express written permission of Construction Manager and Owner.

3. The minimum scope of services to be managed and/or executed by the Startup Manager shall include the following tasks:
    a. Formation of an onsite startup team of supervisory staff, including the Contractor's Project Integrator, qualified in each and every element of the startup process required as part of the Work. This staff shall prepare all Contractor-performed startup and testing documentation and direct the associated startup activities, including all required Contractor and Subcontractor personnel required for testing. This requirement is also applicable to all factory testing, whether witnessed by Construction Manager or not.
    b. Complete planning, development, and where required, the preparation of all Startup and Test Plans, testing procedures, schedules, and related prerequisite, and final documentation for startup activities required by the Contract Documents. This requirement is applicable to all required startup and/or testing plans, reports, and procedures, regardless of the specific portion of the Contract Documents where they may be specified or otherwise required.
    c. Overall coordination and scheduling of all startup and testing activities. This shall include the development of detailed startup and testing schedules, integrated with Contractor's CPM schedule. It shall also include all coordination with the Owner and Construction Manager for operation of the system to accommodate test flows and joint testing activities.
    d. Coordination of all manufacturers' startup activities and certification of proper installation and/or function as required by the Contract Documents.
    e. Coordination, direction, and management of the actual day-to-day testing.
    f. Review and certify all test results. Prepare and/or compile all versions of all test reports and related submittals. Prior to being submitted to the Construction Manager, all test reports shall be certified by the Startup Manager that the reports and associated test results comply with the Contract Documents.
    g. Coordinate all testing and startup with the Engineer, Construction Manager, and Owner.
    h. Integration with the vendor packaged control systems.

C. Project Integrator: Only assigned duties are those specifically required to plan and execute the installation, interconnection, integration, and startup of the various PICS devices, panels, components, systems, and subsystems required for the Work. The Project Integrator shall have the necessary experience to fully understand all PICS and related devices, panels, components, systems, and subsystems installation, integration, and startup requirements and the authority to dedicate Contractor's resources as required to execute the Work.

1. The Project Integrator shall have the following minimum qualifications:
    a. The Project Integrator shall not be the same person as the System Integrator for the Instrumentation and Control system.
2. The Contractor shall allocate the costs for the Project Integrator as a monthly allocation starting at the project limited NTP and terminating at Final Completion.
3. Once the Owner , RPR, and the Construction Manager accept the Project Integrator, the Contractor shall not change the Project Integrator throughout the full period of performance of the Work without the express written permission of RPR, the Construction Manager and Owner.
4. The minimum scope of services to be managed and/or executed by the Project Integrator shall include the following tasks:
    a. Integration of all Process Instrumentation and Control System (PICS) components and related devices, panels, components, systems, and subsystems required to be provided as part of the Work, regardless of the actual supplier or prepackage nature of the supply.
    b. Integration and coordination of the Process Instrumentation and Control System with all components provided as packaged systems or supplied with individual equipment suppliers.

D. The Startup Manager and the Project Integrator may not be the same person.

1.8 THE STARTUP MANAGEMENT PLAN

A. The Contractor Startup Manager shall conduct a startup coordination workshop and prepare and submit a Startup Management Plan that describes how Contractor will accomplish the minimum scope of services and manage the daily startup activities. The coordination workshop shall, at a minimum, include the Contractor's Startup Manager, Project Integrator, and Project Superintendent. The requirements for Startup requirements for the Work will be reviewed at the workshop. The Startup Management Plan shall be prepared immediately following the workshop and shall include a detailed description, including procedures and examples of how the Startup Team will manage the interface between Contractor's trades, Contractor's management, Contractor's subcontractors, Contractor's PLC programmers, Construction Manager's field team, Owner, and the DCSP programming team. The workshop shall be conducted within 4 weeks of Notice to Proceed. The draft Startup Management Plan shall be completed and submitted within 4 weeks of the startup coordination workshop. The plan will be reviewed and processed for acceptance in accordance with Section 01 33 00, Submittal Procedures.

1.9 THE STARTUP AND TEST PLANS

A. The Contractor under the guidance of the JTG will develop specific plans for the testing of all elements of the Facility. These plans shall outline the detailed sequence of activities necessary to confirm the proper operation of every component, system, and subsystem.

B. Test plans will be prepared for each phase of startup where testing is required including, but not limited to the following:

1. Factory acceptance testing.
2. Staging site demonstration.
3. Manufacturer's installation inspection.
4. Mechanical/electrical functional testing.
5. Operational Readiness Test Part 1.
6. Operational Readiness Test Part 2.
7. Functional and performance testing on the following unit processes shall have individual test plans for each unit process with its auxiliary systems.
    a. Screening Facility.
    b. High Purity Oxygen.
    c. Influent and Overflow flow control.
8. Pump Performance Testing
9. Pre-Selected Equipment Permit Testing and Extended Performance Tests.

C. Test plans will be developed as described below:

1. The Overall Startup Plan shall include six main sections arranged as follows:
    a. Overall Startup Plan Summary.
    b. Factory Acceptance Testing.
    c. Operational Readiness Testing.
    d. Functional and Performance Testing.
    e. Systemwide 120-Day Integration Period. Startup Schedule.
2. The contents and requirements pertaining to each section are described below. It is expected that each section could require multiple volumes, depending on the size and complexity of the Work.
3. Overall Startup Plan Summary:
    a. The Overall Startup Plan Summary is the master startup plan document. It includes a brief summary of all testing and startup activities and provides the basic organization of the startup and testing program. It shall be submitted in advance of any other test plans except for Factory Acceptance Test Plans as described herein.
    b. The Overall Startup Plan Summary shall include the following:
        1) Introduction with a narrative description of the overall testing and startup program planned for implementation by the Contractor. Tables and flowcharts in addition to those described

below should be included to clearly illustrate the Contractor's intent for the testing and startup program.

2) List of major Acceptance Test Plan categories. Factory Acceptance Testing shall be a specific subset for each category. At a minimum, a separate acceptance test plan shall be prepared for the following four categories:
   a) All PIC and DCS testing specified in Division 40, Process Integration, of the specifications and including all related testing referring to Division 40 from other specification sections and divisions.
   b) All electrical testing specified in Division 26, Electrical, of the specifications and including all related testing referring to Division 26, Electrical, from other specification sections and divisions.
   c) All hydrostatic testing of piping and appurtenances, pipelines, aqueducts, valves, water holding structures, pressure vessels, tanks, and any other component, subsystem, or system specified to be hydrostatic or pressure tested.
   d) Unless otherwise indicated in the Contract Documents, all other testing.

c. In addition to the breakdown listed above, the Contractor may propose to further divide, or group, the testing into categories assigned by process area or physical site delineation. However, said division or grouping must be agreed to, in writing, by the Construction Manager prior to the initial submittal of the Overall Startup Plan Summary. The Construction Manager will be the sole judge as to the acceptability of the additional division or grouping of testing proposed by the Contractor.
   1) Complete listing of component, subsystem, and system tests within each Test Plan category. Special focus should be placed on a complete listing of tests for all major equipment items and all auxiliary systems identified in the Contract Document. In any case, all components, sub-systems, and systems and their associated testing shall be included in the listing.
   2) Complete listing of Factory Acceptance Testing (witnessed and unwitnessed). All specified Factory Acceptance Testing will be required to be successfully completed to achieve Substantial Completion. It may be to the Contractor's benefit to obtain concurrence on the listing of Factory Acceptance Testing early in the project. In that case, this section would simply be a copy of the material already agreed to, with any updates.
   3) Flowchart the full testing program from Factory Acceptance Testing and initial shakedown through Acceptance Testing and ending at Substantial Completion. The flowchart shall demonstrate the precedence, or order, by which the testing will

take place. The order of testing shall be such that it is consistent with the requirements of the Contract Documents.

4) Provide a preliminary schedule illustrating the timeline associated with the flowchart described above. This schedule does not need to be CPM based as it will be replaced with schedules developed according to requirements stated below for the Startup Schedule.

4. Factory Acceptance Test Plan:
   a. The Factory Test Plan shall be a comprehensive description of the complete test setup, procedures, analyses, and reporting program for each factory test required for the Work. Detailed step by step procedures describing all activities in the test process shall be included for all factory tests, witnessed or unwitnessed. Unwitnessed readiness tests prior to witnessed PIC Factory Acceptance Test are exempt from this requirement. However, all other shop or factory tests, witnessed, or unwitnessed, that require testing to demonstrate compliance with the Contract Documents and require submittal of test results, must have a Factory Acceptance Test Plan accepted by the Engineer and Construction Manager at least 4 weeks prior to the test.
   b. At a minimum, the following shall be included for each Factory Acceptance Test Plan:
      1) Identification information for the component, subsystem, or system being tested. All applicable tag numbers shall be included.
      2) A narrative description of the purpose and goals of the test.
      3) Pass/Fail criteria.
      4) A listing and copy of all pertinent reference documents (Contract Documents and industry standards or specifications applicable to the testing).
      5) Complete description, including drawings, for all test stands and/or test apparatuses.
      6) Credentials of test personnel.
      7) Descriptions of all test equipment.
      8) Descriptions and product information, including calibration certificates, for all test instruments.
      9) Step-by-step detailed procedures of how the test will be conducted. The level of detail shall be sufficient for any witness with a rudimentary technical aptitude to be able to follow the steps and develop confidence that the tests were being performed as planned. All steps are significant, and all steps shall be included in the procedures.
      10) Copies of the actual data logs and/or data recording forms that will be used for the test.
      11) A complete disclosure of all calculation methodologies.
      12) Sample computations or analyses with results in the same format as the final report. This item is intended to demonstrate

how data collected will be used to generate final results. A sample shall be included for each type of computation required for the test and analysis of results.

13) A detailed outline of the final factory testing report.

c. Each factory test shall be described separately. Factory Acceptance Test Plans are the only portion of the Startup and Test Plans that will be accepted prior to acceptance of the Overall Startup Plan Summary. Also, Factory Acceptance Test Plans will be allowed to be submitted and reviewed individually. However, the Overall Startup Plan Summary is required to summarize the factory testing program and all submittal numbers for individually submitted Factory Acceptance Test Plans shall be accurately accounted for in that document.

d. This section is not intended to supersede the specific requirements for PIC/DCS Factory Acceptance Tests (FATs) described for the Work. However, Factory Acceptance Test Plans shall be provided for the PIC/DCS FATs in accordance with these requirements. In the case of conflict, the specific testing requirements of the FATs in the PIC/DCS specification sections shall prevail. All other Factory Acceptance Testing Plans shall strictly comply with this section unless otherwise approved by the Construction Manager.

D. Contractor shall execute these test plans with the witnessing of the Construction Manager and/or Engineer and/or Owner.

E. For startup and testing purposes, the following designations are made:

1. Main Unit Processes:
   a. High Purity Oxygen.
   b. Screening Facility.
   c. Influent and Overflow Sewer System.
   d. DCS/Control:
      1) DCS with UPS.
      2) Instruments.
      3) Interconnection and control cables/wiring.
      4) Appurtenant communication and interconnection devices and equipment.
      5) Fiber Optic Communications Systems.

2. Auxiliary Systems:
   a. Main Piping:
      1) Associated main discharge pipe valves and piping out to NCWRP, and other facility interfaces
      2) Yard piping.
      3) Appurtenant instruments, devices, valves, and piping.
   b. Building Systems (all structures, as applicable):
      1) Bridge cranes.

2) Hoists.
3) HVAC.
4) Potable water.
5) Non-potable utility water.
6) Lighting.
7) Sump pumps.
8) Miscellaneous instruments and devices (i.e., flood switches).

c. Corrosion Control: Coating materials.

d. Landscaping:
1) Controllers.
2) Appurtenant instruments, devices, valves, sprinklers, and piping.

e. Security Systems:
1) Access control devices.
2) Cameras.
3) Door and Hatch Switches
4) Other security devices.

f. Fire Protection:
1) Automatic call systems.
2) Detection devices.
3) Fire protection devices.

F. Contractor shall submit the completed test reports as part of the Startup Results Submittal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL STARTUP AND TESTING REQUIREMENTS

A. Contractor is responsible for the complete testing, check out, startup, and commissioning of all elements of the Facility. Verify these activities through daily inspection reports, test records/reports, onsite vendor certifications, specified testing, and by other appropriate means. Startup and Testing Plans and Test Reports shall include specific language to demonstrate that the requirements stated herein are planned, executed, and accomplished. The requirements below are complementary to those indicated elsewhere in the Contract Documents.

B. Engineer and Construction Manager shall be solely responsible for determining the party responsible for conducting any and all corrective actions and for determining the party responsible for any and all delays.

C. Facility Startup Meetings:

1. Schedule and attend a minimum of twenty facility startup meetings. The first of such meetings shall be held prior to submitting Facility Startup Plan and shall include preliminary discussions regarding such plan.
2. Agenda items shall include, but not limited to, content of Facility Startup Plan, coordination needed between various parties in attendance, and potential problems associated with startup.
3. Attendees will include:
    a. Contractor.
    b. Contractor's designated quality control representative.
    c. Subcontractors and equipment manufacturer's representatives whom Contractor deems to be directly involved in facility startup.
    d. Construction Manager.
    e. Engineer's Representative.
    f. Owner's operational personnel.
    g. Others as required by Contract Documents or as deemed necessary by Contractor or City.

D. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.

E. Owner will:

1. Provide water, power, chemicals, and other items as required for startup, unless otherwise indicated.
2. Operate process units and facility with support of Contractor.
3. Provide labor and materials as required for laboratory analyses.

3.2 FACTORY ACCEPTANCE TESTING

A. Contractor shall coordinate the timing and location of all Factory Acceptance Testing (FAT) including, but not limited to the following items:

1. High Purity Oxygen
2. Screens
3. Vertical Turbine Pumps
4. Any other systems containing PLC's or complex control panels as identified by the Construction Manager.

B. The JTG will prepare the test plans for each FAT or review manufacturer standard test plans in accordance with these Contract Documents. The Contractor's Startup Manager shall be the lead representative for the development of these test plans.

C. The following Contractor personnel are required to attend all FATs:

1. Startup Manager.
2. Project Integrator.
3. Manufacturer Representative(s).

3.3 STAGING SITE DEMONSTRATION

A. The DCSP shall provide the required items for the development of the application software programming.

3.4 MANUFACTURER'S INSTALLATION INSPECTION

A. When Contractor has completed installation of components, systems, or subsystems, they shall schedule a manufacturer inspection. This manufacturer or approved manufacturer's representative shall certify that the component, system, or subsystem is properly installed and that testing of the component, system, or subsystem may commence.

B. Preparation:

1. Complete installation before testing.
2. Furnish qualified manufacturers' representatives, when required by individual Specification sections.
3. Obtain and submit from equipment manufacturer's representative Manufacturer's Certificate of Proper Installation Form, in accordance with Section 01 43 33, Manufacturers' Field Services, when required by individual Specification sections.
4. Cleaning and Checking:
    a. Prior to beginning functional testing:
        1) Calibrate testing equipment in accordance with manufacturer's instructions.
        2) Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
        3) Lubricate equipment in accordance with manufacturer's instructions.
        4) Turn rotating equipment by hand when possible to confirm that equipment is not bound.
        5) Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
        6) Check power supply to electric-powered equipment for correct voltage.
        7) Adjust clearances and torque.
        8) Test piping for leaks.
5. Ready-to-test determination will be by Engineer and Construction Manager based at least on the following:
    a. Acceptable Operation and Maintenance Data.
    b. Notification by Contractor of equipment readiness for testing.
    c. Receipt of Manufacturer's Certificate of Proper Installation, if so specified.
    d. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.

e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
f. Satisfactory fulfillment of other specified manufacturer's responsibilities.
g. Equipment and electrical tagging complete.
h. Delivery of all spare parts and special tools.

3.5 MECHANICAL/ELECTRICAL FUNCTIONAL TESTING

A. After each mechanical system is completely installed, the Contractor shall confirm proper installation according to these Contract Documents. Mechanical system testing shall include, but not be limited to the following system types:

1. Piping (buried and exposed).
2. HVAC systems.
3. Freestanding tanks.
4. Pumps, Motors, and Drives

B. After the complete installation of electrical systems (or portions thereof), the Contractor shall conduct all testing, including the independent electrical testing, as specified in Division 26, Electrical.

3.6 OPERATIONAL READINESS TEST PART 1

A. This work shall consist of manual verification of controls, verification of instrument calibration, and the completion of all loop checks.

B. The Operational Readiness Test Part 1 shall be performed by the PIC Integrator to test and document the PIC, excluding DCSP provided applications software, is ready for operation.

3.7 OPERATIONAL READINESS TEST PART 2

A. The Operational Readiness Test shall be a coordinated effort between the Contractor, PIC System Integrator, and DCSP to confirm the PIC, including the applications software is ready for operation. This testing is described in Division 40, Process Interconnections.

3.8 FUNCTIONAL TESTING ON UNIT PROCESSES

A. Functional Testing shall include successful completion of all specified testing and related work required by the Contract Documents. Successful Functional Testing will demonstrate that all portions of the unit processes or auxiliary systems are functional, operational, installed as specified, and perform their intended function.

B. Demonstration of the ability of all portions of the facilities to successfully operate, as specified, over their full range of capacity or capability is required as part of Functional Testing. Functional Testing shall include all balancing,

adjustments, specified tests (both factory and field), tuning, and startup activities not included in Performance Testing.

C. Functional testing shall be performed using the process flow stream indicated in Attachment 2.

D. Functional Testing shall include testing of all specified shutdown conditions, failure conditions, pumping station power fail and restart, bypass conditions, and failure resets. Functional Testing shall include all equipment testing for operating parameters. Functional Testing shall not be considered complete until all testing produces successful results and all documentation of tests and all manufacturer's certifications required by the Contract Documents are submitted and accepted by the Construction Manager. Functional Testing shall be successfully completed prior to conducting and Performance Testing or Facility Commissioning.

E. Equipment Testing shall be conducted as part of Functional Testing.

1. Furnish the services of an experienced and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedules (excluding manually-operated valves smaller than 24 inches in size, injectors, tanks, batch-type disc meters, rotameters, and other minor items of equipment specifically exempted by the Engineer or Construction Manager in writing), who shall visit the Site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, arrange to have the supplier or manufacturer's representative revisit the Site as often as necessary until any and all trouble is corrected, and the equipment installation and operation are satisfactory to the Construction Manager.
2. Contractor shall require that each manufacturer's representative furnish to the Construction Manager a written report addressed to the City certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts and has been operated satisfactorily over its full range of capability and under full-load conditions.
3. Contractor shall require that the electrical and/or instrumentation subcontractor and the adjustable speed drive supplier furnish a written and signed report to the Construction Manager certifying that the motor control logic for the equipment items that reside in motor control centers, control panels, control boards, microprocessors, computers, and the like furnished by the electrical and/or instrumentation Subcontractor have been properly tested and calibrated. The report shall certify that the control logic for equipment startup, shutdown, sequencing, resets, interlocks, and emergency shutdown has been tested and is properly operating. The Contractor shall also sign said certification.

3.9 EQUIPMENT PERFORMANCE TESTING

A. Testing specified within specific equipment specifications to verify performance requirements of a piece of equipment.

B. This testing shall be performed by the equipment supplier with support from the Contractor.

C. The method for testing to validate the performance requirements shall be provided in submitted and approved test plan submittals.

3.10 SYSTEM PERFORMANCE TESTING

A. Testing of the defined main unit process systems over the specified period of time to demonstrate that the unit process is fully operation and meets all specifications, performance objectives and Contract requirements.

B. Complete the performance testing of each upstream unit process prior to performance testing of a downstream unit process in order to provide each unit process with the required influent water quality conditions for operation.

C. Submit a performance testing plan that incorporates the sequences and water supplies shown in Attachment 1 and provide temporary connections as required for the testing operations indicated.

D. Each unit process system shall continuously meet performance requirements specified and shall operate without fault, failure, or defect for a continuous period.

1. Individual equipment/system failures that are corrected within 24 hours and do not prevent the entire process from continuously satisfying the established operational requirements shall not require the consecutive-day test to be restarted unless the failure recurs.
2. Restart the consecutive test period for any of the following conditions:
    a. Any failure of the complete unit process system to meet operational requirements.
    b. When malfunctions or deficiencies cause shutdown or partial operation of the unit process system.
    c. Any individual equipment/system failure that meets any of the following conditions:
        1) Requires more than 24 hours to correct.
        2) Recurs within the 24-hour correction period requiring further correction.
    d. Immediately correct defects in material, workmanship, or equipment/system which became evident during Performance Testing.

E. Performance Testing Requirements and Durations.

1. Conduct tests as specified in this Section and as required in the process startup specification sections for each main unit process system. As indicated in Attachment 1, unless otherwise approved by the Construction Manager, performance testing will commence upon completion of the increase of flow to the NCWRP.
2. Main Unit Process Tests. – 7 continuous days
3. The specified test duration represents the continuous operation of the system.

F. Temporary Facilities.

1. Install temporary piping, valves, hoses, supports and materials as required for testing.
2. Permanent facilities use potable water for various processes,

3.11 FACILITY COMMISSIONING

A. Facility Commissioning Testing:

1. The disciplined and systematic process of assuring that all components, subsystems and systems of a constructed unit are designed, installed, tested and operated in conformance with the design intent, and functional intent and operational requirements of the Owner.
2. Notify Construction Manager, Engineer and Owner in writing at least 10 days prior to scheduled date of test.
3. Commissioning shall not commence until equipment has been accepted by Construction Manager and Engineer as having satisfied performance test requirements specified.
4. Type of fluid, gas, or solid for testing shall be as specified.
5. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking samples and performance measurements.
6. Prepare Test Reports summarizing test method and results.
7. When, in Construction Manager's and Engineer's opinion, the integrated facility operates as specified and is accepted as to conforming to Contract requirements. Such acceptance will be evidenced by Construction Manager's and Engineer's signature on Facility Commissioning Report.

3.12 TRAINING

A. All components, systems, or subsystems require separate training by the manufacturer.

B. Training for each component, system, or subsystem shall be a minimum of 4 hours if no specific requirements are described in the individual specification sections.

C. All training shall be requested at least 14 days in advance of proposed training date.

1. Proposed training shall be requested by the Contractor in an acceptable format including the following information as a minimum:
   a. Description of training.
   b. Name and contact information of trainer.
   c. Location of training.
   d. Proposed date.
   e. Alternative dates (if applicable).
   f. Proposed start time.
   g. Proposed duration.
   h. Proposed detailed agenda including topics, times, breaks, etc.

D. All training shall be scheduled through the Construction Manager.

E. If suitable training facilities are not available at the Facility, Contractor shall arrange and pay for training offsite.

3.13 INTEGRATION PERIOD TESTING

A. A 120-Day time period commencing 120 days after Intermediate Substantial Completion during which the overall Pure Water Program system will be tested and operated, including the Morena Conveyance, the NCWRP Expansion, NCPWF Influent Pump Station and Conveyance, NCPWF the Metropolitan Biosolids Center Improvements, the NCPW Pump Station and the NCPWPL, and Dechlorination Facilities. The project milestone for the commencement of the 120 Day Integration Period is 120 days after Intermediate Substantial Completion. The overall logic of the 120-Day Integration Period is shown on Attachment 1 – Phase 1 Commissioning Model.

B. The testing during this period shall be led by the Construction Manager (CM). The JTG shall support the CM in the development of the test plans and in the Integration Period testing process.

C. The costs for the support during the Integration Period shall be covered under a lump sum Bid Item

D. Successful completion of the Integration Period testing shall be a prerequisite to Substantial Completion.

E. The Contractor is advised that the entire time between Intermediate Substantial Completion and Substantial Completion will be considered the Integration Period, even though the NCPWF Acceptance Test is not expected to be conducted until sometime during the later portion of the period. All Work applicable to the period between Intermediate Substantial Completion and Substantial Completion shall

apply to all activities conducted during that period whether specifically designated for any particular activity or not.

F. The Contractor shall provide personnel on a 3-shift, 24-hour per day basis to maintain the Work as directed by the Construction Manager during the Integration Period. The Contractor shall provide a minimum of 2 persons (actual distribution to be as directed by the Construction Manager) for each 8-hour shift. This coverage shall be for 24 hours per day, 7 days per week for the full duration of the period unless otherwise designated by the Construction Manager. Personnel shall be properly trained, experienced, and qualified to maintain the Work. The Contractor shall submit credentials of said personnel demonstrating proper training and qualifications. The Construction Manager shall be the sole judge as to the suitability of the personnel to be provided.

G. An estimated quantity of 5760 hours has been allocated for the designated maintenance personnel during the Integration Period at the hourly rate of the Contractor's support staff. Time paid for these maintenance personnel will be verified and approved by the Construction Manager.

H. Construction Manager may elect to increase or decrease the number of maintenance personnel to be provided at any time during the Integration Period.

I. Contractor shall maintain the Work as directed by the Construction Manager. Flow rates, delivery locations, equipment used, and other related operational aspects of the system shall be closely coordinated with the Construction Manager and the City.

J. Contractor shall keep on 24-hour standby and provide all crews, materials, and equipment required to repair, replace adjust, balance, modify and provide other services as may be required to immediately correct all failures or malfunctions of any kind.

K. In addition to maintenance personnel, Contractor shall keep on standby and provide technicians who were actually involved in the installation of the local fiber optic/DCS network, serial links, instruments, and all control wiring at the various facilities included in the Work. A minimum of two technicians shall be onsite 8 hours per day, 6 days per week, during the Integration Period and on call 24 hours per day, 7 days per week. All technicians used during the Period shall have a thorough understanding of the system and be capable of taking corrective action as may be needed.

L. Authorized representatives of equipment suppliers or manufacturers shall certify that all corrective actions for all defects, malfunctions, faulty equipment operation, calibration, adjustment, or related flaws are complete and acceptable.

3.14 FACILITY ACCEPTANCE TEST

A. The Facility Acceptance Test, commencing immediately upon completion of the 120-Day Integration Period as shown on Attachment 1, shall be a 30-day operational run of the completed systems demonstrating that all portions of the facility operate continuously as intended.

B. All aspects of the Work and all Project facilities must be functional and operate in automatic mode 24 hours per day, 7 days per week during the acceptance test at varying flow rates established by the Construction Manager.

C. Unless indicated otherwise, if any item fails or malfunctions during the test, the item shall be repaired, and the test restarted at time zero with no credit given for the operating time before the aforementioned failure or malfunction. Malfunctions meeting all of the following conditions, in the opinion of the Owner/Construction Manager, will not be considered grounds for restarting the test at time zero:

1. Malfunctions that do not cause any interruption of the continuous operation of any other components, subsystems, systems, and equipment during the acceptance test.
2. Malfunctions that are corrected without causing or requiring any components, subsystems, systems, and equipment to cease operations during the acceptance.
3. Malfunctions that are corrected properly and permanently, in the opinion of the Owner and Construction Manager, within 4 hours of the time the malfunction is detected (the 4-hour period includes the time required to locate the cause of the malfunction and shall begin upon Contractor's notification from the Construction Manager that a malfunction exists and shall end when the item is corrected and the system is successfully placed back into operation).

D. Time lost during the test for equipment repairs, wiring corrections, control point settings, or other reasons that are not determined by the Construction Manager to be grounds to restart the test shall be justifiable cause for extending the test duration by an amount of time equal to the time required to repair the problems.

E. Operation of the system for the acceptance test shall be conducted on a schedule or plan of operations developed by the JTG and supported by Contractor as specified. The Contractor shall provide personnel to operate the Work and support said testing activities to be performed jointly with the Construction Manager in accordance with a test plan prepared by the JTG.

F. During the test, furnish the services of authorized representatives of the manufacturers, in addition to those services required in support of other testing, as necessary, to correct faulty equipment operation, calibration, adjustment, or related flaws.

G. Contractor's acceptance test personnel shall include qualified representatives for the electrical and instrumentation crews as indicated for Acceptance Testing.

H. The Contractor's warrantee period.

3.15 WITNESSING AND SUPERINTENDENCE

A. The Engineer, Owner, Construction Manager, and others as necessary shall be allowed to witness all testing conducted during any phase of startup.

B. The Contractor shall maintain overall superintendence of the Work during all phases of startup.

C. The Contractor shall promptly and permanently repair damage to any portion of the Work during startup and testing.

1. All repair work shall be performed by the manufacturer or with manufacturer's approved published methods.

D. The Contractor shall perform all scheduled maintenance in strict compliance with manufacturers' published procedures and with products acceptable to manufacturers.

E. Authorized representatives of equipment suppliers or manufacturers shall certify that all corrective actions for all defects, malfunctions, faulty equipment operation, calibration, adjustment, or related flaws are complete and acceptable.

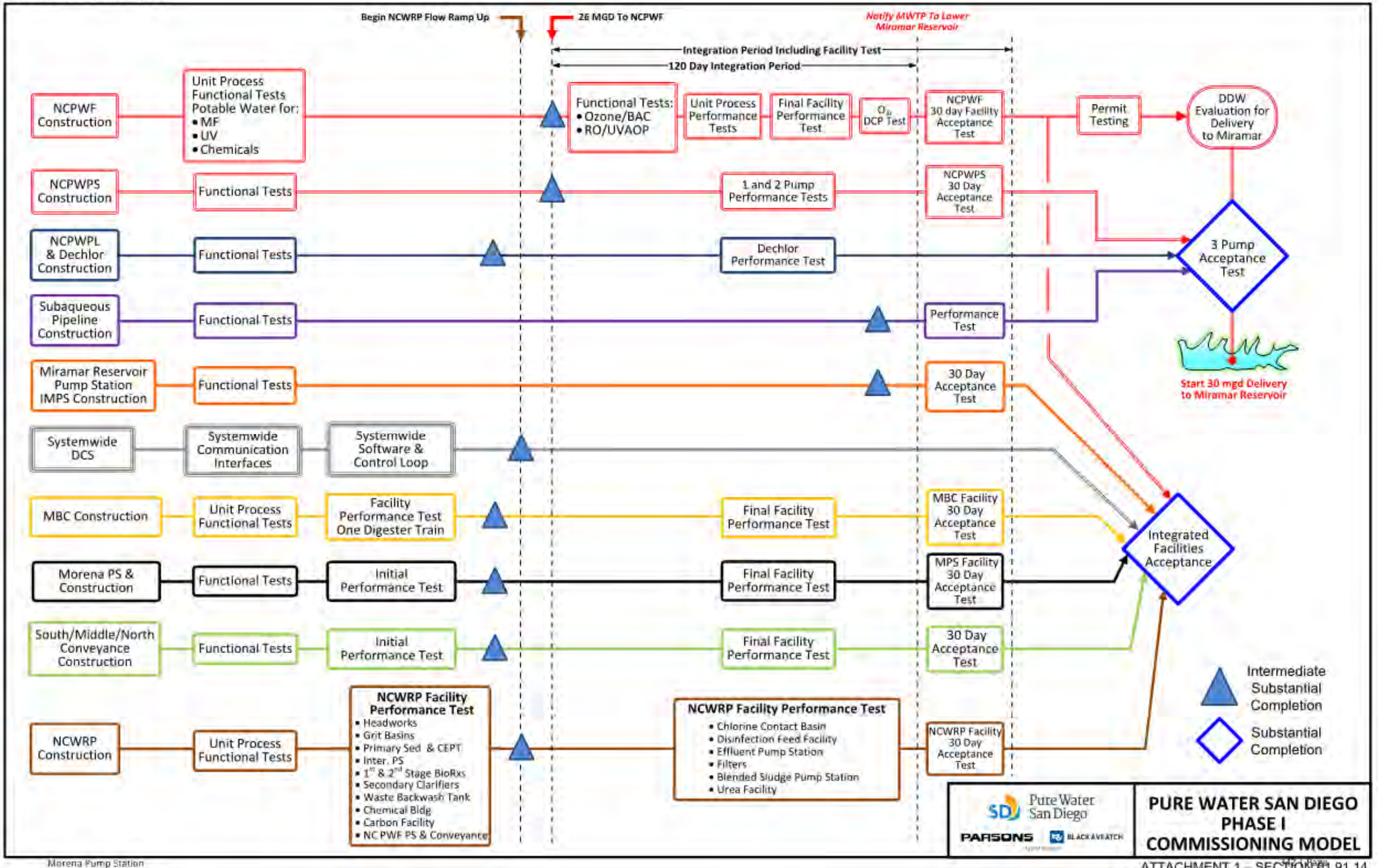
F. The Contractor shall keep on 24-hour local standby and provide all crews, materials, and equipment required to repair, replace adjust, balance, modify and provide other services as may be required to immediately correct all failures or malfunctions of any kind.

3.16 SUPPLEMENT

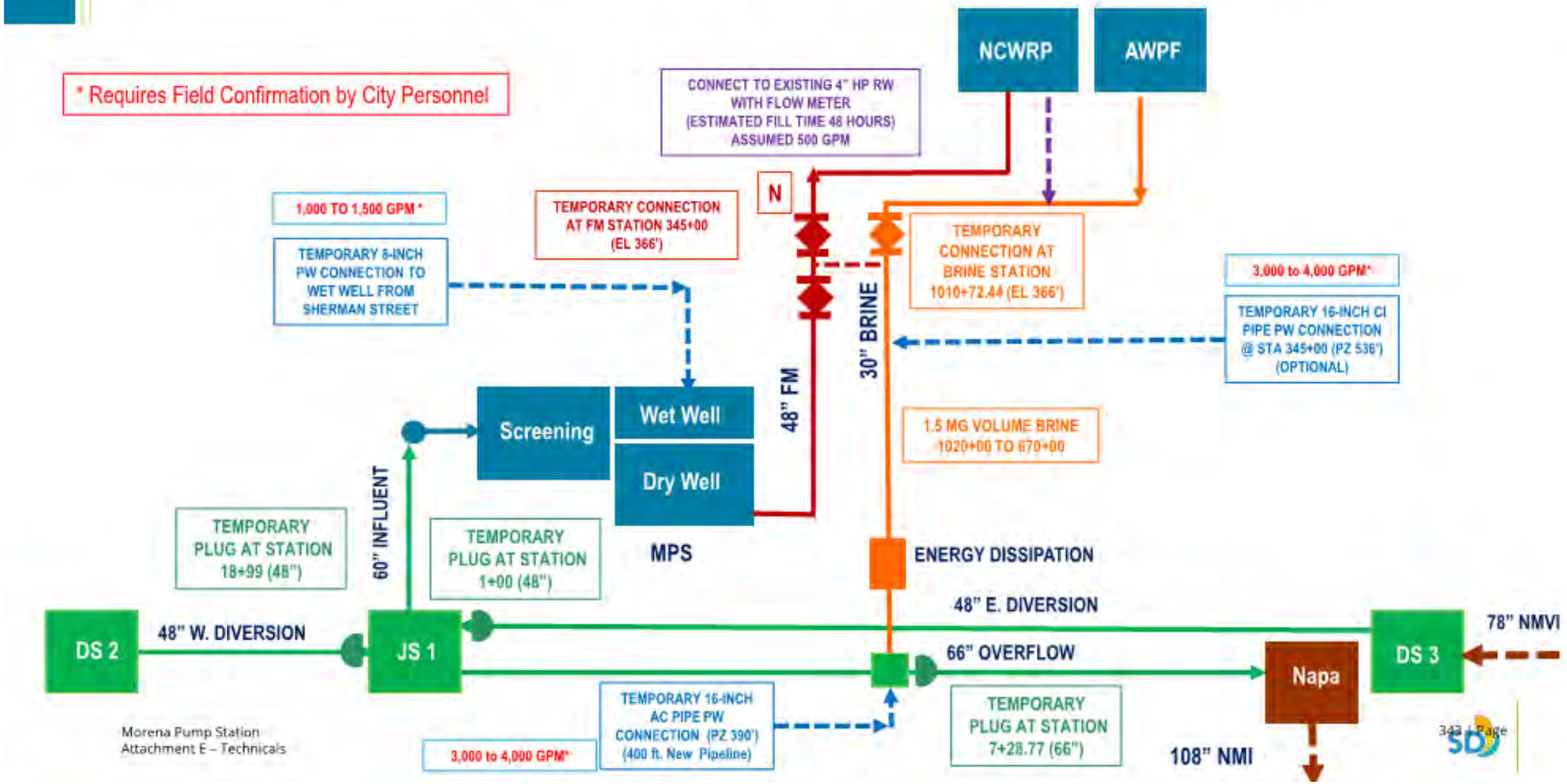
A. The supplement listed below, following "End of Section," is part of this Specification.

1. Attachment 1, Phase 1 Commissioning Model
2. Attachment 2, Proposed MPS Testing System Schematic

END OF SECTION


Begin NCWRP Flow Ramp Up
26 MGD To NCPWF
Notify MWTP To Lower Miramar Reservoir
Integration Period Including Facility Test
120 Day Integration Period
NCPWF Construction
Unit Process Functional Tests Potable Water for: • MF • UV • Chemicals
Functional Tests: • Ozone/BAC • RO/UVAOP
Unit Process Performance Tests
Final Facility Performance Test
O_3 DCP Test
NCPWF 30 day Facility Acceptance Test
Permit Testing
DDW Evaluation for Delivery to Miramar
NCPWPS Construction
Functional Tests
1 and 2 Pump Performance Tests
NCPWPS 30 Day Acceptance Test
NCPWPL & Dechlor Construction
Functional Tests
Dechlor Performance Test
3 Pump Acceptance Test
Subaqueous Pipeline Construction
Functional Tests
Performance Test
Miramar Reservoir Pump Station IMPS Construction
Functional Tests
30 Day Acceptance Test
Start 30 mgd Delivery to Miramar Reservoir
Systemwide DCS
Systemwide Communication Interfaces
Systemwide Software & Control Loop
MBC Construction
Unit Process Functional Tests
Facility Performance Test One Digester Train
Final Facility Performance Test
MBC Facility 30 Day Acceptance Test
Integrated Facilities Acceptance
Morena PS & Construction
Functional Tests
Initial Performance Test
Final Facility Performance Test
MPS Facility 30 Day Acceptance Test
South/Middle/North Conveyance Construction
Functional Tests
Initial Performance Test
Final Facility Performance Test
30 Day Acceptance Test
Intermediate Substantial Completion
Substantial Completion
NCWRP Construction
Unit Process Functional Tests
NCWRP Facility Performance Test
• Headworks
• Grit Basins
• Primary Sed & CEPT
• Inter. PS
• 1st & 2nd Stage BioRxs
• Secondary Clarifiers
• Waste Backwash Tank
• Chemical Bldg
• Carbon Facility
• NC PWF PS & Conveyance
NCWRP Facility Performance Test
• Chlorine Contact Basin
• Disinfection Feed Facility
• Effluent Pump Station
• Filters
• Blended Sludge Pump Station
• Urea Facility
NCWRP Facility 30 Day Acceptance Test
Pure Water San Diego
PARSONS
BLACK & VEATCH
PURE WATER SAN DIEGO PHASE I COMMISSIONING MODEL

PROPOSED MPS TESTING SYSTEM SCHEMATIC



SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.1 REFERENCES

A. The requirements and specifications identified in the following report is made a part of these specifications and included as supplementary special provisions section 2-15.

1. Inspection Report Asbestos, Lead, and Universal Waste for Humane Society (Facility 950405), Demolition for Pump Station Project, dated July 13, 2018.

B. The following is a list of standards which may be referenced in this Section:

1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): Guideline K, Containers for Recovered Non-flammable Fluorocarbon Refrigerants.
2. American National Standards Institute (ANSI): A10.6, Safety Requirements for Demolition Operations.
3. Occupational Safety and Health Administration (OSHA), U.S. Code of Federal Regulations (CFR) Title 29 Part 1926—Occupational Safety and Health Regulations for Construction.
4. Environmental Protection Agency (EPA), U.S. Code of Federal Regulations (CFR), Title 40:
   a. Part 61—National Emission Standards for Hazardous Air Pollutants.
   b. Part 82—Protection of Stratospheric Ozone.
   c. Part 273—Standards for Universal Waste Management.

1.2 DEFINITIONS

A. ACM: Asbestos-containing material

B. Demolition: Dismantling, razing, destroying, or wrecking of any fixed building or structure or any part thereof. Demolition also includes removal of pipes, manholes tanks, conduits, all ancillary components, and other underground or above grade facilities, whether as a separate activity or in conjunction with construction of new facilities.

C. Modify: Provide all necessary material and labor to modify an existing item to the condition indicated or specified.

D. Relocate: Remove, protect, clean and reinstall equipment, including electrical, instrumentation, and all ancillary components required to make the equipment fully functional, to the new location identified on the Drawings.

E. Renovation: Altering a facility or one or more facility components in any way.

F. Salvage/Salvageable: Remove and deliver, to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property to remain that of Owner. Unless otherwise specified, title to items identified for demolition shall revert to Contractor.

G. Universal Waste Lamp: In accordance with 40 CFR 273, the bulb or tube portion of an electric lighting device, examples of which include, but are not limited to, fluorescent, high-intensity discharge, neon, mercury vapor, high-pressure sodium, and metal halide lamps.

H. Universal Waste Thermostat: A temperature control device that contains metallic mercury in an ampule attached to a bimetal sensing element, and mercury-containing ampules that have been removed from these temperature control devices in compliance with the requirements of 40 CFR 273.

1.3 SUBMITTALS

A. Informational Submittals:

1. Submit proposed Demolition/Renovation Plan, in accordance with requirements specified herein, for approval before such Work is started.
2. Submit copies of any notifications, authorizations and permits required to perform the Work.
3. Copies of reports and other documentation required for abandoning wells.
4. Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped.
5. Submit a shipping receipt or bill of lading for all containers of ACM shipped.
6. Submit a shipping receipt or bill of lading for all universal waste shipped.
7. Submit all items as required by the Inspection report for Asbestos, Lead, and Universal Waste for Humane Society.

1.4 REGULATORY AND SAFETY REQUIREMENTS

A. When applicable, demolition Work shall be accomplished in strict accordance with 29 CFR 1926-Subpart T.

B. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the General Conditions, Contractor's safety requirements shall conform to ANSI A10.6.

C. Furnish timely notification of this demolition project to applicable federal, state, regional, and local authorities in accordance with 40 CFR 61-Subpart M.

1.5 DEMOLITION PLAN

A. Demolition Plan shall provide for safe conduct of the Work and shall include:

1. Detailed description of methods and equipment to be used for each operation;
2. The Contractor's planned sequence of operations, including coordination with other work in progress;
3. Procedures for removal and disposition of materials specified to be salvaged.
4. Disconnection schedule of utility services.

B. Include statements affirming Contractor inspection of the existing roof deck, floors, walls, and framing members, and their suitability to perform as a safe working platform or, if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the Work.

1.6 SEQUENCING AND SCHEDULING

A. The Work of this Specification shall not commence until Contractor's Demolition Plan has been approved by Engineer.

B. Include the Work of this Specification in the progress schedule, as specified in Section 01 32 00, Construction Progress Documentation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE DEMOLISHED

A. Facilities:

1. Buildings and adjacent designated areas scheduled for complete demolition are as shown on the Drawings.
2. All buildings and all ancillary items above grade or below grade within the property lines designated for the Morena Pump Station project, shall

be demolished, hauled and disposed off-site in accordance with the approved Contractor's demolition plan.

B. Structures:

1. Existing above-grade structures indicated shall be removed entirely including all of the foundation, including interior walls, retaining walls and partitions
2. Sidewalks, curbs, gutters, landscaping, and street light bases shall be removed as indicated.

C. Utilities and Related Equipment:

1. Notify Owner Representative and appropriate utilities to turn off affected services at least 72 hours before starting demolition activities.
2. Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by Engineer.
3. When utility lines are encountered that are not indicated on the Drawings, notify Owner Representative prior to further work in that area.
4. Remove meters and related equipment and deliver to a location as determined by Owner's Representative.
5. Excavate and remove utility lines serving buildings to be demolished to a distance of 10 feet beyond the outside perimeter of the demolition, or as approved by the Construction Manager.
6. Provide a permanent leak-proof closure for water and gas lines.
7. Plug sewer lines with concrete to a minimum plug length of 3 feet to prevent groundwater infiltration.

D. Paving and Slabs:

1. Remove concrete and asphaltic concrete paving and slabs entirely**.**
2. Provide neat saw cuts at limits of pavement removal as indicated.

E. Concrete:

1. Core drill corners of new opening to avoid overcutting adjacent reinforcing in existing concrete to remain. Saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished Work, and the remaining concrete is sound.

2. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Repair exposed rebar ends and embeds as shown on Drawings.
3. Where new concrete adjoins existing concrete, thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 3/16 inch. Rebar and small embeds at existing concrete may be required to be left to engage new concrete. Saturate surface with water for 24 hours prior to placing new concrete. The new Work shall tie into the existing construction as shown on Drawings.
4. At submerged locations not to receive new concrete, paint exposed rebar or metal embed ends per Section 09 90 00, Painting and Coating.

F. Patching:

1. Where removals leave holes and damaged surfaces exposed in the finished Work, patch and repair to match adjacent finished surfaces as to texture and finish.
2. Where new Work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new Work.
3. Patching shall be as specified and indicated, and shall include:
   a. Fill holes and depressions left as a result of removals in existing ls with an approved patching material, applied in accordance with the manufacturer's printed instructions.

G. Air-Conditioning Equipment:

1. Remove air-conditioning equipment without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990.
2. Recover all refrigerants prior to removing air-conditioning equipment and dispose of as specified in Paragraph Ozone Depleting Substances (ODS).
3. Turn in salvaged Class I ODS refrigerants as specified in Article Salvaged Materials and Equipment.

H. Cylinders and Canisters: Remove all fire suppression system cylinders and canisters and dispose as specified in Paragraph Ozone Depleting Substances (ODS).

I. Door Locksets: Remove all locksets from all doors indicated to be removed and disposed of. Turn locksets over to Owner Representative immediately after their removal.

J. Electrical:

1. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 3/4 inch below final finished surface.
2. When removing designated equipment, conduit and wiring may require rework to maintain service to other equipment.
3. Rework existing circuits, or provide temporary circuits as necessary during renovation to maintain service to existing lighting and equipment not scheduled to be renovated. Existing equipment and circuiting shown are based upon limited field surveys. Verify existing conditions, make all necessary adjustments, and record the Work on the Record Drawings. This shall include, but is not limited to, swapping and other adjustments to branch circuits and relocation of branch circuit breakers within panelboards as required to accomplish the finished work.
4. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated.
5. Raceways and cabling not scheduled for reuse.
6. Inaccessibly Concealed: Cut off and abandon in place.
7. Exposed or Concealed Above Accessible Ceilings: Remove.
8. Raceways and Cabling Scheduled for Future Use: Cap/seal and tag.
9. Relocating Equipment: Extend existing wiring or run new wiring from the source.
10. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover plate installed.
11. Where the concealed raceway is uncovered remove raceway (or extended to new location if appropriate).
12. Provide new typewritten panelboard circuit directory cards.

K. Universal Waste Lamps and Thermostats: Manage, contain, package, and label in strict accordance with 40 CFR 273.

3.2 PROTECTION

A. Dust and Debris Control:

1. Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.
2. Vacuum and dust the Work area daily.
3. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to vehicular traffic.

B. Traffic Control Signs: Where pedestrian and driver safety are endangered in the area of removal Work, use traffic barricades with flashing lights.

C. Existing Work:

1. Survey the site and examine the Drawings and Specifications to determine the extent of the Work before beginning any demolition or renovation.
2. Take necessary precautions to avoid damage to existing items scheduled to remain in place, to be reused, or to remain the property of Owner; any Contractor-damaged items shall be repaired or replaced as directed by Engineer.
3. Provide temporary weather protection during interval between removal of existing exterior surfaces and installation of new to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
4. Ensure that structural elements are not overloaded as a result of or during performance of the Work. Responsibility for additional structural elements or increasing the strength of existing structural elements as may be required as a result of any Work performed under this Contract shall be that of the Contractor. Repairs, reinforcement, or structural replacement must have Engineer approval.
5. Do not overload pavements to remain.

D. Weather Protection: For portions of the building scheduled to remain, protect building interior and materials and equipment from weather at all times. Where removal of existing roofing is necessary to accomplish the Work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent loss.

E. Trees: Protect trees within the Site that might be damaged during demolition and are indicated to be left in place, by a 6-foot-high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the Work shall be replaced in kind, as approved by the Engineer.

F. Facilities:

1. Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.
2. Floors, roofs, walls, columns, pilasters, and other structural elements that are designed and constructed to stand without lateral support or shoring, and are determined by Contractor to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Engineer.

3. Protect all facility elements not scheduled for demolition.
4. Provide interior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities.

G. Protection of Personnel:

1. During demolition, continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.
2. Provide temporary barricades and other forms of protection to protect Owner's personnel and the general public from injury due to demolition Work.
3. Provide protective measures as required to provide free and safe passage of Owner's personnel and the general public to occupied portions of the structure.

3.3 BURNING

A. The use of burning at the Site for the disposal of refuse and debris will not be permitted.

3.4 RELOCATIONS

A. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Clean all items to be relocated prior to reinstallation, to the satisfaction of Engineer. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by Engineer.

3.5 BACKFILL

A. Do not use demolition debris as backfill material.

B. Fill excavations, open basements and other hazardous openings to existing ground level or foundation level of new construction in accordance with Section 31 23 23, Fill and Backfill.

3.6 TITLE TO MATERIALS

A. All salvaged equipment and materials will remain the property of Owner.

3.7 DISPOSITION OF MATERIAL

A. Do not remove equipment and materials without approval of Contractor's Demolition Plan by Engineer.

B. Remove salvaged items in a manner to prevent damage, and pack or crate to protect the items from damage while in storage or during shipment. Properly identify containers as to contents.

C. Repair or replace, at the discretion of Engineer, items damaged during removal or storage.

D. Deliver salvaged items that are designated as the property of Owner to a storage site as directed within 15 miles of the Site.

3.8 REUSE OF MATERIALS AND EQUIPMENT

A. Remove and store materials and equipment listed in Article Title to Materials to be reused or relocated to prevent damage, and reinstall as the Work progresses.

B. Properly store and maintain equipment and materials in same condition as when removed.

C. Store equipment and material designated to be reused in a location designated by Owner's Representative.

D. Equipment and material designated to be reused shall be cleaned, serviced and checked for proper operability before being put back into service.

E. Engineer will determine condition of equipment and materials prior to removal.

3.9 SPECIALIZED SALVAGE

A. Ozone Depleting Substances (ODS):

1. Class I and Class II ODS are defined in Section 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling.
2. Dispose of all Class I and Class II ODS refrigerants in accordance with the Clean Air Act Amendment of 1990.
3. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g., residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

B. Fire Suppression Containers: Fire suppression system cylinders and canisters with electrical charges or initiators shall be deactivated prior to shipment.

Also, safety caps shall be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.10 UNSALVAGEABLE MATERIAL

A. Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of in the following manner and location.

1. City-approved Construction and Demolition Debris Landfill.

B. After disposal is completed, the disposal area shall be uniformly graded to drain.

C. Combustible material shall be disposed of in a City-approved Sanitary Landfill.

D. Universal Waste Lamps and Thermostats: Dispose of in strict accordance with 40 CFR 273.

3.11 CLEANUP

A. Debris and rubbish shall be removed from all excavations, and shall be transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

END OF SECTION

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 117, Specification for Tolerances for Concrete Construction and Materials.
   b. 301, Specifications for Structural Concrete.
   c. 318, Building Code Requirements for Structural Concrete and Commentary.

DEFINITIONS

B. Defective Areas: See definition in Section 03 30 00, Cast-in-Place Concrete.

C. Exposed Concrete: See definition in Section 03 30 00, Cast-in-Place Concrete.

DESIGN REQUIREMENTS

D. Design formwork in accordance with ACI 301 and ACI 318 to provide concrete finishes specified in Section 03 30 00, Cast-in-Place Concrete.

E. When high-range water reducer (superplasticizer) is used in concrete mix, form design shall account for increased hydrostatic pressures.

F. Joints in forms shall be watertight.

G. Limit panel deflection to 1/360th of each component span to achieve tolerances specified.

SUBMITTALS

H. Action Submittals:

1. Shop Drawings:
   a. Formwork drawings sealed by a licensed professional engineer, where required by state professional engineering regulations.
   b. Double Wall Construction (new wall placed against an existing wall): Drawings and details of double-wall forming and pre-molded joint filler attachment; refer to details shown on Drawings.

2. Product Data:
    a. Form release agent.
    b. Form ties.
    c. Products to be used for sealing tie holes.

I. Informational Submittals:

1. Statement of qualifications for formwork designer.

QUALITY ASSURANCE

J. Qualifications:

1. Formwork Designer: Where required by state professional engineering regulations, formwork, falsework, and shoring design shall be designed by an engineer licensed in the state of Project.

PART 2 PRODUCTS

FORM MATERIALS

A. Wall Forms and Underside of Slabs and Beams:

1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel in "new and undamaged" condition, of sufficient strength and surface smoothness to produce specified finish.
2. Where steel forms are used, treat steel surfaces to prevent rusting using products approved for use on steel forms.

B. Column Forms:

1. Rectangular Columns: As specified for walls.
2. Circular Columns: Fabricated steel or fiber-reinforced plastic with bolted sections or spirally wound laminated fiber form. Internally treat with release agent for full height of column.

C. Sandblasted Surface Forms: Medium density overlay plywood for flat concrete surfaces to be sandblasted.

D. Painted Surface Forms: High-density overlay plywood for flat concrete surfaces to be painted.

E. All Other Forms: Materials as specified for wall forms.

ACCESSORIES

F. Form Release Agent:

1. Material:
   a. Shall not bond with, stain, or adversely affect concrete surfaces.
   b. Shall not impair subsequent treatments of concrete surfaces when applied to forms.
   c. Ready-to-use water-based material formulated to reduce or eliminate surface imperfections.
   d. Contain no mineral oil or organic solvents.
2. Manufacturers and Products: Not for surfaces exposed to potable water.
   a. BASF, Shakopee, MN; MBT Master Finish RL 211.
   b. Cresset Chemical Company; Crete-Lease 20-VOC-Xtra.

G. Rustication Grooves and Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

H. Form Snap-Ties:

1. Material: Stainless steel.
2. Spreader Inserts:
   a. Conical or spherical type.
   b. Design to maintain positive contact with forming material.
   c. Furnish units that will leave no metal closer than 1.5 inches to concrete surface when forms, inserts, and tie ends are removed.
3. Wire ties not permitted.
4. Flat bar ties for panel forms; furnish plastic or rubber inserts with minimum 1.5-inch depth and sufficient dimensions to permit patching of tie hole.

I. Form Snap-Ties with Water Stop: For water-holding structures and all spaces below finish grade, furnish one of the following:

1. Integral steel waterstop 0.103-inch thick and 0.625-inch diameter tightly and continuously welded to tie.
2. Neoprene waterstop 3/16-inch thick and 15/16-inch diameter whose center hole is one half diameter of tie, or molded plastic water stop of comparable size.
3. Orient waterstop perpendicular to tie and symmetrical about center of tie.
4. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.

J. Through-Bolts:

1. At Contractor's option, may be used as alternate to form snap-tie or form snap-tie with waterstop.
2. Tapered minimum 1-inch diameter at smallest end.
3. Elastic Vinyl Plug for Through-Bolt Tie Holes:
    a. Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length and diameter upon removal; forms watertight seal.
    b. Manufacturers and Products:
        1) Dayton Superior, Miamisburg, OH; A58 Sure Plug.
        2) Greenstreak Group, Inc., St Louis, MO; X-Plug.

PART 3 EXECUTION

3.1 FORM SURFACE PREPARATION

A. Prior to coating surface, thoroughly clean form surfaces that will be in contact with concrete or that have been in contact with previously cast concrete, dirt, and other surface contaminants.

B. Exposed Wood Forms in Contact with Concrete: Apply form release agent as recommended by manufacturer.

C. Steel Forms: Apply form release agent as soon as they are cleaned to prevent discoloration of concrete from rust.

3.2 ERECTION

D. General: In accordance with ACI 301, unless otherwise specified.

E. Beveled Edges (Chamfer):

1. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
2. Where beveled edges on existing adjacent structures are other than 3/4 inch, obtain Engineer's approval of size prior to placement of beveled edge.

F. Wall Forms:

1. Do not reuse forms with damaged surfaces.
2. Locate form ties and joints in uninterrupted uniform pattern.
3. Inspect form surfaces prior to installation to ensure conformance with specified tolerances.

G. Double-Wall Construction (new wall cast against existing wall):

1. Joint Filler Attachment:

a. Use attachments to secure premolded joint filler to one wall only.
b. Secure premolded joint filler without gaps and separations keeping concrete from second wall pour from penetrating thickness and space occupied by premolded joint filler.

2. Do not use form ties or other devices permanently penetrating premolded joint filler between walls or produce a rigid connection between walls.
3. First cast wall shall obtain the greater of the wall design concrete strength or the construction strength required, as determine by form design engineer, prior to casting second wall. Strength determination shall be based on field cast and cured test cylinders.
4. Do not use formwork that leaks mortar.
5. Provide premolded joint filler or sealant to minimize transfer of movement from one structure to the other.

H. Curb, Sidewalk, and Driveway Forms:

1. Provide standard steel or wood forms.
2. Set forms to true lines and grades, and securely stake in position.

I. Form Tolerances: Provide forms in accordance with ACI 117 and ACI 318, and the following tolerances for finishes specified:

1. See the Schedule of Concrete Finishes in Section 03 30 00, Cast-in-Place Concrete, for beam, column, and wall types related to required form tolerances.
2. Wall Tolerances:
   a. Straight Vertical or Horizontal Wall Surface: Flat planes within tolerance specified.
   b. Wall Type W-A:
      1) Plumb within 1/4 inch in 10 feet or within 1 inch from top to bottom for walls over 40 feet high.
      2) Depressions in Wall Surface: Maximum 5/16 inch when 10-foot straightedge is placed on high points in all directions.
   c. Wall Type W-B:
      1) Plumb within 1/8 inch in 10 feet or within 1/2 inch from top to bottom for walls over 40 feet high.
      2) Depressions in Wall Surface: Maximum 1/8 inch when 10-foot straightedge is placed on high points in all directions.
   d. Thickness: Maximum 1/4-inch minus or 1/2 inch plus from dimension shown.
   e. Form Offset: Between adjacent pieces of formwork, facing material shall not exceed 1/4 inch.

3. Beams and Columns Tolerances:
    a. Exposed Straight Horizontal and Vertical Surfaces: Flat planes within tolerances specified.
    b. Lateral Alignment:
        1) Centerlines shall be within plus or minus 1/2 inch from dimensions shown.
        2) At intersections, centerlines shall intersect within plus or minus 1/2 inch of dimensions shown.
    c. Beams:
        1) Physical Dimensions: Maximum 1/4-inch minus or 1/2 inch plus from dimension shown.
        2) Elevations: Within plus or minus 1/2 inch, except where tops of beams become part of finished slab. In this case refer to slab tolerances.
    d. Columns:
        1) Physical Dimensions: Maximum 1/4-inch minus or 1/2 inch plus from dimension shown.
        2) Plumb within 1/4 inch in 10 feet in all directions with maximum 1/2 inch out-of-plumb at top with respect to bottom.

3.3 FORM REMOVAL

J. Non-supporting forms, sides of beams, walls, columns, and similar parts of Work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:

1. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
2. Curing and protection operations are maintained.

K. Elevated Structural Slabs or Beams: In accordance with ACI 318, Chapter 6, and at such time as concrete has reached compressive strength equal to 80 percent of specified 28-day compressive strength as determined by test cylinders.

L. Form Ties: Remove conical inserts or through bolts and plug holes as specified in Section 03 30 00, Cast-in-Place Concrete.

3.4 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

M. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

N. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 15 00
CONCRETE JOINTS AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A36/A36M, Specification for Carbon Structural Steel.
   b. A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated by the Hot-Dip Process.
   d. A767/A767M, Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
   e. C920, Specification for Elastomeric Joint Sealants.
   f. D994, Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
   g. D1056, Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
   h. D1171, Standard Guide for Evaluating Nonwoven Fabrics.
   i. D1751, Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
   j. D1752, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
   k. D2240, Standard Test Method for Rubber Property – Durometer Hardness.
2. Corps of Engineers (COE): CRD-C-572, Corps of Engineers Specifications for Polyvinylchloride Waterstop.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Waterstop: Details of splices, method of securing and supporting waterstop in forms to maintain proper orientation and location during concrete placement.
   b. Construction Joints, Expansion Joints and Control Joints: Layout and location for each type. Include joints locations shown on

Drawings, additional required joint locations and any proposed alternate locations.

2. Product Data:
   a. Waterstops.
   b. Bond breaker.
   c. Premolded joint fillers.
   d. Pourable joint fillers.
   e. Preformed control joints.
   f. Epoxy-coated dowels.
   g. Accessories not specified in other sections.
3. Samples: PVC waterstop splice, joint, and fabricated cross of each size, shape, and fitting of waterstop.

B. Informational Submittals:

1. Certification:
   a. Letter stating compatibility between liquids being contained and materials used for:
      1) Waterstops.
      2) Joint fillers.
   b. Manufacturer's application instructions for:
      1) Bonding agent.
      2) Bond breaker.
2. Manufacturer's written instructions for product shipment, storage, handling, installation/application, and repair for:
   a. Waterstops.
   b. Bond breaker.
   c. Bonding agent.
   d. Premolded joint fillers.
   e. Pourable joint fillers (sealant proportions not required as products used only as a filler).
   f. Preformed control joints.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site: Verify delivered materials are in accordance with Specifications, regulatory agencies, and Manufacturer's product data sheets prior to unloading and storing onsite.

B. Storage: Store materials under tarps to protect from oil, dirt, and sunlight or as required by Manufacturer.

PART 2 PRODUCTS

2.1 PLASTIC WATERSTOP

A. Extruded from elastomeric plastic compound of which basic resin shall be prime virgin polyvinyl chloride (PVC). Compound shall not contain scrapped material, reclaimed material, or pigment.

B. Specific Gravity: Approximately 1.37.

C. Shore Durometer Type A Hardness: Approximately 80.

D. Performance Requirements: COE Specification CRD-C-572.

E. Type Required in All Expansion, Contraction, and Control Joints: 9 inches wide with center bulb and parallel longitudinal ribs or protrusions on each side of strip center, as indicated on Drawings.

F. Type Required in Construction Joints: Flat ribbed, 6 inches wide with parallel longitudinal ribs or protrusions on each side of strip center. Center bulb is optional.

G. Corrugated or tapered type waterstops are not acceptable.

H. Thickness: Constant from bulb edge (or center of waterstop) to outside stop edge.

I. Minimum Weight per Foot of Waterstop:

1. 0.50 pound for 3/16 inch by 4 inches.
2. 1.60 pounds for 3/8 inch by 6 inches.
3. 2.30 pounds for 3/8 inch by 9 inches.

J. Factory Fabrications: Use only factory fabrications for intersections, transitions, and changes of direction.

K. Manufacturers and Products for Center Bulb Type:

1. Use same manufacturers for flat ribbed profile:
   a. Vinylex Corp., St Louis, MO.; No. RB638H (6 inches by 3/8 inch) and No. RB938H (9 inches by 3/8 inch).
   b. Greenstreak, St. Louis, MO; Style No. 702, (4 inches by 3/16 inch), Style 732 (6 inches by 3/8 inch) and Style 735 (9 inches by 3/8 inch).
   c. Durajoint, Garrettsville, OH.; Type 3, (4 inches by 3/16 inch,), Type 9 (6 inches by 3/8 inch), and Type 10 (9 inches by 3/8 inch).

d. BoMetals, Carrollton, GA.: No. RCB-4316LB (4 inches by 3/16 inch), No. RCB-638LB (6 inches by 3/8 inch) and No. RCB-938NT (9 inches by 3/8 inch).
e. Dacon Plastics LLC, Jacksonville, TX; No. RCB11, (4 inches by 3/16 inch), No. RCB17 (6 inches by 3/8 inch) and No. RCB18 (9 inches by 3/8 inch).

2.2 WIRE LOOPED PLASTIC WATERSTOP

A. Furnish as alternative to plastic waterstops.

B. Same material and geometry as plastic waterstops.

C. Furnish with continuous galvanized wire looping at edge for convenience in positioning and securing stop in place in forms.

D. Manufacturer and Product: Paul Murphy Plastics, Roseville, MI; "Wire Stop Waterstop"; geometry numbers ACR 6380, ACR 9380, as shown on Paul Murphy Plastics Co. Drawing No. CCP-120-12M.

2.3 HYDROPHILIC WATERSTOP

A. For use at construction joints only, where new concrete is placed against existing concrete and as shown on Drawings.

B. Material shall be a non-bentonite hydrophilic rubber compound.

C. Manufacturers and Products:

1. Greenstreak Plastic Products, St. Louis, MO; Hydrotite CJ-1020-2K with Leakmaster LV-1 adhesive and sealant.
2. Adeka Ultra Seal, JLM Associates, Spearfish, SD; MC-2010M with 3M-2141 adhesive and P-201 sealant.

2.4 INJECTION-TYPE WATERSTOP

A. Reinjectable waterstop hose system for use where shown on Drawings.

B. Reinjectable Water Stop Hose:

1. Fabricated of polyvinyl chloride (PVC) compound.
2. Contain discharge openings to allow for disbursement of an injection material into expansion joint.
   a. Discharge openings designed to be sealed tight during concreting operation to prevent entry of mixing water and cement slurry.
3. Allows free and uniform discharge of injection material over entire length of hose during injection process.

4. Able to be internally cleaned by using water and vacuum pressure.

C. Injection Material: Hydrophilic or hydrophobic resin grout for use in expansion joints as recommended by reinjectable waterstop hose manufacturer.

D. Manufacturers and Products:

1. Greenstreak/BBZ, St. Louis, MO.; Fuko Injection Hose System with Multigel 850.
2. Deneef Construction Chemicals, Inc., Houston, TX; TRIOject Injection Hose System with Hydro Active Grout.

2.5 SPLIT FACE PVC WATERSTOP

A. Material: See Article Plastic Waterstop.

B. Splice face PVC waterstop are for vertical applications only, where no directional changes or intersections will be required.

C. Manufacturers and Products:

1. Vinylex Corp., St Louis, MO; No. RBB638 (6 inches by 3/8 inch) and No. RBB938 (9 inches by 3/8 inch).
2. Greenstreak, St. Louis, MO; Style 724 (6 inches by 3/8 inch) and Style 653 (9 inches by 3/8 inch).
3. Dacon Plastics LLC, Jacksonville, TX; No. SR15 (6 inches by 3/8 inch).

2.6 RETROFIT PVC WATERSTOP

A. Material: See Article Plastic Waterstop.

B. Factory Fabrications: Use only factory fabrications for intersections, transitions, and changes of direction

C. Stainless Steel Batten Bar: AISI Type 304. Size and configuration in accordance with manufacturer's instructions.

D. Manufacturers and Products:

1. Vinylex Corp., St Louis, MO; No. RET638 (6 inches by 3/8 inch) and No. RET912 (9 inches by 3/8 inch).
2. Greenstreak, St. Louis, MO; Style 609 (6 inches by 3/8 inch) and Style 667 (9 inches by 1/2 inch).
3. BoMetals, Carrollton, GA; No. RF-912 (9 inches by 1/2 inch).

2.7 BOND BREAKER

A. Tape for Joints: Adhesive-backed glazed butyl or polyethylene tape. Same width as joint that will adhere to premolded joint material or concrete surface.

B. Use bond prevention material as specified in Section 03 30 00, Cast-in-Place Concrete, except where bond breaker tape is specifically called for on Drawings.

2.8 PREMOLDED JOINT FILLER

A. Bituminous Type: ASTM D994 or ASTM D1751.

B. Sponge Rubber:

1. Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 psi to 24 psi) minimum. Use in joints for potable and nonpotable water containment structures.
2. Manufacturer and Product: Monmouth Rubber and Plastics, Corp, Long Branch, NJ; Durafoam DK5151.

2.9 BUILDING PREFORMED CONTROL JOINT

A. One-Piece, Flexible, Polyvinyl Chloride Joint Former:

1. Manufacturer and Product: WR Meadows, Inc., Hampshire, IL; Keyway.

B. One-Piece Galvanized Steel Strip with Preformed Groove:

1. Manufacturer and Product: BoMetals, Inc. Carrollton, GA; QuickKey or ProKey Joint.

C. Furnish in full-length, unspliced pieces.

2.10 POURABLE JOINT FILLERS

A. General:

1. Although product is a sealant, it is being specified as a filler to prevent debris accumulation and allow expansion and contraction under shrinkage and thermal loads. It does not need to meet proportional sealant geometry requirements.

B. Filler for Potable or Non-Potable Water Containment Structures:

1. Multicomponent sealant, self-leveling or no sag as required for level, sloping, or vertical joints.
2. Color: White.
3. Manufacturer and Product: Sika Corp., Lyndhurst, NJ; Sikaflex-2c SL.

C. Filler for Nonpotable Water Containment Structures Only:

1. Pourable, two-component, cold-applied compound meeting ASTM C920, Type M, Grade P, Class 25, Use T.
2. Color: Black.
3. Manufacturer and Product: W.R. Meadows, Inc., Elgin, IL; Gardox.

D. Urethane or Polyurethane Filler: Two-component, pourable, immersible, and compatible with Project-specific, high-purity oxygen environment, of self-leveling or nonsag consistency.

1. Example Manufacturer and Product: Sika Corp., Lyndhurst, NJ; Sikaflex 2c SL.
2. Primer: As recommended by manufacturer.

2.11 STEEL EXPANSION JOINT DOWELS

A. Dowels: ASTM A36/A36M round smooth steel bars.

B. Bar Coating: As specified in Section 09 90 00, Painting and Coating, with factory-applied epoxy coating and factory or field applied lubrication coating.

2.12 ACCESSORIES

A. Joint Sealant:

1. Polyurethane as specified in Section 07 92 00, Joint Sealants.

B. One-Part Polyurethane, Immersible:

1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products for Nonsag:
   a. Sika Chemical Corp.; Sikaflex-1a.
   b. Tremco; Vulkem 116.
4. Manufacturers and Products for Self-leveling:
   a. BASF; Sonneborn, SL-1.
   b. Tremco; Vulkem 45.

c. Sika Chemical Corp.; Sikaflex 1c SL.

C. Steel Reinforcement: As specified in Section 03 21 00, Steel Reinforcement.

D. Nails: Galvanized, as required for securing premolded joint filler.

E. Galvanized Rebar at Control Joints: ASTM A767/A767M and ASTM A615/A615M Grade 60 prior to galvanizing.

F. Ties for PVC Waterstop: "Hog Rings" or grommets for each edge at 12-inch maximum spacing.

PART 3 EXECUTION

3.1 GENERAL

A. Commence concrete placement after joint preparation is complete.

B. Time Between Concrete Pours: As specified in Section 03 30 00, Cast-in-Place Concrete.

3.2 SURFACE PREPARATION

A. Construction Joints: Prior to placement of abutting concrete, clean contact surface.

1. Remove laitance and spillage from steel reinforcement and dowels.
2. Roughen surface to minimum of 1/4-inch amplitude:
   a. Sandblast after concrete has fully cured.
   b. Water blast after concrete has partially cured.
   c. Green cut fresh concrete with high-pressure water and hand tools.
3. Perform cleaning so as not to damage waterstop, if one is present.

B. Expansion Joint:

1. Use wire brush or motorized device to mechanically roughen and thoroughly clean concrete surfaces on each side of joint from plastic waterstop to top of joint.
2. Use dry, high-pressure air to remove dust and foreign material, and dry joint.
3. Prime surfaces as required before placing joint filler.
4. Avoid damage to waterstop.

C. Contraction Joint and Control Joint:

1. Coat concrete surfaces above and below plastic waterstop with bond breaker.

2. Do not damage or coat waterstop.

D. Construction Joint with Hydrophilic Waterstop:

1. Follow hydrophilic waterstop manufacturer's written instructions.
2. Clean debris, dirt, dust, and foreign material from concrete surface. Concrete surface must be smooth, clean, and dry. Grind concrete as required.

3.3 INSTALLATION OF WATERSTOPS

A. General:

1. Continuous waterstop shall be installed in all construction joints in walls and slabs of water holding basins and channels and of below-grade structures, unless specifically noted otherwise.
2. Join waterstop at intersections to provide continuous seal.
3. Center waterstop on joint.
4. Secure waterstop in correct position. Tie waterstop to steel reinforcement using grommets, "Hog Rings," or tie wire at maximum spacing of 12 inches. Do not displace waterstop during concrete placement.
5. Repair or replace damaged waterstop.
6. Place concrete and vibrate to obtain impervious concrete in vicinity of joints.
7. Joints in Footings and Slabs:
   a. Ensure that space beneath horizontal waterstop is completely filled with concrete.
   b. During concrete placement, make visual inspection of waterstop area.
   c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift ribbed waterstop to confirm full consolidation without voids, then place remaining concrete to full height of slab.

B. Plastic Waterstop:

1. Install in accordance with manufacturer's written instructions.
2. Splice in accordance with waterstop manufacturer's written instructions using Teflon-coated thermostatically controlled heating iron at approximately 380 degrees F.
   a. Allow at least 10 minutes before new splice is pulled or strained in any way.
   b. Finished splices shall provide cross section that is dense and free of porosity with tensile strength of not less than 80 percent of unspliced materials.

c. Use only factory made waterstop fabrications for all intersections, changes of directions and transitions.
d. Field splice permitted only for straight butt welds.

3. Wire looped plastic waterstop may be substituted for plastic waterstop.

C. Hydrophilic Waterstop:

1. Install in accordance with manufacturer's written instructions.
2. Provide minimum of 2-1/2 inches of concrete cover over waterstop. When structure has two layers of steel reinforcement, locate centered between layers of steel or as shown.
3. Apply adhesive to concrete surface and allow to dry for specified time before applying waterstop strip.
4. Lap ends of waterstop strip together at splices and corners and join with sealant.
5. Verify that waterstop is anchored firmly in place before placing concrete. Do not allow vibrator to come into contact with waterstop.
6. Lap hydrophilic waterstop 2 feet minimum with intersecting plastic waterstops.

D. Injection-Type Waterstop:

1. Install reinjectable waterstop hose in accordance with manufacturer's instructions.
2. After concrete has been placed and cured for a minimum of 28 days, inject specified injection material into reinjectable waterstop hose in accordance with manufacturer's instructions.
3. Upon completion of injection process, clean out remaining injection material in hose in accordance with manufacturer's instructions to allow for future injections.

E. Split Face PVC Waterstop: Install split face PVC waterstop in accordance with manufacturer's instructions.

F. Retrofit PVC Waterstop:

1. Install retrofit PVC waterstop in accordance with manufacturer's instructions.
2. Prepare surface of existing concrete in accordance with manufacturer's instructions. Apply a bed of epoxy, approximately 1/8 inch thick and slightly wider than waterstop base, to concrete surface.
3. Place the retrofit waterstop in place prior to the curing of the epoxy, securing waterstop with stainless steel batten bars and stainless steel post-installed anchors. Fasten one side at a time, making sure retrofit

profile is positioned to eliminate any air pockets or voids between waterstop and existing concrete.

4. Butt splice by thermally fusing the free ends together prior to attaching to wall in accordance with manufacturer's instructions.

3.4 EXPANSION JOINT INSTALLATION

A. Premolded Joint Filler:

1. Sufficient in width to completely fill joint space where shown.
2. Install per manufacturer's written instructions.
3. If waterstop is in joint, cut premolded joint filler to butt tightly against waterstop and concrete face.
4. Precut premolded joint filler to required depth at locations where joint filler or sealant is to be applied.
5. Form cavities for joint filler with either precut, premolded joint filler, or smooth removable accurately shaped material. Entire joint above waterstop, in slabs, shall be formed and removed so that entire space down to waterstop can be filled with the pourable joint filler.
6. Vibrate concrete thoroughly along joint form to produce dense, smooth surface.

B. Bituminous Type Premolded Joint Filler:

1. Drive nails approximately 1 foot 6 inches on center through filler, prior to installing, to provide anchorage embedment into concrete during concrete placement.
2. Secure premolded joint filler in forms before concrete is placed.
3. Install in walkways, at changes in direction, at intersections, at each side of driveway entrances, and at 45-foot intervals, maximum.

C. Sponge Rubber Joint Filler: Install per manufacturer's written instructions.

D. Pourable Joint Filler:

1. General:
   a. Install in accordance with the manufacturer's written instructions, except as specified below:
      1) Apply primer prior to pouring joint filler.
      2) Fill entire joint above the waterstop with joint filler as shown.
      3) Use masking tape on top of slabs at sides of joints; clean spillage. Remove masking tape afterwards.
      4) Sealant products used as fillers need not meet sealant geometry parameters. Do not use backing rods.

E. Steel Expansion Joint Dowels:

1. Install coated and lubricated bars parallel to wall or slab surface and in true horizontal position perpendicular to joint in both plan and section view, so as to permit joint to expand or contract without bending dowels.
2. Secure dowels tightly in forms with rigid ties.
3. Install steel reinforcement in concrete as shown.

3.5 CONTRACTION JOINT INSTALLATION

A. Place bond breaker above and below waterstop.

B. Vibrate concrete thoroughly along the joint form to produce a dense, smooth surface. Do not roughen surface.

3.6 CONTROL JOINT INSTALLATION

A. Locate steel reinforcement as shown on Drawings.

B. Install waterstop.

C. Vibrate concrete thoroughly along the joint form to produce a dense, smooth surface. Do not roughen surface.

D. Install bond breaker to concrete surfaces above and below waterstop.

3.7 PREFORMED CONTROL JOINTS

A. Use only where specifically shown; do not use in water-holding basins.

B. Locate slightly below top of slab.

C. Install in accordance with manufacturer's written instructions in straight, full-length pieces.

3.8 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at Site for installation assistance, inspection, and certification of proper installation for products specified.

3.9 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 15 20
CONCRETE WALL BASE AND TOP JOINTS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. NSF International (NSF): 61, Drinking Water System Components – Health Effects.

1.2 SUBMITTALS

A. Action Submittals:

1. Proposed method for holding projecting half of waterstop as wall concrete is placed.

B. Informational Submittals:

1. Manufacturer's instructions for method of splicing of plastic waterstop.

PART 2 PRODUCTS

2.1 MATERIALS

A. Plastic Waterstop: As specified in Section 03 15 00, Concrete Joints and Accessories.

B. Sealant: Gun grade or pourable immersible sealant. Provide sealant certified by NSF and meeting the requirements of NSF 61 for use in contact with potable water.

1. Manufacturer and Product: Sika Chemical Co.; Sikaflex-1A or 2C.

PART 3 EXECUTION

3.1 INSTALLATION

A. Plastic Waterstop:

1. Continuous and as specified in Section 03 15 00, Concrete Joints and Accessories.

2. Field bond waterstop in wall base joint to waterstops in the wall vertical joint and slab or footing joints to form a continuous barrier capable of withstanding water pressure involved.
3. Make connections and splices required with field equipment capable of applying sufficient heat to bond the joint.
4. Method of Splicing: Butt splices in accordance with manufacturer's instructions.
5. Completed splice shall develop strength of at least 80 percent of the strength of the continuous factory-molded strip.
6. Installation in Footings:
    a. Form footing so base of wall joint waterstop shall be continuously supported as concrete is placed.
    b. Position waterstop in base of wall joint as shown on Drawings to vertical and horizontal tolerance of plus or minus 1/4 inch.
    c. Provide approved means to ensure support of the projecting half of the waterstop as wall concrete is placed, to prevent out-of-tolerance movement and location due to concrete pressure or other construction loads that might be placed on waterstop.

3.2 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 21 00
STEEL REINFORCEMENT

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 318, Building Code Requirements for Structural Concrete and Commentary.
   b. SP-66, Detailing Manual.
2. American Welding Society (AWS): D1.4/D1.4M, Structural Welding Code - Reinforcing Steel.
3. ASTM International (ASTM):
   a. A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   b. A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   c. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
   d. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   e. A706/A706M, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   f. A767/767M, Standard Specification for Zinc-Coated (Galvanized) Steel bars for Concrete Reinforcement
   g. A775/A775M, Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
4. Concrete Reinforcing Steel Institute (CRSI):
   a. Placing Reinforcing Bars.
   b. Manual of Standard Practice.
5. International Code Council (ICC): Evaluation Services Report.
6. Wire Reinforcement Institute (WRI): WWR-500, Manual of Standard Practice, Structural Welded Wire Reinforcement.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings prepared in accordance with CRSI Manual of Standard Practice and ACI SP-66:
   a. Bending lists.
   b. Placing drawings.

2. Welded, metallic sleeve splice, and mechanical threaded connection.

B. Informational Submittals:

1. Lab test reports for steel reinforcement showing stress-strain curves and ultimate strengths.
2. Mechanical Threaded Connections:
   a. Current ICC Evaluation Services Report or equivalent code agency report listing findings to include acceptance, special inspection requirements, and restrictions.
   b. Verification device threads have been tested and meet requirements for thread quality, in accordance with manufacturer's published methods.
   c. Manufacturer's instructions.
3. Epoxy-Coated Reinforcing Bars: Written certification in accordance with Paragraph 14.1 of ASTM A775/A775M.
4. Welding Qualification: Prior to welding, submit welder qualifications and nondestructive testing procedures in accordance with Section 05 05 23, Welding.
5. Test results of field testing.

1.3 QUALITY ASSURANCE

A. Welder Qualifications: Certified in accordance with AWS D1.4/D1.4M.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Unload, store, and handle bars in accordance with CRSI publication "Placing Reinforcing Bars."

B. Epoxy-coated Reinforcing Bars:

1. Protect contact areas of epoxy-coated bars from handling equipment.
2. Lift bundles of bars at multiple pickup points to minimize bar-to-bar abrasion from sags in bundles.
3. Do not drop or drag bars or bundles of bars.
4. Store bars on protective cribbing.
5. Color fading of coating is not cause for rejection of epoxy-coated reinforcing bars.

PART 2 PRODUCTS

2.1 MATERIALS

A. Reinforcing Bars:

1. Includes stirrups, ties, and spirals.
2. ASTM A615/A615M, Grade 60, where welding is not required.
3. ASTM A706/A706M, Grade 60, for reinforcing to be welded.
4. ASTM A767/767M, Grade 60, for galvanized bars.
5. ASTM A775/A775M, for epoxy-coated bars.

B. Mechanical Splices and Connections:

1. Metal Sleeve Splice:
   a. Furnish with cast filler metal, capable of developing, in tension or compression, 125 percent of minimum tensile strength of bar.
   b. Manufacturer and Product: Erico Products, Inc., Cleveland, OH; Cadweld T-Series.
2. Mechanical Threaded Connections:
   a. Furnish metal coupling sleeve with internal threads engaging threaded ends of bars developing in tension or compression 125 percent of yield strength of bar.
   b. Manufacturers and Products:
      1) Erico Products, Inc., Cleveland, OH; Lenton Reinforcing Steel Couplers.
      2) Erico Products, Inc., Cleveland, OH; Lenton Lock Mechanical Rebar Splicing System.
      3) Richmond Screw Anchor Co., Inc., Fort Worth, TX; Richmond DB-SAE Dowel Bar Splicers.

C. Welded Wire Fabric:

1. ASTM A185 or ASTM A497 and ACI 318, using ASTM A82 wire of 75 ksi minimum tensile strength.
2. Furnish flat sheets only, rolled sheets not permitted.

2.2 ACCESSORIES

A. Tie Wire:

1. Black, soft-annealed 16-gauge wire.
2. Nylon-, epoxy-, or plastic-coated wire.

B. Bar Supports and Spacers:

1. Use precast concrete bar supports or all-plastic bar supports and side form spacers, unless noted otherwise. Do not use other types of supports or spacers.
2. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports.
3. Use only precast concrete bar supports where concrete surfaces are exposed to weather, earth, water, chloride intrusion, or corrosive chemicals. Bar supports shall be nonconductive and have geometry and bond characteristics that deter movement of moisture from the surface to the reinforcement.
4. Precast concrete supports shall have same minimum strength and shall be made from same materials as that of the concrete in which they are to be embedded. Precast concrete supports shall be cast and properly cured for at least 7 days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to steel reinforcement.
5. In Beams, Columns, Walls, and Slabs Exposed to View after Form Removal: Use small precast concrete blocks made of same color as concrete in which they are embedded. All-plastic bar supports and side form spacers may be used, except where surface is exposed as described above.
6. Design and fabricate special bar supports for top reinforcing bars in slabs where standard bar supports do not possess necessary geometry, strength, or stiffness.
7. Use supports made of dielectric material for epoxy-coated reinforcing bars supported from formwork.
8. If epoxy-coated reinforcing is used, furnish epoxy-coated reinforcing bars for spreader bars.
9. Plastic Bar Supports: Manufactured by Aztec Concrete Accessories, Bloomington, CA.
10. Precast Concrete Supports:
    a. Total bond precast, high-performance concrete bar supports as supplied by:
        1) Con Sys Inc., Pinawa, MB, Canada.
        2) Dayton Superior, Miamisburg, OH, Dobies.

2.3 FABRICATION

A. Follow CRSI Manual of Standard Practice.

B. Bend bars cold.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify Engineer when reinforcing is ready for inspection and allow sufficient time for inspection prior to placing concrete.

B. Repair epoxy coating damaged as a result of handling, shipment, and placing. Repair with patching material in accordance with ASTM A775/A775M and manufacturer's recommendations.

C. Clean reinforcing bars of loose mill scale, oil, earth, and other contaminants.

D. Coat wire projecting from precast concrete bar supports with dielectric material, epoxy, or plastic.

3.2 INSTALLATION

A. Bundle or space bars, instead of field bending where construction access through reinforcing is necessary.

B. Spacing and Positioning: Conform to ACI 318.

C. Location Tolerances: In accordance with CRSI publication, "Placing Reinforcing Bars".

D. Splicing:

1. Follow ACI 318.
2. Use lap splices, unless otherwise shown or permitted in writing by Engineer.
3. Welded Splices: Accomplish by full penetration groove welds and develop a minimum of 125 percent of yield strength of bar.
4. Stagger splices in adjacent bars where indicated.

E. Mechanical Splices and Connections:

1. Use only in areas specifically approved in writing by Engineer.
2. Install threaded rods as recommended by manufacturer with threads totally engaged into coupling sleeve and in accordance with ICC Evaluation Services Report or equivalent code agency report.
3. For metal sleeve splice, follow manufacturer's installation recommendations.
4. Maintain minimum edge distance and concrete cover.

F. Tying Reinforcing Bars:

1. Tie every other intersection on mats made up of Nos. 3, 4, 5, and 6 bars to hold them firmly at required spacing.
2. Bend tie wire away from concrete surface to provide minimum clearance of 1 inch from surface of concrete to tie wire.
3. Epoxy-coated Reinforcing Bars:
   a. Use epoxy-coated or nonmetallic clips.
   b. Repair coating damage at clipped or welded intersections.

G. Reinforcement Around Openings: On each side and above and below pipe or opening, place an equivalent area of steel bars to replace steel bars cut for opening. Extend steel reinforcing a standard lap length beyond opening at each end. See Drawings for additional information.

H. Welding Reinforcement:

1. Only ASTM A706/A706M bars may be welded.
2. Do not perform welding until welder qualifications are approved.

I. Straightening and Rebending: Field bending of steel reinforcement bars is not permitted.

J. Unless permitted by Engineer, do not cut reinforcing bars in field. When epoxy-coated reinforcing bars are cut in field, coat ends of bars with same material specified for repair of epoxy coating damage.

3.3 WELDED WIRE FABRIC INSTALLATION

A. Use only where specifically shown.

B. Extend fabric to within 2 inches of edges of slab and lap splices at least 1-1/2 courses of fabric or minimum 8 inches.

C. Tie laps and splices securely at ends and at least every 24 inches with tie wire.

D. Place welded wire fabric on concrete blocks and rigidly support equal to that provided for reinforced bars. Do not use broken concrete, brick, or stone.

E. Follow ACI 318 and WRI WWR-500.

F. Do not use fabric that has been rolled. Install flat sheets only.

3.4 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 117, Specification for Tolerances for Concrete Construction and Materials.
   b. 301, Specifications for Structural Concrete.
   c. 305.1, Specification for Hot Weather Concreting.
   d. 306.1, Standard Specification for Cold Weather Concreting.
   e. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures.
   f. CP-1, Technical Workbook for ACI Certification of Concrete Field Testing Technician – Grade 1.
2. ASTM International (ASTM):
   a. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   b. C33/C33M, Standard Specification for Concrete Aggregates.
   c. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   e. C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
   f. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
   g. C150/C150M, Standard Specification for Portland Cement.
   h. C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
   i. C227, Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
   j. C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
   k. C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
   l. C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
   m. C595/C595M, Standard Specification for Blended Hydraulic Cements.

n. C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
o. C1074, Standard Practice for Estimating Concrete Strength by the Maturity Method.
p. C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
q. C1218/C1218M, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
r. C1582/C1582M, Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete.
s. C1602/C1602M, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
t. E329, Standard Specification for Agencies Engaged in Construction Inspection, Special Inspection, or Testing Materials Used in Construction.
u. E1155, Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.

3. National Ready Mixed Concrete Association (NRMCA).

1.2 DEFINITIONS

A. Architectural Concrete: Concrete indicated as such in Contract Documents. Requires specified care in selection of concrete materials, forming, placing, and finishing in order to obtain desired architectural appearance.

B. Contractor's Licensed Design Engineer: Individual representing Contractor who is licensed to practice engineering as defined by statutory requirements of professional licensing laws in state or jurisdiction in which Project is to be constructed.

C. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4 inch in diameter, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, and cracks in other structures that are 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.

D. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.

E. Hot Weather: As defined in ACI 305.1 – One or a combination of the following conditions that tends to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration, or otherwise causing detrimental results: high ambient temperature, high concrete temperature, low relative humidity, and high wind speed.

F. Hydraulic Structure: Liquid containment structure.

G. New Concrete: Less than 60 days old.

H. Crystalline Waterproofing Admixture: Concrete waterproofing and protection system shall be of the crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure within the pores and capillary tracts of the concrete. This crystalline system causes the concrete to become sealed against the penetration of liquids from any direction, and protects the concrete from deterioration due to harsh environmental conditions. The system is used for above or below-grade walls and slabs, including liquid retaining structures and where enhanced chemical resistance is required.

I. Mass Concrete: Concrete members with a minimum specified height, width and thickness dimensions that are greater than 2 feet 6 inches and a monothic volume of 10 cubic yards.

1.3 SUBMITTALS

A. Action Submittals:

1. Mix Designs:
    a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
    b. Documentation of average strength for each proposed mix design in accordance with ACI 301.
    c. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
        1) Portland cement.
        2) Aggregates, including specified class designation for coarse aggregate.
        3) Admixtures.
        4) Concrete producer has verified compatibility of constituent materials in design mix.
    d. Test Reports:
        1) Cement: Chemical analysis report.
        2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.

3) Water-Soluble Chloride-Ion Content in Hardened Concrete: Unless otherwise permitted, in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
4) Shrinkage Test Results: In accordance with ASTM C157/C157M as modified herein.

e. Aggregates:
1) Coarse Aggregate Gradation: List gradings and percent passing through each sieve.
2) Fine Aggregate Gradation: List gradings and percent passing through each sieve.
3) Combined gradation for coarse and fine aggregates. List gradings and percent passing through each sieve**.**
4) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
5) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
6) Test Reports:
a) Alkali Aggregate Reactivity: Aggregate shall be classified as nonpotentially reactive in accordance with Article Concrete Mix Design. Include documentation of test results per applicable standards.

f. Admixtures:
1) Manufacturer's catalog cut sheets and product data sheets, including manufacturer's specifications and installation instructions for each admixture used in proposed mix designs.

2. Product Data: Specified ancillary materials.
3. Detailed plan for curing and protection of concrete placed and cured in cold weather. Details shall include, but not be limited to, the following:
a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
b. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
c. Methods for temperature protection during placement.
d. Types of covering, insulation, housing, or heating to be provided.
e. Curing methods to be used during and following protection period.
f. Use of strength accelerating admixtures.
g. Methods for verification of in-place strength.
h. Procedures for measuring and recording concrete temperatures.
i. Procedures for preventing drying during dry, windy conditions.

4. Detailed plan for hot weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:
    a. Procedures for measuring, and recording temperatures of reinforcement and other embedded items prior to concrete placement.
    b. Use of retarding admixture.
    c. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
    d. Types of shading and wind protection to be provided.
    e. Curing methods, including use of evaporation retardant.
    f. Procedures for measuring and recording concrete temperatures.
    g. Procedures for preventing drying during dry, windy conditions.
5. Concrete repair techniques.

B. Informational Submittals:

1. Preinstallation Conference minutes.
2. Manufacturer's application instructions for bonding agent and bond breaker.
3. Manufacturer's Certificate of Compliance to specified standards:
    a. Bonding agent.
    b. Bond breaker.
    c. Repair materials.
    d. Crystalline waterproofing additive.
4. Statement of Qualification:
    a. Batch Plant: Certification as specified herein.
    b. Mix designer.
    c. Installer.
    d. Testing agency.
5. Field test reports.
6. Thermal Control Plan for Mass Concrete
7. Recorded temperature data from concrete placement where specified.
8. Tightness test results.
9. Concrete Delivery Tickets:
    a. For each batch of concrete before unloading at Site.
    b. In accordance with ASTM C94/C94M, including requirements 14.2.1. through 14.2.10.
    c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.4 QUALITY ASSURANCE

A. Concrete construction shall conform to requirements of ACI 117 and ACI 301, except as modified herein.

B. Qualifications:

1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
3. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.
4. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
    a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
    b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Thermal Control Plan: For Mass Concrete, a Thermal Control Plan shall be prepared by a licensed engineer. The plan shall include the following minimum requirements:

1. Calculated or measured adiabatic temperature rise of concrete.
2. Upper limit for concrete temperature at time of placement.
3. Description of specific measures and equipment that will be used to ensure maximum temperature in placement will not exceed specified maximum temperature limit. A cooling system that includes cooling water circulated through metal pipes embedded in the concrete shall be used to achieve adequate temperature control.
4. Calculated maximum temperature in placement based on expected conditions at time of placement and use of proposed measures to control temperatures.
5. Description of specific measures and equipment that will be used to ensure temperature difference will not exceed specified temperature

difference limit. A cooling system that includes cooling water circulated through metal pipes embedded in the concrete shall be used to achieve adequate temperature control.

6. Calculated maximum temperature difference in placement based on expected conditions at time of placement and use of proposed measures to control temperature differences.
7. Description of equipment and procedures that will be used to monitor and log temperatures and temperature differences.
8. Drawing showing locations for temperature sensors in placement.
9. Description of format and frequency of providing temperature data to Engineer.
10. Description of measures to address and reduce excessive temperatures and temperature differences, if they occur.
11. Description of curing procedures, including materials and methods, and curing duration.
12. Description of formwork removal procedures to ensure temperature difference at temporarily exposed surface will not exceed temperature difference limit, and how curing will be maintained.
13. Alternate temperature limits when permitted by Engineer.
    a. Determination of alternate temperature limits shall be based on detailed thermal and crack analyses.
    b. Analyses shall be stamped by Contractor's Licensed Design Engineer.
14. If concrete design mixture is changed, thermal control plan must be updated.
15. Permissible temperature of water used for exterior curing of exterior surfaces.

D. Preinstallation Conference:

1. Required Meeting Attendees:
    a. Contractor, including pumping, placing and finishing, and curing subcontractors.
    b. Ready-mix producer.
    c. Admixture representative(s).
    d. Testing and sampling personnel.
    e. Engineer who authored Statement of Special Inspection Plan or Engineer's designee.
2. Schedule and conduct prior to incorporation of respective products into Project. Notify Engineer of location and time.
3. Agenda shall include:
    a. Admixture types, dosage, mixing requirements, performance, and redosing at Site.
    b. Mix designs, test of mixes, and Submittals.

c. Placement methods, techniques, equipment, consolidation, and form pressures.
d. Slump and placement time to maintain slump.
e. Finish, curing, and water retention.
f. Thermal control plan.
g. Protection procedures for weather conditions.
h. Other specified requirements requiring coordination.

4. Conference minutes.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cementitious Materials:

1. Cement:
   a. Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.
   b. Blended Hydraulic Cement:
      1) Unless otherwise specified, conform to requirements of ASTM C595/C595M.
      2) Portland cement used in blended hydraulic cement, conform to requirements of ASTM C150/C150M.
   c. Furnish from one source.

B. Aggregates: Furnish from one source for each aggregate type used in a mix design.

1. Normal-Weight Aggregates:
   a. In accordance with ASTM C33/C33M, except as modified herein.
      1) Class Designation: 4S unless otherwise specified.
   b. Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
   c. Alkali Silica Reactivity: See Article Concrete Mix Design.
2. Fine Aggregates:
   a. Clean, sharp, natural sand.
   b. ASTM C33/C33M.
   c. Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:
      1) Limit material finer than 75-µm (No. 200) sieve to 5 percent mass of total sample.
3. Coarse Aggregate:
   a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no

more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).

b. Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.

C. Admixtures: Unless otherwise permitted or indicated, furnish from one manufacturer.

1. Characteristics:
   a. Compatible with other constituents in mix.
   b. Contain at most, only trace amount chlorides in solution.
   c. Do not use admixtures known to be toxic after concrete is 30 days.
   d. Furnish type and dosage of admixture as recommended by manufacturer for anticipated temperature ranges.
2. Air-Entraining Admixture: ASTM C260/C260M.
3. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
   a. Manufacturers and Products:
      1) BASF Admixtures Inc., Shakopee, MN; Pozzolith Series or PolyHeed Series.
      2) Euclid Chemical Co., Cleveland, OH; Eucon Series.
      3) W. R. Grace & Co., Cambridge, MA; Daracem Series or Mira Series.
4. Retarding Admixture: ASTM C 494/C 494M, Type B.
5. Accelerating Admixture: ASTM C 494/C 494M, Type C.
6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
   a. Manufacturers and Products:
      1) BASF Admixtures Inc., Shakopee, MN; Glenium Series, PS 1460, or Rheobuild 1000.
      2) Euclid Chemical Co., Cleveland, OH; Eucon Series or Plastol Series.
      3) W. R. Grace & Co., Cambridge, MA; ADVA Series, Daracem Series, or EXP 950.
7. Plasticizing Admixture: ASTM C1017/C1017M, Type I or Type II.
8. Corrosion Inhibiting Admixtures: ASTM C1582/C1582M.
9. Shrinkage Reducing Admixture:
   a. Manufacturers and Products:
      1) BASF Admixtures Inc., Shakopee, MN; Tetraguard AS20.
      2) Euclid Chemical Co., Cleveland, OH; Eucon SRA Series.
      3) W. R. Grace & Co., Cambridge, MA; Eclipse Series.
10. Crystalline Waterproofing Admixture:
    a. Manufacturers and Products:
       1) Penetron, East Setauket, NY; Penetron Admix
       2) Xypex Chemical Corporation, Richmond BC, Canada; Xypex Admix C-Series

11. Do not use calcium chloride as an admixture.

D. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.

1. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
   a. Chloride Content: 500 ppm.
   b. Sulfate Content as SO_4: 3,000 ppm.
   c. Alkalis as (Na_2O + 0.658 K_2O): 600 ppm.
   d. Total Solids by Mass: Less than 50,000 ppm.

2.2 ANCILLARY MATERIALS

A. Bonding Agent: Unless otherwise specified, in accordance with the following:

1. ASTM C881/C881M, Type V.
2. Two-component, moisture insensitive, 100 percent solids epoxy.
3. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.
4. Manufacturers and Products:
   a. BASF Building Systems Inc., Shakopee, MN; Concresive Standard LVI.
   b. Euclid Chemical Co., Cleveland, OH; Euco # 352 Epoxy System LV.
   c. Prime Resins, Conyers, GA; Prime Bond 3000 to 3900 Series.
   d. Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod.

B. Bond Breaker:

1. Nonstaining type, providing positive bond prevention.
2. Manufacturers and Products:
   a. Dayton Superior Corporation, Kansas City, KS; EDOCO Clean Lift Bond Breaker.
   b. Nox-Crete Products Group, Omaha, NE; Silcoseal Select.

2.3 CONCRETE MIX DESIGN

A. General:

1. See Supplement at the end of this section for mix design requirements for each class of concrete used on Project.
2. Prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301, unless otherwise specified.

3. Selection of constituent materials and products in mix design are optional, unless specified otherwise.
4. Unless otherwise permitted, use water-reducing admixture or water-reducing admixture and high-range, water-reducing admixture or plasticizing admixture in pumped concrete, in concrete with a water-cementitious materials ratio below 0.50, and in concrete that is part of a liquid-containment structure.
5. Unless otherwise permitted, use water-reducing admixture and high-range, water-reducing admixture, or plasticizing admixture in columns, piers, pilasters, and walls.
6. Use water-reducing admixture or high-range, water-reducing admixture**,** or plasticizing admixture to achieve fresh properties that facilitate handling, placing, and consolidating of concrete, and specified hardened properties.
7. Use water-reducing and retarding admixture when anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
8. Use crystalline waterproofing admixture in all concrete exposed to soil for the following structures: diversion structures, junction structures, screening facility, pump station. Use crystalline waterproofing admixture in roof/upper level slab concrete at the screening facility and pump station.
9. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.
10. Contractor is encouraged to consider using environmentally sustainable concrete mix design technologies such as use of supplementary cementitious materials, aggregate packing, and self-consolidating concrete.

B. Potential alkali-aggregate reactivity of concrete:

1. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).
2. Aggregates shall have been tested to determine potential alkali-aggregate reactivity in concrete in accordance with ASTM C1260 or ASTM C1567.
    a. Aggregates that indicate expansion greater than 0.10 percent at 16 days after casting shall not be used unless they have been shown to be nondeleteriously reactive in accordance with ASTM C227 or ASTM C1293, with less than 0.04 percent expansion at 1 year for cement-aggregate combinations or less

than 0.04 percent expansion at 2 years for combinations with pozzolan or slag.

b. Alkali content of cement used in proposed concrete mixture shall not be greater than alkali content of cement used in test for potential alkali-aggregate reactivity.

c. Use low-alkali cement or incorporate pozzolans into concrete mixture as necessary to satisfy testing for potential alkali reactivity. Alternately, a chemical inhibitor such as a lithium based admixture may be proposed.

C. Proportions:

1. Design mix to meet aesthetic, durability, and strength requirements.

D. Concrete Shrinkage Limits: Where shrinkage limits are specified, design mix for following shrinkage limits and test in accordance with ASTM C157/C157M, with the following modifications:

1. Prisms shall be moist cured for 7 days prior to 28-day drying period.
2. Comparator reading at end of 7-day moist cure shall be used as initial length in length change calculation.
3. Reported results shall be average of three prisms.
4. If shrinkage of a specimen departs from average of that test age by more than 0.004 percent, disregard results obtained from that specimen.
5. Unless otherwise specified, results at end of 28-day drying period shall not exceed 0.040 percent if 3-inch prisms are used, or exceed 0.038 percent if 4-inch prisms are used. Aggregate will be rejected if test values exceed these limits.

E. Slump Range at Site:

1. Unless otherwise permitted, target slump value is 4 inches at point of delivery, for concrete without high-range, water reducing admixture.
2. Design mixes that include a high-range, water-reducing, or a plasticizing admixture shall have a minimum slump of 2 inches prior to addition of admixture. Unless otherwise permitted, slump shall be 8 inches maximum at point of delivery, for concrete with a high-range, water-reducing admixture.
3. Slump tolerance shall meet requirements of ACI 117.

F. Combined Aggregate Gradation:

1. Combined Gradation Limits: Fine aggregate shall be in range of 36 percent to 40 percent of total aggregate weight.

2. Combined Gradation Limits: Limits shown are for coarse aggregates and fine aggregates mixed together (combined). Select one of the gradations shown in the following table:

Sieve Sizes	Combined Gradation Percentage Passing		
	1-1/2" Max.	1" Max.	3/4" Max.
2"	100	-	-
1-1/2"	95 - 100	100	-
1"	65 - 85	90 - 100	100
3/4"	55 - 75	70 - 90	92 - 100
1/2"	-	-	68 - 86
3/8"	40 - 55	45 - 65	57 - 74
No. 4	30 - 45	31 - 47	38 - 57
No. 8	23 - 38	23 - 40	28 - 46
No. 16	16 - 30	17 - 35	20 - 36
No. 30	10 - 20	10 - 23	14 - 25
No. 50	4 - 10	2 - 10	5 - 14
No. 100	0 - 3	0 - 3	0 - 5
No. 200	0 - 2	0 - 2	0 - 2

2.4 CONCRETE MIXING

A. General: In accordance with ACI 301, except as modified herein.

B. Where required, crystalline waterproofing admixture shall be added in accordance with the manufacturer's written instructions. Instructions may vary depending on the type of batch plant operation and equipment.

C. Truck Mixers:

1. For every truck, test slump of samples taken per ASTM C94/C94M, paragraph 12.5.1.
2. Where specified slump is more than 4 inches, and if slump tests differ by more than 2 inches, discontinue use of truck mixer, unless causing condition is corrected and satisfactory performance is verified by additional slump tests.

2.5 TEMPERATURE LIMITS

A. For Mass Concrete**,** unless otherwise approved:

1. Provide documentation that maximum concrete temperature in structure will not and did not exceed 135 degrees Fahrenheit, and maximum temperature differential between center of section and external surfaces of concrete will not and did not exceed 35 degrees Fahrenheit.

2.6 SOURCE QUALITY CONTROL

A. Source Quality Control Inspection: Engineer shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and Subcontractors, providing products included in this section.

PART 3 EXECUTION

3.1 PLACING CONCRETE

A. Preparation: Meet requirements ACI 301, except as modified herein.

B. Inspection: Notify Engineer and Special Inspector at least 1 full working day in advance before starting to place concrete.

C. Placement into Formwork:

1. Where vapor retarder or barrier is required, coordinate subgrade preparation with requirements in Division 07 of Specifications.
2. Reinforcement: Secure in position before placing concrete.
3. Place concrete as soon as possible after leaving mixer, no more than 90 minutes after water has been added to the cementitious materials and aggregates, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs which shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
4. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
5. Use placement devices, for example chutes, pouring spouts, and pumps as required to prevent segregation.
6. Vertical Free Fall Drop to Final Placement:
   a. Forms 8 Inches or Less Wide: 4 feet.
   b. Forms Wider than 8 Inches: 6 feet, except as specified.
7. For placements where drops are greater than specified, use placement device such that free fall below placement device conforms to required value.

a. Limit free fall to prevent segregation caused by aggregates hitting steel reinforcement.

8. Do not use aluminum conveying devices.
9. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
10. Joints in Footings and Slabs:
    a. Ensure space beneath plastic waterstop completely fills with concrete.
    b. During concrete placement, make visual inspection of entire waterstop area.
    c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, and place remaining concrete to full height of slab.
    d. Apply procedure to full length of waterstop.
11. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.
12. Cure concrete as specified in Section 03 39 00, Concrete Curing.

D. Conveyor Belts and Chutes:

1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
2. Do not use chutes longer than 50 feet.
3. Minimum Slopes of Chutes: Angled to allow concrete to readily flow without segregation.
4. Conveyor Belts:
    a. Approved by Engineer.
    b. Wipe clean with device that does not allow mortar to adhere to belt.
    c. Cover conveyor belts and chutes.

E. Retempering: Not permitted for concrete where cement has partially hydrated.

F. Pumping of Concrete:

1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
3. Replace pumping equipment and hoses (conduits) that are not functioning properly.

G. Concrete sections with a minimum specified dimension that is greater than 2 feet 6 inches:

1. Cure and protect concrete in accordance with accepted thermal control plan and as follow:
   a. Minimum curing period shall be 14 days.
   b. Unless otherwise permitted, preserve moisture by maintaining forms in place.
2. Strength measurement shall be representative of in-place concrete within 2 inches of concrete surface.
3. Concrete strength shall be verified through correlation of concrete temperature and compressive strengths established by cylinder compressive tests and in accordance with ASTM C1074.
4. Unless otherwise specified, control concrete temperatures to within specified limits from time concrete is placed until time internal temperature has cooled from its maximum, such that difference between average daily ambient and maximum internal concrete temperature at time of protection removal, is less than specified temperature difference limit.
5. Unless otherwise specified, place one temperature sensor at center of mass of placement and one temperature sensor at a depth 2 inches from center of nearest exterior surface. Place additional sensor at each location to serve as a backup in event that other temperature sensor fails. In addition, provide temperature sensor in shaded location for monitoring ambient onsite temperature.
   a. Unless otherwise specified, monitor temperatures hourly using electronic sensors capable of measuring temperature from 32 degrees F to 212 degrees F to an accuracy of 2 degrees F.
   b. Ensure temperature sensors are operational before placing concrete.
   c. Unless otherwise specified, provide data from sensors to Engineer on a daily basis, until requirements are met.
   d. Compare temperatures and temperature differences with maximum limits specified in Article Temperature Limits every 12 hours, unless otherwise permitted. If either exceeds specified limits, take immediate action as described in accepted thermal control plan to remedy situation. Do not place additional mass concrete until cause of excessive temperature or temperature difference has been identified and corrections are accepted.

H. Maximum Size of Concrete Placements:

1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.

2. Locate expansion, control, and contraction joints where shown on Drawings.
3. Construction Joints: Unless otherwise shown or permitted, locate construction joints as follows:
    a. Locate construction joints as shown on Drawings or where approved in joint location submittal required in Section 03 15 00, Concrete Joints and Accessories.
    b. Provide vertical construction joints in walls and slabs at maximum spacing of 40 feet, unless shown or approved otherwise.
    c. When vertical expansion, contraction, or control joint spacing does not exceed 60 feet, intermediate construction joints are not required.
    d. Uniformly space vertical construction joints within straight sections of walls and slabs, avoiding penetrations.
4. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.
5. Should placement sequence result in cold joint located below finished grade, install waterstop in joint.

I. Minimum Time between Adjacent Placements:

1. Construction or Control Joints: 7 days unless otherwise specified.
2. Construction joint between top of footing or slab, and column or wall: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
3. Expansion or Contraction Joints: 1 day.
4. For columns and walls with a height in excess of 10 feet, wait at least 2 hours before depositing concrete in beams, girders, or slabs supported thereon.
5. For columns and walls 10 feet in height or less, wait at least 1 hour prior to depositing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.

J. Consolidation and Visual Observation:

1. Consolidation Equipment and Methods: ACI 301.
2. Provide at least one standby vibrator in operable condition at Site prior to placing concrete.
3. Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.
4. Vibrate concrete in vicinity of joints to obtain impervious concrete.

K. Hot Weather:

1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
    a. Maintain concrete temperature below 90 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
    b. Monitor evaporation rate and implement evaporation control measures in accordance with ACI 305.1 when evaporation rate is equal to or greater than 0.2 lb/ft^2/h.
    c. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete temperature and evaporation rate specified.
2. Concrete Curing: As specified in Section 03 39 00, Concrete Curing.

3.2 CONCRETE WALL FINISHES

A. Type W-2 (Smooth Wall Finish):

1. Patch tie holes. For concrete with crystalline waterproofing admixture, use manufacturer's crystalline waterproofing repair compound/mortar in accordance with manufacturer's written instructions.
2. Grind off fins and other projections.
3. Repair defective areas to provide smooth uniform appearance.
4. Inject cracks in accordance with requirements of Section 03 64 23, Epoxy Resin Injection Grouting.

3.3 CONCRETE SLAB FINISHES

A. General:

1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
2. Do not use "jitterbugs" or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
3. Finish slab in accordance with specified slab finish.
4. Do not dust surfaces with dry materials nor add water to surfaces.
5. Cure concrete as specified in Section 03 39 00, Concrete Curing.

B. Type S-1 (Steel Troweled Finish):

1. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation.

2. Wood float to true, even plane with no coarse aggregate visible.
3. Use sufficient pressure on wood floats to bring moisture to surface.
4. After surface moisture has disappeared, hand steel trowel concrete to produce smooth, smooth dense surface, free from trowel marks.
5. Provide light steel-troweled finish (two trowelings) at air-entrained slabs. Provide hard steel-troweled finish (ringing sound from the trowel) for nonair-entrained slabs.
6. Do not use dry cement or additional water during troweling, nor will excessive troweling be permitted.
7. Power Finishing:
    a. Approved power machine may be used in lieu of or in addition to hand finishing in accordance with directions of machine manufacturer.
    b. Do not use power machine when concrete has not attained necessary set to allow finishing without introducing high and low spots in slab.
    c. Do first steel troweling for slab S-1 finish by hand.

C. Type S-2 (Wood Float Finish):

1. Finish slab to receive fill and mortar setting bed by screeding with straightedges to bring surface to required finish plane.
2. Wood float finish to compact and seal surface.
3. Remove laitance and leave surface clean.
4. Coordinate with other finish procedures.

D. Type S-3 (Underside Elevated Slab Finish): When forming is removed, grind off projections on underside of slab and repair defective areas, including small shallow air pockets where schedule of concrete finishes requires:

1. Prepare surfaces to match Type W-2 (Smooth Wall Finish).

E. Type S-5 (Broomed Finish):

1. Finish as specified for Type S-1 floor finish, except use only a light-steel troweled finish, and then finish surface by drawing fine-hair broom lightly across surface.
2. Broom in same direction and parallel to expansion joints, or, in case of inclined slabs, perpendicular to slope, except for round roof slab, broom surface in radial direction.

F. Type S-6 (Sidewalk Finish):

1. Slope walks down 1/4 inch per foot away from structures, unless otherwise shown.

2. Strike off surface by means of strike board and float with wood or cork float to true plane, then flat steel trowel before brooming.
3. Broom surface at right angles to direction of traffic or as shown.
4. Lay out sidewalk surfaces in blocks, as shown or as directed by Engineer, with grooving tool.

G. Concrete Curbs:

1. Float top surface of curb smooth, and finish all discontinuous edges with steel edger.
2. After concrete has taken its initial set, remove front form and give exposed vertical surface an ordinary wall finish, Type W-1.

3.4 CONCRETE SLAB TOLERANCES

A. Slab Tolerances:

1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
3. Slab Type S-A: Steel gauge block 5/16 inch thick.
4. Slab Type S-A Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
5. Thickness: Maximum 1/4 inch minus or 1/2 inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2 inch plus.
6. Slab Flatness and Levelness:
   a. Floor finish tolerances shall meet requirements specified herein, and as measured in accordance with ASTM E1155.
   b. Levelness tolerance, FL, shall not apply to slabs placed on unshored form surfaces or shored form surfaces after removal of shores.
   c. Levelness tolerances, FL, shall not apply to cambered or inclined surfaces, and shall be measured within 72 hours after slab concrete placement.

Slab Type S-A			
Minimum Overall F Numbers		Minimum Local F Numbers	
Flatness, FF	Levelness, FL	Flatness, FF	Levelness, FL
20	15	15	10

Slab Type S-B			
Minimum Overall F Numbers		Minimum Local F Numbers	
Flatness, FF	Levelness, FL	Flatness, FF	Levelness, FL
30	20	15	10

B. Slab Elevation and Thickness:

1. Finish Slab Elevation: Slope slabs to floor drains and gutter. Slabs shall adequately drain regardless of tolerances.
2. Thickness: Maximum 1/4 inch minus or 1/2 inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2 inch plus.

3.5 BEAM AND COLUMN FINISHES

A. Beams: Match wall Type W-2.

B. Columns: Match wall Type W-2.

3.6 BACKFILL AGAINST STRUCTURES

A. Do not backfill against walls until concrete has obtained specified 28-day compressive strength.

B. Refer to General Structural Notes on the Drawings for additional requirements, including elevated slab and diaphragm completion prior to backfill.

C. Unless otherwise permitted, place backfill simultaneously on both sides of structure, where such fill is required, to prevent differential pressures.

3.7 FIELD QUALITY CONTROL

A. General:

1. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
2. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.

3. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
    a. For Each Concrete Mixture: Provided results of air content tests for first load of the day are within specified limits, testing need only be performed at point of delivery for subsequent loads of that concrete mixture except that testing should be performed at point of placement every 4 hours.
4. Evaluation will be in accordance with ACI 301 and Specifications.
5. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
6. Frequency of testing may be changed at discretion of Engineer.
7. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M, and shrinkage specimens (ASTM C157/C157M) at placement (discharge) end of line.
8. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.
2. If result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing specified in Section 03 39 00, Concrete Curing, by 7 additional days.
3. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Engineer.

C. Shrinkage Tests:

1. When required to conform to shrinkage limits, collect actual concrete materials being batched and before liquids have been added to mix.
2. Mix sampled material in a laboratory at proportions matching batched concrete.
3. Test shrinkage characteristics every 5,000 cubic yards of concrete used on job and every 3 months during construction when compression test cylinders are made.

4. Concrete Shrinkage Limits: Test in accordance with ASTM C157/C157M, with the following modifications:
    a. Prisms shall be moist cured for 7 days prior to 28-day drying period.
    b. Comparator reading at end of 7-day moist cure shall be used as initial length in length change calculation.
    c. Reported results shall be average of three prisms.
    d. If drying shrinkage of a specimen departs from average of that test age by more than 0.004 percent, disregard results obtained from that specimen.
    e. Results at end of 28-day drying period shall not exceed 0.040 percent if 3-inch prisms are used, or exceed 0.038 percent if 4-inch prisms are used.
    f. If 7-day or 14-day shrinkage tests results exceed shrinkage limits established by design mix testing, furnish additional 14 days of water curing beyond original curing period, for concrete surfaces of hydraulic structures represented by prisms. Modify concrete mix design to reduce shrinkage prior to casting additional concrete on Project.

D. High-Range, Water-Reducer (Superplasticizer) Admixture Segregation Test: Test each truck prior to use on Project.

1. Segregation Test Objective: Concrete with 4-inch to 8-inch slump shall stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump test.
2. Test Procedure: Make slump test and check for excessive slump and observe to see if mortar or moisture flows from slumped concrete.
3. Reject concrete if mortar or moisture separates and flows out of mix.

E. Tolerances:

1. Walls: Measure and inspect walls for compliance with tolerances specified in Section 03 10 00, Concrete Forming and Accessories.
2. Slab Finish Tolerances and Slope Tolerances:
    a. Slab Flatness and Levelness: Make measurements within 72 hours of concrete placement.
        1) Flatness measurements are not applicable to unshored form surfaces or shored form surfaces after removal of shores.
        2) Levelness measurements are not applicable to cambered or sloped surfaces.
    b. Slab flatness and levelness shall be determined in accordance with ASTM E1155.

F. Liquid Tightness Tests:

1. Purpose: To determine integrity and liquid-tightness of finished exterior and interior concrete surfaces of liquid containment structures.
2. Water for initial tightness test will be provided by Owner.
   a. Provide means to transport water to structure to be tested.
   b. If additional tightness tests are required because of failure to meet criteria, Contractor shall provide water for subsequent tests.
3. After testing has been completed, dispose of test water in a manner approved by Owner.
4. Liquid-Tightness Test Requirement:
   a. Perform tightness tests in accordance with ACI 350.1 and as specified herein.
   b. Do not place backfill or install grout topping slab, coatings, or other work that will cover concrete surfaces until tightness testing has been completed and approved.
   c. Measure evaporation, precipitation, and temperature as specified.
5. Measure water surface at two points 180 degrees apart when possible where attachments, such as ladders exist, at 24-hour intervals.
6. Acceptance Criteria:
   a. Volume loss shall not exceed 0.050 percent of contained liquid volume per 24-hour period, adjusted for evaporation, precipitation, and temperature.
   b. Acceptance that structure has passed tightness test shall be based on total volume loss at end of specified test period.
7. Repairs When Test Fails:
   a. Dewater structure; fill leaking cracks with crack repair epoxy as specified in Section 03 64 23, Epoxy Resin Injection Grouting.
   b. Patch areas of damp spots previously recorded, and repeat water leakage test in its entirety until structure successfully passes test.

3.8 MANUFACTURER'S SERVICES

A. Provide representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection, and certification of proper installation for concrete ingredients, mix design, mixing, and placement.

1. Concrete Producer Representative:
   a. Assist with concrete mix design, performance, placement, weather problems, and problems as may occur with concrete mix throughout Project, including instructions for redosing.
   b. Establish control limits on concrete mix designs.

c. Provide equipment for control of concrete redosing for air entrainment or high-range, water-reducing admixture, superplasticizers, at Site to maintain proper slump and air content if needed.

2. Admixture Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.
3. Bonding Agent Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

3.9 PROTECTION OF INSTALLED WORK

A. After curing as specified in Section 03 39 00, Concrete Curing, and after applying final floor finish, cover slabs with plywood or particle board or plastic sheeting or other material to keep floor clean and protect it from material and damage as a result of other construction work.

B. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.10 SCHEDULE OF CONCRETE FINISHES

A. Form Tolerances: As specified in Section 03 10 00, Concrete Forming and Accessories.

B. Special Floor Finishes: As specified in Section 03 35 00, Concrete Finishing.

C. Provide concrete finishes as scheduled:

Area	Type of Finish	Required Form Tolerances
Exterior Wall Surfaces		
Abovegrade/exposed (above point 6" below finish grade)	W-2	W-B
Abovegrade/covered with brick veneer or other finish material	W-2	W-A
Backfilled/waterproofed (below point 6" below finish grade)	W-2	W-A
Backfilled/not waterproofed (below point 6" below final grade)	W-2	W-A

Area	Type of Finish	Required Form Tolerances
Interior Wall Surfaces		
Open top water-holding tanks and basins/not painted or coated	W-2	W-A
Covered water-holding tanks and basins/not painted or coated	W-2	W-A
Buildings, pipe galleries, and other dry areas/not painted or coated	W-2	W-A
Exterior Slabs		
Roof slab/exposed	S-5	S-B
Water-holding tanks and basins/top of wall	S-5	S-B
Top of footing	S-2	S-A
Stairs and landings	S-5	S-B
Sidewalks	S-6	S-B
Other exterior slabs	S-5	S-A
Interior Slabs		
Buildings, pipe galleries, and other dry areas	S-1	S-B
Hydraulic channels	S-1	S-A
Underside of elevated slabs	S-3	S-A

3.11 SUPPLEMENTS

A. Requirements of concrete mix designs following "End of Section," are a part of this Specification and supplement requirements of Part 1 through Part 3 of this section:

1. Concrete Mix Design, Class 4500F1S1P0C1.
2. Concrete Mix Design, Class 3000F0S1P0C0.

END OF SECTION

CONCRETE MIX DESIGN, CLASS 4500F1S1P0C1

A. Mix Locations: Typical, unless otherwise specified.

B. Exposure Categories and Classifications: F1S1P0C1.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.45.
2. Minimum concrete compressive strength (f'c) shall be 4,500 psi at 28 days.
3. Designed to conform to shrinkage limits.
4. Total air content shall not be greater than 3 percent.
5. Provide cementitious materials in accordance with the following:
   a. ASTM C150/C150M Type V.
6. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent, unless otherwise specified.
   a. Limits are stated in terms of chloride ions in percent by weight of cement.
   b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to PART 1 through PART 3 of this section for additional requirements.

CONCRETE MIX DESIGN, CLASS 3000F0S1P0C0

A. Mix Locations:

1. Pipe encasements, duct banks, concrete curb and gutter, sidewalks, miscellaneous site work.
2. Where specified in Contract Documents.

B. Exposure Categories and Classifications: F0S1P0C0.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.50.
2. Minimum concrete compressive strength (f'c) shall be 3,000 psi at 28 days.
3. Total air content shall not be greater than 3 percent.
4. Provide cementitious materials in accordance with the following:
   a. ASTM C150/C150M Type II.
5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent, unless otherwise specified.
   a. Limits are stated in terms of chloride ions in percent by weight of cement.
   b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to PART 1 through PART 3 of this section for additional requirements.

SECTION 03 34 00
CONTROLLED LOW STRENGTH MATERIAL (CLSM)

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Provide and install controlled low strength material as indicated and specified.

1.2 REFERENCES:

A. American Concrete Institute (ACI):

1. 229R: Controlled Low-Strength Materials
2. 301: Specifications for Structural Concrete
3. 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete
4. 305R: Hot Water Concreting.
5. 306R: Cold Water Concreting
6. 308: Standard Practice for Curing Concrete
7. 318: Building Code Requirements for Structural Concrete and Commentary

B. ASTM International (ASTM):

1. C31: Practice for Making and Curing Concrete Test Specimens in the Field
2. C33: Specification for Concrete Aggregates
3. C39: Test Method for Compressive Strength of Cylindrical Concrete Specimens
4. C94: Standard Specification for Ready-Mixed Concrete
5. C138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
6. C143: Standard Test Method for Slump of Hydraulic-Cement Concrete.
7. C150: Standard Specification for Portland Cement.
8. C172: Practice for Sampling Freshly Mixed Concrete
9. C231: Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

10. C494: Standard Specification for Chemical Admixtures for Concrete.

11. C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

12. C940: Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory

13. C1064: Test Method for Temperature of Freshly Mixed Portland Cement Concrete

14. D75: Practice for Sampling Aggregates

1.3 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01 33 00.

1. CLSM mix design and results of strength tests from trial mixes by the Contractor's testing laboratory firm.

2. Submit manufacturer's Stable-Air Generator Admixture product data, installation instructions and recommendations for material use.

3. Test and Performance - Submit the following data:

a. Any required deviations from prescribed tests and special handling instructions for test specimens.

b. Controlled Low Strength Material shall have a maximum strength of 200 psi according to ASTM C39 at 56 days after placement.

c. Controlled Low Strength Material shall have minimal subsidence and bleed water which is measured as a final bleeding of less than 2.0 percent (retains 98.0 percent of original height after placement, approximately 1/4-inch per foot of depth) as measured in Section 10 of ASTM C940.

d. Controlled Low Strength Material shall have a unit weight of 90 - 110 lbs./ft^3 measured at the point of placement.

1.4 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01 45 16.13.

B. Sustainability Standards Certifications.

C. Do not place CLSM until design mix, material tests and trial batch mix compression test results are approved by the Engineer. Approvals are required at least 30 days before placing any production CLSM.

D. Employ an independent testing laboratory, acceptable to the Engineer to test conformity of materials to specifications and to design CLSM mixes.

E. Furnish, pay for and deliver representative samples of sufficient quantity of cement, aggregates and admixtures required for trial batch mixes to the testing laboratory. Obtain materials from the batching plant that will be supplying production CLSM in conformance with ASTM D75.

F. Measure all materials for CLSM, including water, with equipment and facilities suitable for accurate measurement and capable of being adjusted in conformance with ASTM C94. Use scales certified by local Sealer of Weights and Measures within one year of use and accurate when static load tested to plus or minus 0.4 percent of total capacity of scale. Batch all materials by weight except admixtures that may be batched by volume.

G. The testing laboratory will take control test specimens; conduct slump tests and measure air content and temperature in the field.

H. Methods of Sampling and Testing:

1. Fresh Concrete Sampling: ASTM C172.

2. Specimen Preparation: ASTM C31.

3. Compressive Strength: ASTM C39.

4. Air Content: ASTM C231.

5. Slump: ASTM C143.

6. Temperature: ASTM C1064.

7. Unit Weight: ASTM C138.

1.5 DELIVERY STORAGE AND HANDLING:

A. Order CLSM from batching plant so that trucks arrive at discharge locations when material is required.

B. Deliver CLSM to discharge locations in watertight agitator or mixer trucks without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

C. Reject CLSM not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket

1.6 PROJECT/SITE CONDITIONS:

A. Do not place CLSM until conditions and facilities for making and curing control test specimens are in compliance with ASTM C31 and as specified herein.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Furnish Portland cement conforming to ASTM C150. Use one approved brand from one mill throughout the contract term unless otherwise approved by the Engineer. Use Type II for all work, unless otherwise specified.

B. Water:

1. Use water that is potable and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances, and conforms to the requirements for water in ASTM C94, and as specified herein.

2. The maximum water-soluble chloride ion in the water shall not exceed 0.060 percent by weight of cement.

C. Aggregates:

1. Use aggregates for CLSM conforming to ASTM C33 and to the following requirements.

D. Admixtures:

1. General Requirements: ASTM C494.

E. Fly Ash: Provide fly ash conforming to the following requirements:

1. Class F fly ash conforming to ASTM C618 for chemical and physical properties.

2. Supplemental requirements in percent:

a.	Maximum carbon content	3 percent
b.	Maximum sulfur trioxide (SO_3) content	4 percent
c.	Maximum loss on ignition	3 percent
d.	Maximum water requirement (as a percent of control)	100 percent
e.	Fineness, maximum retained on No. 325 sieve	25 percent

2.2 MIXES:

A. Mix design shall produce a consistency that will result in a flowable product at the time of placement that does not require manual means to move it into place.

B. Provide mix with compressive strength of maximum 200 psi (1.5 MPa) when measured 56 days after placement

C. Controlled Low Strength Material shall have minimal subsidence and bleed water which is measured as a Final Bleeding of less than 2.0 percent (retains 98.0 percent of original height after placement, approximately 1/4-inch per foot of depth) as measured in Section 10 of ASTM C940 "Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory".

D. The fresh unit weight shall be 90 - 110 lbs./ft^3 (1440 - 1760 kg/m3), except where specified, and in the absence of strength data the cementitious content shall be a maximum of 150 lbs./cy (90 kg/m3).

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Batch, mix and deliver CLSM in conformance with ASTM C94. Batch all constituents at a central batching or mixing plant.

B. Seasonal Conditions:

1. Conform to ACI 305R and as specified herein for hot weather concreting. Do not add retarder admixture to any concrete.

2. Conform to ACI 306R and as specified herein for cold weather concreting. Do not add accelerator admixture to any concrete.

3.2 TRANSPORTING AND MIXING:

A. Conform to concreting procedures set forth in ACI 304R and as specified herein.

B. Transport CLSM to discharge locations without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

3.3 FIELD TESTING:

A. General:

1. The testing laboratory will use concrete samples taken at the point of agitator or mixer truck discharge to perform slump, air content, and temperature tests and for field control test specimens.

B. Notification of Delivery:

1. Notify the Engineer of concrete deliveries a minimum of 48 hours in advance of the scheduled placement. Include within this notification, the mix design and quantity of concrete, method and location of placement, frequency of trucks, ordered slump and time of initial delivery.

2. Furnish delivery batch ticket to the representative from the owner's testing laboratory or to the Engineer representative in the field with each batch delivered to the discharge locations in conformance with ASTM C94.

C. Test Measurements at Discharge:

1. The testing laboratory firm will take measurement of concrete slump, air content and temperature for each 50 cubic yards (40 cubic meters) of each mix design but not less than once a day. The laboratory will conduct the slump, air content and temperature test measurements in conformance with ASTM C143, ASTM C231, and ASTM C1064, respectively.

2. The testing laboratory will submit test reports of field measurements specified above to the Contractor and to the Engineer.

D. Control Test Specimens:

1. The testing laboratory will cast a minimum of one set of three field control test specimens in conformance with ASTM C31 for each 150 cubic yards (115 cubic meters) of each mix design of concrete but not less than once a day.

2. Laboratory personnel will record truck and load number from the delivery batch ticket, the concrete placement location of each specimen, the date, concrete strength, slump, air content, temperature and truck driver's name.

3. Furnish tightly constructed nonabsorbent test cylinder molds. Use molds of same type and manufacture for all test specimens. Leave molds on cylinders until received in testing laboratory.

4. Furnish boxes for initial curing of test cylinders in conformance with ASTM C31 from time of fabrication until they are transported to the testing laboratory.

5. The testing laboratory will compression test one of each set of three specimens at seven days. Immediately notify the Contractor and the Engineer if the seven-day strength is deficient. Test the two remaining cylinders at 65 days for concrete strength acceptance. The acceptance test result is the average of the strengths of the two specimens tested at 56 days. The laboratory firm will submit compression test results of the control test specimens to both the Contractor and the Engineer. Evaluation and acceptance of concrete shall conform to ACI 301 and ACI 318.

3.4 CURING AND PROTECTION:

A. Protect CLSM from premature drying, hot or cold temperatures, and mechanical injury, beginning immediately after placement and maintain concrete with minimal moisture loss at relatively constant temperature.

B. Comply with curing procedures set forth in ACI 301, applicable portions of ACI 308 and as specified herein.

C. Perform hot weather concreting in conformance with ACI 305R and as specified herein when the ambient atmospheric temperature is 80 degrees F or above.

D. Perform cold weather concreting in conformance with ACI 306R and as specified herein when the ambient atmospheric temperature is 40 degrees F or below.

E. Protect Controlled Low Strength Material from traffic until sufficient strength has been achieved for further construction operations

3.5 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 03 35 00
CONCRETE FINISHING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-In. or 50-Mm Cube Specimens).

1.2 SUBMITTALS

A. Action Submittals: Manufacturer's product data sheet(s).

B. Informational Submittals:

1. Agenda: Conference prior to slab placement.
2. Manufacturer's written procedures for slab preparation, product application, protection of finished surface, and post-application cleanup.
3. Product manufacturers representatives' names and phone numbers.
4. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for products to be furnished.
5. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
6. Statement of Qualifications:
   a. Manufacturer's Product Service Record.
   b. Application personnel.
   c. Manufacturer's representative.
7. Manufacturer's installation instructions.
8. Manufacturer's written instructions for maintenance and repair of floor finishes installed.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Floor Product Manufacturer: Manufacture components of floor material, except the epoxy, in own plant and under control of trained quality control manager.

B. Preinstallation Training: Manufacturer-approved training of application personnel and quality control inspectors for these floor finishes.

C. Conference Prior to Slab Placement:

1. Conducted by Contractor.
2. Agenda:
   a. Concrete mix design.
   b. Placing techniques.
   c. Finishing techniques.
   d. Floor hardener application procedures.
   e. Equipment required for these procedures.
3. Attendees:
   a. Contractor's superintendent.
   b. Subcontractor's representative involved in slab installation and finishing.
   c. Engineer.

1.4 (NOT USED)

PART 2 PRODUCTS

2.1 CLEAR LIQUID SEALER DUST PROOFER

A. Colorless, aqueous solution of zinc and magnesium fluorosilicate.

B. Each gallon of solution shall contain a minimum of 2 pounds of fluorosilicate compound.

C. Manufacturers:

1. Master Builders Co., Cleveland, OH.
2. Sonneborn, Minneapolis, MN.
3. Euclid Chemical Co., Cleveland, OH.

2.2 DRY SHAKE HARDENERS

A. Mix: Surface hardener with natural aggregate, premixed and packaged at factory, delivered to Site ready to apply.

B. Natural Aggregate: Mixture of specially processed graded iron aggregate, selected portland cement, and necessary plasticizing agents formulated, processed, and packaged under stringent quality control at the manufacturer's factory.

1. Manufacturer and Product:

a. Natural concrete gray, “Surflex” by Euclid Chemical Co. or “Mastercron” by Master Builders, Cleveland, OH.

2.3 (NOT USED)

PART 3 EXECUTION

3.1 CLEAR LIQUID SEALER DUST PROOFER APPLICATION

A. Before application, thoroughly cure floors to receive treatment for minimum 28 days, keep clean, unpainted, free from membrane curing compounds, and perfectly dry with all Work above them completed.

B. Apply hardener evenly to surface, using three coats, allowing 24 hours between coats.

1. First coat 1/3 strength, second coat 1/2 strength, and third coat 2/3 strength, mix with water.
2. Apply each coat so as to remain wet on surfaces for 15 minutes.
3. Apply approved treatment in accordance with manufacturer’s instructions.
4. After final coat is completed and dry, remove surplus hardener from surface by scrubbing and mopping with water.

3.2 INSTALLATION OF DRY SHAKE HARDENERS

A. Application:

1. Application Rate: As recommended by manufacturer.
2. Penetration: Top 1/8-inch to 3/16-inch depth of floor slab.
3. Commence application immediately upon completion of floating surface area; bleed water shall not be present during and after application.
4. Distribute 2/3 of specified total quantity evenly on concrete surface to receive treatment by mechanical spreader; do not throw shake product.
5. Apply first to areas adjacent to forms, entry ways, columns, and walls where rapid moisture loss may occur.

B. Finishing:

1. Commence first mechanical float with finishing machines using float blades as soon as shake has absorbed moisture, as indicated by darkening of the surface area.
2. Float until moisture from base slab penetrates through first shake application.
3. Immediately distribute remaining 1/3 of total required shake by spreader and commence second mechanical float, as specified above.

4. Compact surface further by third mechanical float as time and setting characteristics of concrete allow.
5. Do not add water to surface area. In drying conditions, an evaporation retarder may be used to prevent plastic shrinkage cracking and rapid surface drying, subject to manufacturer's recommendations and approval of Engineer.
6. Hand or mechanically trowel surface while stiffening progresses, as indicated by loss of sheen with blades relatively flat.
7. Run trowel blades as soon as possible to achieve representative finish obtained on mockup panel.
8. Avoid excessive trowel blade speed which may "burn" or darken floor surface resulting in loss of wear.
9. Remove marks and pinholes in final raised trowel operation.

C. Curing:

1. Cure treated floor surface to meet the recommendations of the dry shake hardener manufacturer. Apply curing compounds as soon as possible without marring the slab surface.
2. Commence slab protection when curing compound is dry.
   a. Cover slab with nonstaining kraft building paper to protect area from droppings.
   b. Maintain floor free of traffic and loads for at least 10 days after completion.

3.3 (NOT USED)

3.4 TESTS AND INSPECTION

A. Vapor Transmission Test: Conduct test on new and existing concrete to show that no surface moisture exists prior to application of specified special floor treatment, as follows:

1. Place polyethylene plastic sheet, minimum 4 feet by 4 feet and sealed along four sides with duct tape to prevent moisture transmission by evaporation, over concrete floor area for 24 hours.
2. Indication of moisture transmission will be apparent by accumulation of moisture on enclosed surface of polyethylene plastic sheet.
3. Do not apply concrete bonding agent until test results indicate moisture is not being transmitted from concrete surface.

B. Epoxy Joint Filler:

1. Allow 90 days after slab placement before filling joints.
2. Mix and install in accordance with manufacturer's instructions.

3. Fill contraction or construction joints in areas receiving armored joint treatment.

3.5 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection and certification of proper installation, and training of application personnel.

1. Technical assistance with design and adjustment of concrete mixes to receive floor finishes and toppings.
2. Technical assistance to assure and certify application and installation of system being used.
3. Consultation, direction, and certification of mockup, for full-scale application of floor finishes, and at other times as needed.
4. Attendance at the conference prior to slab placement to finalize proper methods and procedures.

END OF SECTION

SECTION 03 39 00
CONCRETE CURING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 308.1, Specification for Curing Concrete.
2. ASTM International (ASTM):
   a. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   b. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
3. NSF International: 61, Drinking Water System Components – Health Effects.

1.2 SUBMITTALS

A. Action Submittals:

1. Manufacturers' data indicating compliance with the requirements specified herein for the following products:
   a. Evaporation retardant.
   b. Curing compound.
   c. Penetrating water repellent sealer.
   d. Clear liquid densifier.
2. Curing methods proposed for each type of element such as slab, walls, beams, and columns in each facility.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
   a. Curing compound showing moisture retention requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Curing Compound:

1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C1315, Type I**,** Class A.
2. Manufacturers and Products:
    a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
    b. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
    c. Vexcon Chemical, Inc.; Philadelphia, PA; Starseal 1315.
    d. Dayton Superior; Safe Cure and Seal 1315 EF.
    e. BASF Construction Chemicals., Shakopee, MN; MasterKure CC 200WB.
    f. Euclid Chemical Co., Cleveland, OH; EucoCure VOX.
    g. Euclid Chemical Co., Cleveland, OH; Kurez VOX White Pigmented.

B. Evaporation Retardant:

1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
2. Manufacturers and Products:
    a. BASF Construction Chemicals, Shakopee, MN; MasterKure ER 50.
    b. Euclid Chemical Co., Cleveland, OH; Eucobar.

C. Penetrating Water Repellent Sealer: Water based, ready to use, single component, silane/siloxane, penetrating, clear water repellant sealer.

1. Viscosity: 50 cps.
2. Flash Point: 200 degrees F.
3. NCHRP No. 244 Reduction in Chloride Content:
    a. Average: 82 percent.
    b. Minimum Required: 75 percent.
4. NCHRP No. 244 Reduction in Weight Gain:
    a. 21 Days: 85 percent.
    b. VOCs: 50 g/l.
    c. Depth of Penetration: 1/4 inch.
5. Manufacturers and Products:
    a. BASF Construction Chemicals, Shakopee MN; MasterProtect H 400.
    b. Euclid Chemical Co.; Baracade WB 244.

D. Clear Liquid Densifier:

1. Colorless, aqueous solution of magnesium fluorosilicate.
2. Each gallon of solution shall contain a minimum of 2 pounds of fluorosilicate compound.

3. Manufacturers and Products:
    a. BASF Construction Chemicals, Shakopee, MN; MasterKure HD 300WB.
    b. Euclid Chemical Co., Cleveland, OH; Surfhard.

E. Water: Clean and potable, containing less than 500 ppm of chlorides.

PART 3 EXECUTION

3.1 CONCRETE CURING

A. General:

1. Cure all concrete in accordance with project specifications and ACI 308.1.
2. Where surfaces are to receive coatings, painting, cementitious material, or other similar finishes, use only water curing procedures. Refer to Interior Finish Schedule for surfaces to receive coatings.
3. Use only water curing on potable water structures.
4. Use only water curing for Mass Concrete. Permissible curing water temperature shall be addressed in the Thermal Control plan.
5. Where curing compound cannot be used, water curing as described below or special methods using moisture shall be agreed upon by Engineer prior to placing concrete.
6. As required in Section 03 30 00, Cast-in-Place Concrete, if result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing specified below, by 7 additional days.

B. Use one of the following methods as approved by Engineer:

1. Vertical Surfaces:
    a. Method 1: Leave concrete forms in place and keep surfaces of forms and concrete wet for 7 days.
    b. Method 2: Continuously sprinkle with water 100 percent of exposed surfaces for 7 days starting immediately after removal of forms.
    c. Method 3: Apply curing compound, where allowed, immediately after removal of forms.
2. Horizontal Surfaces:
    a. Method 1: Protect surface by water ponding for 7 days.
    b. Method 2: Cover with burlap or cotton mats and keep continuously wet for 7 days.
    c. Method 3: Cover with 1-inch layer of wet sand, earth, or sawdust, and keep continuously wet for 7 days.
    d. Method 4: Continuously sprinkle exposed surface for 7 days.

e. Method 5: Apply curing compound, where allowed, immediately after final finishing when surface will no longer be damaged by traffic.

3.2 EVAPORATION RETARDANT APPLICATION

A. Use on flatwork when environmental conditions are anticipated to cause rapid drying of the concrete surface. Do not use evaporation retardant on potable water structures, unless product is NSF 61 approved.

B. Spray onto surface of fresh flatwork concrete immediately after screeding to react with surface moisture.

C. Reapply as needed to ensure a continuous moist surface until final finishing is completed.

3.3 NOT USED

3.4 PENETRATING WATER REPELLENT SEALER APPLICATION

A. Apply to slabs exposed to weather.

B. Before application and with Work above completed, water cure concrete walls and floors for a minimum of 28 days to receive sealer, keep clean, unpainted, and free from membrane curing compounds.

C. Concrete to receive penetrating sealer shall be dry for a minimum 24 hours immediately prior to application.

D. Apply per manufacturer's recommendations utilizing low pressure airless spray equipment.

1. Actual coverage and number of coats to be determined by field test sample application and water absorption testing. Final approval by Owner is required.

E. Apply at a coverage rate of 125 square feet per gallon to 200 square feet per gallon. Cure penetrating sealer on slabs for the minimum time recommended by manufacturer prior to allowing foot or vehicular traffic.

3.5 CLEAR LIQUID DENSIFIER APPLICATION

A. Apply to interior non-water-bearing slabs.

B. Before application and with Work above completed, water cure concrete walls and floors for a minimum of 28 days to receive sealer, keep clean, unpainted, and free from membrane curing compounds.

C. Apply liquid densifier evenly, using three coats, allowing 24 hours between coats.

1. First coat 1/3 strength, second coat 1/2 strength, and third coat 2/3 strength, mix with water.
2. Apply each coat so as to remain wet on surface for 15 minutes.
3. Apply approved liquid densifier in accordance with manufacturer's instructions.
4. After final coat is completed and dry, remove surplus liquid densifier from surface by scrubbing and mopping with water.

3.6 NOT USED

3.7 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at Site for installation assistance, inspection, and certification of proper installation for products specified.

B. Provide penetrating water repellent sealer manufacturer's representative to demonstrate proper application of product.

C. Provide clear liquid densifier manufacturer's representative to demonstrate proper mixing and application of product.

D. Provide curing compound manufacturer's representative to demonstrate proper application of curing compound to show coverage in one coat.

E. Provide retardant for exposed aggregate surfaces manufacturer's representative to demonstrate proper application and surface mortar removal procedures.

END OF SECTION

SECTION 03 40 00
PRECAST CONCRETE

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
2. ASTM International (ASTM):
   a. A36, Standard Specification for Structural Steel.
   b. A416, Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
   c. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. Precast/Prestressed Concrete Institute (PCI):
   a. MNL-120, Design Handbook for Precast and Prestressed Concrete, Third Edition.

1.2 SUBMITTALS

A. Action Submittals:

1. Sealer for Exterior Surfaces: Product data with mixing/application instructions.
2. Calculations and Technical Data: Proposed details and design calculations for stresses in all critical sections of precast members for all loading conditions including transportation, handling, and erection.

B. Informational Submittals:

1. For Precasting Manufacturers Not Listed in Article Quality Assurance:
   a. Experience record on production of precast concrete as shown, with information on precasting plant, that will indicate capability to satisfactorily perform the Work.
   b. Evidence of current NPCA plant certification, and evidence of current PCI plant certification for prestressed concrete as applicable.
2. Certificate of Compliance: Certify admixtures and concrete do not contain calcium chloride.
3. Test Reports:
   a. For precast manufacturer's concrete test cylinders.
   b. Inspection of installed precast members.

1.3 QUALITY ASSURANCE

A. Qualifications of Precasting Manufacturers:

1. Precast Concrete and Precast Prestressed Concrete: Product of manufacturer producing precast concrete products of quality specified.
2. Precast Plant: NPCA certified plant with current certification.
3. Precasting Manufacturers with Apparent Capability to Meet These Specifications:
   a. Oldcastle Precast Inc.
   b. Jensen Precast.
4. Calculations stamped by an engineer registered in the same state as the Project.

PART 2 PRODUCTS

2.1 MATERIALS

A. Formwork:

1. One-piece, full length and without seams.
2. As specified in Section 03 10 00, Concrete Forming and Accessories.

B. Reinforcing Steel: As specified in Section 03 21 00, Reinforcing Steel.

C. Cement: As specified in Section 03 30 00, Cast-in-Place Concrete.

D. Pretensioning Strands: Seven-wire, uncoated, stress relieved, ASTM A416, Grade 270.

E. Aggregates: As specified in Section 03 30 00, Cast-in-Place Concrete, for 3/4-inch maximum size.

F. Admixtures: As specified in Section 03 30 00, Cast-in-Place Concrete.

G. Embedded Items:

1. ASTM A36 steel.
2. Anchor Studs: Headed anchor studs (HAS), deformed bar anchors (DBA), or threaded studs as manufactured by Nelson Stud Welding Co., Lorain, OH.
3. Furnish inserts for lifting, and as otherwise required.

H. Grout: Nonshrink, nonmetallic Type II grout as specified in Section 03 62 00, Nonshrink Grouting.

I. Sealer for Exterior Surfaces:

1. Silane Sealer: One-component penetrating sealer, hydrophilic (isopropyl alcohol as a carrier) with 40 percent active ingredients.
2. Manufacturers:
   a. Master Builders Co.
   b. Euclid Chemical Co.

2.2 CONCRETE MIX

A. As specified in Section 03 30 00, Cast-in-Place Concrete.

B. Design Strength: 5,000 psi at 28 days.

C. Water/Cement Ratio: 0.38 maximum.

2.3 DESIGN REQUIREMENTS

A. Structural Precast and Prestressed Members:

1. Meet applicable sections of PCI MNL-120.
2. Design for spans and superimposed live and dead loads shown plus dead loads of members.

B. Prestressed Members:

1. Calculated tension at full service loads shall not exceed six times the square root of design strength except that in wet or corrosive service conditions**,** the calculated tension due to live load and dead load shall not exceed zero.
2. Limit long-term camber growth to span length divided by 360.

2.4 FABRICATION

A. General:

1. Comply with PCI MNL-117.
2. Reinforcing Steel and Pretensioning Strands:
   a. Place in position before concrete is cast.
   b. Keep clean and free from form oil or other substances harmful to bond.
3. Pretensioning Force, if Used: Determine by elongation and by gauge pressure.
   a. Method: Meet requirements of Prestressed Concrete Institute.
4. Forms: Produce smooth surfaces.

5. Concrete: Deposit, vibrate, finish, and cure in accordance with recommended practices of ACI 304R. Steam curing is permitted.
6. Release Strength for Pretensioning Method: Minimum 4,000 psi, unless otherwise approved.
7. Coordinate dimensions, determine type, quantity, size, and location of, and furnish necessary embedded items in precast concrete. Coordinate location of embedded items in cast-in-place concrete necessary to connect precast items.

B. Surface Finish for Precast Structural Units: Furnish concrete finish, as specified in Section 03 30 00, Cast-in-Place Concrete, to additional concrete field placed on precast units.

1. Other Surfaces: Smooth screeded finishes, unless otherwise shown.

C. Sealer:

1. Apply to exterior surfaces of vaults at precast plantsite in accordance with manufacturer's instructions.
2. Protect surface until installed in the Work.
3. Repair damage as approved by manufacturer.

2.5 SOURCE QUALITY CONTROL

A. Prepare minimum three standard concrete test cylinders for each 50 cubic yards or fraction thereof of concrete placed in the precast work in accordance with ASTM C31.

B. Test and record concrete strengths.

PART 3 EXECUTION

3.1 ERECTION

A. Verify that anchorage inserts are in correct locations.

B. Handle and erect precast concrete with care as recommended by manufacturer.

C. Erect precast units plumb, straight, level, square, and in proper alignment.

D. Fasten units securely in place and brace to maintain position, stability, and alignment until permanently connected and structure is complete and stable.

E. Field Cutting: Not allowed without prior approval of Engineer.

3.2 (NOT USED)

3.3 PATCHING

A. Mix and place patching mixture to match texture of surrounding concrete and to minimize shrinkage.

B. Demonstrate patching method and obtain acceptance and approval.

3.4 (NOT USED)

3.5 FIELD QUALITY CONTROL

A. Inspection:

1. With Engineer, inspect precast units for chips, cracks, and other damage.
2. Record location and condition of damaged units.

B. Resolution:

1. Repair damage to satisfaction of Engineer and Owner.

3.6 PROTECTION

A. Protect precast units from chipping, spalling, cracking, or other damage to the units after delivery to Site.

B. After erection, protect units from damage.

END OF SECTION

SECTION 03 62 00
GROUTING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C230, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
   b. C307, Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.
   c. C531, Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   d. C579, Standard Test Methods for Compressive Grout Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   e. C882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
   f. C939, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
   g. C940, Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.
   h. C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
   i. C1181, Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
   j. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

1.2 SUBMITTALS

A. Action Submittals:

1. Product data of grouts.
2. Proposed method for keeping existing concrete surfaces wet prior to placing nonshrink grout.
3. Forming method for fluid grout placements.
4. Curing method for grout.

B. Informational Submittals:

1. Manufacturer's Written Instructions:
    a. Adding fiber reinforcing to batching.
    b. Mixing of grout.
2. Manufacturer's proposed training schedule for grout work.
3. Manufacturer's Certificate of Compliance in accordance with Section 01 61 00, Common Product Requirements.
    a. Grout free from chlorides and other corrosion-causing chemicals.
    b. Nonshrink grout properties of Category II and Category III, verifying expansion at 3 days or 14 days will not exceed the 28-day expansion and nonshrink properties are not based on gas or gypsum expansion.
4. Manufacturer's Certificate of Proper Installation.
5. Statements of Qualification: Grout manufacturer's representative.
6. Test Reports:
    a. Test report for 24-hour evaluation of nonshrink grout.
    b. Test results and service report from demonstration and training session.
    c. Field test reports and laboratory test results for field-drawn Samples.
7. List of Contractor's equipment installation staff trained by grout manufacturer's representative in:
    a. Nonshrink grout installation and curing.
    b. Epoxy grout installation and curing.

1.3 QUALIFICATIONS

A. Grout Manufacturer's Representative: Authorized and trained representative of grout manufacturer.

B. For grout suppliers not listed herein, provide completed 24-hour Evaluation of Nonshrink Grout Test Form, attached at the end of this section. Provide independent testing laboratory test results for testing conducted within last 18 months.

PART 2 PRODUCTS

2.1 NONSHRINK GROUT AND EPOXY GROUT SCHEDULE

A. Furnish nonshrink grout (Category I, II, and III) and epoxy grout for applications as indicated in the following schedule:

Application	Temperature Range	Max. Placing Time	
	40 deg F to 100 deg F	20 Min.	Greater Than 20 Min.
Blockouts for gate guides	I or II		II
Precast joints	I or II		II
Column baseplates single-story	I or II		II
Machine bases 20 hp or less, equipment + driver less than 1000 pounds	II	II	II
Bases for precast wall sections	II	II	II
Form Tie-Through bolt openings	II	II	II
Machine bases 21 hp and up	Epoxy Grout	Epoxy Grout	Epoxy Grout
Baseplates and/or soleplates with vibration, thermal movement, etc.	III or Epoxy Grout	III or Epoxy Grout	III or Epoxy Grout

2.2 NONSHRINK GROUT

A. Category I:

1. Nonmetallic and nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Test in accordance with ASTM C1107/C1107M:
   a. Grout shall have flowable consistency.
   b. Flowable for 15 minutes.
4. Grout shall not bleed at maximum allowed water.
5. Minimum strength of flowable grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
6. Manufacturers and Products:
   a. BASF Building System, Inc., Shakopee, MN; MasterFlow 100.
   b. Euclid Chemical Co., Cleveland, OH; NS Grout.
   c. Dayton Superior Corp., Miamisburg, OH; 1107 Advantage Grout.
   d. US MIX Co., Denver, CO; US SPEC GP Grout.
   e. Five Star Products Inc., Fairfield, CT; Five Star Grout.

B. Category II:

1. Nonmetallic, nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
    a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
    b. Temperatures of 40 degrees F, 80 degrees F, and 90 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 3,500 psi at 1 day, 4,500 psi at 3 days, and 7,500 psi at 28 days.
7. Maintain fluid consistency when mixed in 1-yard to 9-yard loads in ready-mix truck.
8. Manufacturers and Products:
    a. BASF Building Systems, Inc., Shakopee, MN; MasterFlow 928.
    b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
    c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
    d. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.
    e. US MIX Co., Denver, CO; US SPEC MP Grout.

C. Category III:

1. Metallic and nongas-liberating.
2. Prepackaged aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
    a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
    b. Temperatures of 40 degrees F and 100 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 4,000 psi at 1 day, 5,000 psi at 3 days, and 9,000 psi at 28 days.
7. Maintain fluid consistency when mixed in 1-yard to 9-yard loads in ready-mix truck.
8. Manufacturer and Product:
    a. BASF Building Systems, Inc., Shakopee, MN; MasterFlow 885.
    b. Euclid Chemical Co, Cleveland, OH; Hi-Flow Metallic Grout.

2.3 EPOXY GROUT

A. High-strength, nonshrink, high-temperature epoxy grouting material developed for the support of heavy equipment with vibratory loads.

B. Three-component mixture of a two-component epoxy resin system (100 percent solids) with a graded, precision aggregate blend.

C. Premeasured, prepackaged system.

D. Flowable.

E. Minimum compressive strength in accordance with ASTM C579 Method B, 9,500 psi at 75 degrees F at 7 days, 11,000 psi at post cure.

F. Maximum creep resistance in accordance with ASTM C1181 at 600 psi, 140 degrees F; 6.0 by 10^{-3} in/in.

G. Minimum bond strength in accordance with ASTM C882, 2,000 psi.

H. Minimum tensile strength in accordance with ASTM C307, 2,000 psi.

I. Maximum coefficient of thermal expansion in accordance with ASTM C531 at 73 degrees F to 210 degrees F, 23.0 by10^{-6} in/in/degrees F.

J. Working Time: Minimum 2 hours at 50 degrees F; 1.5 hours at 70 degrees F; 50 minutes at 90 degrees F.

K. Good chemical resistance.

L. Good effective bearing area.

M. Noncorrosive.

N. Moisture insensitive.

O. Modify resin and aggregate content where recommended by epoxy grout manufacturer to provide desired epoxy grout flow properties.

P. Manufacturer and Product:

1. BASF Building System, Inc., Shakopee MN; MasterFlow 648.
2. Euclid Chemical Co., Cleveland, OH; E^3-G.
3. Dayton Superior Corp., Miamisburg, OH; Pro-Poxy 2000 Normal Set.
4. Five Star Products Inc., Fairfield, CT; DP Epoxy Grout.

PART 3 EXECUTION

3.1 GROUT

A. General: Mix, place, and cure grout in accordance with grout manufacturer's representative's training instructions.

B. Epoxy Grout: Concrete slab shall be fully cured for 28 days to ensure excess water has evaporated. Test concrete surface for moisture in accordance with ASTM D4263 before epoxy grout is placed.

C. Form Tie-Through Bolt Holes: Provide nonshrink grout, Category II, fill space with dry pack dense grout hammered in with steel tool and hammer. Through-bolt holes; coordinate dry pack dense grout application with vinyl plug in Section 03 10 00, Concrete Forming and Accessories, and bonding agent in Section 03 30 00, Cast-in-Place Concrete.

D. Form Snap-Tie Hole: Fill tie hole in accordance with requirements of Section 03 30 00, Cast-in-Place Concrete.

3.2 GROUTING MACHINERY FOUNDATIONS

A. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.

B. Clean metal surfaces of all paint, oil, grease, loose rust, and other foreign material that will be in contact with grout.

C. Sandblast to bright metal all metal surfaces in contact with epoxy grout in accordance with manufacturer's written instructions.

D. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.

E. Form with watertight forms at least 2 inches higher than bottom of plate.

F. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's representative's training instructions.

G. If grout cannot be placed from one edge and flowed to the opposite edge, air vents shall be provided through the plate to prevent air entrapment.

H. Radius all corners of grout pad.

I. Install expansion joints for epoxy grout placement in accordance with manufacturer's written instructions.

3.3 TANK FOUNDATIONS

A. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.

B. Clean metal surfaces of all paint, oil, grease, loose rust and other foreign material that will be in contact with grout.

C. Set tank in position and wedge to elevation with steel wedges, or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.

D. Form with watertight forms at least 2 inches higher than bottom of plate.

E. Fill space between bottom of tank base and original concrete in accordance with manufacturer's representative's training instructions.

3.4 FIELD QUALITY CONTROL

A. General:

1. Performed by Project representative's inspection staff.
2. Perform the following quality control inspections. The grout manufacturer's representative shall accompany the Project representative's inspection staff on the first installation of each size and type of equipment.

B. Evaluation and Acceptance of Nonshrink Grout:

1. Inspect the surface preparation of concrete substrates onto which nonshrink grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.
2. Inspect preparation and application of nonshrink grout form work for conformance to the manufacturer's recommendations.
3. Conduct a final review of completed nonshrink grout installation for conformance to these Specifications.
4. Provide a flow cone and cube molds with restraining plates onsite. Continue tests during Project as demonstrated by grout manufacturer's representative.
5. Perform flow cone and bleed tests, and make three 2-inch by 2-inch cubes for each 25 cubic feet of each type of nonshrink grout used. Use restraining caps for cube molds in accordance with ASTM C1107/ C1107M.

6. For large grout applications, make three additional cubes and one more flow cone test. Include bleed test for each additional 25 cubic feet of nonshrink grout placed.
7. Consistency: As specified in Article Nonshrink Grout. Flow cone test in accordance with ASTM C939. Grout with consistencies outside range requirements shall be rejected.
8. Segregation: As specified in Article Nonshrink Grout. Grout when aggregate separates shall be rejected.
9. Nonshrink grout cubes shall test equal to or greater than minimum strength specified.
10. Strength Test Failures: Nonshrink grout work failing strength tests shall be removed and replaced.
11. Perform bleeding test in accordance with ASTM C940 to demonstrate grout will not bleed.
12. Store cubes at 70 degrees F.
13. Independent testing laboratory shall prepare, store, cure, and test cubes in accordance with ASTM C1107/C1107M.
14. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

C. Evaluation and Acceptance of Epoxy Grout:

1. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.
2. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.
3. Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.
4. Inspect the epoxy-primed metallic substrate for coverage and adhesion.
5. Inspect preparation and application of epoxy grout form work for conformance to the manufacturer's recommendation.
6. Verify consistency obtained is sufficient for the proper field placement at the installed temperatures.
7. Inspect and record that the "pot life" of epoxy grout materials is not exceeded during the installation.
8. Inspect epoxy grout for cure.
9. Inspect and record that localized repairs made to grout voids are in conformance with the specification requirements.
10. Conduct a final review of completed epoxy grout installation for conformance to these Specifications.
11. Compression tests and fabrication of specimens for epoxy grout shall be made in accordance to ASTM C579, Method B, at intervals during

construction as selected by the Project representative. A set of three specimens shall be made for testing at 7 days, and each earlier time period as appropriate.

12. Independent testing laboratory shall prepare, store, cure, and test cubes in accordance with ASTM C579.
13. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

3.5 MANUFACTURER'S SERVICES

A. General:

1. Coordinate demonstrations, training sessions, and applicable Site visits with grout manufacturer's representative. Allow 2-week notice to grout manufacturer's representative for scheduling purposes.
2. Provide and conduct onsite, demonstration and training sessions for bleed tests, mixing, flow cone measurement, cube testing, application, and curing for each category and type of grout.
3. Necessary equipment and materials shall be available for demonstration.
4. Conduct training prior to equipment mount installation work on equipment pads.
5. Training for each type of grout shall be not less than 4 hours' duration.

B. Nonshrink Grout Training:

1. Training is required for all Type II and Type III grout installations.
2. Provide nonshrink grout installation training by the qualified grout manufacturer's representative for Contractor's workers that will be installing nonshrink grout for baseplates and equipment mounts. Schedule training to allow Engineer's attendance.
3. Mix nonshrink grouts to required consistency, test, place, and cure on actual Project, such as, baseplates and form tie-through bolt holes to provide actual on-the-job training.
4. Use minimum of two bags for each grout Category II and Category III. Mix grout to fluid consistency and conduct flow cone and two bleed tests, make a minimum of six cubes for testing of two cubes at 1 day, 3 days, and 28 days. Use remaining grout for final Work.
5. Include recommended grout curing methods in the training.
6. Mix and demonstrate patching through-bolt holes and blockouts for gate guides, and similar items.
7. Transport test cubes to independent test laboratory and obtain test reports.
8. Training by manufacturer's representative does not relieve Contractor of overall responsibility for this portion of the work.

9. Submit a list of attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

C. Epoxy Grout Training:

1. Provide epoxy grout installation training by the qualified epoxy grout manufacturer's representative for Contractor's workers that will be installing epoxy grout for equipment mounts. Schedule training to allow Engineer's attendance.
2. Include training in:
   a. Performance testing such as compressive strength testing of the epoxy grout.
   b. All aspects of using the products, from mixing to application.
3. Transport test cubes to independent test laboratory and obtain test reports.
4. Training by manufacturer's representative does not relieve Contractor of overall responsibility for this portion of the work.
5. Submit a list of attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

3.6 SUPPLEMENTS

A. The supplement listed below, following "End of Section," is part of this Specification.

1. 24-hour Evaluation of Nonshrink Grout Test Form and Grout Testing Procedures.

END OF SECTION

SUPPLEMENT 1

_____

(Test Lab Name)

_____

(Address)

_____

(Phone No.)

24-HOUR EVALUATION OF NONSHRINK GROUT TEST FORM

OBJECTIVE: Define standard set of test procedures for an independent testing laboratory to perform and complete within a 24-hour period.

SCOPE: Utilize test procedures providing 24-hour results to duplicate field grouting demands. Intent of evaluation is to establish grout manufacturer's qualifications.

PRIOR TO TEST: Obtain three bags of each type of grout.

1. From intended grout supplier for Project.
2. Three bags of grout shall be of same lot number.

ANSWER THE FOLLOWING QUESTIONS FOR GROUT BEING TESTED FROM LITERATURE, DATA, AND PRINTING ON BAG:

A.	Product data and warranty information contained in company literature and data?	Yes_____No_____
B.	Literature and bag information meet specified requirements?	Yes_____No_____
C.	Manufacturer guarantees grout as specified in Article Guarantee?	Yes_____No_____
D.	Guarantee extends beyond grout replacement value and allows participation with Contractor in replacing and repairing defective areas?	Yes_____No_____
E.	Water demands and limits printed on bag?	Yes_____No_____
F.	Mixing information printed on the bag?	Yes_____No_____
G.	Temperature restrictions printed on bag?	Yes_____No_____

*Rejection of a grout will occur if one or more answers are noted NO.

GROUT TESTING PROCEDURES

A. Bagged Material:

1. List lot numbers. _____
2. List expiration date. _____
3. Weigh bags and record weight. _____

Owner's Representative will disqualify grout if bag weights have misstated measure plus or minus 2 pounds by more than one out of three bags. (Accuracy of weights is required to regulate amount of water used in mixing since this will affect properties.)

B. Mixing and Consistency Determination:

1. Mix full bag of grout in 10-gallon pail.
2. Use electric drill with a paddle device to mix grout (jiffy or jiffler type paddle).
3. Use maximum water allowed per water requirements listed in bag instructions.
4. Mix grout to maximum time listed on bag instructions.
5. In accordance with ASTM C939 (flow cone) determine time of mixed grout through the flow cone. _____seconds.
6. Add water to attain 20- to 30-second flow in accordance with ASTM C939.
7. Record time of grout through cone at new water demand._____seconds.
8. Record total water needed to attain 20- to 30-second flow._____pounds.
9. Record percent of water._____percent.

C. When fluid grout is specified and additional water is required beyond grout manufacturer's listed maximum water, ASTM C1107/C1107M will be run at new water per grout ratio to determine whether grout passes using actual water requirements to be fluid. Use new water per grout ratio on remaining tests.

D. Bleed Test:

1. Fill two gallon cans half full of freshly mixed grout at ambient temperatures for each category and at required consistency for each.
2. Place one can of grout in tub of ice water and leave one can at ambient temperature.
3. Cover top of both cans with glass or plastic plate preventing evaporation.
4. Maintain 38 degrees F to 42 degrees F temperature with grout placed in ice and maintain ambient temperature for second container for 1 hour.
5. Visually check for bleeding of water at 15-minute intervals for 2 hours.

6. Perform final observation at 24 hours.

If grout bleeds a small amount at temperatures specified, grout will be rejected.

E. Extended Flow Time and Segregation Test (for Category II and Category III):

1. Divide the remaining grout into two 3-gallon cans. Place the cans into the 40-degree F and 90-degree F containers and leave for 20, 40, and 60 minutes. Every 20 minutes remove and check for segregation or settlement of aggregate. Use a gloved hand to reach to the bottom of the can, if more than 1/4 inch of aggregate has settled to the bottom or aggregate has segregated into clumps reject the grout.
2. Right after the settlement test mix the grout with the drill mixer for 10 seconds. Take a ASTM C939 flow cone test of grout and record flow time. Maintain this process for 1 hour at ambient temperatures of 40 degrees F and 90 degrees F.
   a. 20 min_____, sec. @ 40 degrees F.
   b. 40 min_____, sec. @ 40 degrees F.
   c. 60 min_____, sec. @ 40 degrees F.
   d. 20 min_____, sec. @ 90 degrees F.
   e. 40 min_____, sec. @ 90 degrees F.
   f. 60 min_____, sec. @ 90 degrees F.

All Category II and Category III grout that will not go through the flow cone with continuous flow after 60 minutes will be disqualified.

_____ _____

Qualified Disqualified

F. 24-hour Strength Test:

1. Using grout left in mixing cans in accordance with ASTM C1107/C1107M for mixing and consistency determination test and for extended time flow test, make minimum of nine cube samples.
2. Store cubes at 70 degrees F for 24 hours.
3. Record average compressive strength of nine cubes at 24 hours.

Grout will be disqualified if 24-hour compressive strengths are less than 2,500 psi for grouts claiming fluid placement capabilities.

Grouts that have not been disqualified after these tests are qualified for use on the Project for the application indicated in Nonshrink Grout Schedule.

_____ _____

Signature of Independent Testing Laboratory Date Test Conducted

SECTION 03 63 00
CONCRETE DOWELING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American National Standards Institute (ANSI).
2. ASTM International (ASTM):
   a. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
   b. E488, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
3. International Code Council (ICC):
   a. 2016 California Building Code (CBC).
   b. Evaluation Services Reports.

1.2 DEFINITIONS

A. ICC Evaluation Services Report: Published by ICC for products provided by concrete adhesive anchor manufacturers.

B. Special Inspection: As defined in the ICC CBC and indicated on the Statement of Special Inspection (Plan) on the Drawings.

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data: Manufacturer's catalog information.

B. Informational Submittals:

1. Manufacturer's instructions for preparation, placement, drilling of holes, installation of dowels and adhesive, and handling of cartridges, nozzles, and equipment.
2. ICC Evaluation Services Report: Specific to proposed doweling system manufacturer.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installer: Trained and certified by manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Container Markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

B. Store adhesive components in accordance with manufacturer's written instructions.

C. Dispose of when:

1. Shelf life has expired.
2. Stored other than per manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Adhesive:

1. Approved by an ICC Evaluation Services Report for conformance to 2015 IBC requirements for doweling of steel reinforcing bars in cracked concrete.
2. Suitable for long-term loads as well as for wind and seismic loads.
3. Meet requirements of ASTM C881/C881M.
4. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
5. Disposable, Self-Contained Cartridge System:
   a. Capable of dispensing both components in proper mixing ratio.
   b. Fit into manually or pneumatically operated caulking gun.
6. Manufacturers and Products:
   a. Hilti, Inc., Plano, TX; HIT-RE 500 V3 (ESR-3814) or HIT-HY 200 (ESR-3187) Adhesive Anchors.
   b. Dewalt/Powers Fasteners, Towson, MD; PURE110+ Epoxy Adhesive Anchor System (ESR-3298).
   c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-XP Epoxy Adhesive Anchors (ESR-2508).

B. Mixing Nozzles:

1. Disposable, manufactured in several sizes to accommodate size of reinforcing dowels.

C. Reinforcing Dowels:

1. As specified in Section 03 21 00, Steel Reinforcement.
2. Smooth Epoxy-Coated Expansion Joint Dowels: As specified in Section 03 15 00, Concrete Joints and Accessories.

PART 3 EXECUTION

3.1 INSTALLATION

A. Drilling Equipment:

1. Drilling Hammers for Dowel Holes:
   a. Electric or pneumatic rotary type with medium or light impact.
   b. Hollow drills with flushing air systems are preferred.
2. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.

B. Hole Diameter: Use drill bit diameter meeting ICC Evaluation Services Report requirements and as recommended by manufacturer.

C. Obstructions in Drill Path: When existing steel reinforcement is encountered during drilling, obtain Engineer approval for proposed fix.

D. Doweling:

1. Install per details shown on Drawings and in accordance with adhesive manufacturer's instructions.
2. Dowels may be prebent prior to installation to 15 degrees to align with other bars. Do not heat dowels to bend.
3. Bent Bar Dowels: Where edge distances are critical, and intersection with steel reinforcement is likely, drill hole at 10-degree angle or less and use prebent reinforcing bars.

E. Adhesive:

1. Install in accordance with written manufacturer's instructions.
2. Dispense components through specially designed static mixing nozzle that thoroughly mixes components and places mixed adhesive at base of predrilled hole.

3.2 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Proof Loading:

1. To be performed where continuous inspection of concrete dowels is required.
2. Testing will be performed by Owner's Independent Testing Agency.
3. Proof loading to be performed only after adhesive has achieved proper cure per manufacturer's requirements.
4. Testing will be conducted on minimum of 10 percent of installed dowels, with a minimum of two tension tests. A minimum of two cartridges per box or packaging unit will be tested.
5. Testing will be conducted in accordance with ASTM E488 and as follows:
    a. Performance of a static tension test of each test dowel.
    b. Test apparatus reaction base will not interfere with bond failure of dowel, but will preclude a concrete pullout cone failure.
    c. Each test dowel will be tested at a proof load equal to the lesser of 80 percent of the yield strength of the dowel bar or 50 percent of calculated ultimate load based on adhesive bond strength.
    d. Test load to be maintained for a minimum of 30 seconds without visible signs of movement of dowel or drop in gauge reading.
6. Failure of dowel bar or failure within base concrete will cause dowel to be rejected. For each rejected dowel, two additional dowels will be tested. Replace rejected dowels as approved by Engineer.

B. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspection (Plan) on Drawings. Contractor responsibilities and related information on special inspection and testing are included in Section 01 45 33, Special Inspection, Observation, and Testing.

1. Special inspection will be performed by the Special Inspector in accordance with ICC ESR requirements and as specified in Section 01 45 33, Special Inspection, Observation, and Testing.
2. Continuous inspection required where noted on Drawings, where concrete dowels are installed in overhead applications, and where concrete dowels are installed in horizontal applications subject to sustained tension loading.
3. Periodic inspection required where continuous inspection is not specified.
4. Special Inspector will observe installation in accordance with requirements of the ICC Evaluation Services Report and will submit report including the following:

a. Product Description: Product name, rod/dowel diameter, and length.
b. Drill bit compliance.
c. Hole diameter, depth, cleaning procedure, and cleanliness.
d. Dowel spacing and edge distances.
e. Adhesive expiration date.
f. Concrete type, thickness, and compressive strength.

5. Verification of dowel installation in accordance with manufacturer's published instructions

C. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 64 23
EPOXY RESIN INJECTION GROUTING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C882, Standard Specification for Test Method for Bond Strength of Epoxy Resin System Used with Concrete by Slant Shear.
   b. D570, Standard Test Method for Water Absorption of Plastics.
   c. D638, Standard Test Method for Tensile Properties of Plastics.
   d. D648, Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edgewise Position.
   e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
   f. D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
2. National Sanitation Foundation (NSF):
   a. Standard 60, Standard for Drinking Water Treatment and Chemicals – Health Effects.
   b. Standard 61, Standard for Drinking Water System Components – Health Effects.

1.2 DEFINITIONS

A. Crack: Complete or incomplete separation of concrete into two or more parts produced by breaking or fracturing.

B. Defective Area: As defined in Section 03 30 00, Cast-in-Place Concrete.

C. Hydraulic Structure: Liquid containment structure and/or structure designed to mitigate liquid infiltration. Portions of structures 6-ft or greater below grade are considered to be hydraulic structures due to high groundwater conditions.

D. Injection: Method of bonding together, addressing or eliminating leakage through cracks or joints by installing resin under pressure to fill the void in crack or joint.

E. Joint: A planned and formed discontinuity in concrete structure at junction of adjacent and sequential concrete placements and may contain embedded waterstops.

F. Leak or Leakage: Crack or joint exhibiting presence of moisture, sign of efflorescence, intermittently wet to touch, or continuous flow of liquid.

G. Narrow Cracks: Width equal to or less than 0.015 inch.

H. Wide Cracks: Wider than 0.015 inch.

1.3 SUBMITTALS

A. Action Submittals:

1. Physical and chemical properties for epoxy resin.
2. Technical data for metering, mixing, and injection equipment.
3. Depth of penetration, length, material used, and procedures where epoxy is approved for use.
4. Marked up drawings of proposed epoxy injection repair crack locations, widths, and lengths and direction on structure.
5. Sample bottle.
6. Pot Life Test.
7. Slant Shear Test (Bond Strength).

B. Informational Submittals:

1. Manufacturer's recommended surface preparation procedures and application instructions for epoxy resins.
2. Manufacturer's Certificate of Compliance in accordance with Section 01 61 00, Common Product Requirements. Certified test results for each batch of epoxy resin.
3. Statements of Qualification for Epoxy Resin:
   a. Manufacturer's Site representative.
   b. Injection applicator.
   c. Injection pump operating technician.
4. Sample of epoxy resin two component ratio and injection pressure test records for concrete crack repair work.
5. Installation instructions for repairing core holes with repair mortar.
6. Test results of epoxy resin bond tests.
7. Epoxy resin two component ratio and injection pressure test records for concrete crack repair work.

1.4 QUALITY ASSURANCE

A. Qualifications for Injection Staff:

1. Manufacturer's Site Representative:
   a. Capable of instructing successful methods of epoxy injection process for concrete structure.

b. Understands and is capable of explaining technical aspects of correct material selection and use.
c. Experienced in operation, maintenance, and troubleshooting of application equipment.

2. Injection Crew and Job Foreman:
   a. Provide written and verifiable evidence showing compliance with the following requirements:
      1) Licensed or certified by epoxy resin material manufacturer.

B. Injected Epoxy Resin: Fill cracks and joints with minimum resin depth penetration no less than 90 percent of:

1. Full thickness of concrete section for cracks or joints.
2. Depth between waterstop and inside face of structure for joints with an embedded waterstop.

C. Injected cracks and joints which leak shall be considered deficient work irrespective of depth of penetration. Reinjection of deficient work or, with approval of Engineer, provide other repairs to eliminate leakage.

D. Bond Strength Test for Epoxy Resin:

1. Concrete failure before resin failure.
2. 1,500 psi minimum bond strength per ASTM C882 test requirements with no failure of either concrete or epoxy resin.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:

1. Package resin material in new sealed containers and label with following information:
   a. Manufacturer's name.
   b. Product name and lot number.
   c. ANSI Hazard Classification.
   d. ANSI recommended precautions for handling.
   e. Mix ratio by volume for components.

B. Storage and Protection: Store epoxy resin material containers in accordance with manufacturer's printed instructions and at ambient temperatures below 110 degrees F and above 45 degrees F.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials and accessories specified in this section shall be products of:

1. BASF Construction Chemicals, LLC-Building Systems, Shakopee, MN; SCB Concresive Series products that meet properties indicated in sub-section 2.2.B.
2. Sika Corp., Lyndhurst, NJ; Sikadur Series products that meet properties below.
3. Euclid Chemical Co., Cleveland, OH; Euco Series (#452) products that meet properties below.

2.2 EPOXY INJECTION RESIN

A. Two-component A and B structural epoxy resin for injection into cracks or joints in concrete structures for bonding or grouting.

B. Uncured Resin Properties:

1. When mixed in ratio specified on resin container label:

	Test Method	Wide Cracks [A: or Joints]	Narrow Cracks [A: or Joints]
Pot Life (60-gram mass) @ 77, plus or minus 4 deg F	As specified in Article Source Quality Control	13 to 25 minutes	15 to 30 minutes
Pot Life (60-gram mass) @ 100, plus or minus 4 deg F	As specified in Article Source Quality Control	3 to 10 minutes	10 to 20 minutes
Viscosity @ 40, plus or minus 3 deg F	Brookfield RVT Spindle No. 4 @ 20 rpm	4,400 cps	600 cps
Viscosity @ 75 to 77 deg F	Brookfield RVT Spindle No. 2 @ 20 rpm	375 to 350 cps	175 to 140 cps

C. Epoxy Resin Properties: When cured for 7 days at 77 degree F, plus or minus 3 degrees F and conditioned at test temperature 12 hours prior to test, unless otherwise specified.

	Test Method	Wide Cracks or Joints	Narrow Cracks or Joints
Ultimate Tensile Strength, psi	ASTM D368	**[A: 8,000]** min.	**[A: 5,000]** min.

	Test Method	Wide Cracks or Joints	Narrow Cracks or Joints
Tensile Elongation @ Break, percent	ASTM D638	4.2 max.	3.0 max.
Flexural Strength, psi	ASTM D790	10,000 min.	10,000 min.
Flexural Modulus, psi	ASTM D790	5.5 x 10^5 min.	4.5x10^5 min.
Compressive Yield Strength, psi	ASTM D695*	15,000 min.	12,000 min.
Compressive Modulus, psi	ASTM D695*	4.0x10^5 min.	4.0x10^5 min.
Heat Deflection Temperature	ASTM D648*	130 deg F min.	140 deg F min.
Cured 3 days @ 40 deg F – Wet Concrete		3,500 psi min.	3,500 psi min.
Cured 1 day @ 77 deg F – Dry Concrete		5,000 psi min.	5,000 psi min.
Cured 3 days @ 77 deg plus or minus 3 deg F		5,000 psi min.	5,000 psi min.
*Cure test specimens so that peak exothermic temperature of resin does not exceed 100 degrees F. Note: See referenced specifications for preparation method of test specimens.			

2.3 SURFACE SEAL

A. Sufficient strength and adhesion for holding injection fittings firmly in place and to resist internal pressures, preventing leakage during injection.

B. Capable of removal after injection resin has cured.

2.4 (NOT USED)

2.5 WATER

A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances, meeting federal drinking water standards.

2.6 SAMPLE BOTTLE

A. Five-inch natural wide mouth HDPE bottle or 4-ounce clear PVC cylinder bottle; supplied with caps.

2.7 SOURCE QUALITY CONTROL

A. Test Requirements: Perform tests for each batch of epoxy resin.

B. Pot Life Test:

1. Condition Component A and Component B to required temperature.
2. Measure components in ratio of Component B as stated on manufacturer's label into an 8-fluid ounce paper cup.
3. Mix components for 60 seconds using non-metallic stirring instrument. Scrape sides and bottom of cup periodically.
4. Probe mixture once with non-metallic stirring instrument every 30 seconds, starting 2 minutes prior to minimum specified pot life.
5. Pot Life Definition: Time at which a soft stringy mass forms in center of cup.

C. Slant Shear Test: Prepare specimens and perform tests in accordance with ASTM C882.

PART 3 EXECUTION

3.1 GENERAL

A. Unless permitted otherwise, structurally repair cracks or joints listed below:

1. Cracks considered to be defective as defined in Section 03 30 00, Cast-in-Place Concrete.
2. All cracks caused by voids or honeycombs.
3. All crack and joints with leaks and dampness.
4. All cracks caused by construction overloading.

B. Do not proceed with injection work until submittals have been reviewed and approved by Engineer.

C. Perform crack or joint injection work after removing defective surface materials and after performing surface preparation, but prior to applying surface repair material unless otherwise noted.

D. Width of cracks may vary along length and through thickness of concrete section.

E. Remove all excess, unused epoxy resin materials on concrete surfaces exposed to view prior to end of Work.

3.2 EQUIPMENT

A. Portable, positive displacement type pumps with in-line metering to meter and mix two epoxy resin components and inject mixture into cracks or joints.

B. Pumps:

1. Electric or air powered with interlocks providing positive ratio control of proportions for the two components at nozzle.
2. Primary injection pumps for each material of different mix ratio, including a standby backup pump of similar ratio.
3. Capable of immediate compensation for changes in resins.
4. Do not use batch mix pumps.

C. Discharge Pressure: Automatic pressure controls capable of discharging mixed epoxy resin at pressures in accordance with epoxy resin manufacturer's printed instruction and able to maintain pressure.

D. Automatic Shutoff Control: Provide sensors on both Component A and Component B reservoirs for stopping machine automatically when only one component is being pumped to mixing head.

E. Proportioning Ratio Tolerance: Maintain epoxy resin manufacturer's prescribed mix ratio within a tolerance of plus or minus 5 percent by volume at discharge pressure up to 160 psi.

F. Ratio/Pressure Check Device:

1. Two independent valve nozzles capable of controlling flow rate and pressure by opening or closing valve to restrict material flow.
2. Pressure gauge capable of sensing pressure behind each valve.

3.3 PREPARATION

A. Free cracks or joints from loose matter, dirt, laitance, oil, grease, efflorescence, salt, and other contaminants.

B. Clean cracks or joints in accordance with epoxy resin manufacturer's instructions.

C. Clean surfaces adjacent to cracks or joints from dirt, dust, grease, oil, efflorescence, and other foreign matter detrimental to bond of surface seal system and to expose the full extent of cracks and joints in accordance with manufacturer's printed instruction.

D. Do not use acids and corrosives for cleaning, other than those specified herein unless neutralized prior to injecting epoxy resin.

E. During installation and curing of materials, if ambient temperature is expected to drop below manufacturer's recommended minimum temperature, provide enclosures and heat as required.

F. Provide work platforms as required.

G. Dry out cracks or joints if required by manufacturer's instructions.

3.4 APPLICATION

A. All liquid is to be removed from hydraulic structure prior to commencing with epoxy injection, unless approved otherwise.

B. Entry Ports:

1. Establish openings for epoxy resin entry in surface seal along crack.
2. Determine space between entry ports equal to thickness of concrete member to allow epoxy resin to penetrate to the full thickness of the member.
3. Drill injection holes at an angle between 45 degrees and 60 degrees from surface of concrete and perpendicular to alignment of cracks or joints, to intersect crack at midpoint of concrete section, and intersect joints at midpoint between waterstop and interior concrete surface, except as noted otherwise.
4. Locate drill holes on alternate sides of crack or joint where possible, unless orientation of crack or joint is known or has been verified by non-destructive testing techniques or core drilling.
5. Drill Hole Spacing: Do not to exceed concrete thicknesses or 12 inches maximum, except as noted otherwise.
6. Adjust location and angle of drill holes to suit orientation of crack or joint and at commencement of drilling holes for injection.
7. Take measures to prevent drilling holes for injection too shallow or too deep, or damaging existing waterstop in joints.
8. Remove dust and debris in drill holes and on surface of structure resulting from drilling operation, by flushing with water prior to installing the injection packers or ports.
9. Space entry ports closer together to allow adjustment of injection pressure to obtain minimum loss of epoxy to soil at locations where:
    a. Cracks or joints extend entirely through concrete element.
    b. Backfill of walls on one side.
    c. Slab-on-grade.
    d. Difficult to excavate behind wall to seal both surfaces of crack.
10. Install injection packers or ports in drill holes in accordance with manufacturer's printed instructions with zerk coupling or other one-way ball or check valve, to permit testing for watertightness and acid flushing of cracks and joints.

C. Acid Flushing of Cracks and Joints:

1. Flush cracks and joints with acid flushing solution in accordance with manufacturer's printed instructions. Apply acid flushing solution for a

sufficient duration to permit solution to penetrate full depth and length of cracks**,** or to waterstop in joints.

2. Following acid flushing, flush cracks and joints with copious quantities of potable water in accordance with manufacturer's printed instructions until no evidence of acid flushing solution is visible in flush water.
3. Submit in-field health and safety plan for acid flushing operation. As a minimum, identify worker conducting acid flushing by wearing a reflective safety vest and signs indicating "Acid Flushing". Also, clearly identify Work area where acid flushing is underway by signs and isolate by placing orange pylons or other temporary barrier, and signs indicating "Acid Flushing". As work progresses, move pylons or barriers and signs to maintain a safe zone.

D. Application of Surface Seal along Cracks and Joints:

1. Apply surface seal in accordance with manufacturer's instructions to designated crack and joint face(s) prior to injection. Seal surface of cracks or joints to contain and prevent escape of injection epoxy.
2. Cure surface seal in accordance with manufacturer's printed instructions before commencing inject work.

E. Epoxy Injection:

1. Ensure zerk coupling is not installed in ports or packers next to the one being injected.
2. Start injection into each crack or joint at lowest elevation entry port or packer along vertical or diagonal crack or joint, and at one end of horizontal crack or joint.
3. Where injection entry ports or packers are used, continue injection at first port or packer until resin begins to flow out of port or packer at next highest elevation. Plug first port or packer and start injection at second port or packer until resin flows from next port or packer.
4. Inject entire crack or joint with same sequence.
5. At no time inject more than 6 feet length of first vertical crack or joint before verifying resin in sample bottle has start to set and cure.
6. Prior to commencing injection work along a horizontal crack or joint in structure when ports or packers with zerk couplings are used, remove zerk couplings from injection ports or packers except for two ports or packers located where injection work will commence. Commence injection work in first two ports or packers. Once clean resin is vented from third injection port or packer, cease injection at first port or packer, and install zerk coupling and commence injection at third port or packer. Repeat process for fourth and subsequent ports or packers until full length of crack or joint has been injected.

F. Finishing:

1. Allow epoxy resin to cure in accordance with manufacturer's instruction after cracks or joints have been completely injected to allow surface seal removal without draining or runback of uncured epoxy resin material from cracks or joints.
2. Remove surface seal and injection packers or ports from cured injection resin along crack.
3. Finish crack or joint faces flush with adjacent concrete.
4. Indentations or protrusions caused by placement of entry ports, packers, drill holes, or damage from removal of surface seal is not acceptable.
5. Grind off protrusions and patch indentations and holes from injection packers and entry ports with a suitable patch material to satisfaction of Engineer.
6. Remove surplus surface seal material splatters and injection resin material runs and spills from concrete surfaces.

3.5 FIELD QUALITY CONTROL

A. Epoxy Resin Two Component Ratio Tests:

1. Disconnect mixing head and pump two resin components simultaneously through ratio check device.
2. Adjust discharge pressure to 160 psi for both resin components.
3. Simultaneously discharge both resin components into separate calibrated containers.
4. Compare amounts simultaneously discharged into calibrated containers during same time period to determine mix ratio.
5. Complete test at 160 psi discharge pressure and repeat procedure for 0 psi discharge pressure.
6. Run ratio test for each injection unit at beginning and end of each injection work day, and when injection work has stopped for more than 1 hour.
7. Document and maintain complete accurate records of ratios and pressure checks.

B. Injection Pressure Test:

1. Disconnect mixing head of injection equipment and connect two resin component delivery lines to pressure check device.
2. Pressure Check Device:
   a. Two independent valved nozzles capable of controlling flow rate and pressure by opening or closing of valve.
   b. Pressure gauge capable of sensing pressure buildup behind each valve.

3. Close valves on pressure check device and operate equipment until gauge pressure on each line reads 160 psi.
4. Stop pumps and observe pressure; do not allow pressure gauge to drop below 150 psi within 3 minutes.
5. Run pressure test for each injection equipment unit:
    a. Beginning and end of each injection work day.
    b. When injection work stop for more than 45 minutes.
6. Check tolerance to verify equipment capable of meeting specified ratio tolerance.

C. Bottled Sample Tests:

1. During injection operation, provide at least one sample of mixed epoxy resin for each injection pump per shift per injection work day in a sample bottle.
2. Provide sufficient sample to demonstrate sample material epoxy resin will set and cure correctly.
3. Label each bottled sample with Contractor's name, date, and time sample was taken, and location in structure where sample was taken. Record details of bottle sample tests.
4. Place filled sample bottle upright in a container and allow sample to cure.
5. After sample has been allowed to cure, cut bottled sample open and visually inspect contents to verify that epoxy resin material has completely reacted and cured.
6. Evaluation and Assessment of Test:
    a. Should bottled sample(s) indicate a problem; such as epoxy resin not cured or foreign liquid in sample bottle, take verifying core sample immediately from cracks or joints, where material was used.
    b. Should above-referenced bottle sample(s) and core sample(s) indicate a problem with epoxy resin, arrange to have a Technical Representative of the epoxy resin manufacturer come to Site to review bottled sample(s) and core drilled sample(s) with Engineer and provide technical advice on corrective measures.
    c. Carry out further investigation work or corrective measures recommended by Technical Representative of epoxy resin manufacturer.

END OF SECTION

SECTION 04 22 00
CONCRETE UNIT MASONRY

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   c. C33, Standard Specification for Concrete Aggregates.
   d. C90, Standard Specification for Loadbearing Concrete Masonry Units.
   e. C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
   f. C144, Standard Specification for Aggregate for Masonry Mortar.
   g. C150, Standard Specification for Portland Cement.
   h. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
   i. C270, Standard Specification for Mortar for Unit Masonry.
   j. C404, Standard Specification for Aggregates for Masonry Grout.
   k. C476, Standard Specification for Grout for Masonry.
   l. C618 12 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
   m. C744, Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
   n. C979, Pigments for Integrally Colored Concrete.
   o. C1314, Standard Test Method for Compressive Strength of Masonry Prisms.
   p. C1403, Standard Test Method for Rate of Water Absorption of Masonry Mortars.
   q. C1611/C1611M, Standard Test Method for Slump Flow of Self-Consolidating Concrete.
   r. E514/E514M, Standard Test Method for Water Penetration and Leakage through Masonry.
2. The Masonry Society (TMS):
   a. TMS 402/ACI 530/ASCE 5; Building Code Requirements for Masonry Structures and Companion Commentaries. (MSJC Code and Commentary).

b. TMS 602/ACI530.1/ASCE6; Specification for Masonry Structures and Companion Commentaries. (MSJC Specifications and Commentary).

3. International Code Council (ICC):
   a. California Building Code (CBC).
   b. ICC Evaluation Service (ICC-ES) Reports.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings.
2. Data Sheets:
   a. Horizontal joint reinforcement.
   b. Preformed control joint materials.
   c. Water repellant masonry sealer.
   d. Grout proportions.
   e. Mortar proportions.
   f. Grout sand gradation in accordance with ASTM C404.
3. Samples:
   a. Sample:
      1) One of each type of masonry unit to be used on Project from the proposed manufacturer.
      2) One of each type of textured unit for selection of color and texture for each batch of manufacturer.
   b. Mortar colors for color selection.

B. Informational Submittals:

1. Method and Location of Placing Grout: High lift or low lift.
2. Mix design test results.
3. Certifications:
   a. Units comply with ASTM C55 and ASTM C90.
   b. Grout test results conform to ASTM C1019.
   c. Grout aggregates conform to requirements of ASTM C33, including nonreactivity.
   d. Mortar sand conform to requirements of ASTM C144.
4. Test results of Project samples from masonry unit manufacturer stating that units comply with ASTM C90. Documentation of material testing shall be one less than 1 year old.
5. Test results of proposed grout mix deign stating that units comply with ASTM C1019. Documentation of material testing shall be 1 year old or less.
6. Test reports stating aggregates for mortar meet requirements of ASTM C144.

7. Test reports or letter of certification stating aggregates for grout meet requirements of ASTM C404.
8. Method and materials for removal of efflorescence.
9. Field test results to qualify materials.
    a. Grout tests in accordance with ASTM C1019.

1.3 QUALITY ASSURANCE

A. Mockups:

1. Lay up Sample panel for each type of masonry at Site.
2. Dimensions: Minimum 4 feet high by 4 feet long.
3. Use approved materials and procedures.
4. Leave intact after approval until acceptance of permanent masonry work and then remove at the end of the project. May be part of permanent construction.
5. Approved panels shall serve as basis of color, texture, bond, quality of finished joints, surface applied finishes, and for acceptance of permanent construction.
6. Demonstrate ability to keep grout isolated and in certain cells during any sequence of placement, and to demonstrate materials will be restricted to cells and bond beams intended to receive grout.
7. Construction shall show areas required to receive mortar, including webs on each side of each grouted cell to prevent grout from entering adjacent cells or courses.
8. Where bond beams are to be used, demonstrate proper placement of grout to bond beam level, and proper placement of bond beam prior to placement of grout above bond beam level.
9. Demonstrate proper use of running bond.
10. Compliance Requirements: For masonry finish and appearance, dimension tolerances, tolerances of construction, joint tolerances, and wall plumb tolerances, comply with the requirements and criteria of NCMA, ASTM C90, and TMS 602.1.

B. Masonry Unit Manufacturer: Qualified by manufacturer of water repellent admixture to use product.

C. Preinstallation Conference:

1. Required Meeting Attendees:
    a. Masonry subcontractor, including masonry foreman.
    b. Testing and sampling personnel.
    c. Design Structural Engineer.
2. Schedule and conduct prior to start of masonry construction.
3. Notify Engineer of location and time.

4. Agenda shall include:
    a. High lift and low lift procedures.
    b. Mortar, grout, unit, and reinforcing submittals.
    c. Types and locations of rebar splices.
    d. Joint tooling.
    e. Admixture types, dosage, performance, and redosing at Site.
    f. Mix designs and test of mix.
    g. Placement methods, techniques, equipment, consolidation, and reconsolidation.
    h. Protection procedures for environmental conditions.
    i. Other specified requirements requiring coordination.
5. Submit conference minutes.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Keep units and mortar/grout cementitious ingredients, including lime, dry.

PART 2 PRODUCTS

2.1 COMPRESSIVE STRENGTH OF MASONRY ASSEMBLAGE

A. Minimum 28-Day Specified Compressive Strength (f'm) of Masonry Assemblage: 1,500 psi

2.2 CONCRETE MASONRY UNITS (CMU)

A. ASTM C90: Medium weight.

1. Net Area Compressive Strength: 2,000 psi minimum, in accordance with TMS 602, Table 2.
2. Nominal Size: 16 inches long by 8 inches high by thickness shown on Drawings.
3. Color of Units: As shown on Drawings.
4. Surface Texture on Exposed Surfaces: As shown on Drawings.
5. Surface Texture: Smooth on interior, concealed exterior, and surface 1 foot below finished grade.

B. General Concrete Masonry Unit (CMU) Requirements:

1. Furnish or cut special shapes for corners, jambs, lintels, and other areas shown or required.
2. Special units shall match color and texture of standard units.
3. Where units are placed so end of unit is exposed, such as at a corner or intersection, exposed end of that block shall have surface to match color and texture of sides of other units.

4. Furnish sound, dry, clean units free of cracks, prior to placing in structure.
5. Vertical Cells to be Grouted: Capable of alignment sufficient to maintain clear, unobstructed continuous vertical cell dimensions in accordance with TMS 602, Table 7.
6. Masonry unit size and shape shall allow for all placement patterns. Use vertical grout dams to prevent materials, such as grout from escaping from cell being filled to adjacent cells where material is not intended to be placed.

2.3 MORTAR MATERIALS

A. Portland Cement-Lime Mortar:

1. ASTM C270.
2. Cement: ASTM C150, Type I portland cement.
3. Lime: ASTM C207, Type S hydrated.
4. Aggregates:
   a. Non-reactive in accordance with ASTM C33, Appendix X1.
   b. Mortar: ASTM C144, sand.

B. Water: Fresh, clean, and potable.

C. Mortar Color Admixture:

1. Meet the requirements of ASTM C979.
2. Manufacturer and Product: Davis Colors, Los Angeles, CA; True Tone Mortar Color.
3. Color shall be as shown on Finish Schedule.

2.4 GROUT MATERIALS

A. Cement: ASTM C150, Type I portland cement.

B. Lime: ASTM C207, Type S hydrated.

C. Aggregates:

1. ASTM C404, fine and coarse.
2. Non-reactive in accordance with ASTM C33, Appendix X1.

D. Water: Fresh, clean, and potable.

2.5 REINFORCEMENT

A. Reinforcement: Clean and free from loose rust, scale, and coatings that reduce bond.

B. Deformed Bars: As specified in Section 03 21 00, Steel Reinforcement.

2.6 PREFORMED CONTROL JOINTS

A. Solid rubber cross-shape extrusions as manufactured by:

1. Dayton Superior/Dur-O-WalDayton, OH; DA 2001 Control Joint Regular Rubber.
2. Hohmann and Barnard, Inc, Hauppauge, NY; #RS-Standard.

2.7 MORTAR MIXES

A. In accordance with ASTM C270, Type S and MSJC Specifications.

B. Mix Method:

1. Property Method: Minimum average mortar 28-day compressive strength 1,800 psi.
2. Proportion Method: Proportion per Table 1 of ASTM C270.

C. Mixing:

1. Machine mix in approved mixers in accordance with ASTM C270.
2. Follow manufacturer's instructions for mortar color admixture.
3. Review compatibility with other mortar admixture.

D. Where colored masonry units are used, color mortar to match. Inert coloring pigments may be added, but shall not exceed 6 percent by weight of cement.

2.8 GROUT MIXES

A. Compressive Strength Property:

1. Minimum 2,000 psi at 28 days. Grout strength shall not exceed two times the minimum specified strength.
2. Proportions: Conform to ASTM C476, Table 1.

B. Mix Design:

1. Proportions:
   a. Design mix to meet proportion requirements.
2. Slump: 8-inch minimum, 11-inch maximum.

C. Mixing:

1. Do not use water reducers, air entrainment, plasticizing, high-range water reducers, or other non-specified admixtures in grout mixes.
2. Transit-Mixed Grout: Meet requirements of ASTM C476.
3. For high lift grouting, add approved grout expansion admixture in accordance with manufacturer's recommendations.
4. Fluid consistency suitable for placing without segregation with a slump of 8 inches to 11 inches.

PART 3 EXECUTION

3.1 GENERAL

A. Meet requirements of 2016 CBC, Chapter 21 and 2013 The Masonry Society (TMS) 602/American Concrete Institute (ACI)530.1/ASCE 6, Specification for Masonry Structures and Companion Commentaries (MSJC), Part 3, Execution, except as modified in this section.

B. Moisture Protection:

1. Keep units dry while stored on Site.
2. Do not wet units prior to laying.

C. Provide measures to prevent moisture from entering incomplete walls and open cells.

D. Hot Weather: Meet requirements of MSJC Specification Section "Hot Weather Construction".

E. After construction during cold weather, maintain newly constructed masonry temperature above 32 degrees F for a minimum of 24 hours using MSJC or other approved cold weather methods.

F. After construction and during hot weather, fog spray newly constructed masonry in accordance with MSJC hot weather construction requirements.

3.2 PREPARATION

A. Concrete Foundations: Meet tolerance requirements of ACI 117 prior to starting any masonry work.

B. Prepare surface contact area of foundation concrete for initial mortar placement by removing laitance, loose aggregate, and other materials, and anything that would prevent mortar from bonding to foundation.

C. Patch or grind out-of-tolerance foundation surfaces to receive mortar prior to starting masonry work.

D. Clean reinforcement dowels and projecting embeds by removing laitance, spillage, or items that will adversely affect grout bond.

E. Prevent surface damage to foundation concrete that will be exposed to view outside of contact area.

3.3 LAYING MASONRY UNITS

A. General:

1. Finish Tolerances (Measured on Interior Surfaces): Meet requirements of "Site Tolerance" requirements of Part 3, Execution, of the MSJC Specifications.
2. Place units with chipped edges or corners such that chipped area is not exposed to view.

B. Wall Units:

1. General:
   a. If necessary to move a unit after once set in-place, remove from wall, clean, and set in fresh mortar.
   b. Toothing of masonry units is not permitted.
2. Running Bond:
   a. Unless otherwise shown, lay up walls in straight, level, and uniform courses using a running bond pattern.
   b. Place units for continuous vertical cells and mortar joints to prevent materials, such as grout from escaping from cell being filled to adjacent cells where material is not intended to be placed.
   c. Corners: Lay standard masonry bond for overlapping units and grout solid.
   d. Intersecting Walls: Half unit appearance shall not extend and be visible on exterior side of intersecting wall. Provide hooked corner bars in bond beam units as shown on Drawings.
3. Special Shapes:
   a. Provide and place such special units as corner block, doorjamb block, lintel block fillers, and similar blocks as may be required.
   b. Use required shapes and sizes to work to corners and openings, maintaining proper bond throughout wall.

3.4 BUILT-IN ITEMS

A. Position door frames, windows, vents, louvers, and other items to be built in wall, and construct wall around them.

B. Install masonry anchors to secure items to wall.

C. Fill spaces around items with grout except use mortar at mortar joints.

D. Do not place electrical, instrumentation, or water conduits in a cell containing parallel reinforcement, unless approved in writing by Engineer. Additionally, pipes, sleeves, and conduits shall meet requirements of TMS 402/ACI 530/ASCE 5, Building Code Requirements for Masonry Structures (MSJC Code) and MSJC specification construction requirements.

3.5 MORTAR JOINTS

A. General:

1. Meet masonry erection requirements of MSJC, Part 3, Execution, 3.3B.
2. As units are laid, remove excess mortar from grout space of cells to be filled. Final grout space, including any remaining mortar projections, shall be as required by MSJC Table "Grout Space Requirements".
3. Place mortar before initial setting of cement takes place. Retemper only as required for it to remain plastic. Retempering of colored mortar is not allowed.

B. Exposed Joints:

1. Tool joints exposed to view after final construction, unless otherwise noted or shown.
2. Cut joints flush and as mortar takes its initial set; tool to provide a concave joint.
3. Perform tooling with tool that compacts mortar, pressing excess mortar out.
4. Perform tooling when mortar is partially set, but still sufficiently plastic to bond rather than dragging it out.
5. Rake out joints that are not tight at time of tooling, point, and then tool.
6. Rake and tool joints at split-face surfaces, interior and exterior.

C. Concealed Joints: Strike flush with no further treatment required.

3.6 CONTROL JOINTS

A. Preformed Control Joints:

1. Omit mortar from vertical joints.
2. Place in units fabricated to receive rubber control joint material as wall is built.
3. After wall is grouted, cured, and cleaned, install backing rod and sealant as specified in Section 07 92 00, Joint Sealants.

4. Place and tool sealant to match depth of typical joint.

3.7 REINFORCING

A. Foundation Dowels:

1. Locate first foundation dowel at end of wall in center of first cell; typically 4 inches from end of wall.
2. Locate at each side of control joints and openings and below beam and joist seats, and then locate at maximum required spacing between these bars.
3. Size, number, and location of foundation dowels shall match all typical and additional vertical wall reinforcing, unless otherwise noted.
4. When foundation dowel does not line up with vertical core, do not slope more than 1 horizontal to 6 vertical to bring it into alignment.

B. Vertical Reinforcing:

1. Use deformed bars.
2. Hold in position near ends of bars by wire ties to dowels or by reinforcing positioners.
3. For high lift grouting, hold in position at maximum intervals of 160 bar diameters by reinforcing positioners.
4. Lap reinforcing bars as shown or approved.
5. Wire tie splices together.
6. Minimum Bar Clearance: 1/2-inch from masonry for coarse grout, 1/4-inch from masonry for fine grout, from formed surfaces, and from parallel bars in same grout space.

C. Horizontal Reinforcing:

1. Use deformed bars.
2. Lay on webs of bond beam units and place as wall is built. Increase web depth to ensure 1/2-inch cover over top of rebar.
3. Lap reinforcing bars where spliced and wire tie together.
4. Minimum Bar Clearance: 1/2 inch from masonry for coarse grout, 1/4 inch from masonry for fine grout, from formed surfaces, and from parallel bars in same grout space.
5. Terminate alternating reinforcing bars 2 inches clear from control joints except horizontal bars at roof and floor courses shall be continuous through joints.

3.8 MORTAR PRODUCTION

A. Mix bulk materials in accordance with MSJC Specification.

B. Mix prebagged materials with water to produce a workable consistency.

C. Remix or retemper to maintain workability. Discard mortar that has begun to stiffen or is not used within 2-1/2 hours after initial mixing.

3.9 GROUT PLACEMENT

A. Do not mix, convey, or place with equipment constructed of aluminum.

B. Secure vertical and horizontal reinforcement, ties, bolts, anchors, and other required embedments in place; inspect and verify before placing grout.

C. Grout beams over openings in one continuous operation.

D. Maintain vertical alignment in accordance with TMS 602/ACI 530.1/ASCE 6, Table 7:

1. Place grout within 1-1/2 hours of addition of water to mix.
2. Use reinforcing positioners to secure vertical reinforcement.

E. Grouting Requirements:

1. Solid grout all walls.
   a. Slump: 8 inches to 11 inches.
   b. Do not start grouting until wall mortar has cured for 24 hours, minimum.
2. Fully embed horizontal steel with grout in an uninterrupted pour.
3. Do not construct wall more than one course above top of grout pour prior to placing grout.

F. Cleanouts:

1. Construct in accordance with MSJC specification.
2. Provide for grout pours heights over 5 feet 4 inches in accordance with TMS 602/ACI 530.1/ASCE 6.
3. Provide of sufficient size to permit cleaning of cell, positioning of reinforcing, and inspection at bottom of every vertical cell containing reinforcing.
4. Location: Concealed from view after final construction, unless otherwise approved by Engineer.
5. After wall has been inspected and approved and prior to grouting, cap cleanouts in a manner that will seal them from grout leakage and provide a flush finish.

3.10 FIELD QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

C. Masonry shall be tested by testing agency retained by the City.

D. Provide adequate facilities for safe storage and proper curing of masonry prisms, mortar samples, and grout samples, as applicable, onsite for first 24 hours, and for additional time as may be required before transporting to test lab.

E. Masonry Testing:

1. Masonry strength shall be determined using prism testing as shown.
2. Masonry test prisms, when required or desired, shall be constructed onsite with same materials and workmanship to be used for Project and in accordance with ASTM C1314**.** Method and frequency of prism testing shall be as shown on the Special Inspection and Testing Plan.
3. Unit Strength Method:
    a. Method and frequency for mortar, grout, and masonry unit sampling and testing shall be as shown.
    b. Provide masonry units for test samples required.

F. Corrective Action:

1. If compressive strength tests made prior to construction of permanent structure fail to meet Specifications, adjustments shall be made to mix designs for mortar, or grout, or both, as needed to produce specified strength.
2. If strength tests performed on materials representative of in-place construction fail to meet Specifications, prisms or cores shall be cut from constructed walls in sufficient locations to adequately determine strength in accordance with TMS 602/ACI 530.1/ASCE 6 Article 1.4 B.4.

3.11 CLEANING

A. Immediately after completion of grouting, clean masonry surfaces of excess mortar, grout spillage, scum, stains, dirt, and other foreign substances using clean water and fiber brushes.

B. Clean walls not requiring painting or sealing so there are no visible stains.

3.12 PROTECTION OF INSTALLED WORK

A. Do not allow grout and mortar stains to dry on face of exposed masonry.

B. Protect tops of walls at all times. Cover tops of walls with waterproof paper when rain or snow is imminent and when the Work is discontinued.

C. Adequately brace walls until walls and roof are completed.

D. Provide sufficient bracing to protect walls against damage from elements, including wind and snow.

E. Protect masonry against freezing for minimum 72 hours after being laid.

F. Protect masonry from damage until final acceptance of the Work. Damaged units will not be accepted.

END OF SECTION

SECTION 04 23 00
GLASS UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass block set in mortar.
2. Glass block set in silicone sealant.
3. Glass block set in glass-block grid systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: Glass-block units

1.3 QUALITY ASSURANCE

A. Fire-Rated Glass Unit Masonry Assemblies: Assemblies listed by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 257.

PART 2 - PRODUCTS

2.1 GLASS BLOCK

A. Hollow Glass Block: Hollow units made from transparent glass, with manufacturer's standard edge coating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

a. Mulia Inc. (Distributed by Glass Blocks Unlimited and Mulia, Inc.).
b. Nippon Electric Glass Co., Ltd. (Distributed by Glass Blocks Unlimited and Nippon Electric Glass America, Inc.).
c. Oberland Glas AG, Bauglas Div.; Solaris Glasstein (Distributed by Glass Blocks Unlimited and North America Glass).
d. Pittsburgh Corning Corporation.

e. Seves (Distributed by Glass Blocks Unlimited, International Product Supply, and Seves North America).
f. J. Weck GmbH (Distributed by Glashaus, Inc. and Glass Blocks Unlimited).

2. Glass Color: Colorless
3. Pattern: Smooth, undistorted inner and outer faces.
4. Edge-Coating Color: White
5. Sizes: Manufacturer's standard sizes corresponding to nominal sizes indicated on Drawings.
6. Thick-Faced Block: Units with faces at least 3/4 inch (19 mm) thick.

2.2 GLASS-BLOCK GRID SYSTEMS

A. General: Aluminum extrusions complying with ASTM B 221 (ASTM B 221M), Alloy 6063-T6 or Alloy 6463-T6, forming a grid system and frame designed for application indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by IBP; a Berkshire Hathaway company, or approved equal.
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B. Window and Wall System: Aluminum T-bar grid with tubular frame and vinyl glass-block boots.

1. Finish: Satin aluminum
2. Glass-Block Size: 7-3/4 inches (197 mm) square by 3-1/8 inches (79 mm) thick.
3. Provide self-flashing aluminum exterior frame covers with vinyl thermal break.
4. Provide aluminum trim and closures as indicated.

C. Sealant: Product recommended by glass-block grid system manufacturer.

1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.

1. Where joints are indicated to be raked out and pointed, gray cement may be used for setting mortar.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

E. Colored Cement Product: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.

F. Aggregate: ASTM C 144, with 100 percent passing No. 8 (2.36-mm) sieve.

1. For pointing mortar and joints narrower than 1/4 inch (6 mm), use aggregate graded with 100 percent passing No. 16 (1.18-mm) sieve.
2. White Aggregates: Natural white sand or crushed white stone.
3. Colored Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Water-Repellent Admixture: Manufacturer's standard dry mixture of stearates, water-reducing agents, and fine aggregates intended to reduce capillarity in mortar.

H. Water-Repellent Admixture: Liquid polymeric water-repellent mortar admixture that does not reduce flexural bond strength of mortar.

I. Water: Potable.

2.4 GLASS UNIT MASONRY ACCESSORIES

A. Panel Reinforcement: Ladder-type units, butt welded, not lapped and welded; complying with ASTM A 951 in straight lengths of not less than 10 feet (3 m), and as follows:
1. Exterior Walls: Hot-dip galvanized, carbon Stainless-steel wire.
2. Wire Size: W1.7 or 0.148-inch (3.8-mm) diameter.
3. Width: 2 inches (50 mm) 1-5/8 inches (40 mm).
4. Spacing of Cross Rods: Not more than 16 inches (407 mm) apart.

B. Panel Anchors: Glass-block manufacturer's standard perforated steel strips, 0.0359 inch (0.9 mm) by 1-3/4 inches (44 mm) wide by 24 inches (600 mm) long, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.

C. Fasteners, General: Unless otherwise indicated, provide Type 304 or Type 316 stainless-steel fasteners at exterior walls and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at interior walls. Select fasteners for type, grade, and class required.

D. Asphalt Emulsion: Cold-applied asphalt emulsion complying with ASTM D 1187 or ASTM D 1227.

E. Mineral-Fiber Expansion Strips: Comply with requirements of fire-rated assembly listing and glass-block manufacturer.

F. Plastic-Foam Expansion Strips: Polyethylene foam complying with requirements of glass-block manufacturer; 3/8 inch (9 mm) thick.

G. Sealants: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants."

1. Single-component, neutral acid-curing silicone sealant.
2. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

H. Sealant Accessories: Provide sealant accessories that comply with applicable requirements in Section 079200 "Joint Sealants."

2.5 MORTAR MIXES

A. General: Do not use admixtures unless otherwise indicated.

1. For mortar in exterior panels, use water-repellent admixture according to admixture manufacturer's written instructions.
2. Limit cementitious materials in mortar to portland cement and lime.

B. Mortar for Glass Unit Masonry Assemblies: Comply with ASTM C 270, Proportion Specification for Type S mortar.

PART 3 - EXECUTION

3.1 INSTALLING GLASS BLOCK WITH MORTAR

A. Apply a heavy coat of asphalt emulsion to sill and adhere expansion strips to jambs and heads with asphalt emulsion. Allow asphalt emulsion to dry before placing mortar. Trim expansion strips to width required to fit glass block and to full lengths of heads and jambs.

B. Set glass block with completely filled bed and head joints, with no furrowing, accurately spaced and coordinated with other construction. Maintain 1/4-inch (6-mm) exposed joint widths unless otherwise indicated.

C. Install panel reinforcement in horizontal joints at spacing indicated and continuously from end to end of panels; comply with the following requirements:

1. Vertical Spacing of Panel Reinforcement for Exterior Panels: Every other course but not more than 16 inches (407 mm) o.c., starting with first course above sill.
2. Vertical Spacing of Panel Reinforcement for Interior Panels: Not more than 16 inches (407 mm) o.c.
3. Do not bridge expansion joints with panel reinforcement.
4. Place panel reinforcement in joints immediately above and below all openings within glass unit masonry assemblies.
5. Lap panel reinforcement not less than 6 inches (150 mm) if more than one length is necessary.

D. Install panel anchors at locations indicated and in same horizontal joints where panel reinforcement occurs. Extend panel anchors at least 12 inches (300 mm) into joints, and bend within expansion joints at edges of panels and across the head. Attach panel anchors as indicated.

E. Use plastic spacers in mortar joints to produce uniform joint widths and to prevent mortar from being squeezed out of joints.

F. Keep expansion joints free of mortar.

G. Rake out joints indicated to be pointed to a uniform depth sufficient to accommodate pointing material, but not less than joint width.
1. Point joints at both faces of exterior and interior panels with sealant.

H. Install sealant at jambs, heads, mullions and other locations indicated. Prepare joints, including installation of primer and bond-breaker tape or cylindrical sealant backing, and apply elastomeric sealants to comply with requirements in Section 079200 "Joint Sealants."

3.2 GLASS-BLOCK GRID SYSTEM INSTALLATION

A. General: Install glass-block grid systems according to manufacturer's written instructions.

B. Window and Wall System Installation: Assemble grid system, apply continuous sealant bead to back of window Z-bar, place in position, adjust as needed to make grid level and plumb, and fasten to substrate.

1. Insert glass blocks into vinyl glass-block boots and carefully insert into grid from exterior side. Install blocks firmly against T-bars without deforming boots.
2. Apply sealant to completely fill channel around each glass block, and tool flush with exterior surface. Remove excess sealant and smears.

3.3 CLEANING

A. Perform final cleaning of glass unit masonry assemblies when surface is not exposed to direct sunlight. Start at top of panel using generous amounts of clean water. Remove water with clean, dry, soft cloths; change cloths frequently to eliminate dried mortar particles and aggregate.

END OF SECTION

SECTION 05 05 19
POST-INSTALLED ANCHORS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
    a. 318, Building Code Requirements for Structural Concrete.
    b. 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
    c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
2. American Iron and Steel Institute (AISI): Stainless Steel Type 316.
3. American National Standards Institute (ANSI).
4. ASTM International (ASTM):
    a. A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    b. A143, Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
    c. A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    d. A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
    e. A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
    f. A380, Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
    g. A385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
    h. A563, Specification for Carbon and Alloy Steel Nuts.
    i. A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
    j. A967, Specification for Chemical Passivation Treatments for Stainless Steel Parts.
    k. E488, Standard Test Methods for Strength of Anchors in Concrete Elements.
    l. F436, Specification for Hardened Steel Washers.
    m. F468, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.

n. F568M, Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.
o. F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
p. F594, Specification for Stainless Steel Nuts.
q. F1554, Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

5. International Association of Plumbing and Mechanical Officials Uniform ES (IAPMO-UES): Evaluation Reports for Concrete and Masonry Anchors.
6. International Code Council Evaluation Service (ICC-ES):
   a. Evaluation Reports for Concrete and Masonry Anchors.
   b. AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
   c. AC70, Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements.
   d. AC106, Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.
   e. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
   f. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements. Evaluation Reports for Concrete and Masonry Anchors.
7. Specialty Steel Industry of North America (SSINA):
   a. Specifications for Stainless Steel.
   b. Design Guidelines for the Selection and Use of Stainless Steel.
   c. Stainless Steel Fabrication.
   d. Stainless Steel Fasteners.

1.2 DEFINITIONS

A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.

B. Exterior Area: Location not protected from weather by a building or other enclosed structure to include buried roof structures.

C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or wash down, and where wall or roof slab is not common to a water-holding or earth-retaining structure.

D. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or wash down, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

E. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel; or wall, ceiling, or floor surface inside a covered water-holding structure; or exterior below-grade wall or roof surface for all structures.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

B. Informational Submittals:

1. Concrete and Masonry Anchors:
   a. Manufacturer's product description and installation instructions.
   b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.
2. Passivation method for stainless steel members.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program or equivalent.
2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.5 DELIVERY, STORAGE AND HANDLING

A. Package stainless steel items in a manner to provide protection from carbon impregnation.

B. Protect hot-dip galvanized finishes from damage as a result of metal banding and rough handling.

PART 2 PRODUCTS

2.1 GENERAL

A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Stainless Steel:	
Threaded Rods	F593, AISI Type 316, Condition CW
Nuts*	F594, AISI Type 316, Condition CW
Carbon Steel:	
Threaded Rods	F1554, Grade 36 or F568M Class 5.8 [A193/A193M, Grade B7]
Flat and Beveled Washers (Hardened)	F436
Nuts*	A194/A194M, Grade 2H
Galvanized Steel:	
All	A153/A153M
*Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod.	

B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, and zinc-plated steel material types as indicated in Fastener Schedule at end of this section.

2.2 POST-INSTALLED CONCRETE ANCHORS

A. General:

1. AISI Type 316 stainless, hot-dip galvanized or zinc-plated steel, as shown in Fastener Schedule at end of this section.
2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind and earthquake.
3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.

B. Torque-Controlled Expansion Anchors (Wedge Anchors):

1. Manufacturers and Products:
   a. Hilti, Inc., Plano, TX; Kwik-Bolt –TZ (KB-TZ) Anchors (ESR-1917).
   b. Dewalt/Powers Fasteners, Towson, MD; Power-Stud +SD1 , +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818).
   c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-3037).

C. Self-Tapping Concrete Screw Anchors:

1. Manufacturers and Products:
   a. Dewalt/Powers Fasteners, Towson, MD; Wedge-Bolt+, Vertigo+ Rod Hanger Screw Anchor (ESR-2526).
   b. Dewalt/Powers Fasteners, Towson, MD; Snake+ Anchor (ESR-2272).
   c. Hilti, Inc., Plano, TX; HUS-EZ Screw Anchor (ESR-3027).
   d. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Titen HD Screw Anchor (ESR-2713).

D. Adhesive Anchors:

1. Threaded Rod:
   a. Diameter as shown on Drawings.
   b. Length as required to provide minimum depth of embedment indicated and thread projection required.
   c. Clean and free of grease, oil, or other deleterious material.
2. Adhesive:
   a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
   b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
3. Packaging and Storage:
   a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
   b. Store adhesive on pallets or shelving in a covered storage area.
   c. Package Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
   d. Dispose of When:
      1) Shelf life has expired.
      2) Stored other than in accordance with manufacturer's instructions.
4. Manufacturers and Products:
   a. Hilti, Inc., Plano, TX; HIT Doweling Anchor System, HIT-RE 500 V3 (ESR-3814), or HIT-HY 200 (ESR-3187).
   b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-XP Epoxy Adhesive Anchors (ESR-2508).
   c. Dewalt/Powers Fasteners, Towson, MD; Pure 110+ Epoxy adhesive anchor system (ESR-3298).

E. Adhesive Threaded Inserts:

1. Type 316 stainless steel, internally threaded inserts.
2. Manufacturer and Product: Hilti, Inc., Plano, TX; HIS-(R)N Insert with HIT-RE 500-SD or HIT-HY 200 adhesive.

2.3 POST-INSTALLED MASONRY ANCHORS

A. General: AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as shown in Fastener Schedule at end of section.

B. Current ICC Evaluation Report indicating acceptance for anchors at structural applications in masonry.

C. Manufacturers and Products:

1. Hilti, Inc., Plano, TX; Kwik-Bolt-3 (KB-3) (ESR-1385), for grout-filled CMU, HIT-HY 70 (ESR-2682) for grout-filled CMU, hollow CMU, or unreinforced masonry.
2. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 (IAPMO ER 240) for grout-filled CMU, Titen-HD (ESR-1056) for grout-filled or hollow CMU, AT-XP (IAPMO ER-281) for grout-filled CMU.
3. Dewalt/Powers Fasteners, Towson, MD; Power-Stud+ SD1 (ESR-2966) for grout-filled masonry, Wedgebolt+ (ESR-1678) for grout-filled masonry.

PART 3 EXECUTION

3.1 CONCRETE AND MASONRY ANCHORS

A. Begin installation only after concrete or masonry to receive anchors has a minimum age of 21 days and has attained design strength.

B. Locate existing reinforcing with electromagnetic non-destructive steel reinforcement detection system, or other method approved by Engineer prior to drilling. Coordinate with Engineer to adjust anchor locations where installation would result in hitting reinforcing.

C. Install in accordance with written manufacturer's instructions.

D. Provide minimum embedment, edge distance, and spacing as indicated on Drawings.

E. Use only drill type and bit type and diameter recommended by anchor manufacturer.

F. Clean hole of debris and dust per manufacturer's requirements.

G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer's installation instructions to clear obstruction, notify Engineer for direction on how to proceed.

H. Adhesive Anchors:

1. Unless otherwise approved by Engineer and adhesive manufacturer:
   a. Do not install adhesive anchors when temperature of concrete or masonry is below 40 degrees F or above 100 degrees F.
   b. Do not install prior to concrete attaining an age of 21 days.
   c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
   d. Do not disturb anchor during recommended curing time.
   e. Do not exceed maximum torque as specified in manufacturer's instructions.

I. Prestressed Concrete: Do not use drilled-in anchors in prestressed or post-tensioned concrete members without Engineer's prior approval unless specifically shown on Drawings.

3.2 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

C. Proof Loading:

1. To be performed where continuous inspection of anchors is required.
2. Testing will be performed by Owner's Independent Testing Agency.
3. Proof loading of adhesive anchors to be performed only after adhesive has achieved proper cure per manufacturer's requirements.
4. Testing will be conducted on minimum of 10 percent of installed anchors, with a minimum of two tension tests.
5. Testing will be conducted in accordance with ASTM E488 and as follows:
   a. Performance of a static tension test of each test anchor.
   b. Test apparatus reaction base shall not interfere with bond failure of anchor, but shall preclude a pullout cone failure.
   c. Each test anchor to be tested at a proof load equal to the lesser of 80 percent of the yield strength of the anchor or 50 percent of

calculated ultimate load based on adhesive bond strength or as directed by Engineer.

d. Test load to be maintained for a minimum of 30 seconds without visible signs of movement of anchor or drop in gauge reading.

6. Failure of anchor or failure within base material will cause anchor to be rejected. For each rejected anchor, test two additional anchors. Rejected anchors shall be replaced as approved by Engineer.

3.3 MANUFACTURER'S SERVICES

A. Adhesive Anchors: Conduct Site training of installation personnel for proper installation, handling, and storage of adhesive anchor system. Notify Engineer of time and place for sessions.

3.4 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Post Installed Anchors for Metal Components to Cast-in-Place Concrete (such as, Ladders, Handrail Posts, Electrical Panels, Platforms, and Equipment)		
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel adhesive anchors	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application

Service Use and Location	Product	Remarks
2. Anchors in Grout-Filled Concrete Masonry Units		
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel adhesive anchors	
3. All Others		
All service uses and locations	Stainless steel fasteners	

B. Anti-seizing Lubricant: Use on all stainless steel threads.

C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

SECTION 05 05 23
WELDING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
   a. BPVC SEC V, Nondestructive Examination.
   b. BPVC SEC IX, Welding and Brazing Qualifications.
2. American Society of Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
3. ASTM International (ASTM): A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
4. American Welding Society (AWS):
   a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   b. A3.0, Standard Welding Terms and Definitions.
   c. D1.1/D1.1M, Structural Welding Code - Steel.
   d. D1.8/D1.8M, Structural Welding Code - Seismic Supplement.
   e. D1.3/1.3M, Structural Welding Code - Sheet Steel.
   f. D1.4/D1.4M, Structural Welding Code - Reinforcing Steel.
   g. QC1, Standard for AWS Certification of Welding Inspectors.

1.2 DEFINITIONS

A.CJP: Complete Joint Penetration.

B. CWI: Certified Welding Inspector.

1. Contractor's Welding Inspector: Contractor's CWI acts for, and on behalf of, the Contractor for all inspection and quality matters within the scope of the Contract Documents. Contractor is required to provide a welding inspector to oversee welding operations and be responsible for visual inspection and necessary correction of all deficiencies in materials and workmanship required to meet referenced welding codes. This type of Quality Control Inspection is not classified as Special Inspection.
2. Verification Inspector: CWI who acts on behalf of the Owner. This type of independent inspection and testing is the prerogative of the Owner, who may perform this function, or waive independent verification inspection if it is not required by the building official and building code.

C. MT: Magnetic Particle Testing.

D. NDE: Nondestructive Examination.

E. NDT: Nondestructive Testing.

F. PJP: Partial Joint Penetration.

G. PQR: Procedure Qualification Record.

H. PT: Liquid Penetrant Testing.

I. Special Inspection: Non-destructive examination exclusive of VT. Special inspection includes NDE such as MT, PT, UT, RT and Verification Inspection. Special Inspection personnel report to, and are retained by the Owner. See additional requirements in Section 01 45 33, Special Inspection, Observation, and Testing.

J. RT: Radiographic Testing.

K. UT: Ultrasonic Testing.

L. VT: Visual Inspection/Testing.

M. WPQ: Welder/Welding Operator Performance Qualification Record.

N. WPS: Welding Procedure Specification.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Shop and field WPSs and PQRs.
    b. NDT procedure specifications prepared in accordance with ASME BPVC SEC V.
    c. Welding Data (Shop and Field): Submit welding data together with Shop Drawings as a complete package.
        1) Show on Shop Drawings, or on a weld map, complete information regarding base metal specification designation, location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tails of combined welding and NDE symbols as indicated in AWS A2.4.
        2) Clearly distinguish between shop and field welds.
        3) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint

welding details showing bevels, groove angles, and root openings for welds.

4) Welding and NDE Symbols: In accordance with AWS A2.4.
5) Welding Terms and Definitions: In accordance with AWS A3.0.

B. Informational Submittals:

1. WPQs.
2. CWI credentials.
3. Testing agency personnel credentials.
4. CWI visual inspection (VT) reports.
5. Welding Documentation: Submit on forms in referenced welding codes.

1.4 QUALIFICATIONS

A. WPSs: In accordance with AWS D1.1/D1.1M (Annex M Forms) for shop or field welding; or ASME BPVC SEC IX (Forms QW-482 and QW-483) for shop welding only.

B. WPQs: In accordance with AWS D1.1/D1.1M (Annex M Forms); or ASME BPVC SEC IX (Form QW-484).

C. CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require prior approval by Engineer.

D. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

1.5 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, Submittals required in this section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

A. Fabricator's CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:

1. Verifying conformance of specified job material and proper storage.
2. Monitoring conformance with approved WPS.

3. Monitoring conformance of WPQ.
4. Inspecting weld joint fit-up and performing in-process inspection.
5. Providing 100 percent visual inspection of welds.
6. Coordinating with nondestructive testing personnel and reviewing NDE test results.
7. Maintaining records and preparing reports documenting that results of CWI VT and subsequent NDE testing comply with the Work and referenced welding codes.

PART 3 EXECUTION

3.1 GENERAL

A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

B. Qualify welding procedure specifications for joist installation for notch toughness by limiting heat input; conduct charpy testing of weld metal and heat-affected zone as part of the welding procedure qualification. Conduct charpy tests on full-size specimens in accordance with ASTM A370 at a test temperature of 30 degrees F**.** The minimum average energy of the test coupons shall not be less than 25 foot-pounds.

3.2 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Quality Control Inspection:

1. All Welds: 100 percent VT by Contractor's CWI.
2. Acceptance Criteria:
   a. Structural Pipe and Tubing: AWS D1.1/D1.1M, Paragraph 9.25.
   b. All Other Structural Steel: AWS D1.1/D1.1M, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
   c. Stud Connections: AWS D1.1/D1.1M, Paragraph 7.8.1.

B. Nondestructive Testing Requirements:

1. NDT frequency shall be as specified below, as required by referenced welding codes, or as specified in the attached table. In case there is a conflict, the higher frequency level of NDT shall apply.
   a. Nontubular Connections:
      1) CJP Butt Joint Groove Welds: 10 percent random RT. Use UT for CJP butt joint groove welds that cannot be readily radiographed.
      2) All Other CJP Groove Welds: 10 percent random UT.
      3) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.

b. Tubular Connections:
   1) CJP butt joint groove welds made from one side without backing: 100 percent RT or UT in accordance with AWS D1.1/D1.1M, Paragraph 9.26.2 requirements.
   2) CJP Butt Joint Groove Welds made without backing or back-gouging: 10 percent random RT. Use UT for CJP butt joint groove welds that cannot be readily radiographed.
   3) All Other CJP Groove Welds: 10 percent random UT.
   4) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.

2. NDT Procedures and Acceptance Criteria:
   a. Nontubular Connections:
      1) RT: Perform in accordance with AWS D1.1/D1.1M, Clause 6, Part E. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 6.12.1.
      2) UT: Perform in accordance with AWS D1.1/D1.1M, Clause 6, Part F. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 6.13.1.
      3) PT and MT:
         a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.14.4 and Paragraph 6.14.5.
         b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
   b. Tubular Connections:
      1) RT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 9, Paragraph 9.28 and Paragraph 9.29.
      2) UT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 9, Paragraph 9.27.
      3) PT and MT:
         a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.14.4 and Paragraph 6.14.5.
         b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 9.25.

3.3 FIELD QUALITY CONTROL

A. Contractor's CWI shall be present whenever field welding is performed. CWI shall perform inspection, at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:

1. Verify conformance of specified job material and proper storage.
2. Monitor conformance with approved WPS.
3. Monitor conformance of WPQ.
4. Inspect weld joint fit-up and perform in-process inspection.
5. Provide 100 percent visual inspection of all welds in accordance with Subparagraph Quality Control Inspection.
6. Supervise nondestructive testing personnel and evaluating test results.
7. Maintain records and prepare report confirming results of inspection and testing comply with the Work.

3.4 WELD DEFECT REPAIR

A. Repair and retest rejectable weld defects until sound weld metal has been deposited in accordance with appropriate welding codes.

3.5 SUPPLEMENTS

A. The supplement listed below, following "End of Section," is a part of this specification.

1. Welding and Nondestructive Testing Table.

END OF SECTION

Welding and Nondestructive Testing						
Specification Section	**Governing Welding Codes or Standards**	**Submit WPS**	**Submit WPQ**	**Onsite CWI Req'd**	**Submit Written NDT Procedure Specifications**	**NDT Requirements**
03 21 00 Steel Reinforcement	AWS D1.4/D1.4M, Structural Welding Code - Reinforcing Steel	Yes	Yes	Yes	Yes	100% VT and 100% MT of all rebar splices; also see Section 03 21 00
03 40 00 Precast Concrete	AWS D1.1/D1.1M, Structural Welding Code - Steel and AWS D1.4/D1.4M, Structural Welding Code - Reinforcing Steel	No	No	Yes	No	100% VT; also see Section 03 40 00
05 12 00 Structural Steel Framing	AWS D1.1/D1.1M, Structural Welding Code - Steel	Yes	Yes	Yes	Yes	100% VT and 10% UT or RT of all groove-and-butt joint welds; 10% MT of all fillet welds; also see Section 05 12 00
05 21 19 Open Web Steel Joists Framing	AWS D1.1/D1.1M, Structural Welding Code - Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 05 21 19
05 31 00 Steel Decking	AWS D1.1/D1.1M, Structural Welding Code - Steel or AWS D1.3/D1.3M, Structural Welding Code - Sheet Steel	Yes	Yes	Yes	No	100% VT; also see Section 05 31 00
05 50 00 Metal Fabrications	AWS D1.1/D1.1M, Structural Welding Code–Steel or AWS D1.2/D1.2M, Structural Welding Code - Aluminum or AWS D1.6/D1.6M, Structural Welding Code - Stainless Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 05 50 00
05 52 16 Aluminum Railings	AWS D1.2/D1.2M, Structural Welding Code - Aluminum	No	No	No	No	100% VT; also see Section 05 52 16, Aluminum Railings
05 53 00 Metal Gratings	AWS D1.1/D1.1M, Structural Welding Code - Steel or AWS D1.2/D1.2M, Structural Welding Code - Aluminum	No	No	No	No	100% VT; also see Section 05 53 00

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Galvanizers Association (AGA): Quality Assurance Manual.
2. American Institute of Steel Construction (AISC):
   a. 201, Certification Program for Structural Steel Fabricators.
   b. 206, Certification Program for Structural Steel Erectors—Standard for Structural Steel Erectors.
   c. 303, Code of Standard Practices for Steel Buildings and Bridges.
   d. 325, Steel Construction Manual.
   e. 326, Detailing for Steel Construction.
   f. 341, Seismic Provisions for Structural Steel Buildings.
   g. 360, Specification for Structural Steel Buildings.
   h. 420, Certification Standard for Shop Application of Complex Protective Coating Systems.
3. American Welding Society (AWS):
   a. D1.1/D1.1M, Structural Welding Code—Steel.
   b. D1.8/D1.8M, Structural Welding Code—Seismic Supplement.
4. ASTM International (ASTM):
   a. A6/A6M, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
   b. A36/A36M, Standard Specification for Carbon Structural Steel.
   c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   d. A123/123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   e. A143/A143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   f. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   g. A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
   h. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   i. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

j. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
k. A490, Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
l. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
m. A563, Standard Specification for Carbons and Alloy Steel Nuts.
n. A572/A572M, Standard Specification for High-Strength Low Alloy Columbium-Vanadium Structural Steel.
o. A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
p. A992/A992M, Standard Specification for Structural Steel Shapes.
q. B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
r. A1085/A1085M, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
s. F436, Standard Specification for Hardened Steel Washers.
t. F959, Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
u. F1136, Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners.
v. F1852, Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
w. F2280, Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
x. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

5. Occupational Safety and Health Administration (OSHA).
6. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.

1.2 SUBMITTALS

A. Action Submittals:

1. Provide Shop Drawing details showing:
   a. Erection plans.

b. Members, including piece numbers, sizes, grades, dimensions, cambers, and connection details.
c. Anchor bolt layouts.
d. Hardened washer details.
e. Connection material specifications.
f. Indicate type, size, and length of bolts.
g. Joint details for complete penetration welds.
h. Indicate welds by standard AWS symbols, distinguishing between shop and field welds and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

2. Product specifications, including primer and other coatings.
3. Designation of the members and connections that are part of the seismic force resisting system (SFRS).
4. Identify pretensioned and slip-critical high strength bolted connections.
5. Locations of Class A, or higher, faying surfaces.
6. Weld access hole dimensions, surface profile, and finish requirements.
7. Location of demand critical shop welds.
8. Locations and dimensions of protected zones.
9. Nondestructive testing (NDT) where performed by the fabricator.
10. Welding requirements as specified in AISC 341 Appendix W, Section W2.2.

B. Informational Submittals:

1. Schedule for submittal of shop and erection drawings.
2. Name and address of manufacturer(s).
3. Mill Certificates of tests made in accordance with ASTM A6/A6M.
4. Manufacturers' testing procedures and standards.
5. Preparation and installation or application instructions, as appropriate.
6. Proposed method to resolve misalignment between anchor bolts and bolt holes in steel members.
7. High-Strength Bolts:
   a. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that products meet specified chemical and mechanical requirements.
   b. Manufacturer's inspection test report results for production lot(s) furnished to include:
      1) Tensile strength.
      2) Yield strength.
      3) Reduction of area.
      4) Elongation and hardness.
   c. Certified Mill Test Reports for Bolts and Nuts:
      1) Name and address of manufacturer.
      2) Bolts correctly marked.

3) Marked bolts and nuts used in required mill tests and manufacturer's inspection tests.

8. Direct Tension Indicators (DTIs): Manufacturer's test report meeting requirements of ASTM F959.
9. Twist-Off-Type Tension-Control (TC) Bolts: Manufacturer's test report meeting requirements of ASTM F1852.
10. Welding Procedures, Qualifications, and Inspection Reports: As specified in Section 05 05 23, Welding.
11. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer with description of material processed and ASTM standard used for coating.
12. AISC Quality Certification: AISC certificate showing name and address of certified firm, effective date, and category of certification.
13. Charpy V-notch test results.
14. Nondestructive Testing (NDT) report.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Welding qualifications as specified in Section 05 05 23, Welding.
2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of AGA's Quality Assurance Manual.

B. Certifications:

1. Mill identification marks, heat number, size of section, and length in accordance with ASTM A6/A6M.
2. AISC Quality Certification for Fabricator: A fabricator who participates in the AISC Certification program and is designated an AISC certified plant, Category STD.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Load structural members in such a manner that they will be transported and unloaded without damage to coatings and without being excessively stressed, deformed, or otherwise damaged.

B. Storage:

1. Store materials to permit easy access for inspection and identification. Store in a dry area and keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

a. Do not store materials in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials as directed.

2. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   a. Fasteners may be repackaged provided testing and inspecting agency observes repackaging and sealing of containers.
   b. Clean and lubricate bolts and nuts that become dry or rusty before use.
   c. Comply with manufacturer's written recommendations for cleaning and lubricating fasteners and for retesting fasteners after lubrication.

C. Handle materials to avoid distortion or damage to members or supporting structures.

PART 2 PRODUCTS

2.1 MATERIALS

A. Rolled Plates, Shapes except W-Shapes and Bars:
ASTM A36/A36M or A572/A572M, Grade 50, unless indicated otherwise.

B. W-Shapes: ASTM A992/A992M, unless indicated otherwise on Drawings.

C. Steel Pipe: ASTM A53/A53M, Grade B.

D. Round Hollow Structural Sections (HSS): ASTM A500/A500M, Grade C (Fy equals 46 ksi).

E. Square and Rectangular Hollow Structural Sections (HSS):
ASTM A500/A500M, Grade C (Fy equals 50 ksi).

F. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon, such as plates over 1.5 inches thick for ASTM A36/A36M and ASTM A572/A572M steels, limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent**.**

2.2 FASTENERS

A. Anchor Bolts: As specified in Section 05 50 00, Metal Fabrications.

B. Post-Installed Anchors: As specified in Section 05 05 19, Post-Installed Anchors.

C. Bolts:

1. ASTM A307, hot-dip galvanized
2. Bolt Length and Thread Length: As required for connection type shown, with hardened washers as required.

D. High-Strength Bolts:

1. ASTM A325, Type 1, hot-dip galvanized, or ASTM A490, bolt Type 1.
2. Bolt Length and Thread Length: As required for connection type shown, with hardened washers as required.

E. Direct Tension Indicators (DTIs) or Load Indicator Washers:

1. ASTM F959, coating type to match bolt finish.
2. Type A325 or A490, to match bolt type.
3. Manufacturers and Products:
   a. TurnaSure LLC, Langhorne, PA; DTIs.
   b. Applied Bolting Technology Products, Ludlow, VT; DTIs, regular or Squirter type.

F. Twist-Off-Type Tension-Control (TC) Bolts:

1. High-strength, ASTM F1852, bolt Type 1, mechanically galvanized.
2. Manufacturers:
   a. LeJeune Bolt Company, Burnsville, MN.
   b. Nucor Fastener, Saint Joe, IN.
   c. Haydon Bolts, Philadelphia, PA.
   d. Vermont Fasteners Manufacturing, Swanton, VT.

G. Nuts: ASTM A563, type to match bolt type and finish.

H. Hardened Steel Flat and Beveled Washers: ASTM F436, type to match bolt finish.

I. Stud Shear Connectors: As specified in Section 05 50 00, Metal Fabrications.

2.3 ANCILLARY MATERIALS

A. Surface Preparation and Primer: As specified in Section 09 90 00, Painting and Coating.

B. Grout: As specified in Section 03 62 00, Grout.

2.4 FABRICATION

A. General:

1. Fabricate as shown and in accordance with AISC 360 and AISC 303.
2. Columns: Full-length members without splices, unless shown otherwise or approved by Engineer.
3. Mark and match mark materials for field assembly.
4. Complete assembly, including bolting and welding of units, before start of finishing operations.
5. Fabricate to agree with field measurements.
6. Fabricate beams with rolling camber up.
7. Fillet re-entrant cuts and corners to radius of not less than 1/2 inch.
8. Sheared and flame-cut edges shall be free from rough corners and projections.

B. Connections:

1. Shop Connections: Weld or bolt as shown on Drawings.
2. Meet requirements of AISC 325 for bolted double-angle shear connections, unless indicated otherwise.
3. Meet OSHA requirements for one independent bolt at beams framing in to column web connections.

C. Welded Construction:

1. As specified in Section 05 05 23, Welding.
2. Groove and Butt Joint Welds: Complete penetration, unless otherwise indicated.

D. Interface with Other Work:

1. Holes:
   a. As necessary or as indicated for securing other Work to structural steel framing, and for passage of other Work through steel framing members shall be approved by Engineer.
   b. No flame-cut holes are permitted without prior approval of Engineer.
2. Weld threaded nuts to framing members, and other specialty items to receive other Work.

2.5 FINISHES

A. Shop Paint Primer:

1. Surface Preparation and painting as specified in Section 09 90 00, Painting and Coating.
2. Do not shop prime the following surfaces, unless indicated otherwise:
   a. Within 2 inches of field-welded connections.
   b. Steel members to be completely encased in reinforced concrete or coated with cementitious fireproofing.
3. Shop primer for steel members to be coated with intumescent fireproofing shall be compatible with specified fireproofing.

B. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of steel.
2. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
3. Remove, by blast cleaning or other methods, surface contaminants and coatings not removable by normal chemical cleaning process in galvanizing operation.
4. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
5. Hot-dip galvanize ASTM A307 and A325 bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop-assemble bolts, nuts, and washers with special lubricant and test in accordance with ASTM A325 and ASTM A563.
6. Mechanically zinc coat ASTM F1852 twist-off-type tension-control (TC) bolts, nuts, and washers in accordance with ASTM F1852 and ASTM B695, Class 50.
7. Coat ASTM F2280 twist-off-type tension-control (TC) bolts, nuts, and washers in accordance with ASTM F1136.
8. Galvanize components of bolted assemblies separately before assembly.

C. Slip Critical Bolted Connections:

1. Galvanized Faying Surfaces: Roughen galvanized surfaces of slip critical bolted connections by hand wire brushing in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts as a Class C faying surface.

2.6 SOURCE QUALITY CONTROL

A. Welding:

1. Contractor's Certified Welding Inspector (CWI): Inspect and test fabrication welds as specified in Section 05 05 23, Welding.
2. Visually inspect fabrication welds in accordance with AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
3. An independent testing agency will be retained by Owner to perform the inspection and testing of fabrication welds as specified in Section 05 05 23, Welding.
4. Repair and retest defective welds as specified in Section 05 05 23, Welding.

B. Hot-Dip Galvanizing:

1. An independent testing agency will be retained by Owner to inspect and test hot-dip galvanized fabricated items in accordance with ASTM A123/A123M and ASTM A153/A153M.
2. Visually inspect and test for thickness and adhesion of zinc coating for minimum of three test samples from each lot in accordance with ASTM A123/A123M and ASTM A153/A153M.
3. Reject and retest nonconforming articles in accordance with ASTM A123/A123M and ASTM A153/A153M.

PART 3 EXECUTION

3.1 ERECTION

A. General:

1. Meet requirements of AISC 360 and AISC 303, with exceptions as specified.
2. Install Contractor-designed temporary construction bracing to provide necessary support until components are in place and construction is complete.
3. Provide additional field connection material as required by AISC 303.
4. Splice members only where indicated and accepted on Shop Drawings.

B. Field Assembly:

1. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly.
2. Set structural frames accurately to lines and elevations shown.
3. Align and adjust various members forming a part of a complete frame or structure before permanently fastening.
4. Level and plumb individual members of structure within tolerances shown in AISC 303.

5. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be completed and in service.
6. Perform necessary adjustments to compensate for minor discrepancies in elevations and alignment.

C. Setting Baseplates and Bearing Plates:

1. Clean concrete and masonry bearing surfaces of bond reducing materials and roughen to improve bond to surfaces.
2. Clean bottom surface of baseplates and bearing plates.
3. Set loose and attached baseplates and bearing plates for structural members on wedges, shims, leveling nuts, or other adjustable devices. Use leveling plates where indicated.
4. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to placing grout. Weld plate washer to baseplate where indicated.
5. Grout Under Baseplate: As specified in Section 03 62 00, Grout, prior to placing loads on structure.

D. Anchor Bolts:

1. Coordinate installation of anchor bolts and other connectors required for securing structural steel to in-place work.
2. Provide templates and other devices for presetting bolts and other anchors to accurate locations.
3. Projection of anchor bolts beyond face of concrete and threaded length shall be adequate to allow for full engagement of threads of hold-down nuts, adjustment of leveling nuts, washer thicknesses, and construction tolerances, unless indicated otherwise.
4. Placement Tolerances:
    a. As required by AISC 303, unless indicated otherwise.
    b. Embedded anchor bolts shall not vary from dimensions shown on Drawings by more than the following:
        1) Center-to-Center of Any Two Bolts Within an Anchor Group: 1/8 inch.
        2) Center-to-Center of Adjacent Anchor Bolt Groups: 1/4 inch.
        3) Variation from Perpendicular to Theoretical Bearing Surface: 1:50.

E. Connections:

1. High-Strength Bolted:

a. Tighten in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
b. Pretension all bolts unless noted otherwise on Drawings.
c. Hardened Washers:
    1) Provide at locations required by Washer Requirements section of RCSC Specification for Structural Joints Using High Strength Bolts, to include pretensioned and slip critical connections using slotted or oversized holes or ASTM A490 bolts.
    2) Use beveled style and extra thickness where required by RCSC Specification.
    3) Use square or rectangular beveled washers at inner flange surfaces of American Standard beams and channels.
    4) Do not substitute DTIs for hardened flat washers required at slotted and oversize holes.
d. For snug-tightened connections (N, X), tighten to snug tight condition. Use hardened washer over slotted or oversize holes in outer plies.

2. Pretensioned Bolted:
    a. Use DTIs or twist-off-type tension-control (TC) bolts at slip critical (SC) and pretensioned bearing-type connections.
    b. DTIs:
        1) Position within bolted assembly in accordance with ASTM F959.
        2) Install bolts, with DTIs plus hardened washers as required, in holes of assembly and tighten until plies are in firm contact and fasteners are uniformly snug tight.
    c. Final tightening bolts begin at most rigid part of bolted connection and progress toward free edges until final twist-off-type tension-control (TC) bolts or until DTIs have been compressed to an average gap equal to or less than shown in ASTM F959, Table 2.
3. Welded:
    a. As specified in Section 05 05 23, Welding.
    b. Groove and Butt Joint Welds: Complete penetration, unless otherwise indicated.

3.2 MISFITS

A. At Bolted Connections:

1. Immediately notify Engineer for approval of one of the following methods of correction:
    a. Ream holes that must be enlarged to admit bolts and use oversized bolts.

b. Plug weld misaligned holes and redrill holes to admit standard size bolts.
c. Drill additional holes in connection, conforming to AISC for bolt spacing and end and edge distances, and add additional bolts.
d. Reject member containing misfit, incorrect sized, or misaligned holes and fabricate new member to ensure proper fit.

2. Do not enlarge incorrectly sized or misaligned holes in members by burning or by use of drift pins.

B. At Anchor Bolts:

1. Resolve misalignments between anchor bolts and bolt holes in steel members in accordance with approved Shop Drawing.
2. Do not flame cut to enlarge holes without prior approval of Engineer.

C. Gas Cutting:

1. Do not use gas cutting torches in field for correcting fabrication errors in structural framing.
2. Secondary members not under stress and concealed in finished structure may be corrected by gas cutting torches, if approved by Engineer.
3. Finish flame-cut sections equivalent to sheared and punched appearance.

3.3 REPAIR AND CLEANING

A. Clean shop primer from field welds, bolted connections, and abraded areas immediately after erection.

B. Remove and grind smooth tack welds, fit-up-lugs, and weld runoff tabs.

C. Remove weld back-up bars and grind smooth where indicated on Drawings.

D. Apply touchup paint primer by brush or spray of same thickness and material as that used in shop application and as specified in Section 09 90 00, Painting and Coating.

E. Hot-Dip Galvanized Coating Repair:

1. Conform to ASTM A780/A780M.
2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

3.4 FIELD FINISH

A. Field finish in accordance with Section 09 90 00, Painting and Coating.

3.5 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with CIBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspect and test as required in Section 01 45 16.13, Contractor Quality Control.

C. High-Strength Bolted Connections:

1. An independent testing agency will be retained by Owner to perform the following inspection and testing in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts:
   a. Marking identification and conformance to ASTM standards.
   b. Alignment of bolt holes.
   c. Placement, type, and thickness of hardened washers.
   d. Tightening of bolts.
2. Snug-Tightened Connections (N, X): Snug tight condition with plies of joint in firm contact.
3. Pretensioned Bearing and Slip Critical (SC) Connections:
   a. Conduct preinstallation test.
   b. Monitor installation and tightening of DTIs or TC bolts.
   c. Monitor condition of faying surfaces for slip critical connections.
4. Preinstallation Test:
   a. Conduct test in accordance with Specification for Structural Joints Using ASTM A325 or ASTM A490 bolts prior to using bolt tension measuring device.
   b. Select representative sample of not less than three bolts of each diameter, length, and grade.
   c. Include DTIs and flat hardened washers as required to match actual connection assembly.
5. Nondestructive Testing (NDT): Inspect bolted connections and perform corrections as required to meet code acceptance criteria per RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
6. Defective Connections: Correct and reinspect defective and improperly tightened high-strength bolted connections. Retest pretensioned bolts as necessary to demonstrate compliance of completed work.

D. Welding:

1. Contractor's Certified Welding Inspector (CWI): Inspect and test field welds as specified in Section 05 05 23, Welding.
2. Visually inspect field welds in accordance with AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
3. An independent testing agency will be retained by Owner to perform inspection and testing of field welds as specified in Section 05 05 23, Welding.
4. Repair and retest defective welds as specified in Section 05 05 23, Welding.

E. Special inspection will be provided by Owner as indicated on Drawings.

END OF SECTION

SECTION 05 21 19
OPEN WEB STEEL JOIST FRAMING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Institute of Steel Construction (AISC):
   a. Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design.
   b. Allowable Stress Design Specification for Structural Joints using ASTM A325 or A490 Bolts.
   c. Code of Standard Practice for Steel Buildings and Bridges.
2. American Welding Society (AWS): D1.1, Structural Welding Code - Steel.
3. Steel Joist Institute (SJI):
   a. Standard Specifications and Load Tables:
      1) Open-Web Steel Joists, K-Series.
      2) Long Span Steel Joists, LH-Series.
   b. Recommended Code of Standard Practice for Steel Joists and Joist Girders.

1.2 SUBMITTALS

A. Action Submittals:

1. Plan view layout of joists and bridging.
2. Elevation view of each type of joist showing configuration, chord and web member sizes, panel point dimensions, and chord extensions.
3. Connection and bearing details.
4. Special joist reinforcing and connections for supported items, such as monorails and mechanical equipment.
5. Bridging member sizes and connection details.
6. Complete design, including stress and deflection calculations, for joists, joist members, and connections for design load and equipment weight as indicated, plus any construction loads applied by Contractor's operations.
7. Calculations shall include check of joist chord bending stresses for concentrated loads applied between panel points.
8. Registered Professional Engineer's stamp, valid in same state as Project, on structural calculations.
9. Procedure for handling, erection, and bracing of steel joists.

B. Informational Submittals:

1. Joist manufacturer's installation requirements.
2. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05 05 23, Welding.

1.3 QUALITY ASSURANCE

A. General: Design and fabricate steel joists and bridging to meet requirements of SJI Standard Specifications and Load Tables.

B. Certification: SJI Membership, with certification for joist types as indicated on Drawings.

C. Qualifications for Field Welding: As specified in Section 05 05 23, Welding.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Protect joist paint system from abrasion at steel bands and other joists.

C. Store joists and bridging off ground on wood sleepers.

D. Support joists so there is no danger of tipping, sliding, rolling, shifting or material damage.

PART 2 PRODUCTS

2.1 STEEL JOISTS AND BRIDGING

A. Provide type of joist, chord configuration, and depth as indicated on Drawings.

B. Design and Manufacture:

1. In accordance with the applicable SJI Standard Specifications.
2. Chord Members: Rolled double angle sections only.
3. Provide the following where indicated, in accordance with SJI Standard Specifications and Load Tables:
    a. Bottom chord bracing and end anchorage for uplift design criteria.
    b. Ceiling extension to within 1 inch of finished wall surface, unless otherwise indicated.
    c. Top chord extension, S type, unless otherwise indicated.
    d. Full camber, unless otherwise indicated.

C. Joist Bridging:

1. In accordance with applicable SJI Standard Specifications for type of joist.
2. Furnish bridging of minimum size and type as indicated by SJI Standards.
3. Provide anchorage connection to walls.

2.2 SHOP PRIMER

A. Apply one shop coat of rust-inhibitive primer in accordance with SJI Standard Specifications.

1. Remove loose scale, rust, and slag from welds before painting.
2. Apply primer within 8 hours after surface preparation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel joists.

3.2 INSTALLATION

A. Erection: SJI Standard Specifications and approved shop drawings.

B. Welded Connections: As specified in Section 05 05 23, Welding.

3.3 TOUCHUP PAINTING

A. Immediately following erection, remove debris from completed installation.

B. Clean field welds, bolted connections, rust spots, and abraded areas.

C. Repair damaged painted and galvanized surfaces as specified in Section 09 90 00, Painting and Coating.

3.4 FIELD QUALITY CONTROL

A. Welding:

1. Visually inspect field welds in accordance with AWS D1.1, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.

2. An independent testing agency will be retained by Owner to visually inspect field welded connections in accordance with AWS D1.1, Table 6.1, and as specified in Section 05 05 23, Welding.
3. Repair defective welds as specified in Section 05 05 23, Welding.

B. Special inspection will be provided by Owner where indicated on Drawings.

END OF SECTION

SECTION 05 31 00
STEEL DECKING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Iron and Steel Institute (AISI):
   a. Specifications for the Design of Cold Formed Steel Structural Members.
   b. S310-16: North American Standard for the Design of Profiled Steel Diaphragm Panels
2. American Welding Society (AWS): D1.3, Structural Welding Code - Sheet Steel.
3. ASTM International (ASTM):
   a. A611, Standard Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled.
   b. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   c. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   d. A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
4. Steel Deck Institute (SDI):
   a. Design Manual for Composite Decks, Form Decks and Roof Decks.
   b. Diaphragm Design Manual.
5. Factory Mutual (FM):
   a. Factory Mutual Approval Guide.
   b. FM Research Corporation (FMRC): Approval Requirements for Steel Roof Deck Construction.
6. International Code Council Evaluation Service, Inc. (ICC-ES): Evaluation Reports for Deck Fasteners.
7. Underwriters Laboratories, Inc. (UL): Fire Resistance Directory.

1.2 SUBMITTALS

A. Action Submittals:

1. Plan view layout of decking showing type and section properties of deck panels, reinforcing channels, pans, special jointing, and accessories.
2. Location of openings, deck laps, and deck attachment details.

B. Informational Submittals:

1. Decking manufacturer's installation requirements.
2. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05 05 23, Welding.
3. Operation manuals for mechanical fastener installation tools.
4. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

1.3 QUALITY ASSURANCE

A. General: For metal decking section properties, meet requirements of AISI Specifications for Design of Cold-Formed Steel Structural Members. For diaphragm shear capacity, calculated in accordance with AISI S310-16.

B. FM Requirements:

1. Steel Roof Deck: Listed in Factory Mutual "Approval Guide" for Class 1 fire rating and Class 1-90 wind uplift rating.
2. Mechanical Fasteners: Packing containers shall show name of manufacturer and product and FMRC approval mark.

C. Qualifications for Field Welding: As specified in Section 05 05 23, Welding.

1.4 DELIVERY, STORAGE AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store deck bundles on platforms or pallets, with one end elevated to provide drainage.

C. Protect bundles against condensation with a ventilated waterproof covering.

D. Stack bundles so there is no danger of tipping, sliding, rolling, shifting or material damage.

PART 2 PRODUCTS

2.1 METAL DECKING

A. Provide metal deck as shown in the following schedule:

	STEEL DECK SCHEDULE								
Type	**Depth (in)**	**Panel Width (in)**	**Gage**	**Design Thickness (in)**	**Min. Yield Strength Fy (ksi)**	**Min. (+) S (in^3/ft)**	**Min. I (in^4/ft)**	**Minimum Diaphragm Shear Capacity (lbs/ft)**	**Finish**
Roof Deck ('BI')	1-1/2	36	18	0.0474	50	0.318	0.287	2100 Screening Fac. 750 Elec. Bldg.	Galv, G-90
Roof Deck ('BI')	1-1/2	36	20	0.0358	50	0.234	0.216	670	Galv, G-90

B. Materials and Finishes:

1. Galvanized Deck:
   a. Sheet steel for galvanized deck and accessories shall conform to ASTM A653 Structural Quality Grade 50 or higher, as shown in Steel Deck Schedule.
   b. Galvanizing shall conform to ASTM A924 with coating class of G90 as defined in ASTM A653 and as shown in Steel Deck Schedule.

C. Manufacturers:

1. Vulcraft Division of Nucor Co., Brigham City, UT.
2. BHP Steel Building Products, USA, Inc., West Sacramento, CA.
3. Verco Manufacturing, Inc., Phoenix, AZ.
4. United Steel Deck, Inc., Summit, NJ.

2.2 (NOT USED)

2.3 ACCESSORIES

A. Provide pour stops, column closures, end closures, cover plates, ridge and valley plates, finish strips, reinforcing channels, and other accessories as required for complete installation.

B. Accessories shall be minimum 20-gauge, except edge forms shall be sized as required by the deck manufacturer, unless shown otherwise on the Drawings.

2.4 MECHANICAL FASTENERS

A. Self-Drilling Screws:

1. Self-drilling, self-tapping screws with hexagonal washer head and corrosion-resistant finish.
2. Manufacturers and Products:
   a. ITW Buildex, Itasca, IL; ICH Traxx Self-Drilling Fasteners with Climaseal Coating and Autotraxx Standup Installation Tool.
   b. Hilti, Inc., Tulsa, OK; Kwik-Pro HWH Self-Drilling Screws with Kwik-Cote Treatment and Kwik-Tapper Screwdriver.

B. Powder Driven Fasteners:

1. Knurled shank, minimum 1/2-inch diameter steel washer, corrosion-resistant coating.
2. Pin diameter and length to suit deck type and flange thickness of steel support member.
3. Manufacturers and Products:
   a. ITW Buildex, Itasca, IL; Buildex BX14 pins with yellow dichromate galvanizing and BX900 Installation Tool.
   b. Hilti, Inc., Tulsa, OK; ENP-series fasteners with electroplated zinc coating and DX-750 Installation Tool.

2.5 (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.2 INSTALLATION

A. Locate deck bundles to prevent overloading of support framing members.

B. Install at right angles to supporting members in a three span minimum lay-up, unless shown otherwise, and in accordance with Specification and manufacturer's installation recommendation.

C. Bearing: 1-1/2 inches, minimum.

D. Endlaps: Minimum of 2 inches and located over supports.

E. Do not stretch sidelaps.

F. Closure Plates:

1. Install closure and cover plate accessories as recommended by the metal deck manufacturer, unless shown otherwise on the Drawings.

G. Holes and Openings

1. Cut and fit around roof openings and other work projecting through or adjacent to decking.
2. Locate holes and openings as shown to clear structural framing and bracing members.
3. Reinforcement around openings:
   a. Roof Deck: For hole sizes of at least 6 inches across, but not more than 12 inches across in roof deck, reinforce with 0.0474-inch design thickness steel plate, painted or galvanized to match deck coating. Extend plate at least 12 inches beyond opening in all directions and attach to top of roof deck with No. 10 self-drilling screws at 6-inch spacing and at all corners. For openings larger than 12 inches across, reinforce roof deck with framing as shown on Drawings.

H. Protect deck areas from heavy concentrated loads or wheel traffic with planking or other approved means.

I. Completed Deck: Free from buckles and irregularities, and in accordance with FM and UL requirements.

3.3 DECK ATTACHMENT

A. Fasten panels as shown on Drawings.

B. Welded Connections: Weld deck sidelaps, attachment to framing, and accessories in accordance with AWS D1.3 and as specified in Section 05 05 23, Welding.

C. Mechanical Fasteners:

1. Self-Drilling Screws:
   a. Install screws in accordance with manufacturer's written instructions and with special installation tool. Do not over-torque.
   b. Remove and redrive screws at sidelaps where upper sheet is not drawn tightly against lower sheet.
2. Powder Driven Fasteners:
   a. Install fasteners in accordance with manufacturer's written instructions and with special installation tool.
   b. Minimum Sidelap Edge Distance: 3/8 inch.

c. Minimum End/End Lap Distance: 1 inch.
d. Head Projection: As specified by manufacturer for correct penetration into flange of steel support member.

3.4 TOUCHUP PAINTING

A. Immediately following erection, remove unused deck edge trimmings, screws, fasteners, welding washers, butt ends of welding rods, and debris from completed installation.

B. Clean field welds, bolted connections, rust spots, and abraded areas.

C. Repair damaged painted surfaces as specified in Section 09 90 00, Painting and Coating.

D. Repair damaged galvanized surfaces with zinc-rich spray paint in accordance with ASTM A780; color to match galvanized deck.

E. Use magnetic gauge to determine that thickness of repair is equal to or greater than base painted or galvanized coating.

3.5 FIELD QUALITY CONTROL

A. An independent testing agency will be retained by Owner to perform the following inspections.

1. Welded Connections: Visually inspect in accordance with AWS D1.3, Section 7, and as specified in Section 05 05 23, Welding.
2. Mechanical Fasteners: Visually inspect, in accordance with manufacturer's instructions, for each type of fastener.

B. Repair or replace defective welds and fasteners.

C. Special inspection will be provided by Owner where indicated on Drawings.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. The Aluminum Association, Inc. (AA): The Aluminum Design Manual.
2. American Galvanizers Association (AGA):
   a. Inspection of Hot-Dip Galvanized Steel Products.
   b. Quality Assurance Manual.
3. American Iron and Steel Institute (AISI): Stainless Steel Types.
4. American Ladder Institute (ALI): A14.3, Ladders - Fixed - Safety Requirements.
5. American National Standards Institute (ANSI).
6. American Society of Safety Engineers (ASSE): A10.11, Safety Requirements for Personnel and Debris Nets.
7. American Welding Society (AWS):
   a. D1.1/D1.1M, Structural Welding Code - Steel.
   b. D1.2/D1.2M, Structural Welding Code - Aluminum.
   c. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
8. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48/A48M, Specification for Gray Iron Castings.
   c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   d. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   e. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   f. A143/A143M, Standard for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   h. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   i. A325, Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
   j. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

k. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
l. A489, Standard Specification for Carbon Steel Lifting Eyes.
m. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
n. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
o. A563, Standard Specification for Carbon and Alloy Steel Nuts.
p. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
q. A780/A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
r. A992/A992M, Standard Specification for Structural Steel Shapes.
s. A1085, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
t. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
u. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
v. B429/B429M, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
w. B632/B632M, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
x. F436, Standard Specification for Hardened Steel Washers.
y. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
z. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
aa. F594, Standard Specification for Stainless Steel Nuts.
bb. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
cc. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

9. NSF International (NSF): 61, Drinking Water System Components—Health Effects.
10. Occupational Safety and Health Administration (OSHA):
    a. 29 CFR 1910.27, Fixed Ladders.
    b. 29 CFR 1926.502, Fall Protection Systems Criteria and Practices.

1.2 DEFINITIONS

A. Anchor Bolt: Cast-in-place anchor; concrete or masonry.

B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals. Corrosive area includes areas exposed to corrosive atmosphere such as hydrogen sulfide from wastewater.

C. Exterior Area: Location not protected from weather by building or other enclosed structure.

D. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.

E. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

F. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel; or wall, ceiling or floor surface inside a covered water-holding structure; or exterior below-grade wall or roof surface for all structures.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Metal fabrications, including welding and fastener information.

B. Informational Submittals:

1. Pre-engineered Ladders: Letter of certification that ladder meets OSHA 29 CFR 1910.27 requirements.
2. Passivation method for stainless steel members.
3. Galvanized coating applicator qualifications.
4. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer, with description of material processed and ASTM standard used for coating.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Insofar as practical, factory assemble specified items. Package assemblies, which have to be shipped unassembled to protect materials from damage and tag to facilitate identification and field assembly.

B. Package stainless steel items to provide protection from carbon impregnation.

C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.

D. Store fabricated items in dry area, not in direct contact with ground.

1.6 SPECIAL GUARANTEE

A. Manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at option of Owner, removal and replacement of items found defective during a period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

1.7 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following extra materials:

Item	Quantity
Neoprene Gasket	Two for each location requiring neoprene gaskets.
4 inches wide by 50 feet long Neoprene Gasket Material	One roll for each location requiring neoprene gaskets.
Neoprene Gasket Adhesive	One (manufacturer's recommended) for each location requiring neoprene gaskets.

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit the combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon (such as plates over 1.5 inches thick for ASTM A36/A36M steel), limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.

B. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Steel Wide Flange Shapes	A992/992M
Other Steel Shapes and Plates	A36/A36M or A572/A572M, Grade 50 or A992/A992M for other steel shapes
Steel Pipe	A500, Grade B
Hollow Structural Sections (HSS)	A500/A500M, Grade C
Aluminum:	
Aluminum Plates	B209, Alloy y6061-T6
Aluminum Structural Shapes	B308/B308M, Alloy 6061-T6
Stainless Steel:	
Bars and Angles	A276, AISI Type 316 (316L for welded connections)
Shapes	A276, AISI Type 304 (304L for welded connections)
Steel Plate, Sheet, and Strip	A240/A240M, AISI Type 316 (316L for welded connections)
Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs	F593, AISI Type 316, Group 2, Condition SH
Nuts	F594, AISI Type 316, Condition CW
Steel Bolts and Nuts:	
Carbon Steel	A307 bolts, with A563 nuts
High-Strength	A325, Type 1 bolts, with A563 nuts

Item	ASTM Reference
Anchor Bolts and Rods	F1554, Grade 55, with weldability supplement S1.
Eyebolts	A489
Threaded Rods	A36/A36M
Flat Washers (Unhardened)	F844
Flat and Beveled Washers (Hardened)	F436
Thrust Ties for Steel Pipe:	
Threaded Rods	A193/A193M, Grade B7
Nuts	A194/A194M, Grade 2H
Plate	A283/A283M, Grade D
Welded Anchor Studs	A108, Grades C-1010 through C-1020
Aluminum Bolts and Nuts	F468, Alloy 2024-T4
Cast Iron	A48/A48M, Class 35

C. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

2.2 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

A. Cast-In-Place Anchor Bolts:

1. Headed type, unless otherwise shown on Drawings.
2. Material type and protective coating as shown in Fastener Schedule at end of this section.

B. Anchor Bolt Sleeves:

1. Plastic:
   a. Single unit construction with corrugated sleeve.
   b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
   c. Material: High-density polyethylene.
2. Fabricated Steel: ASTM A36/A36M.

2.3 POST-INSTALLED CONCRETE AND MASONRY ANCHORS

A. See Section 05 05 19, Post-Installed Anchors.

2.4 STUD SHEAR CONNECTORS

A. Headed anchor studs (HAS), or threaded anchor studs (TAS),or stud shear connectors, as indicated on Drawings.

1. Carbon Steel: ASTM A108, Standard Quality Grades 1010 through 1020, inclusive either semikilled or killed aluminum or silicon dioxidation, unless indicated otherwise.
2. Stainless Steel: ASTM F593, AISI Type 316, Condition CW, where indicated.

B. Manufacturers:

1. Nelson Stud Welding, FabriSteel Co., Elyria, OH.
2. Stud Welding Associates, Inc., Elyria, OH.

2.5 PIPE SLEEVES

A. ASTM A53/A53M, Schedule 40 steel pipe sleeves with continuously welded 3/16-inch-thick seep ring with outside diameter 3 inches greater than sleeve outside diameter. Hot-dip galvanize in accordance with ASTM A123/A123M.

2.6 STEEL LINTELS AND SHELF ANGLES

A. ASTM A36/A36M, hot-dip galvanize after fabrication in accordance with ASTM A123/A123M.

2.7 EMBEDDED STEEL SUPPORT FRAMES FOR FLOOR PLATE AND GRATING

A. Steel angle support frames to be embedded in concrete shall be stainless steel, ASTM A276, AISI Type 316, unless indicated otherwise.

B. Welded anchors for stainless steel support frames shall also be stainless steel.

2.8 CRANE RAIL

A. Crane Rails: ASTM A1, end hardened and ultrasonic tested; cross section and length as indicated on drawings.

B. Beam sections; prime paint finish.

2.9 LADDERS

A. Fabricate ladders with rails, rungs, landings, and cages to meet applicable requirements of OSHA, CFR Part 1910.27, and ALI A14.3.

1. Design ladder for concentrated load of 200 pounds imposed by user concentrated at points that will cause maximum stress in structural member being considered.
2. Include weight of ladder and attached appurtenances together with live load in design of rails and fastenings.
3. Self-closing gates at landings.

B. Flat Bar Ladder:

1. Punch rails, pass rungs through rails, and weld on outside.
2. Weld brackets to ladder for fastening ladder to wall.
3. Hot-dip galvanize steel after fabrication in accordance with ASTM A123/A123M and ASTM A385/A385M.
4. ASTM A276, AISI Type 316L stainless steel.

C. Ladder Safety Post:

1. Telescoping tubular, spring balanced and automatically locking in raised position, with release lever for unlocking.
2. Post: Stainless steel, AISI Type 304.
3. Hardware: Stainless steel, AISI Type 316.
4. Furnish dissimilar metal protective coatings at connections.
5. Manufacturer and Product: Bilco Co., New Haven, CT; “Ladder Up” to fit ladder rungs.

2.10 SAFETY CLIMB DEVICE

A. General:

1. Conforms to ALI A14.3 and OSHA CFR Part 1910.27.
2. Belt and harness shall withstand minimum drop test of 250 pounds in 6-foot free fall.
3. Fall Prevention System Material: Aluminum 6061-T6.

B. Components and Accessories:

1. Main Components: Sleeve or trolley, safety harness, and carrier or climbing rail.
2. Ladder rung clamps with aluminum mounting brackets and hardware.
3. Removable extension kit with tiedown rod or trolley gate, mandrel, and carrier rail for ladders under manholes and hatches.

C. Manufacturers and Products:

1. Miller by Honeywell, Franklin, PA; Miller Saf-T-Climb.
2. TS Products, Cambridge, Ontario, Canada; TS Safety Rail System.

2.11 LADDER CLIMB PREVENTION SHIELD

A. Eight feet long with angled sides to within 2 inches of wall when closed.

B. Furnish dissimilar metals protective coatings at bolted connections.

C. Manufacturer and Product: North Safety Products, Specialty Products Division, Toronto, Ontario, Canada; Ladder Gate 770-000-001.

2.12 ACCESSORIES

A. Antiseizing Lubricant for Stainless Steel Threaded Connections:

1. Suitable for potable water supply.
2. Resists washout.
3. Manufacturers and Products:
   a. Bostik, Middleton, MA; Neverseez.
   b. Saf-T-Eze Div., STL Corp., Lombard, IL; Anti-Seize.

B. Neoprene Gasket:

1. ASTM D1056, 2C1, soft, closed-cell neoprene gasket material, suitable for exposure to sewage and sewage gases, unless otherwise shown on Drawings.
2. Thickness: Minimum 1/4 inch.
3. Furnish without skin coat.
4. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK1111LD.

2.13 FABRICATION

A. General:

1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical; where exposed, flush countersink.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.

6. Fit and assemble in largest practical sections for delivery to Site.

B. Materials:

1. Use steel shapes, unless otherwise noted.
2. Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 percent and 0.25 percent.
3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures–Allowable Stress Design.

C. Welding:

1. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
3. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.
4. Aluminum: Meet requirements of AWS D1.2/D1.2M.
5. Stainless Steel: Meet requirements of AWS D1.6/D1.6M.
6. Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1/D1.1M, Section 7, and manufacturer's instructions.
7. Complete welding before applying finish.

D. Painting:

1. Shop prime with rust-inhibitive primer as specified in Section 09 90 00, Painting and Coating, unless otherwise indicated.
2. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
3. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

E. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385/A385M.
3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.

4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
7. Galvanize steel sheets in accordance with ASTM A653/A653M.
8. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.

F. Electrolytic Protection: Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.

G. Watertight Seal: Where required or shown, furnish neoprene gasket of a type that is satisfactory for use in contact with sewage. Cover full bearing surfaces.

H. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.

I. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.14 SOURCE QUALITY CONTROL

A. Visually inspect all fabrication welds and correct deficiencies.

1. Steel: AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
2. Aluminum: AWS D1.2/D1.2M.
3. Stainless Steel: AWS D1.6/D1.6M.

B. Hot-Dip Galvanizing:

1. An independent testing agency will be retained by Owner to inspect and test hot-dip galvanized fabricated items in accordance with ASTM A123/A123M and ASTM A153/A153M.
2. Visually inspect and test for thickness and adhesion of zinc coating for minimum of three test samples from each lot in accordance with ASTM A123/A123M and ASTM A153/A153M.
3. Reject and retest nonconforming articles in accordance with ASTM A123/A123M and ASTM A153/A153M.

PART 3 EXECUTION

3.1 INSTALLATION OF METAL FABRICATIONS

A. General:

1. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.
2. Install rigid, substantial, and neat in appearance.
3. Install manufactured products in accordance with manufacturer's recommendations.
4. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.

B. Aluminum:

1. Do not remove mill markings from concealed surfaces.
2. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.
3. Fabrication, mechanical connections, and welded construction shall be in accordance with the AA Aluminum Design Manual.

C. Pipe Sleeves:

1. Provide where pipes pass through concrete or masonry.
2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.
3. Provide center flange for water stoppage on sleeves in exterior or water-bearing walls.
4. Provide rubber caulking sealant or a modular mechanical unit to form watertight seal in annular space between pipes and sleeves.

D. Steel Lintels and Shelf Angles: Provide as required for support of masonry and other construction not attached to structural steel framing, unless otherwise shown on Drawings.

3.2 CAST-IN-PLACE ANCHOR BOLTS

A. Locate and hold anchor bolts in place with templates at time concrete is placed.

B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.

C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.3 SAFETY CLIMB DEVICE SYSTEM

A. Provide for each ladder where unbroken height between levels exceeds 20 feet, or at lesser height where indicated on Drawings.

B. Install in accordance with manufacturer's instructions.

C. Furnish additional accessories required to complete system for each ladder.

D. Furnish one harness for each ladder equipped with safety climb device.

E. Furnish pivot section at platforms, landings, and roofs.

F. When installed to required height, fall prevention system shall be rigid and an integral part of the structure.

3.4 ELECTROLYTIC PROTECTION

A. Aluminum and Galvanized Steel:

1. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.
3. Allow coating to dry before installation of the material.
4. Protect coated surfaces during installation.
5. Should coating become marred, prepare and touch up in accordance with paint manufacturer's written instructions.

B. Titanium: Where titanium equipment is in contact with concrete or dissimilar metal, provide full-face neoprene insulation gasket, 3/32-inch minimum thickness and 70-durometer hardness.

C. Stainless Steel:

1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.
3. Remove contamination using cleaning and passivation methods in accordance with requirements of ASTM A380 and ASTM A967.

4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.
5. After treatment, visually inspect surfaces for compliance.

3.5 PAINTING

A. Painted Galvanized Surfaces: Prepare as specified in Section 09 90 00, Painting and Coating.

B. Repair of Damaged Hot-Dip Galvanized Coating:

1. Conform to ASTM A780/A780M.
2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

C. Field Painting of Shop Primed Surfaces: Prepare surfaces and field finish in accordance with Section 09 90 00, Painting and Coating.

3.6 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance:

1. In accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings.
2. Contractor responsibilities and related information on special inspection, observation, and testing are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control:

1. Inspection and testing required in Section 01 45 16.13, Contractor Quality Control.
2. Manufacturer's Certificate of Compliance per Section 01 61 00, Common Product Requirements, for test results, or calculations, or drawings that ensure material and equipment design and design criteria meet requirements of Section 01 61 00, Common Product Requirements and Section 01 88 15, Anchorage, Thrust Restraint and Bracing.

3.7 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Anchor Bolts Cast Into Concrete for Structural Steel, Metal Fabrications and Castings		
Interior Dry Areas	Hot-dip galvanized steel headed anchor bolts, unless indicated otherwise	
Exterior and Interior Wet Areas	316 Stainless steel headed anchor bolts	
Submerged and Corrosive Areas	316 Stainless steel headed anchor bolts with fusion bonded coating	See Section 09 90 00, Painting and Coating
2. Anchor Bolts Cast Into Concrete for Equipment Bases		
Interior Dry Areas	Hot-dip galvanized steel headed anchor bolts, unless otherwise specified with equipment	
Submerged, Exterior, Interior Wet, and Corrosive Areas	316 Stainless steel headed anchor bolts with fusion bonded coating, unless otherwise specified with equipment	See Section 09 90 00, Painting and Coating
3. Post-Installed Anchors: See Section 05 05 19, Post-Installed Anchors		
4. Anchors Cast in Grout-Filled Concrete Masonry Units		
Dry Areas	Hot-dip galvanized steel headed anchor bolts or zinc-plated steel sleeve anchors	

Service Use and Location	Product	Remarks
Exterior and Interior Wet Areas	Hot-dip galvanized steel headed anchor bolts, or zinc-plated steel sleeve anchors	
5. Connections for Structural Steel Framing		
Exterior and Interior Wet and Dry Areas	Bolted or high-strength steel bolted connections as noted on Drawings	Use hot-dipped galvanized high-strength bolted connections for galvanized steel framing members.
6. Connections of Aluminum Components		
Submerged, Exterior and Interior Wet and Dry Areas	316 Stainless steel bolted connections, unless otherwise specified with equipment	
7. All Others		
Exterior and Interior Wet and Dry Areas	316 Stainless steel fasteners	

B. Antiseizing Lubricant: Use on stainless steel threads.

END OF SECTION

SECTION 05 52 16
ALUMINUM RAILINGS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Aluminum Association, Incorporated (AA): DAF45, Designation System for Aluminum Finishes.
2. American Concrete Institute (ACI) 318, Building Code Requirements for Structural Concrete.
3. American Iron and Steel Institute (AISI).
4. ASTM International (ASTM):
   a. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   b. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   c. E894, Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
   d. E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
   e. E985, Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
5. International Code Council (ICC): California Building Code (CBC).
6. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.

1.2 DEFINITIONS

A. ICC Evaluation Services Report: ICC report on evaluation of manufactured concrete anchor systems.

B. Railings: This term includes guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.

C. Special Inspection: As defined by the ICC CBC.

D. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.

1.3 DESIGN REQUIREMENTS

A. Structural Performance of Railing Systems: Design, test, fabricate, and install railings to withstand the following structural loads without exceeding allowable design working stress or allowable deflection. Apply each load to produce maximum stress and deflection in railing system components.

1. Railing System: Capable of withstanding the following load cases applied:
   a. Concentrated load of 200 pounds applied at any point and in any direction on the handrail or top rail in accordance with ICC CBC and OSHA.
   b. Uniform load of 50 pounds per linear foot applied in any direction along the handrail or top rail in accordance with ICC CBC.
   c. Concentrated load need not be assumed to act concurrently with uniform loads in accordance with ICC CBC.
2. Intermediate Rail(s) of Railing Systems:
   a. Capable of withstanding a horizontally applied normal load of 50 pounds applied to 1 square foot at any point in system including panels, intermediate rails, balusters, and openings and space between railings.
   b. Intermediate rail load need not be assumed to act concurrently with loads on top rails of railings.
3. Calculated lateral deflection at top of posts shall not exceed 1 inch.

1.4 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.
   b. Manufacturer's literature and catalog data of railing and components.
   c. Design Data: Calculations or test data using specified design performance loads and including the following:
      1) Bending stress in, and deflection of, posts in accordance with ASTM E985 as modified herein.
      2) Design of post base connection.

3) Documentation that concrete anchors have been designed in accordance with one of the following:
a) ACI 318-14.
b) ICC Evaluation Services Report for selected anchor.

2. Samples:
a. Rail sections, 6 inches long showing each type of proposed connection, proposed finish, and workmanship.
b. Each fitting including wall brackets, castings, toeboard, and rail expansion joints.

B. Informational Submittals:

1. Manufacturer's assembly and installation instructions.
2. Special Inspection: Manufacturer's instructions for Special Inspection of post-installed anchors.
3. Test Reports: Test data may supplement load calculations providing data covers complete railing system, including anchorage:
a. Test data for railing and components showing load and deflection as a result of load, in enough detail to prove railing is strong enough and satisfies national, state, local standards, regulations, code requirements, and OSHA 29 CFR 1910, using design loads specified. Include test data for the following:
1) Railing and post connections.
2) Railing wall connections.
3) Railing expansion joint connections.
4) Railing system gate assembly, including latch, gate stop, and hinges. Both gate latch and stop to support required loads applied independent of each other.
b. Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with ICC CBC.
c. Deflection Criteria: In accordance with ASTM E985 and design loads specified, except as follows: maximum calculated lateral deflection at top of posts shall not exceed 1 inch.
d. Aluminum Rail Piping: Test data showing yield strength of pipe as delivered equals or exceeds specified values.
4. Manufacturer's written recommendations describing procedures for maintaining railings including cleaning materials, application methods, and precautions to be taken in use of cleaning materials.

1.5 QUALITY ASSURANCE

A. Qualifications: Calculations required for design data shall be stamped by a registered civil or structural engineer licensed in state where Project will be constructed.

1.6 DELIVERY, STORAGE AND HANDLING

A. Package and wrap railings to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to the extent possible until railing is completely installed.

B. Delivery:

1. Shop assemble into practical modules of lengths not exceeding 24 feet for shipment.
2. Deliver toeboards loose for field assembly.
3. Deliver clear anodized railing pipe and posts with protective plastic wrap.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Thermal Movements: Allow for thermal movement resulting from the following maximum range in ambient temperature in design, fabrication, and installation of railings to prevent buckling, opening up of joints, over stressing of components, connections and other detrimental effects. Base design calculation on actual surface temperature of material as a result of both solar heat gain and night time sky heat loss. Temperature change is difference between high or low temperature and installation temperature.

1. Temperature Change Range: 70 degrees F, ambient; 100 degrees F, material surfaces.

PART 2 PRODUCTS

2.1 ALUMINUM RAILINGS

A. General:

1. Furnish pre-engineered and prefabricated railing systems as shown on Drawings.
2. Railing systems using pop rivets or glued railing construction are not permitted.
3. Sand cast accessories and components are not permitted.
4. Fasteners shall be AISI Type 316 stainless steel, unless otherwise noted.

B. Rails, Posts, and Formed Elbows:

1. Extruded Alloy 6105-T5, 6061-T6, or equivalent.
2. Tensile Strength: 38,000 psi, minimum.
3. Yield Strength: 35,000 psi, minimum.
4. Wall Thickness: 0.145 inch, minimum.

5. Posts and railings shall be nominal 1-1/2-inch diameter (1.90-inch outside diameter).

C. Accessories:

1. Fittings and Accessories:
   a. Extruded, machined bar stock, permanent mold castings, or die castings of sufficient strength to meet load requirements.
   b. Gauge metal components are not acceptable for load-resisting components.
   c. Fittings shall match color of pipe in railings.
2. Miscellaneous Extruded Aluminum Parts: Alloys 6063-T6, 6061-T6, or 6105 T5 aluminum, or equivalent, and of adequate strength for all loads.
3. Castings for Railings:
   a. Cast Al-mag with sufficient strength to meet load and test requirements.
   b. Anodizable grade finish with excellent resistance to corrosion when subjected to exposure of sodium chloride solution intermittent spray and immersion.
4. Post Anchorages:
   a. Refer to standard details for types of post anchorages and minimum requirements.
   b. Bolts at anchorages shall be minimum 1/2-inch diameter.
5. Wall Brackets: Adjustable wall fitting, with provision for minimum three 3/8-inch diameter AISI Type 316 stainless steel bolts or concrete anchors.
6. Rail Terminals (including Wall Returns): Aluminum wall fitting with provision for three 3/8-inch Type 304 fasteners.
7. Railing System Gate:
   a. Extruded aluminum rail components.
   b. Hardware Manufacturers and Products:
      1) Julius Blum & Co., Inc., Carlstadt, NJ; No. 782/3 gate hinges with springs, and No. 784 gate latch and stop.
      2) CraneVeyor Corp., South El Monte, CA; No. C4370b gate hinges with spring, No. C4369 gate latch, and No. C4368 gate stop.
      3) Moultrie Manufacturing Co., Moultrie, GA; Part No. W60006.
8. Toeboards:
   a. Molded or extruded Alloy 6063-T6 or 6061-T6 aluminum.
   b. Provide slotted holes for expansion and contraction where required.
9. Fasteners: Stainless steel.

D. Metal Supports Embedded in Concrete: In accordance with Section 05 50 00, Metal Fabrications.

E. Finishes:

1. Pipe and Post: In accordance with AA DAF45, designation AA-M32-C22-A41.
2. Cast Fittings and Toeboards: In accordance with AA DAF45, designation AA-M10-C22-A41.

2.2 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

A. Locknuts, Washers, and Screws:

1. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): AISI Type 316 stainless steel.
2. Flat Washers: Molded nylon.

B. Bolts and Nuts for Bolting Railing to Metal Beams: ASTM A193/A193M and ASTM A194/A194M, Type 316 stainless steel.

C. Concrete Anchors:

1. Stainless steel, AISI Type 316.
2. Post-installed anchors in accordance with Section 05 50 00, Metal Fabrications, unless otherwise specified herein.
3. Bolt Diameter: 1/2-inch, minimum.

2.3 FABRICATION

A. Shop Assembly:

1. Post Spacing: Maximum 6-foot horizontal spacing.
2. Railing Posts Bolted to Metal or Concrete:
   a. In lieu of field cutting, provide approved fitting with sufficient post overlap, containing provisions for vertical adjustment.
   b. Field fit-up is required.
3. Free of burrs, nicks, and sharp edges when fabrication is complete.
4. Welding is not permitted.

B. Shop/Factory Finishing:

1. Use same alloy for uniform appearance throughout fabrication for railings.
2. Railing and Post Fittings: Match fittings with color of pipe in railing.

C. Shop Assembly:

1. Shop assemble rails, posts, and formed elbows with a close tolerance for tight fit.
2. Fit dowels tightly inside posts.

D. Repair of Defective Work: Remove stains and replace defective Work.

PART 3 EXECUTION

3.1 GENERAL

A. Field fabrication of aluminum railing systems is not permitted.

B. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on actual structure.

C. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.

D. Modification to supporting structure is not permitted where railing is to be attached.

E. Mount railings only on completed walls. Do not support railings temporarily by means not satisfying structural performance requirements.

F. Protection from Entrapped Water:

1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
2. For posts mounted in concrete, bends, and elbows occurring at low points, drill weep holes of 1/4-inch diameter at lowest possible elevations, one hole per post or rail. Drill hole in plane of rail.

3.2 RAILING INSTALLATION

A. Assembly and Installation: Perform in accordance with manufacturer's written recommendations for installation.

B. Expansion Joints:

1. Maximum intervals of 54 feet on center and at structural joints.
2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
3. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.

4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.

C. Posts and Rails:

1. Surface Mounted Posts:
   a. Bolt post baseplate connectors firmly in place.
   b. Shims, wedges, grout, and similar devices for railing post alignment not permitted.
2. Grouted Posts:
   a. Clean dust and foreign matter from sleeves or blockouts.
   b. Moisten interior of hole and surrounding surface with clean water. Fill hole with nonshrink grout or epoxy grout prior to installing post.
   c. Brace railing until grout sets.
   d. Posts installed outside and exposed to freezing temperatures, drill weep hole through post approximately 1/2 inch above level of grout inside post and in plane of rail to prevent entrapment and freezing of water inside post.
3. Set posts plumb and aligned to within 1/8 inch in 12 feet.
4. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
5. Install posts and rails in same plane.
6. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.
7. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
8. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.

D. Wall Brackets:

1. Support wall rails on brackets spaced maximum 5 feet on centers as measured on the horizontal projection.
2. Install wall anchor backplates on solid blocking in stud walls.

E. Toeboard:

1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or at stairways unless shown otherwise.
2. Accurately measure in field for correct length; after railing post installation cut and secure to posts.
3. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.

4. Install plumb and aligned to within 1/8 inch in 12 feet.

F. Railing System Gate: Install in accordance with manufacturer's installation instructions.

3.3 FIELD FINISHING

A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete, grout, and dissimilar metals by coating metal surfaces as specified in Section 09 90 00, Painting and Coating.

3.4 FIELD QUALITY CONTROL

A. Post-installed anchors supporting railing systems require special inspection.

B. City-Furnished Quality Assurance, in accordance with ICC CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

3.5 CLEANING

A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.

B. Do not use acid solution, steel wool, or other harsh abrasive.

C. If stain remains after washing, restore in accordance with railing manufacturer's recommendations or replace stained railings.

END OF SECTION

SECTION 05 53 00
METAL GRATINGS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): Standard Specifications for Highway Bridges.
2. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A510, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
   c. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   d. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   e. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. National Association of Architectural Metal Manufacturers (NAAMM):
   a. MBG 531, Metal Bar Grating Manual.
   b. MBG 532, Heavy-Duty Metal Bar Grating Manual.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Grating: Show dimensions, weight, size, and location of connections to adjacent grating, supports, and other Work.
   b. Grating Anchorage: Show details of anchorage to supports to prevent displacement from traffic impact.
   c. Product data for grating, grating clips, anchors, accessories, and other manufactured products specified herein.
   d. Manufacturer's specifications, including coatings, surface treatment, and finishes.
2. Samples: Two Samples of grating approximately 4 inches by 8 inches, showing at least four crossbars each and four bearing bars each. One Sample will be retained at Site to be used as a basis for acceptance or rejection of grating installed.

B. Informational Submittals:

1. Special handling and storage requirements.
2. Installation instructions.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Insofar as is practical, factory assemble items.

B. Package and clearly tag parts and assemblies that are, due to necessity, shipped unassembled.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Alabama Metal Industries Corporation (AMICO), Birmingham, AL.
2. IKG Industries, Houston, TX.
3. Ohio Gratings, Inc., Canton, OH.
4. Seidelhuber Metal Products, Inc., South San Francisco, CA.
5. Approved Equal.

2.2 GRATING MATERIALS

A. Aluminum: Provide alloy and temper as designated below.

1. Bearing Bars and Banding: ASTM B221 alloy 6061-T6 or 6063-T6.
2. Swaged Crossbar Rods: ASTM B221 alloy 6061 or 6063, or ASTM B210 alloy 3003.
3. Finish: Mill.

B. Carbon Steel:

1. Bearing Bars, Banding, and Rectangular Cross Bars: ASTM A1011/A1011M commercial steel Type II for hot rolled carbon steel sheet and strip, or ASTM A36/A36M.
2. Cross Bars made from Wire Rods: Not Permitted.
3. Finish: Galvanized after fabrication.

C. Stainless Steel:

1. Bearing Bars, Banding and Cross Bars: ASTM A666, Type 316L.
2. Finish: Mill.

2.3 METAL BAR GRATING

A. General Requirements:

1. Maximum Service Load:
   a. Light Duty (Type A): 100 psf uniformly distributed load.
2. Maximum Deflection: Span/240 or 1/4 inch, whichever is less.
3. Bearing Bar Spacing:
   a. Light Duty: 1-3/16 inch maximum, center-to-center.
4. Cross Bar Spacing: 4 inches maximum, center-to-center. For aluminum I-bar grating with depths greater than 2 inches, provide cross bars at 2 inches maximum, center-to-center.
5. Bearing Bars, Cross Bars and Banding: Minimum thickness as specified in NAAMM MBG 531 or as shown on Drawings.

B. Grating Materials:

1. Aluminum, pressure-locked rectangular bar grating fabricated by pressing crossbars between rectangular bearing bars.
2. Galvanized steel welded, rectangular bar grating fabricated by electro-forging cross bars to bearing bars.
3. Stainless steel pressure-locked rectangular bar grating fabricated by swaging crossbars between rectangular bearing bars.

C. Surface:

1. Plain, unless noted otherwise. Serrated as indicated on Drawings. Slip resistant, consisting of an applied abrasive finish of aluminum-oxide aggregate, as indicated on Drawings.
2. When surface of bars is serrated provide 1/4-inch deeper bearing bars than shown on Drawings to maintain specified load carrying capacity of grating.

D. Stair Treads:

1. Material and Type: Same as grating material and grating type as furnished for connecting walkway or work surface.
2. Nosings: Integral ribbing and serrated edge on one long axis of tread, or nonslip abrasive on each tread along one long edge.
3. Carrier Plate or Angle: Furnish at each end for connection to stair stringers.

2.4 ACCESSORIES

A. Embedded Frames:

1. As indicated on Drawings and as specified in Section 05 50 00, Metal Fabrications.

B. Grating Clamps:

1. Use at flanged beam and bolted angle frame supports.
2. Removable from above grating walkway surface.
3. Provide hat bracket, recessed bolt, and bottom clamp of same material as grating.
4. Manufacturers and Products:
   a. Direct Metals Company, LLC, Kennesaw, GA; Grating Clamp.
   b. Grating Fasteners, Inc., Harvey, LA; G-Clip.

C. Anchor Stud and Saddle Clip:

1. Use at embedded angle frame supports with stud anchor and nut recessed below top of grating surface.
2. Removable from above grating walkway surface.
3. Provide Type 316 stainless steel welded threaded stud anchor, nut, washer, and saddle clip.
4. Manufacturers and Products:
   a. Welded Stud Anchor:
      1) Nelson Stud Welding, Inc., Elyria, OH.
      2) Stud Welding Associates, Inc. Elyria, OH.
   b. Saddle Clip:
      1) Direct Metals Company, LLC, Kennesaw, GA; Saddle Clip.
      2) Grating Fasteners, Inc., Harvey, LA; Saddle Clip.
      3) Struct-Fast, Inc., Baltimore, MD; Gratefast.
5. At Embedded Extruded Aluminum:
   a. Provide aluminum clip, bolt, nut, and washer, with clip engaging bottom flange of I-bar.
   b. Manufacturers and Products:
      1) Direct Metals Company, LLC, Kennesaw, GA; Plank Clip.
      2) Thompson Fabricating Company, Inc., Birmingham, AL; TFCO Standard Hold Down Clip.

2.5 (NOT USED)

2.6 FABRICATION

A. General:

1. In accordance with NAAMM MBG 531 or NAAMM MBG 532.
2. Do not weld aluminum grating.
3. Conceal fastenings where practical.

4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Cutouts:
    a. Fabricate in grating sections for penetrations indicated.
    b. Arrange to permit grating removal without disturbing items penetrating grating.
    c. Edge band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
6. Do not notch bearing bars at supports to maintain elevation.
7. Field measure areas to receive grating. Verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.
8. Section Length: Sufficient to prevent section from falling through clear opening when oriented in the span direction and one end is touching either the concrete or the vertical leg of grating support.
9. Minimum Bearing: 1 inch for grating depth up to 2-1/4 inches and 2 inches for grating depth greater than 2-1/4 inches.
10. Banding and Toe Plates: Same material as grating and welded to bearing bars in accordance with requirements of NAAMM MBG 531 and NAAMM MBG 532.

B. Metal Bar Grating: A single grating section shall be not less than 1.5 feet or greater than 3 feet in width, or weigh more than 150 pounds.

C. Heavy Duty Metal Bar Grating: Minimum width of grating sections shall be 2 feet regardless of length and weight.

D. Supports:

1. Same material as grating, except that supports which are to be embedded in concrete shall be Type 316 stainless steel, unless part of an extruded aluminum system.
2. Coordinate dimensions and fabrication with grating to be supported.
3. Coordinate dimensions with increased depth due to serrations.

PART 3 EXECUTION

3.1 PREPARATION

A. Electrolytic Protection:

1. Protect aluminum surfaces in contact with dissimilar metals, or embedded or in contact with masonry, grout, or concrete as specified in Section 09 90 00, Painting and Coating.
2. Allow paint to dry before installation of material.

3.2 INSTALLATION

A. Until grating sections are securely fastened in place, area shall be appropriately barricaded or flagged to alert people working in the area of potential fall hazard.

B. Install manufactured products in accordance with manufacturer's recommendations.

C. Install supports such that grating sections have a solid bearing on both ends, and that grating sections will not rock or wobble under design loads.

D. Install grating supports plumb and level as applicable.

E. Install sections of welded frames with anchors to straight plane without offsets.

F. Field locate and install fasteners to fit grating layout.

G. Anchor grating securely to supports using minimum of four fastener clips and bolts per grating section.

H. Each grating or plank section shall be easily removable and replaceable.

I. Completed installation shall be rigid and neat in appearance.

J. Protect painted and galvanized surfaces during installation.

K. Repair damaged coatings as specified in Section 09 90 00, Painting and Coating.

END OF SECTION

SECTION 06 82 00
GLASS-FIBER-REINFORCED PLASTIC

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate Apparatus.
   b. D570, Standard Test Method for Water Absorption of Plastics.
   c. D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning Plastics in a Horizontal Position.
   d. D638, Standard Test Method for Tensile Properties of Plastics.
   e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
   f. D696, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 Degrees C and 30 Degrees C.
   g. D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
   h. D792, Standard Test Methods for Density and Specific Gravity (Relative Density) by Plastics Displacement.
   i. D2344, Standard Test Method for Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short-Beam Method.
   j. D2583, Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
   k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
2. International Conference of Building Officials (ICBO): California Building Code (CBC).
3. Occupational Safety and Health Act (OSHA): 29 CFR 19.10, Code of Federal Regulations.
4. Underwriters' Laboratories, Inc. (UL): 94, UL Standard for Safety Test for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.2 DESIGN REQUIREMENTS

A. This section contains components and connectors that require Contractor design.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product Data: Catalog information and catalog cuts showing materials, design tasks, and showing load, span, and deflection; include manufacturer's specifications.
   b. Grating: Show dimensions, weight, size, and location of connections to adjacent grating, supports, and other Work.
   c. Grating Supports: Show dimensions, weight, size, location, and anchorage to supporting structure.
   d. Guardrails and Support Structures:
      1) Show dimensions, weight, size, and location of connections to adjacent supports and other Work.
      2) Structural calculations for guardrails and anchorage for same.
2. Samples: Each type of grating, guardrail, and guardrail connection.

B. Informational Submittals:

1. Handling and storage requirements.
2. Manufacturer's installation instructions.
3. Factory test reports for physical properties of product.
   a. Test data for guardrails and supports may supplement load calculations providing data covers the complete system, including anchorage.
   b. Test data for all components showing load and deflection due to load, in enough detail to prove guardrail is strong enough and satisfies national, state, local standards, regulations, code requirements, and OSHA 29 CFR 19.10, using design loads specified.
   c. Include test data for the following:
      1) Railing and post connections.
      2) Railing wall connections.
      3) Post and base connections.
      4) Railing expansion joint connections.
4. Manufacturer's Certification of Compliance for specified products.
5. Fabricator's qualification experience.
6. Manufacturer's qualification experience.
7. Independent laboratory test report, dated within 2 years of submittal date, of fire retardant testing conducted on exact type of grating proposed (not a resin test report).

1.4 QUALIFICATIONS

A. Designer: Calculations required for Contractor design shall be stamped by a registered engineer, licensed in the State of California.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Shipment:

1. Insofar as is practical, factory assemble items provided hereunder.
2. Package and clearly tag parts and assemblies that are of necessity shipped unassembled in a manner that will protect materials from damage, and facilitate identification and final assembly in field.

B. Storage and Handling: In accordance with manufacturer's recommendations and in such a manner as to prevent damage of any kind, including overexposure to sunlight.

PART 2 PRODUCTS

2.1 GENERAL

A. Like Items of Materials: Provide end products of one manufacturer in order to achieve standardization for appearance, maintenance, and replacement.

B. Unless otherwise specified, all products shall be manufactured by a pultruded process using vinyl ester resin.

C. Exterior surfaces shall have a synthetic surface veil covering.

D. Fire Retardance:

1. Flame spread shall be less than 25 as measured by ASTM E84.
2. Include combinations of aluminum trihydrate, halogen, and antimony trioxide, where required to meet fire retardance, in the resin system.
3. Meet self-extinguishing requirements of ASTM D635.

E. Color pigment shall be dispersed in resin system. Color to by selected by the City.

F. Fabricate FRP products exposed to outdoor conditions with an additional 1-mil thick UV coating to shield product from UV light.

G. All cut ends, holes, and abrasions of FRP shapes shall be sealed with resin to prevent intrusion of moisture.

2.2 GRATING

A. General:

1. 100 psf minimum uniform load, unless otherwise shown, or concentrated load of 300 pounds on an area of 4 square inches located at mid-span, whichever produces maximum stress.
2. Maximum Deflection: 1/4 inch, unless otherwise shown.

B. Pultruded Type:

1. Main bars joined by cross bars secured in holes drilled in main bars.
2. Cross bars with 6-inch maximum spacing shall mechanically lock main bars in position such that they prevent movement.
3. Intersections: Bond using adhesive as corrosive-resistant as pultrusion resin.
4. Main Bar Ends: Minimum bearing support width of 1-1/2 inches.
5. Skid-Resistant Surface: Grit adhesively bonded, manufacturer's standard.
6. Provide extra stiffness around openings.

C. Hold-Down Clamps: Type 316 stainless steel.

D. Bolts and Connectors:

1. Type 316 stainless steel.
2. Size and strength to meet CBC requirements.

E. Fabrications:

1. Field measure areas to receive grating. Verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.
2. Section Length: Sufficient to prevent it falling through clear opening when oriented in span direction when one end is touching either concrete or vertical leg of grating support.

F. Manufacturers:

1. Fibergrate Composite Structures, Inc., Addison, TX.
2. Strongwell Corp., Bristol Division, Bristol, VA or Chatfield Division, Chatfield, MN.

2.3 (NOT USED)

2.4 GUARDRAIL

A. Structural Criteria:

1. Deflection: No permanent set in any member or connection when tested to design load.
2. Apply load to produce maximum stress and deflection in each of the respective components.
3. Top Rail and Posts of Guardrails: Capable of withstanding the following load cases applied with a safety factor of 1.33:
   a. Concentrated load of 200 pounds applied at any point and in any direction in accordance with CBC.
   b. Uniform load on the top rail of 50 pounds per linear foot applied in any direction in accordance with CBC.
   c. Concentrated load need not be assumed to act concurrently with uniform loads in accordance with CBC.
4. In-Fill Area of Railing Systems:
   a. Capable of withstanding horizontal concentrated load of 200 pounds applied to 1 square foot at any point in the system including panels, intermediate rails, balusters, or other elements composing in-fill area.
   b. Horizontal concentrated load need not be assumed to act concurrently with loads on top rails of guardrails.
5. Mid-Rails With Corner Returns: Withstand 300-pound concentrated vertical load applied at any point or direction without damage and loosening of fittings or attachment hardware.
6. Concrete Anchors: In accordance with ACI 318.
7. Connections, Mounts, Bases: Withstand all guardrail loads without permanent set and with a safety factor of at least 1.65 against failure.

B. Thermal Movement:

1. Allow for maximum range of ambient temperature change (difference between high or low and installation temperature).
2. Base design on actual surface temperatures of materials due to both solar heat gain and night time sky heat loss.
3. Temperature Change Range**:** 70 degrees F, ambient; 100 **d**egrees F, material surfaces.

C. Rails and Posts:

1. 2-inch nominal square or round tubing posts.

2. 1-3/4- or 2-inch nominal round or square rails.
3. Maximum Post Spacing: 5 feet.
4. Clearance between Rails: 11-1/2 inches

D. Kickplates: Corrugated, 4 inches by 1/2 inch by 0.125 inch thick or 4 inches by 9/16 inch thick at guardrail locations.

E. Kickplate Connectors and Splices: Continuous with provision for expansion and contraction without distortion or buckling.

F. Connections, Mounts, Bases: Fiberglass or Type 316 stainless steel.

G. Pultruded Parts:

Minimum Mechanical Properties	**Test Method**	**Values**
Tensile Stress	ASTM D638	30,000 psi
Tensile Modulus	ASTM D638	2.5×10^6 psi
Compressive Stress	ASTM D695	30,000 psi
Compressive Modulus	ASTM D695	2.5×10^6 psi
Flexural Stress	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	1.6×10^6 psi
Shear Stress	ASTM D2344	4,500 psi
Density	ASTM D792	0.060-0.070 lbs/in.^{3}
24-Hour Water Absorption	ASTM D570	0.6% max.
Coefficient of Thermal Expansion	ASTM D696	4.4×10^{-6} in./in./degree F
Flexural Stress	Full Section	36,000 psi
Flexural Modulus	Full Section	3.7×10^6 psi

H. Manufacturers:

1. Strongwell Corp., Bristol, VA.
2. Fibergrate Composite Structures, Inc., Addison, TX.

2.5 (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. Install in accordance with manufacturer's written instructions.

B. Install plumb or level, rigid and neat, as applicable.

C. Furnish fasteners and anchorages for complete installation.

D. Seal field cut holes, edges, and abrasions with catalyzed resin compatible with original resin.

3.2 GRATING

A. Anchor grating securely to supports to prevent displacement.

B. Install each grating section such that it is easily removable.

C. Clearance (Grating to Vertical Surfaces): 1/4 inch (plus or minus 1/8-inch tolerance).

3.3 GUARDRAIL

A. Provide and install expansion and contraction connections as shown on approved Shop Drawings.

3.4 (NOT USED)

3.5 (NOT USED)

END OF SECTION

SECTION 07 13 26
SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Modified bituminous sheet waterproofing.
2. Modified bituminous sheet waterproofing, fabric reinforced.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

C. Samples: For each exposed product and for each color and texture specified, including the following products:

1. 8-by-8-inch square of waterproofing and flashing sheet.
2. 4-by-4-inch square of drainage panel.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.

a. Size: 100 sq. ft. in area.

b. Description: Each type of wall.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side.

1. Acceptable Manufacturers:
    a. American Hydrotech, Inc.
    b. BASF Corp. – Construction Chemicals
    c. Carlisle Coatings & Waterproofing Inc.
    d. CETCO, a Minerals Technology Co.
    e. Polyguard Products, Inc.
    f. Equal
2. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
3. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
4. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970/D 1970M.
5. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836/C 836M.
6. Puncture Resistance: 40 lbf minimum; ASTM E 154/E 154M.
7. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
8. Water Vapor Permeance: 0.05 perm maximum; ASTM E 96/E 96M, Water Method.
9. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.
10. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.

G. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:

1. Thickness: Nominal 1/8 inch for vertical applications; 1/4 inch elsewhere.

2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection course type.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft..

B. Acceptable Manufacturers:

1. American Hydrotech, Inc.

2. BASF Corp. – Construction Chemicals

3. Carlisle Coatings & Waterproofing Inc.

4. CETCO, a Minerals Technology Co.

5. Polyguard Products, Inc.

6. Equal

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

F. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.

1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
    a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.

b. At plaza-deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and per recommendations in ASTM D 6135.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Re-prime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Two-Ply Application: Install sheets to form a membrane with lap widths not less than 50 percent of sheet widths, to provide a minimum of two thicknesses of sheet membrane over areas to receive waterproofing.

E. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.

F. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

G. Seal edges of sheet-waterproofing terminations with mastic.

H. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

I. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

J. Immediately install protection course with butted joints over waterproofing membrane.

1. Molded-sheet drainage panels may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.4 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install protection course before installing drainage panels.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests.

B. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.

C. Flood Testing: Flood test each deck area for leaks, according to procedures in ASTM D 5957, after completing waterproofing but before placing overlying construction. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and a maximum depth of 4 inches. Maintain 2 inches of clearance from top of sheet flashings.

2. Flood each area for 48 hours.

3. Testing agency shall observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

4. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

D. Electronic Leak-Detection Testing:

1. Testing agency shall test each deck area for leaks using an electronic leak-detection method that locates discontinuities in the waterproofing membrane.

2. Testing agency shall perform tests on abutting or overlapping smaller areas as necessary to cover entire test area.

3. Testing agency shall create a conductive electronic field over the area of waterproofing to be tested and electronically determine locations of discontinuities or leaks, if any, in the waterproofing.

4. Testing agency shall provide survey report indicating locations of discontinuities, if any.

E. Waterproofing will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber board insulation.
2. Mineral-wool board insulation.
3. Glass-fiber blanket insulation.
4. Mineral-wool blanket insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Research/evaluation reports.

PART 2 PRODUCTS

2.1 GLASS-FIBER BOARD INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation.
2. Johns Manville.
3. Knauf Insulation.
4. Owens Corning.
5. Or Equal.

B. Glass-Fiber Board Insulation: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Nominal density of 2.25 lb/cu. ft. (36 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

2.2 MINERAL-WOOL BOARD INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fibrex Insulations Inc.
2. Isolatek International.
3. Owens Corning.
4. Roxul Inc.
5. Thermafiber.
6. Or Equal.

B. Unfaced, Mineral-Wool Board Insulation: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).

2.3 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
3. Johns Manville.
4. Knauf Insulation.
5. Owens Corning.
6. Or Equal.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.4 MINERAL-WOOL BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fibrex Insulations Inc.
2. Owens Corning.
3. Roxul Inc.
4. Thermafiber.

5. Or Equal.

B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF INSULATION FOR ROOF CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.

5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

END OF SECTION

SECTION 07 41 13
METAL ROOF PANELS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated by the Hot-Dip Process.
   b. A792/A792M, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
   c. C1311, Standard Specification for Solvent Release Sealants.
   d. D226, Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
   e. D523, Standard Test Method for Specular Gloss.
   f. D1970, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
   g. E283, Standard Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen.
   h. E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
   i. E903, Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
   j. E1646, Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
   k. E1680, Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems.
2. FM (Factory Mutual) Global (FMG):
   a. Approval Guide.
   b. 4471, Approval Standard for Class 1 Panel Roofs.
3. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Architectural Sheet Metal Manual.
4. Underwriters Laboratories Inc. (UL): 580, Standard for Safety Tests for Uplift Resistance of Roof Assemblies.

1.2 SYSTEM DESCRIPTION

A. Design Requirements: Provide professional engineering services needed to design roof system and assume engineering responsibility.

B. Performance Requirements:

1. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/square foot of roof area when tested in accordance with ASTM E1680 at the following test pressures:
   a. Test Pressure:
      1) Roof slope less than or equal to 30 degrees: Negative 1.57 lbf/square feet
      2) Roof slope greater than 30 degrees: Positive and negative 1.57 lbf/square feet
   b. Preload Test-Pressure Difference:
      1) Positive: Greater than or equal to 15 lbf/square feet and the greater of 75 percent of building live load or 50 percent of building design positive wind pressure difference.
      2) Negative: 50 percent of design wind uplift pressure difference.
2. Water Penetration: No water penetration when tested in accordance to ASTM E1646 at the following test pressures:
   a. Test Pressure:
      1) Roof slope less than or equal to 30 degrees: 2.86 lbf/square feet
   b. Preload Test-Pressure Difference:
      1) Positive: Greater than or equal to 15 lbf/square feet and the greater of 75 percent of building live load or 50 percent of building design positive wind pressure difference.
      2) Negative: 50 percent of design wind uplift pressure difference.
3. Wind Uplift Resistance: Provide metal panel assemblies that comply with UL 580 Class 90.
4. FMG Listing: Provide metal roof panels and system accessories that comply with FMG 4471 as part of a panel roofing system and are listed in FMG "Approval Guide" for Class 1 or noncombustible construction. Materials shall be marked with FMG markings.
5. Structural Performance:
   a. Provide metal roof panel assemblies capable of withstanding the design loads specified in Section 01 61 00, Common Product Requirements.
   b. Deflection Limits: Engineer roof panel assemblies to withstand design loads with vertical deflections no greater than 1/180 of span.

6. Thermal Movement: Provide metal roof panel assemblies that allow for thermal movement resulting from temperature change of 120 degrees F (67 degrees C), ambient and 180 degrees F (100 degrees C), material surface.
7. Solar Reflectance, ASTM E903:
    a. Solar reflectance for roof slopes of 2:12 or less:
        1) Initial: Not less than 0.65.
        2) Maintained: Not less 0.50 for 3 years after installation.
8. Glare Resistance: Specular reflectance of not more than 10 when measured in accordance with ASTM D523 at an angle of 85 degrees.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Drawings showing thickness and dimensions of parts and accessories, fastening and anchoring methods, details, and locations of seams, joints, and other provisions for thermal movement. Distinguish between factory-assembled and field-assembled work. Include drawings at not less than 1/4-inch to 1-foot scale and details at not less than 3-inch to 1-foot scale.
2. Samples: 12-inch square Samples of specified metal. Samples will be reviewed for color and texture only.

B. Informational Submittals:

1. Manufacturer's printed installation instructions.
2. A letter from roofing manufacturer stating roofer is approved by manufacturer to apply the roof.
3. Preliminary and Preinstallation Conference meeting minutes.
4. Special guarantee.
5. Certificate of Proper Installation per Section 01 43 33, Manufacturer's Field Services (or alternately, test results or calculations), that assure item's and its anchorage's design criteria meets requirements of Section 01 88 15, Anchorage and Bracing, for loads provided in Section 01 61 00, Common Product Requirements.

1.4 QUALITY ASSURANCE

A. Applicator's Qualifications: Approved and trained by materials manufacturer.

B. Preliminary Roofing Conference:

1. Before starting roof: deck construction, conduct onsite conference with Engineer, roofing applicator, roofing system materials manufacturer, testing and inspecting agency, and Subcontractors likely to be on roof.

2. Agenda: Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to avoid delays. Discuss and resolve questions regarding acceptability of the deck, roofing system and materials, flashing details, roof insulation, roof-mounted mechanical equipment, and roofing. Document all discussions.

C. Preinstallation Conference:

1. Before starting metal roof installation, conduct a conference with Engineer, roofing applicator, roofing system materials manufacturer, testing and inspecting agency, and Subcontractors likely to be on roof, and installers whose work affects metal roof installation.
2. Items to be reviewed and discussed include, but are not limited to, the following items:
   a. Examine roof deck or substrate conditions for compliance with requirements for flatness and tolerance of structural members.
   b. Review structural loading limitations of roof deck or purlins and rafters during roofing installation.
   c. Review flashing details, roof drainage, roof insulation, roof penetrations, roof-mounted mechanical equipment, and other construction and conditions that might affect metal roof panel installation.
   d. Review governing regulations and requirements for insurance, certificates, and testing and inspecting as applicable.
   e. Review temporary protection requirements for metal roof panels during and after installation.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver components and metal roof panels so as not to be damaged or deformed. Package for protection during transportation and handling.

B. Storage and Handling:

1. Protect against damage and discoloration.
2. Handle panels with nonmarring slings.
3. Do not bend panels.
4. Store panels aboveground on pallets or platforms, with one end elevated for drainage.
5. Protect strippable protective covering from exposure to sunlight except as necessary for metal roof installation.
6. Stack panels to prevent twisting, bending, or abrasion, and to provide ventilation.

7. Protect panels against standing water and condensation between adjacent surfaces.
8. If panels become wet, immediately separate sheets, wipe dry with clean cloth, and separate sheets for air-drying.
9. During storage prevent contact with materials that may cause discoloration or staining.

1.6 COORDINATION

A. Coordinate installation of roof curbs, equipment support, and other roof accessories as specified in Section 07 70 01, Roof Specialties and Accessories.

B. Coordinate work with construction decks, walls, and other adjoining work.

1.7 SPECIAL GUARANTEE

A. Product: Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction or, at the option of the Owner, removal and replacement of roofing panels, flashing, finish, and accessories found defective during a period of 20 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified the General Conditions.

B. Conditions:

1. Roofing Panels: No rupture, structural failure, or perforation.
2. Finish: No cracking, blistering, flaking, chipping, checking, chalking, peeling, or fading.
3. Components: Watertight and weathertight with normal usage.

PART 2 PRODUCTS

2.1 ROOFING A: AND B: FASCIA PANELS

A. Material: Steel, galvanized, ASTM A653/A653M, coating designation G90.

B. Surface: Embossed finish.

C. Finish:

1. Polyvinylidene Fluoride: Kynar 500, two coats minimum.

D. Color: "Silversmith"

E. Standing Seam, Snap-on:

1. Formed with vertical ribs at panel edges and flat pan between vertical ribs designed for independent field installation by mechanically attaching panels to supports using concealed clips located under one side of panel and engaging opposite edge of adjacent panels and installation of snap on battens over panel joints.
2. Panel Coverage: 18 inches.
3. Batten Height: 1.5 inches.
4. Batten Profile: Narrow Profile.
5. Batten Material: Same material, finish, and color as roof panels.
6. Sealant: Factory applied.
7. Manufacturers:
    a. AEP-SPAN
    b. CENTRIA Architectural Systems;
    c. Basis of Design: Pac-Clad/Peterson "Snap-on Standing Seam Panel"

2.2 ACCESSORIES

A. Ice and Water Shield: Cold applied, self-adhering, polyethylene-faced sheet, consisting of slip-resisting polyethylene-film reinforcing top surface laminated to SBS-modified asphalt adhesive with release-paper backing, 40-mil minimum thickness meeting ASTM D1970.

B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal by means of plastic caps or factory-applied coating.

1. Fasteners for Roof Panels: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head with EPDM or PVC washer.
2. Fasteners for Flashing and Trim: Self-drilling screws with hex washer head or blind fastener rivets of high-strength aluminum or stainless steel.

C. Hold down Clips: System manufacturer's ASTM A792/A792M standard shape steel.

D. Closures: Manufacturer's standard neoprene blocks shaped to fit roof metal profile.

E. Sealant:

1. Silicone Sealant: Type 1 as specified in Section 07 92 00, Joint Sealants.
2. Tape Sealant: Type 13 as specified in Section 07 92 00, Joint Sealants.

F. Isolation Paint: ASTM D1187, asphalt

2.3 FABRICATION

A. Fabricate and finish metal roof panels and accessories at factory to the greatest extent possible.

B. Provide panel profile, including major ribs and any intermediate stiffening ribs for full panel length.

C. Panel Length: Roof panels shall be full length from eave to ridge, unless otherwise indicated or limited by shipping limitations.

D. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact.

E. Form and fabricate sheets, battens, strips, cleats, valleys, ridges, edge treatments, integral flashings, gutters, downspouts, and other components of specified metal roofing panels to profiles, patterns, and drainage arrangement shown, and as required for permanent leakproof construction, and as recommended by SMACNA's "Architectural Sheet Metal Manual."

F. Provide for thermal expansion and contraction of Work.

G. Conceal fasteners and methods of expansion where possible. Do not use exposed fasteners on faces of accessories where exposed to view.

H. Finishes:

1. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
2. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half the range of approved sample. Noticeable variations within same piece are not acceptable. Variations in other component appearances are acceptable if within range of approved samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with alignment tolerances required by metal roof panel manufacturer prior to beginning installation, examine rough-in location for items penetrating metal roof panels and coordinate with seam locations.

3.2 PREPARATION

A. Deck: Firm, dry, free of foreign materials, and smooth. Report immediately to Engineer cracks, breaks, holes, or other unusual irregularities in surface.

B. Layout Pattern:

1. Lay out to place seams equidistant from corners and aligned with seams on other side of hip or ridge.
2. Coordinate Work of this section with flashing, trim, and other construction to provide a permanently leakproof, secure, and noncorroding installation.

3.3 INSTALLATION

A. General:

1. Apply roofing only in dry weather and where weather conditions permit.
2. Install in accordance with manufacturer's written instructions and warranty requirements.
3. Comply with recommendations of the SMACNA "Architectural Sheet Metal Manual."
4. Install metal roofing and fascia system consisting of nonstructural sheet metal panels held to substrate with concealed fasteners.
5. Conceal expansion joint provisions wherever possible in exposed Work; locate so as to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
6. Closures and Trim:
    a. Provide gutters, downspouts, and other exposed trim and flashing for a weather-tight roofing system.
7. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.
8. Cutting and Fitting: Neat, square, and true. Saw cut panels, deburr, and use touchup paint immediately as recommended by roofing panel manufacturer. Torch cutting is prohibited.
9. Gutters, Downspouts, and Flashings:
    a. Straight, weather-tight, exposed surfaces free of dents, scratches, abrasions, stains, and other visible defects.
    b. Extend gutter lining under metal roofing 6 inches minimum and terminate in 3/4-inch folded edge secured by cleats.

B. Underlayment and Slip Sheet:

1. Install underlayment and slip sheet on roof sheathing, unless otherwise recommended by metal roof panel manufacturer.

2. Apply underlayment single-ply lapped shingle fashion, 3 inches at head and 6 inches at sides.
3. Cover with loose-laid slip sheet similarly lapped and with joints staggered.
4. Install no more than can be covered by metal roofing or other approved protection, in same day.
5. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal roof panels.

C. Standing-Seam Metal Roof:

1. Install as recommended by metal roof panel manufacturer's installation instructions and recommendations.
2. Begin at eaves. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction.
3. Install clips in panel side joints at location, spacing, and with fasteners as recommended by manufacturer for type of substrate and wind loading specified.

3.4 CLEANING AND PROTECTION

A. Cleaning:

1. At the end of each day sweep metal clean of foreign materials, especially metal particles and scrap.
2. Peel off strippable film.
3. Where needed, clean metals in conformance with metals industry recommendations or use Basic H organic metal cleaner, Shaklee Products, Hayward, CA.

B. Protection:

1. Protect material from exposure to chlorides, hydrochloric-based and muriatic acids. If contaminated, wash affected areas immediately with 5 percent soda and water solution and rinse with clear water.
2. Avoid walking on roof after completion.

C. Final Cleanup:

1. Remove debris, metal clips, nails, and other materials that could prevent adequate drainage or produce corrosion products through electrolysis.
2. Repair and touch up damage.
3. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair.

END OF SECTION

SECTION 07 51 13
BUILT-UP ASPHALT ROOFING

PART 1 GENERAL

1.8 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Wood Preservers' Association (AWPA): U1, Use Category System: User Specification for Treated Wood.
2. ASTM International (ASTM):

B. Roofing Terminology: Refer to the following publications for definitions of roofing work related terms used in this Section:

1. ASTM D 1079 "Standard Terminology Relating to Roofing and Waterproofing."
2. Glossary of NRCA's "The NRCA Roofing Manual."
3. Roof Consultants Institute "Glossary of Roofing Terms."

C. Sheet Metal Terminology and Techniques: SMACNA "Architectural Sheet Metal Manual."

D.

E. Hot Roofing Asphalt: Roofing asphalt heated to temperature recommended by roofing manufacturer to flux modified roofing membrane, measured at the mop cart or mechanical spreader immediately before application.

1. National Roofing Contractors Association (NRCA): Waterproofing Manual.
2. Underwriters Laboratories, Inc. (UL).

1.9 SUBMITTALS

A. Action Submittals:

1. Layout of tapered insulation.
2. Project specific details of roof penetrations and perimeter conditions.
3. Layout and details of mechanical fastening system.
4. List of materials proposed for use including roofing materials, accessories, insulation, and fasteners.
5. Manufacturer's specifications selected for use, including a description of the complete system from the deck up.
6. Documentation that anchoring system meets uplift requirements.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
2. Manufacturer's installation instructions.
3. A letter or other documentation from roofing materials manufacturer stating that installer has been trained and approved to apply the roof.
4. Sample copy of guarantee to be provided.
5. Record of Preroofing Conference.
6. Inspection reports for inspections conducted by membrane manufacturer's representative, including written instructions or recommendations as conditions to special guarantee.
7. Operation and Maintenance Data:

    a. As specified in Section 01 78 23, Operation and Maintenance Data.
    b. Include sketches where applicable; recommendations for periodic inspections, care, and maintenance; identify common causes of damage with instructions for temporary patching until permanent repair can be made.

8. Manufacturer's Certificate of Proper Installation per Section 01 43 33, Manufacturers' Field Services, (or alternately, test results or calculations) that assure item's and its anchorage's design criteria meets requirements of Section 01 88 15, Anchorage and Bracing, for loads provided in Section 01 61 00, Common Product Requirements.
9. Proposed maintenance agreement.

1.10 QUALITY ASSURANCE

A. Installer:

    1. Trained and approved by roof membrane manufacturer.

B. Materials, including insulation used in roofing system, shall be furnished by or approved by manufacturer whose roofing system is selected for use.

C. Preroofing Conference:

    1. Attendees: Conduct Preroofing Conference with Engineer, roofing installer, roofing manufacturer, installers of related Work, and other entities concerned with roofing performance including (where applicable) Owner's insurer, test agencies, governing authorities, and Owner.
    2. Agenda: Follow outline in NRCA's Waterproofing Manual; including acceptability of deck, roofing system materials, manufacturer's specifications selected, flashing details, roof guarantee, and protection of furnished roofing system.
    3. Record discussions and agreements; furnish copy to each participant and entity invited.

D. Membrane manufacturer's inspection as required to meet conditions of guarantee.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in their original, unopened containers, clearly labeled with manufacturer's name, brand name, and such identifying numbers as are appropriate.

B. Storage:

1. Store materials at temperatures between 60 degrees F and 80 degrees F. Should they be exposed to lower temperatures, restore to 60 degrees F prior to use.
2. Store rigid roof insulation materials on clean, raised platform.
3. Do not store uncured flashing membrane on roof or at temperatures exceeding 75 degrees F.

C. Protect materials against wetting, moisture absorption, and construction traffic.

1.12 ENVIRONMENTAL REQUIREMENTS

A. Weather: Do not install roofing during precipitation or when it is probable.

B. Temperature:

1. Install roofing when ambient temperature is 50 degrees F or above.
2. When temperature is below 50 degrees F, install only with approval of, and under supervision of, membrane manufacturer.

1.13 SPECIAL GUARANTEE

A. Product: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing as special guarantee. Special guarantee shall provide for correction or removal and replacement of roofing membrane, flashing, insulation, and accessories found defective during a period of 20 years after date of Substantial Completion, with no dollar limit. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.

B. Coverage and Conditions:

1. Costs for repairs required to maintain roofing system, flashing, expansion joint covers, and roof vents in watertight condition.
2. Natural deterioration of roofing system as a result of ordinary wear and tear by elements.
3. Defects as a result of faulty materials or workmanship during application.

1.14 MAINTENANCE SERVICE

A. Provide maintenance service for roof after it is substantially complete and placed in use for a period of 10 years.

B. Maintenance Work: Performed by trained employees of installer.

C. Roof Inspections:

1. At least twice a year and after severe storms.
2. Perform in Spring and Fall.
3. Clear and remove debris from roof.
4. Check and unclog drains, scuppers, and downspouts.
5. Check full field of roof for blisters, alligatoring, and cracking.
6. Check roof edges and flashings.
7. Check roof penetrations and expansion joints.

D. After inspections and in emergency situations, make repairs needed to keep roof in leak-free condition and to ensure guaranteed service life.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Firestone Building Products;
B. GAF
C. Johns Manville;

2.2 ROOFING SYSTEM

A. Complete system including:
1. Membrane.
2. Flashings.
3. Fasteners and Accessory Materials.

B. Meeting these specifications and approval of membrane manufacturer to provide a 3 ply plus base built-up asphalt roofing system meeting the following:
1. UL Class A fire resistance rating.
2. FM Loss Prevention Data 1-28 requirements for I-90 wind uplift rating.

2.3 ROOFING MEMBRANE CAPSHEET

A. Cap Sheet: ASTM D 3909, asphalt-impregnated and -coated, glass-fiber cap sheet, with white reflective coarse mineral-granule top surfacing and fine mineral surfacing on bottom surface. ASTM D4601, Type II, asphalt coated, fiberglass base felt. Basis of Design: GlasKap

2.4 ROOFING MEMBRANE FELTS

A. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt-impregnated, glass-fiber felt. Basis of Design: GlasPly IV

2.5 BASE SHEET MATERIALS

A. Glass-Fiber Base Sheet: ASTM D4601, Type II, asphalt coated, fiberglass base felt. Basis of Design: PermaPly 28.

2.6 FLASHING MATERIAL

A. Backer Sheet: ASTM D 2178, Type IV, asphalt-impregnated, glass-fiber felt. Basis of Design: GlasPly IV

B. Flashing Sheet: ASTM D 6221, Grade G, Type I, composite polyester- and glass-fiber-reinforced, SBS-modified asphalt sheet; granular surfaced; suitable for application method specified. Basis of Design: DynaFlex.

2.7 AUXILIARY ROOFING MEMBRANE MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with built-up roofing.
   1. Roofing Asphalt: ASTM D 312, Type IV.
   2. Retain paragraph below if asphalt roofing cement is used to adhere flashings or integral metal sheet flashings.

B. Asphalt Primer: ASTM D 41. Basis of Design: JM Asphalt Primer
   1. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application. Basis of Design: MBR Utility Cement
   2. Cold-Applied Flashing Cement: Roofing system manufacturer's asphalt-based, two-component, asbestos-free, trowel-grade, cold-applied adhesive specially formulated for compatibility and use with flashing applications. Basis of Design: MBR Flashing Cement
   3. Mastic Sealant: As required by Johns Manville.
   4. Roofing Granules: Ceramic-coated roofing granules matching specified cap sheet, provided by roofing system manufacturer.

C. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

2.8 ROOFING ACCESSORIES

A. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."

2.9 ROOF WALKWAYS

A. Nonskid white molded rubber walk pads, 30 inches by 30 inches by 3/8-inch nominal.

B. Manufacturers and Products:
   1. Firestone Walkway Pads.
   2. Gaf Walkway Pads
   3. Johns Manville Walkway Pads.

2.10 FASTENERS

A. Into Wood: Zinc-coated, 12-gauge roofing nails with 1-inch diameter metal caps or heads and deformed shanks.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify deck is firm, dry, clean, free of sharp edges, burrs, loose and foreign materials, oil, and grease, and reasonably smooth.
B. Report immediately to Engineer cracks, breaks, holes, or other unusual irregularities in the surface.
C. Fill surface joints and cracks wider than 1/4 inch with pourable sealer.
D. Existing Roofing:
    1. Check for dryness by core sampling, probing, or moisture scanning.
    2. Remove wet insulation, dry deck, and replace insulation to original thickness.
    3. Remove loose gravel, debris, and cutout blisters from existing built-up roofing.
E. Correct irregularities to deck/substrate that may cause ponding longer than 48 hours.
F. Nailers:
    1. Install wooden nailer at perimeter of each roof level, curb flashing, skylights, expansion joints, and similar penetrations.
    2. Firmly anchor nailers to resist a force of 75 pounds per linear foot in all directions.
    3. Thickness: Such that top of nailer is flush with surface to which membrane is to be applied.
    4. Vertical nailer that secures membrane at horizontal plane may be used.

3.2 INSTALLATION

A. Install a complete UL listed Class A system of compatible materials that will create a monolithic watertight single-ply roof membrane.

B. In accordance with membrane manufacturer's instructions for installation of complete, warrantable roof system.

C. In accordance with membrane manufacturer's standard details for flashing and termination conditions.

D. Roof Walkways: Adhere to membrane with bonding adhesive or place paver blocks in walkway pattern.

E. Meet FM Loss Prevention Data 1-28 requirements for I-90 wind uplift rating.

F. On Wood Roof Deck: 100 percent mechanically fastened with nails designed for wood penetration with a 1-inch diameter cap, applied at rate of one every 2 square feet of insulation board.

G. Loose lay insulation over substrate with insulation joints 1/4 inch or less in width.

H. Do not install more insulation each day than can be covered with membrane before end of day or start of inclement weather.

3.3 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection and certification of proper installation, and training of Owner's personnel for maintaining specified system.

B. Provide Engineer with copies of inspection reports.

3.4 CLEANUP

A. Remove spots and smears of adhesive, sealant, asphalt, or other material resulting from the Work in this section from flashing, gravel stops, and other surfaces not intended to be coated with such material.

B. During removal of spots and smears, ensure no damage will be done to the surfaces.

C. Use solvents, if necessary, to satisfactorily clean the materials.

3.5 PROTECTION OF INSTALLED WORK

A. Limit traffic of personnel and equipment on completed roof to that deemed essential for completion of Project.

END OF SECTION

SECTION 07 70 01
ROOF SPECIALTIES AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air Movement and Control Association International (AMCA).
2. American Architectural Manufacturers Association (AAMA).
3. ASTM International (ASTM):
   a. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
   b. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
4. FM (Factory Mutual) Global (FM).
5. Underwriters Laboratories, Inc. (UL).

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings of each item specified showing materials, details, flashing, anchorage, and relation to adjacent structure.
2. Catalog cuts of each item specified item.

B. Informational Submittals: Manufacturer's Certificate of Compliance per Section 01 61 00, Common Product Requirements, (or alternately, test results or calculations) that assure item's and its anchorage's design criteria meets requirements of Section 01 88 15, Anchorage and Bracing, for loads provided in Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 ROOF DRAINS

A. Molded plastic drain with dome grate and flexible neoprene bellows connection to drain.

B. Size: 4 inches.

C. Manufacturers and Products:

1. Johns Manville; Flex-I-Drain.
2. Portals Plus, Inc.; Roof Drain.

2.2 GRAVITY VENTILATORS

A. Gravity Exhaust Ventilator:

1. Steel weatherproof hood.
2. Outside and inside wind deflectors, curb attachment.
3. 1/2-inch mesh steel bird screen.
4. Size as shown, based on pressure loss through ventilator assembly of 0.10-inch WC.
5. Manufacturers and Products:
   a. Penn Ventilation; Type WB.
   b. Breidert; Air-X-Hauster Type L or Type F.

2.3 ANCILLARY MATERIALS

A. Sealing Tape: Polyisobutylene sealing tape specifically manufactured for setting flanges on bituminous roofing.

B. Isolation Paint: ASTM D1187, asphalt.

C. Isolation Tape: Butyl or polyisobutylene, internally reinforced, or 20-mil-thick minimum polyester.

D. Plastic Roof Cement: ASTM D4586, Type II.

E. Fasteners: Stainless steel of type required.

PART 3 EXECUTION

3.1 PREPARATION

A. Examine surfaces and structures to receive the Work of this section.

B. Take measurements at Site and fabricate work to suit. No changes shall be made in supporting structure to accommodate this Work.

3.2 INSTALLATION

A. General:

1. Install roof specialties and accessories as detailed in approved shop drawings and in conformance with manufacturer's instructions, recommendations, and standards.
2. Use appropriate pipe curb assembly, pipe seal, flexible base pipe seal, or vent pipe flashing where pipe, conduit, or cable, etc., penetrate roofing membrane.

3. Factory Finished Units: Place color variations in pieces so no extremes are next to each other.
4. Make Work weathertight and free of expansion and contraction noise.
5. Maintain separation between aluminum surfaces and concrete or dissimilar metals with isolation tape.

B. Roof Vents: Install in accordance with roofing system manufacturer's instructions.

END OF SECTION

SECTION 07 71 00
ROOF SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Roof-edge drainage systems.

B. Preinstallation Conference: Conduct conference at Project site

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

C. Samples: For each type of roof specialty and for each color and texture specified.

1.03 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For tests performed by a qualified testing agency.

B. Sample warranty.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and SPRI ES-1 tested to specified design pressure.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. FM Approvals' Listing: Manufacture and install roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification Class 1-90 Identify materials with FM Approvals' markings.

B. SPRI Wind Design Standard: Manufacture and install roof-edge specialties tested according to SPRI ES-1 and capable of resisting design pressures:

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient, material surfaces.

2.02 ROOF-EDGE DRAINAGE SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by the following.

B. Architectural Products Company:
1. ATAS International, Inc.
2. Berger Building Products, Inc.
3. Castle Metal Products.
4. Cheney Flashing Company.
5. CopperCraft by FABRAL; a Euramax company.
6. Hickman Company, W. P.
7. Merchant & Evans, Inc.
8. Metal-Era, Inc.
9. Metal-Fab Manufacturing, LLC.
10. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.
11. Or Equal.

B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet (3.6 m) with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.
2. Aluminum Sheet: 0.032 inch (0.81 mm) 0.040 inch (1.02 mm) thick.
3. Gutter Profile: Half-round highback according to SMACNA's "Architectural Sheet Metal Manual."
4. Corners: Factory mitered and mechanically clinched and sealed watertight.
5. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.

C. Downspouts: Corrugated rectangular complete with machine-crimped smooth-curve elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.
2. Formed Aluminum: 0.032 inch (0.81 mm) thick.

D. Zinc-Coated Steel Finish: Two-coat fluoropolymer

1. Color: As selected by Architect from manufacturer's full range.

2.03 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.

2.04 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F (116 deg C).
2. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F (29 deg C).
3. Products: Subject to compliance with requirements, provide one of the following:
   a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
   b. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT Ultra.
   c. Henry Company; Blueskin PE200 HT.
   d. Metal-Fab Manufacturing, LLC; MetShield.
   e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

1) Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum.

2.05 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.06 FINISHES

A. Coil-Coated Galvanized-Steel Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.
   a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.

PART 3 INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed

water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under roof-edge specialties.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

B. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.01 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance >.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

3.02 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches (305 mm) apart. Attach ends with rivets and seal with sealant solder to make watertight. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet (15.2 m) apart. Install expansion-joint caps.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

3.03 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION

SECTION 07 72 00
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Roof hatches.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory indicated.

B. Shop Drawings: For roof accessories.

C. Samples: For each exposed product and for each color and texture specified.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items.

B. Warranty: Sample of special warranty.

1.04 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.05 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.

1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on

epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).

3. Exposed Coil-Coated Finish: Two-coat fluoropolymer finish; AAMA 621; system consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

B. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

2.02 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Security Grilles: 3/4-inch (19-mm) < diameter, ASTM A 1011/A 1011M steel bars spaced 6 inches (150 mm) o.c. in one direction and 12 inches (300 mm) o.c. in the other; factory finished with manufacturer's or fabricator's standard, universal shop primer compatible with substrate and field-applied finish paint system indicated.

C. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

D. Sealants: As recommended by roof accessory manufacturer for installation indicated.

2.03 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated single walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AES Industries, Inc.
   b. Babcock-Davis.
   c. Bilco Company (The).
   d. O'Keeffe's Inc.
   e. Pate Company (The).
   f. Precision Ladders, LLC.
   g. Or Equal.

B. Type and Size: Double-leaf lid, 120 by 120 inches

C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

D. Hatch Material: Zinc-coated (galvanized) Aluminum-zinc alloy-coated steel sheet, 0.079 inch (2.01 mm) thick.

1. Finish: Two-coat fluoropolymer.
2. Color As selected by Architect from manufacturer's full range

E. Construction:

1. Insulation: Glass-fiberboard.
2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
5. Fabricate curbs to minimum height of 12 inches (300 mm) unless otherwise indicated.

F. Hardware: Galvanized-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Provide two-point latch on lids larger than 84 inches (2130 mm).
2. Provide remote-control operation.

G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder. Post locks in place on full extension; release mechanism returns post to closed position.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.

C. Security Grilles: Weld bar intersections and, using tamper-resistant bolts, attach the ends of bars to structural frame or primary curb walls.

D. Seal joints with sealant as required by roof accessory manufacturer.

END OF SECTION

SECTION 07 72 33
ROOF HATCHES
(BILCO TYPE D)

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide factory-fabricated roof hatches for ladder access.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data.

B. Shop Drawings: Submit shop drawings including profiles, accessories, location, adjacent construction interface, and dimensions.

C. Warranty: Submit executed copy of manufacturer's standard warranty.

1.3 QUALITY ASSURANCE

A. Manufacturer's Quality System: Registered to ISO 9001 Quality Standards including in-house engineering for product design activities.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.5 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Manufacturer: Type D Roof Hatch by The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Fax: 1-203-535-1582,
Web: www.BILCO.com

2.2 ROOF HATCH

A. Furnish and install where indicated on plans metal roof hatch Type D, size as indicated on drawings. Length denotes hinge side. The roof hatch shall be double leaf. The roof hatch shall be pre-assembled from the manufacturer.

B. Performance characteristics:

1. Covers shall be reinforced to support a minimum live load of 40 psf (195kg/m^2) with a maximum deflection of 1/150th of the span or 20 psf (97 kg/m^2) wind uplift.
2. Operation of the covers shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
3. Operation of the covers shall not be affected by temperature.
4. Entire hatch shall be weather tight with fully welded corner joints on covers and curb

C. Covers: Shall be [select: 14 gauge (1.9 mm) paint bond G-90 galvanized steel or 11 gauge (2.3mm) aluminum] with a 3" (76mm) beaded flange with formed reinforcing members. Covers shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.

D. Cover insulation: Shall be fiberglass of 1" (25mm) thickness, fully covered and protected by a metal liner [select: 22 gauge (.8mm) paint bond G-90 galvanized steel or 18 gauge (1mm) aluminum].

E. Curb: Shall be 12" (305mm) in height and of [select: 14 gauge paint (1.9 mm) bond G-90 galvanized steel or 11 gauge (2.3mm) aluminum]. The curb shall be formed with a 3-1/2" (89mm) flange with 7/16" (11mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6" (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.

F. Curb insulation: Shall be rigid, high-density fiberboard of 1" (25mm) thickness on outside of curb.

G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe [for aluminum construction: welded to the curb assembly; for steel construction: through bolted to the curb assembly].

H. Hardware

1. Heavy pintle hinges shall be provided
2. Covers shall be equipped with an enclosed two point spring latch with interior and exterior turn handles
3. Roof hatch shall be equipped with interior and exterior padlock hasps.
4. The latch strike shall be a stamped component bolted to the curb assembly.
5. Covers shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.
6. Hardware: All hardware shall be zinc plated and chromate sealed. [For installation in highly corrosive environments or when prolonged exposure to hot water or steam is anticipated, specify Type 316 stainless steel hardware].

7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

I. Finishes: Factory finish shall be [select: alkyd based red oxide primed steel or mill finish aluminum].

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.

1. Test units for proper function and adjust until proper operation is achieved.
2. Repair finishes damaged during installation.
3. Restore finishes so no evidence remains of corrective work.

3.3 ADJUSTING AND CLEANING

A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C661, Standard Test Method for Indentation Hardness of Elastomeric Type Sealants by Means of a Durometer.
   b. C834, Standard Specification for Latex Sealants.
   c. C920, Standard Specification for Elastomeric Joint Sealants.
   d. C1193, Standard Guide for Use of Joint Sealants.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Surface preparation instructions. Indicate where each product is proposed to be used.
2. Samples: Material proposed for use showing color range available

B. Informational Submittals:

1. Installation instructions.
2. Documentation showing applicator qualifications.
3. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
4. Special guarantee.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications: Experience installing sealants.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Ambient Temperature: Between 40 degrees F and 80 degrees F (4 degrees C and 27 degrees C) when sealant is applied. Consult manufacturer when sealant cannot be applied within these temperature ranges.

1.5 SPECIAL GUARANTEE

A. Product: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall

provide for correction or, at the option of the Owner, removal and replacement of Work specified in this section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.

B. Conditions: No adhesive or cohesive failure of sealant.

C. Sealed Joints: Watertight and weathertight with normal usage.

PART 2 PRODUCTS

2.1 SEALANT MATERIALS

A. Characteristics:

1. Uniform, homogeneous.
2. Free from lumps, skins, and coarse particles when mixed.
3. Nonstaining, nonbleeding.
4. Hardness of 15 minimum and 50 maximum, measured by ASTM C661 method.
5. Immersible may be substituted for non-immersible.

B. Color: Unless specifically noted, match color of the principal wall material adjoining area of application.

C. Type 1—Silicone, Non-sag, Non-immersible:

1. Silicone base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
2. Capable of withstanding movement up to 50 percent of joint width.
3. Manufacturers and Products:
   a. Dow Corning Corp.; No. 790.
   b. General Electric; Silpruf.
   c. BASF; Sonneborn, Omniseal-50.

D. Type 5—One-part Polyurethane, Immersible:

1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products for no sag:
   a. Sika Chemical Corp.; Sikaflex-1a.
   b. Tremco; Vulkem 116.
4. Manufacturers and Products for Self-leveling:
   a. BASF; Sonneborn, SL-1.

b. Tremco; Vulkem 45.
c. Sika Chemical Corp.; Sikaflex 1c SL.

E. Type 10—Sanitary Sealant:

1. Silicone sealant similar to Type 1, above, formulated to resist mold growth and repeated exposure to high humidity while retaining adhesion, flexibility, and color.
2. Manufacturers and Products:
   a. Dow Corning; 786.
   b. General Electric; Sanitary Sealant SCS1700.

F. Type 11—Fire Penetration Seal:

1. Manufacturers and Products:
   a. 3M Corp.; Fire Barrier Caulk CP25 and Putty 303.
   b. General Electric; Pensil Sealant or Foam.
   c. Unifrax Corporation; Fyre Putty.
   d. Hilti USA; CP 604.

G. Type 12—One-Part Polycarbonate, Immersible:

1. Polycarbonate base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturer and Product: Pro-Seal Products, Inc.; Pro-Seal 34.

2.2 BACKUP MATERIAL

A. Non-gassing, extruded, closed-cell round polyurethane foam or polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.

B. Size: As shown or as recommended by sealant material manufacturer. Provide for joints greater than 3/16 inch wide.

C. Manufacturers and Products:

1. Sonneborn; Sonolastic Closed-cell Backing Rod.
2. Tremco; Closed-cell Backing Rod.
3. Pecora Corporation; Green Rod.

2.3 ANCILLARY MATERIALS

A. Bond Breaker: Pressure sensitive tape as recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Primer: Nonstaining type recommended by sealant manufacturer to suit application.

2.4 PREFORMED SEALS

A. Preformed Compressible Joint Seals:

1. Widths Up to 5 Inches:
   a. BASF, Watson Bowman Acme Div.; Wabo Weatherseal II.
   b. Emseal Joint Systems Limited; Colorseal.
   c. LymTal International; Iso-flex Joint System.
2. Other Widths: Series or model recommended by seal manufacturer.

PART 3 EXECUTION

3.1 GENERAL

A. Use of more than one material for the same joint is not allowed unless approved by sealant manufacturer.

B. Install joint sealants in accordance with ASTM C1193.

C. Horizontal and Sloping Joints up to 1 Percent Maximum Slope: Use self-leveling (Grade P) joint sealant.

D. Steeper Sloped Joints, Vertical Joints, and Overhead Joints: Use no sag (Grade NS) joint sealant.

E. Use joint sealant as required for the applicable application and as follows:

Joint Size	Sealant Type
Less than 1"	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 12
Less than 2"	1, 2, 3, 4, or 7
Over 2"	Follow manufacturer's recommendation

3.2 PREPARATION

A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.

B. Surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.

1. Mask adjacent surfaces where necessary to maintain neat edge.
2. Starting of work will be construed as acceptance of sub surfaces.
3. Apply primer to dry surfaces as recommended by sealant manufacturer.

C. Verify joint shaping materials and release tapes are compatible with sealant.

D. Examine joint dimensions and size materials to achieve required width/depth ratios.

E. Follow manufacturer's instructions for mixing multi-component products.

3.3 INSTALLATION

A. Use joint filler to achieve required joint depths, to allow sealants to perform intended function.

1. Install backup material as recommended by sealant manufacturer.
2. Where possible, provide full length sections without splices; minimize number of splices.
3. Tape sealant may be used as joint filler if approved by sealant manufacturer.

B. Use bond breaker where recommended by sealant manufacturer.

C. Seal joints around window, door and louver frames, expansion joints, control joints, and elsewhere as indicated.

D. Joint Sealant Materials: Follow manufacturer's recommendation and instructions, filling joint completely from back to top, without voids.

E. Joints: Tool slightly concave after sealant is installed.

1. When tooling white or light color sealant, use a water wet tool.
2. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.

F. Tape Sealant: Compress to 50 percent of expanded thickness and install in accordance with manufacturer's instructions.

3.4 PREFORMED SEALS

A. Prepare joint surfaces clean and dry, free from oil, rust, laitance, and other foreign material.

B. Construct joints straight and parallel to each other and at proper width and depth.

C. Apply joint sealant manufacturer's approved primer and adhesive in accordance with manufacturer's instructions.

D. Install seal in accordance with manufacturer's instructions.

3.5 CLEANING

A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.

B. Replace damaged surfaces resulting from joint sealing or cleaning activities.

3.6 JOINT SEALANT SCHEDULE

A. This schedule lists the sealant types acceptable for each joint location. Use as few different sealant types as possible to meet the requirements of Project.

Joint Locations	Sealant Type(s)
Expansion/Contraction and Control Joints At:	
Concrete Walls (except water-holding and below grade portions of structures)	1, 3, 4, 5, 6, 7, 12
Concrete Floor Slabs (except for water-holding Structures)	2, 5
Slabs Subject to Vehicle and Pedestrian Traffic	2, 5
Masonry Walls	1, 3, 4, 5, 6, 7, 12, 13
Material Joints At:	
Metal Door, Window, and Louver Frames (Exterior)	1, 5, 6, 8, 12
Metal Door, Window, and Louver Frames (Interior)	1, 5, 6, 8, 9
Wall Penetrations (Exterior)	1, 5, 6, 8, 12
Wall Penetrations (Interior)	1, 5, 6, 8
Floor Penetrations	5, 6, 7
Roof Penetrations	5
Sheet Metal Flashings	5, 13
Sheet Metal Roofing	5, 13
Other Joints:	

Joint Locations	Sealant Type(s)
Threshold Sealant Bed	5
Openings Around Pipes, Conduits, and Ducts Through Fire-Rated Construction	11

B. A: Use sealant Type 1 for building joints and elsewhere as indicated.

C. A: Use sealant Type 11 to seal voids and holes around penetrations through fire-rated elements.

END OF SECTION

SECTION 08 11 00
METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI):
   a. A250.6, Hardware on Standard Steel Doors (Reinforcement - Application).
   b. A250.8, Recommended Specification for Standard Steel Doors and Frames.
   c. A250.11, Recommended Erection Instructions for Steel Frames.
2. ASTM International (ASTM):
   a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   b. A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
   c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated by the Hot-Dip Process.
   d. A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
   e. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
3. Builders Hardware Manufacturers Association (BHMA): A156.115, Hardware Preparations in Standard Steel Doors and Frames.
4. National Fire Protection Association (NFPA): 80, Standard for Fire Doors and Other Opening Protectives.
5. Underwriters Laboratories, Inc. (UL): Building Materials Directory.

1.2 SUBMITTALS

A. Action Submittals:

1. Applicable information for each type of door and frame, including:
   a. Frame conditions and complete anchorage details, supplemented by suitable schedules covering doors and frames.
   b. Glass and louver opening sizes and locations in doors.

c. Connections of door frames to structural steel framing concealed in frames.
d. Location and field splice joints for frames too large to ship in one piece; indicate complete instructions for making field splices.
e. Joints required to accommodate expansion joint movement.
f. Relate to door numbers used in Contract Drawings.

B. Informational Submittals: Certificate of Compliance per Section 01 43 33, Manufacturer's Field Services (or alternately, test results or calculations) that assure items and its anchorages design criteria meets requirements of Section 01 88 15, Anchorage and Bracing, for loads provided in Section 01 61 00, Common Product Requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Properly identify each item with number used in Contract Drawings.

B. Store doors upright, in protected dry area, at least 1 inch off ground or floor and at least 1/4 inch between individual pieces.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Curries Manufacturing.
2. The Ceco Corp.
3. Fenestra Division, Marmon Group.
4. Mesker Industries, Inc.
5. Monarch Steelcraft, Ltd.
6. Overly Manufacturing Co.
7. Pioneer Industries.
8. Precision Metals, Inc.
9. Republic Steel Corp.
10. Steelcraft Manufacturing Co.
11. Trussbilt, Inc.
12. Williamsburg Steel Products Co.
13. Stiles Custom Metal, Inc.
14. Or Equal.

2.2 MATERIALS

A. Basic Metal Material:

1. ASTM A1008/A1008M; sheet steel, cold-rolled, stretcher level.
2. ASTM A167, Type 316 stainless steel.

B. Hollow Metal Frames:

1. Products of hollow metal door manufacturer.
2. ANSI 250.8, except as modified herein.
3. Frames for Doors 16 gauge for interior and 14 Gauge for exterior, knockdown or welded type, of cross-section shown.
4. Prepare floor and wall anchors, reinforcement, and cutouts for hardware to meet requirements of BHMA A156.115 and ANSI A250.6.
5. Finished size, shape, and profile of frame members as shown.
6. Concealed fasteners or welding are preferred to through-the-face fasteners.
7. Identification: Stamp opening number, as shown on Drawings, on center hinge reinforcement of each frame.

C. Hollow Metal Doors: ANSI A250.8, except as modified herein.
BHMA A156.115 and ANSI A250.6 to receive hardware specified in Door and Hardware Schedule.

1. Exterior:
   a. Flush Panel Doors: D: 16 Gauge, Level 3, Model 1. Stile and Rail Doors: 16 Gauge, Level 3, Model 3.
   b. Double Doors: Overlapping astragals for active leaf, except as noted or detailed otherwise.
   c. Flush end closure at top of doors.

2.3 MISCELLANEOUS ITEMS

A. Filler or Transom Panels: Furnish of same construction and finish as door to include fire-resistive label and sound-retardant construction.

B. Furnish manufacturer's standard core filler, anchors, fasteners, and other ancillary items.

2.4 FACTORY FINISHING REQUIREMENTS

A. Galvanized with A60 zinc coating in accordance with ASTM A653/A653M (Wipe Coat galvanized coating is not acceptable).

B. Phosphate treat metal for paint adhesion.

C. One shop coat of baked-on rust-inhibiting prime coating compatible with finish coating as shown and as specified in Section 09 90 00, Painting and Coating.

PART 3 EXECUTION

3.1 INSTALLATION

A. Frames:

1. Follow ANSI A250.11 and manufacturer's instructions.
   a. Maintain scheduled dimensions, hold head level, and maintain jambs plumb and square.
   b. Secure anchorages and connections to adjacent construction.
   c. Wherever possible, leave frame spreader bars intact until frames are set perfectly square and plumb and anchors are securely attached.

B. Doors:

1. Hollow Metal Doors: ANSI A250.8.
2. Hardware: In accordance with manufacturer's templates and instructions.
   a. Adjust operable parts for correct function.
   b. Remove hardware, with exception of prime coated items, tag, box, and reinstall after finish paint work is completed.

3.2 FIELD PAINTING

A. Where prime coat has been damaged, sand smooth and touch up with same primer as applied at shop.

1. Remove rust before painting.
2. Touch Up: Not obvious.
3. Perform immediately after door and frame installation.

3.3 PROTECTION

A. Protect installed doors and frames against damage from other construction work.

3.4 SCHEDULES

A. For tabulation of door and frame characteristics, such as size, type, detail, and finish hardware requirements, see Door and Hardware Schedule on Drawings.

END OF SECTION

SECTION 08 31 13
ACCESS DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor access doors and frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each door face material.

D. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 tested according to the following test method:

1. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 FLOOR ACCESS DOORS AND FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Acudor Products, Inc.
2. Babcock-Davis.
3. Bilco Company (The).
4. Cendrex Inc.
5. Dur-Red Products.
6. Halliday Products.
7. Jensen Industries; Div. of Broan-Nutone, LLC.
8. Karp Associates, Inc.
9. Maxam Metal Products Limited.

10. Metropolitan Door Industries Corp.
11. MIFAB, Inc.
12. Milcor Inc.
13. Nystrom, Inc.
14. U.S.F. Fabrication.
15. Williams Bros. Corporation of America (The).
16. Or Equal.

B. Floor Doors, General: Equip each door with adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with red vinyl grip that allows for one-handed closure, and recessed lift handle.

C. Steel Angle-Frame Floor Door: Single and Double-leaf opening. Prime-painted structural Galvanized structural-steel frame with 1/4-inch- (6.4-mm-) thick, diamond-pattern, drainage frame with coupling, galvanized structural-steel tread plate door; nonwatertight; loading capacity to 300-lbf/sq. ft. (14.4-kN/sq. m) pedestrian live load.

D. Hardware: Provide the following:

1. Hinges: Heavy-duty, zinc-coated steel or aluminum butt hinges with stainless-steel pins.
2. Latch: Stainless-steel slam latch.
3. Hardware Material: Type 316 Stainless Steel.

E. Insulation: Urethane with liner pan.

F. Safety Accessories: Safety railing.

2.3 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

E. Frame Anchors: Same type as door face.

F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.

E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.
2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Steel and Metallic-Coated-Steel Finishes:

1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 33 23
OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   b. A924/A924M, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
   c. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
2. Intertek Testing Services (Warnock Hersey Listed) (WH): Certification Listings.
3. National Association of Metal Manufacturers (NAAMM).
4. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
   c. MG 1, Motors and Generators.
5. National Fire Protection Association (NFPA):
   a. 80, Standard for Fire Doors and Other Opening Protectives.
   b. 252, Standard Methods of Fire Tests of Door Assemblies.
6. Underwriters Laboratories Inc. (UL):
   a. Building Materials Directory.
   b. 10B, Standard Safety for Fire Tests of Door Assemblies.
   c. 325, Standard Safety for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
2. Product Data: General construction, component connections and details, wiring diagram and electrical equipment.
3. Samples: Submit two door slats, D: 12-inch by 12-inch in size illustrating shape, color and finish texture.

B. Informational Submittals:

1. Certificate of Compliance per Section 01 43 33, Manufacturer's Field Services (or alternately, test results or calculations) that assure item's and its anchorage's design criteria meets requirements of Section 01 88 15, Anchorage and Bracing for loads provided in Section 01 61 00, Common Product Requirements.
2. Manufacturer's Instructions: Indicate installation sequence and procedures, and adjustment and alignment procedures.
3. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data, include lubrication requirements and frequency, and periodic adjustments required.
4. Seismic Anchorage and Bracing:
   a. Drawings and product data as required by Section 01 88 15, Anchorage and Bracing.
   b. Calculations as required by Section 01 88 15, Anchorage and Bracing.
   c. Installer's factory authorization.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Company specializing in manufacturing products specified in this section.
2. Installer: Company specializing in performing work of this section.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Cookson Co.; Model.
2. Cornell Iron Works, Inc.; Model ESD30 Thermiser Max Insulated Rolling Door.
3. Dynaflair Corp.
4. Metro Door.
5. Raynor Garage Door.
6. Trac-Rite Door.
7. Overhead Door Co.
8. Or Equal.

2.2 GENERAL

A. Wind Loads: Design door assembly to withstand wind/suction load of per authority having jurisdiction with a maximum deflection of 1/120 without damage to door or assembly components.

B. Operation: Design door assembly including operator, to operate for not less than 20,000 cycles and 10 cycles per day.

C. Fire Rated Door Construction: Conform to one of the following:

1. NFPA 252.
2. UL 10B.

D. Fire Rated Assemblies: Fire rated door fusible link and fire alarm system activated with automatically governed closing speed.

1. Design release mechanism for easy resetting by facility maintenance personnel.
2. Provide units allowing manual lifting for emergency exit after automatic closing, with curtain closing when released.

E. Products Requiring Electrical Connection: Listed and classified by UL or another testing firm acceptable to authority having jurisdiction.

F. Surface Burning Characteristics, Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

2.3 COMPONENTS

A. Curtain: Conform to following:

1. Steel Slats:
   a. Interlocking, minimum 24 gauge (0.75 mm) thick of ASTM A653/A653M steel, minimum galvanized coating designation G90 (Z275) in accordance with ASTM A924/A924M.
   b. Type: Sandwich slat construction with manufacturer's standard insulated core: with maximum U-value of 0.16 and backing to match face slat, thermally separated from face slat.
2. Nominal Slat Size: 2inches wide by required length.
3. Slat Ends: Each slat fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
4. Curtain Bottom: Fitted with angles, channels, or tubes to provide reinforcement and positive contact with floor in closed position.

B. Guides:

1. Minimum 3/16 inch (5 mm) thick; galvanized steel conforming to ASTM A653/A653M, minimum galvanized coating designation G90 (Z275) in accordance with ASTM A924/A924M
2. Furnish continuous angles of profile to retain door in place; mounting brackets of same metal.

C. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension.

D. Hood Enclosure Square shape, minimum 24 gauge (0.75 mm) thick galvanized steel internally reinforced to maintain rigidity and shape.

E. Hardware:

1. Locks: Furnish locks to allow doors to be secured.
   a. Manual Doors: Manufacturer's standard cylinder dead lock on inside at door jamb, key operated interior.
   b. Electric Doors: Manufacturer's standard cylinder locking system to secure door; interlock with motor to prevent motor from operating when lock is activated.
2. Cylinders: Minimum six-pin cylinders master keyed.
3. Handle: Inside side mounted, adjustable keeper, spring activated latch bar with feature to keep in locked or retracted position; interior handle.
4. Weather stripping (Exterior Assemblies): Moisture and rot proof, resilient type for complete weathertight installation.
   a. Rubber, neoprene, or vinyl water seal at hood to prevent airflow around coil on exterior doors.
   b. Weather seal sealing strip on guide to close space between guide and curtain on exterior doors.

F. Fire Alarm Release Mechanism: Electric operated from fire alarm system.

G. Electric Operation:

1. Electric motor operated unit with manual override in case of power failure.
2. UL 325, side mounted, open drip-proof motor totally enclosed, nonventilated or fan-cooled motor.
3. Motor Enclosure: NEMA MG1 Type 1 enclosure.
4. Motor Rating: 3/4 hp 250 W; continuous duty.
5. Motor Voltage: 115/230 volts single Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
6. Controller Enclosure: NEMA 250 Type 1.
7. Door Speed: 12 inches per second (300 mm/s).

8. Brake: Adjustable friction clutch type, activated by motor controller.
9. Control Station: Standard three button (Open-Stop-Close) constant pressure control for each operator, 24-volt circuit, surface mounted
10. Safety Edge: Manufacturer's standard safety edge and weather seal located at door bottom, full width, sensitized type, wired to: reverse upon striking object.

2.4 FINISHES

A. Curtain Slats: Steel, galvanized and primed and painted.

B. Steel Guides and Hood Enclosure: Primed and painted.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify opening sizes, tolerances and conditions are acceptable.

3.2 INSTALLATION

A. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

B. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

C. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

D. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.

E. Complete wiring from disconnect to unit components and from fire alarm system to door operator.

F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 92 00, Joint Sealants.

G. Install perimeter trim and closures.

3.3 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent Work.

B. Maximum Variation from Plumb: 1/16 inch

C. Maximum Variation from Level: 1/16 inch Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft (3 mm per 3 m) straight edge.

3.4 ADJUSTING

A. Adjust door hardware and operating assemblies for smooth and noiseless operation.

B. Test smoke activated assemblies for proper activation.

3.5 CLEANING

A. Leave door and components clean.

B. Remove labels and visible markings.

END OF SECTION

SECTION 08 44 13
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes glazed aluminum curtain walls.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples: For each exposed finish required.

D. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Field quality-control reports.

D. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller

E. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:
    a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa.

H. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 15 as determined according to NFRC 500.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, Kawneer North America.1600 Wall System.

B. Or comparable product by one of the following:

1. Arcadia, Inc.
2. Arch Aluminum & Glass Co., Inc.
3. Bruce Wall Systems Corporation.
4. CMI Architectural.
5. EFCO Corporation.
6. Oldcastle, Inc.
7. Pittco Architectural Metals, Inc.
8. Shuco USA LP.
9. Tingwall Inc.
10. TRACO.
11. Tubelite.
12. United States Aluminum.

13. Unitized Systems LLC.
14. Waltek & Company Limited.
15. Wausau Window and Wall Systems.
16. YKK AP America Inc.
17. Or equal.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction:-Nonthermal
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center.
4. Finish: Clear anodic finish.
5. Fabrication Method: Either factory- or field-fabricated system

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
   b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
   c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
   d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
   a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
   b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
   c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 GLAZING

A. Glazing: Comply with Section 08 80 00 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

D. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less.

E. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.5 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
7. Components curved to indicated radii.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
3. Preparation includes, but is not limited to, cleaning and priming surfaces.
4. Seal joints watertight unless otherwise indicated.
5. Install glazing to comply with requirements in Section 08 80 00 "Glazing."

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

A. Metal Protection:

8. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying

sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.

9. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

B. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

C. Install components plumb and true in alignment with established lines and grades.

D. Install glazing as specified in Section 08 80 00 "Glazing."

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls.

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
   a. Perform a minimum of three tests in areas as directed by Architect.

D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.

1. Door hardware for steel (hollow metal) doors.
2. Door hardware for aluminum doors.
3. Door hardware for wood doors.
4. Door hardware for other doors indicated.
5. Keyed cylinders as indicated.

B. Related Sections:

1. Division 6: Wood, Plastics, and Composites
2. Division 8: Openings
3. Division 26: Electrical

C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.

1. Builders Hardware Manufacturing Association (BHMA)
2. NFPA 101 Life Safety Code
3. NFPA 80 -Fire Doors and Windows
4. ANSI-A156.xx- Various Performance Standards for Finish Hardware
5. UL10C – Positive Pressure Fire Test of Door Assemblies
6. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware
8. ICC – International Building Code

D. Intent of Hardware Groups

1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

E. Allowances

1. Refer to Division 1 for allowance amount and procedures.

F. Alternates

1. Refer to Division 1 for Alternates and procedures.

1.2 SUBSTITUTIONS:

A. Comply with Division 1.

1.3 SUBMITTALS:

A. Comply with Division 1.

B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

C. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
4. Submit 6 copies of catalog cuts with hardware schedule.
5. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2

D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.

1. List groups and suffixes in proper sequence.
2. Completely describe door and list architectural door number.
3. Manufacturer, product name, and catalog number.
4. Function, type, and style.
5. Size and finish of each item.
6. Mounting heights.
7. Explanation of abbreviations and symbols used within schedule.
8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.

E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.

F. Samples: (If requested by the Architect)

1. 1 sample of Lever and Rose/Escutcheon design, (pair).

2. 3 samples of metal finishes

G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.

1. Operating and maintenance manuals: Submit 3 sets containing the following.

    a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
    b. Catalog pages for each product.
    c. Name, address, and phone number of local representative for each manufacturer.
    d. Parts list for each product.

2. Copy of final hardware schedule, edited to reflect, "As installed".
3. Copy of final keying schedule
4. As installed “Wiring Diagrams” for each piece of hardware connected to power, both low voltage and 110 volts.
5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

A. Comply with Division 1.

1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with experience in the distribution of commercial hardware.

    a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
    b. Hardware Schedule shall be prepared and signed by an AHC.

4. Installer's Qualifications: Firm with experience in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.

    a. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
    b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.

6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.6 PROJECT CONDITIONS:

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.7 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer’s Warranty:

1. Closers: Thirty years
2. Exit Devices: Five Years
3. Locksets & Cylinders: Lifetime
4. All other Hardware: Two years.

1.8 OWNER’S INSTRUCTION:

A. Instruct Owner’s personnel in operation and maintenance of hardware units.

1.9 MAINTENANCE:

A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.

1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.

B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

Item:	Manufacturer:	Approved:
Hinges	Stanley	Bommer, McKinney
Continuous Hinges	Stanley	Select, ABH
Locksets	Best	No Substitution
Cylinders	Best	No Substitution
Exit Devices	Precision	Von Duprin
Closers	LCN	No Substitution
Push/Pull Plates	Trimco	Hager, Don-Jo
Push/Pull Bars	Trimco	Hager, Don-Jo
Protection Plates	Trimco	Hager, Don-Jo
Overhead Stops	ABH	Rixson, Glynn Johnson
Door Stops	Trimco	Hager, Don-Jo
Flush Bolts	Trimco	Hager, Don-Jo
Coordinator & Brackets	Trimco	Hager, Don-Jo
Threshold & Gasketing	National Guard	Reese, Pemko

2.2 MATERIALS:

A. Hinges: Shall be Five Knuckle Ball bearing hinges

1. Template screw hole locations
2. Bearings are to be fully hardened.
3. Bearing shell is to be consistent shape with barrel.
4. Minimum of 2 permanently lubricated non-detachable bearings on standard weight hinge and 4 permanently lubricated bearing on heavy weight hinges.
5. Equip with easily seated, non-rising pins.
6. Non Removable Pin screws shall be slotted stainless steel screws.
7. Hinges shall be full polished, front, back and barrel.
8. Hinge pin is to be fully plated.
9. Bearing assembly is to be installed after plating.
10. Sufficient size to allow 180-degree swing of door
11. Furnish five knuckles with flush ball bearings

12. Provide hinge type as listed in schedule.
13. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
14. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
15. UL10C listed for Fire rated doors.

B. Geared Continuous Hinges:

1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
2. Anti-spinning through fastener
3. UL10C listed for 3 hour Fire rating
4. Non-handed
5. Lifetime warranty
6. Provide Fire Pins for 3-hour fire ratings
7. Sufficient size to permit door to swing 180 degrees

C. Mortise Type Locks and Latches:

1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C.
2. Furnish UL or recognized independent laboratory certified mechanical operational testing to 4 million cycles minimum.
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Fit ANSI A115.1 door preparation
5. Functions and design as indicated in the hardware groups
6. Solid, one-piece, 3/4-inch (19mm) throw, anti-friction latchbolt made of self-lubricating stainless steel
7. Deadbolt functions shall have 1 inch (25mm) throw bolt made of hardened stainless steel
8. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8 inch (9.5mm) when fully extended
9. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated
10. Provide sufficient curved strike lip to protect door trim
11. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable
12. Lock shall have self-aligning, thru-bolted trim
13. Levers to operate a roller bearing spindle hub mechanism
14. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
15. Spindle to be designed to prevent forced entry from attacking of lever
16. Provide locksets with 7-pin removable and interchangeable core cylinders
17. Each lever to have independent spring mechanism controlling it
18. Core face must be the same finish as the lockset.

D. Exit Devices with Weatherized True Architectural Finish 626W:

1. Exit devices to meet or exceed BHMA for ANSI 156.3, Grade 1.

2. Exit devices to be tested and certified by UL or by a recognized independent laboratory to meet or exceed the following :
   A. Mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.
   B. BHMA 156.3 – A156.18 Salt Spray Certified 600 Hours 3 X Standard.
   C. MIL-STD-810G 509.6 Salt Fog Certified.
   D. MIL-STD-810G 510.6 Sand & Dust Certified.
   E. MIL-STD-810G 521.4 Icing/Freezing Rain Certified.
3. Exit devices chassis to be investment cast steel, zinc dichromate.
4. Exit devices to have stainless steel deadlocking ¾" through latch bolt.
5. Exit devices to be equipped with sound dampening on touchbar.
6. Non-fire rated exit devices to have cylinder dogging.
7. Non-fire rated exit devices to have ¼" minimum turn hex key dogging.
8. All Exterior components of the exit device including the Active case cover, Touch bar, device channel, slide channel fillers, Vertical rods, latch covers and device end cap, shall be constructed of a brass base metal then plated in a double dip two step process of satin nickel and chrome.
9. Exit device shall be available with options of WTS Weatherized touch bar switch and WALW Weatherized Exit alarm (hardwired)
10. Additional non-weatherized electrified options are compatible with the 626W. Non-weatherized options are not recommended for harsh environments.
11. Touchpad to be "T" style constructed.
12. Touchbar assembly on wide style exit devices to have a ¼" clearance to allow for vision frames.
13. All exposed exit device components to be of architectural metals and "true" architectural finishes.
14. Provide strikes as required by application.
15. Fire exit hardware to conform to UL10C and UBC 7-2. UL tested for Accident Hazard.
16. The strike is to be black powder coated finish.
17. Exit devices to have field reversible handing.
18. Provide heavy duty vandal resistant lever trim with heavy duty investment cast stainless steel components and extra strength shock absorbing overload springs. Lever shall not require resetting. Lever design to match locksets and latchsets.
19. Provide 9001-Quality Management and 14001-Environmental Management.
20. Vertical Latch Assemblies to have gravity operation, no springs.
21. Approved Manufacturers
    a. The following manufacturers will be approved contingent on meeting or exceeding the above performance criteria:
       1) Precision with 626W finish,Manufactured by Stanley Security Solutions

E. Cylinders:

1. Provide the necessary cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Coordinate and provide as required for related sections.

F. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Closer shall have extra-duty arms and knuckles
5. Conform to ANSI 117.1
6. Maximum 2 7/16 inch case projection with non-ferrous cover
7. Separate adjusting valves for closing and latching speed, and backcheck
8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
9. Full rack and pinion type closer with 1½“ minimum bore
10. Mount closers on non-public side of door, unless otherwise noted in specification
11. Closers shall be non-handed, non-sized and multi-sized.

G. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.

1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

H. Over Head Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.

1. Concealed overhead stops shall be heavy duty bronze or stainless steel.
2. Surface overhead stops shall be heavy duty bronze or stainless steel.

I. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

J. Mop plates: Provide with four beveled edges ANSI J103, 4 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

K. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.

1. Weatherstrip shall be resilient seal of (Neoprene, Polyurethane, Vinyl, Pile, Nylon Brush, Silicone)
2. UL10C Positive Pressure rated seal set when required.

L. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.

1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)

2. UL10C Positive Pressure rated seal set when required.

M. Thresholds: Thresholds shall be aluminum beveled type with maximum height of ½" for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

2.3 FINISH:

A. Designations used in Schedule of Finish Hardware - 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.

B. Cylinders, removable and interchangeable core system: Best CORMAX™ Patented 7-pin.

C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."

D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.

E. Furnish keys in the following quantities:

1. 1 each Grand Masterkeys
2. 4 each Masterkeys
3. 2 each Change keys each keyed core
4. 15 each Construction masterkeys
5. 1 each Control keys

F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking

hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

B. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.

1. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).

2. Recommended locations for Architectural Hardware for flush wood doors (DHI).

3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.3 INSTALLATION:

C. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Conform to local governing agency security ordinance.

E. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.

1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.

F. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

G. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and

properly adjusted, in accordance with both the Contract Documents and final shop drawings.

1. Check and adjust closers to ensure proper operation.

2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.

    a. Verify levers are free from binding.
    b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.5 SCHEDULE OF FINISH HARDWARE:

Manufacturer List

Code	Name
BE	Best Access Systems
LC	LCN Closers
NA	National Guard
PR	Precision
ST	Stanley
TR	Trimco

Finish List

Code	Description
AL	Aluminum
AL	Aluminum (BHMA 689)
600	Primed for Painting
626	Satin Chromium Plated
630	Satin Stainless Steel
626W	Weatherized Satin Chrome
US32D	Stainless Steel, Dull

Option List

Code	Description
CD	Cylinder Dogging
B4E	Beveled 4 Edges
CSK	Counter Sunk Screw Holes

Hardware Sets

SET #1

Doors: 101A, 101D, 201, 202, 301A, 301C, 401A

3	Hinges	FBB199 4 1/2 X 4 1/2 NRP	US32D	ST
1	Exit Device	2103 X 4903D CD	626W	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Mortise Cylinder	1E-74 PATD	626	BE
1	Closer	4040 XP CUSH	AL	LC
1	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
2	Gasketing	5050B Head & Jambs		NA
1	Auto Door Bottom	420NA		NA
1	Threshold	896S	AL	NA

SET #2

Doors: 301B, 302

8	Hinges	FBB199 4 1/2 X 4 1/2 NRP	US32D	ST
1	Removable Mullion	KR822 10'0"	600	PR
2	Exit Device	2103 X 4903D CD	626W	PR
2	Rim Cylinder	12E-72 PATD	626	BE
2	Mortise Cylinder	1E-74 PATD	626	BE
2	Closer	4040 XP CUSH	AL	LC
2	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
4	Gasketing	5050B Head & Jambs		NA
2	Auto Door Bottom	420NA		NA
1	Threshold	896S	AL	NA

SET #3

Doors: 303A

3 Hinges	FBB199 4 1/2 X 4 1/2 NRP	US32D	ST
1 Exit Device	2103 X 4903D CD	626W	PR
1 Rim Cylinder	12E-72 PATD	626	BE
1 Mortise Cylinder	1E-74 PATD	626	BE
1 Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
1 Weatherstrip	160SA Head & Jambs		NA
1 Door Sweep	200NA		NA
1 Handicap Threshold	513A	AL	NA

SET #4

Doors: 303B, 402

3 Hinges	FBB199 4 1/2 X 4 1/2 NRP	US32D	ST
1 Lockset	45H-7D14J PATD	630	BE
1 Closer	4040 XP REG/PA	AL	LC
1 Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
1 Gasketing	5050B Head & Jambs		NA
1 Door Sweep	200NA		NA

SET #5

Doors: 101B, 101C, 401B

NOTE: All hardware by Rolling Door Mfg.

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI): Z97.1, Safety Glazing Materials Used in Buildings—Safety Performance Specifications and Methods of Test.
2. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
3. ASTM International (ASTM):
    a. C509, Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
    b. C864, Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
    c. C920, Standard Specification for Elastomeric Joint Sealants.
    d. C1036, Standard Specification for Flat Glass.
    e. C1115, Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
    f. C1193, Standard Guide for Use of Joint Sealants.
    g. C1376, Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
    h. D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
    i. D2843, Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
    j. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
    k. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
    l. E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
    m. E1300, Standard Practice for Determining Load Resistance of Glass in Buildings.
    n. E1425, Standard Practice for Determining the Acoustical Performance of Windows, Doors, Skylight, and Glazed Wall Systems.
    o. E2190, Standard Specification for Insulating Glass Unit Performance and Evaluation.

4. Consumer Product Safety Commission (CPSC) Code of Federal Regulations (CFR): 16 CFR 1201, Safety Standard for Architectural Glazing Materials.
5. Glass Association of North America (GANA):
    a. Glazing Manual.
    b. Sealant Manual.
6. National Fenestration Rating Council Incorporated (NFRC):
    a. 100, Procedure for Determining Fenestration Product U-Factors.
    b. 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
    c. 300, Standard Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.
7. National Fire Protection Association (NFPA):
    a. 80, Safety Standard for Fire Doors and Other Opening Protectives.
    b. 252, Safety Standard Methods of Fire Tests of Door Assemblies.
    c. 257, Safety Standard on Fire Test for Window and Glass Block Assemblies.
8. South Coast Air Quality Management District: SCAQMD Rule 1168 - Adhesive and Sealant Applications.
9. Underwriters Laboratories, Inc. (UL):
    a. Building Materials Directory.
    b. 10C, Standard for Safety for Positive Pressure Fire Tests of Door Assemblies.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Complete schedule of glass and glazing material to be used for each purpose.
    b. Indicate sizes, layout, thicknesses, and loading conditions for glass.
2. Product Data:
    a. Catalog cuts of glazing materials with inclusion of glass edge cutting procedures.
    b. Glass Provide structural, physical, and thermal and solar optical performance characteristics, size limitations, special handling or installation requirements.
    c. Glazing Sealants, Compounds, and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.
    d. Seismic anchorage and bracing drawings and data sheets, as required by Section 01 88 15, Anchorage and Bracing.

3. Samples:
    a. Glass Two samples 8 by 8-inch in size, illustrating each glass
    b. Glazing Materials: Submit 8-inch long bead of glazing sealant and gaskets, each color as selected.

B. Informational Submittals:

1. Design calculations for glass thicknesses. Signed and sealed by professional engineer registered in state of Project.
2. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
3. Manufacturer's Certificate of Compliance for each type of glazing, in accordance with Section 01 61 00, Common Product Requirements.
4. Details and methods of glazing for each type of glazing condition; include manufacturer's recommendations for setting, sealing materials, and installing each type of glazing.
5. Documentation declaring compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants and other glazing materials.
6. Documentation of glazer's previous experience and manufacturer's approval.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing Work of this section.

B. Preinstallation Meeting: Convene minimum 1week prior to commencing work of this section.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage:

1. Support cases on both sides when stored vertically.
2. After unpacking, place interleaving protection between lites.
3. Keep glass and interleaving dry by storing inside where temperatures are above dewpoint, or if outside storage is necessary, cover glass interleaving with opaque tarpaulins or plastic and inspect periodically. Wet interleaving can stain glass.
4. Avoid exposing stored glass to direct sunlight.

B. Handling:

1. Stack individual lites on edge and lean them against sturdy uprights at a slope of 5 degrees to 7 degrees from vertical.
2. Cushion bottom edges with soft, firm pads free of dirt, grit, glass chips, or other foreign material.
3. Do not rotate or cartwheel insulating glass units over their corners. Use turning device such as a rolling block if units must be rotated.

1.5 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction, or at option of Owner, removal and replacement of Work specified in this specification section found defective during a period of 10 years for coated glass and 5 years for laminated glass 10 years for vertical application insulating glass after date of Substantial Completion. Guarantee to cover deterioration because of normal conditions of use and not because of handling installing and cleaning practices performed contrary to glass manufacturer's published instructions. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.

PART 2 PRODUCTS

2.1 GENERAL

A. Single Source Fabrication Responsibility: Fabrication processes including Low-E and reflective coatings, insulating, laminating, silkscreen, and tempering, shall be fabricated by a single fabricator.

B. Wind Loads: Design and size glass to withstand positive and negative wind loads acting normal to plane of wall, including increased loads at building corners.

1. Design Wind Load: As calculated in accordance with applicable code.
2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable code
3. Exterior Glass Deflection: Maximum of 1/175 of glass edge length or 3/4 inch (19 mm), whichever is less with full recovery of glazing materials.
4. Thermal and Solar Optical Performance: Measured or calculated in accordance with the following:
    a. U-Values: NFRC 100.
    b. Solar Heat Gain Coefficients: NFRC 200.
    c. Solar Optical Properties: NFRC 300.

2.2 FLOAT GLASS MATERIALS

A. Annealed Glass:

1. ASTM C1036, Type 1 transparent flat, Quality Q3, float glass.
2. Furnish annealed glass except where heat strengthened or tempered glass is required to meet specified performance requirements.

B. Heat Strengthened Glass:

1. ASTM C1048, Type 1 transparent flat, Quality Q3, Kind HS heat strengthened, Condition A uncoated, float glass.
2. Furnish heat strengthened glass where annealed glass cannot meet specified performance requirements.

C. Tempered Glass:

1. ASTM C1048, Type 1 transparent flat, Quality Q3, Kind FT fully tempered, Condition A uncoated, float glass with horizontal tempering.
2. Furnish tempered glass where heat strengthened glass cannot meet specified performance requirements.

3. Conforming to CPSC 16 CFR 1201at locations where safety glass is required by: applicable code.

2.3 FLOAT GLASS PRODUCTS

A. Clear Glass:

1. Annealed (FG-CA); Heat strengthened (FG-CH): or; Tempered (FC-CT) float glass as specified; Class 1 clear.
2. Minimum Thickness: 1/4 unless otherwise indicated.

B. Low E Glass:

1. Annealed, clear (FG-ECA),
2. Heat strengthened, E: clear (FG-ECH) Tempered, clear (FG-ECT) float glass as specified; Class 1 clear.
3. Minimum Thickness: N: 1/4 unless otherwise indicated.
4. S: Product: Neutral 78/65 High Performance manufactured by Guardian Industries.
5. Coating: ASTM C1376, vacuum deposited.

2.4 INSULATING GLASS PRODUCTS

A. Insulating Glass:

1. ASTM E2190 A: certified by: Insulating Glass Certification Council and Insulating Glass Manufacturers Alliance; with: silicone sealant edge seal; purge interpane space with dry hermetic air.
2. Total Unit Thickness: 1
3. Insulating Glass Unit Edge Seal Construction: Aluminum, bent and soldered, mitered and spigoted corners.
4. Insulating Glass Unit Edge Seal Material: black color.

2.5 GLAZING SEALANTS

A. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, A: laminated glass core, B: insulating glass seals, and glazing channels.

1. Silicone Glazing Sealant:
   a. ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component; chemical D: solvent curing; capable of water immersion without loss of properties; nonbleeding, non-staining, cured Shore A Hardness Range 15 to 25.

B. Dense Gaskets:

1. Resilient extruded shape to suit glazing channel retaining slot; black.
2. Neoprene: ASTM C864.
3. EPDM: ASTM C864.
4. Silicone: ASTM C1115.

2.6 GLAZING ACCESSORIES

A. Setting Blocks: Elastomeric material recommended by glass manufacturer, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.

B. Spacer Shims: Elastomeric material recommended by glass manufacturer, 50 to 60 Shore A durometer hardness, minimum 3-inch (75-mm) long by one half the height of glazing stop by thickness to suit application self-adhesive on one face.

C. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings for glazing are correctly sized and within acceptable tolerance.

B. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear and ready to receive glazing.

3.2 PREPARATION

A. Do not perform glazing work in damp, foggy, or rainy weather, or when temperatures are not within range recommended by GANA "Glazing Manual."

B. Surfaces:

1. Smooth, even, sound, dry, and clean.
2. Clean contact surfaces with solvent and wipe dry.

C. Priming:

1. Complete and cured.
2. Prime surfaces scheduled to receive sealant.

D. Measure size of frames to receive glass and compute actual glass size allowing for edge clearances.

E. Verify functioning weep system is present.

F. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.3 GLAZING INSTALLATION

A. General: Follow recommendations of glass manufacturer GANA "Sealant Manual, GANA "Glazing Manual" and the following:

1. Glazing Sealants: Comply with ASTM C1193.
2. Fire Rated Openings: Comply with NFPA 80.

B. Exterior Dry Method (Gasket Glazing):

1. Cut glazing gasket to length; install on glazing pane. Seal corners by butting tape and sealing junctions with compatible butyl sealant.

2. Place setting blocks at 1/4 points with edge block no more than 6 inches (150 mm) from corners.
3. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
4. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.

3.4 FIELD QUALITY CONTROL

A. Hose Test:

1. Use 3/4-inch minimum hose without nozzle. With full stream, flood glazing from bottom to top.
2. Correct leaks disclosed by hose test by re-glazing and retesting until eliminated.

3.5 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance and inspection.

3.6 CLEANING

A. Leave glass and glazing in undamaged condition and ready for final cleaning.

B. Remove excess glazing compound from installed glass.

C. Remove labels from glass surface at time of final cleaning.

D. Wash and polish both faces of glass.

E. Clean adjacent surfaces of glass.

3.7 PROTECTION OF COMPLETED WORK

A. Protection:

1. Keep glass free from contamination by materials capable of staining glass.
2. Install tape across lights secured to frames or structure.
3. No tape or marking allowed on glass.

B. Replacements and Repairs:

1. Prior to Substantial Completion, replace broken, defective, or scratched glass and repair damaged compounds.
2. Include patch and repair of existing glass to remain that is damaged or otherwise disturbed as a result of this Work.

END OF SECTION

SECTION 08 90 00
LOUVERS

PART 1 - GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air Movement and Control Association (AMCA): 500-L, Laboratory Methods of Testing Louvers for Rating.
2. The Aluminum Association, Incorporated (AA): Designation System for Aluminum Finishes.
3. ASTM International (ASTM):
    a. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
    b. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
4. Underwriters Laboratories, Inc. (UL): Building Materials Directory.

1.2 DESIGN REQUIREMENTS

A. Installed Louvers:

1. Capable of resisting wind load of 30 pounds per square foot.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Large scale details of louvers, anchorage, and relationship to adjoining construction.
    a. Manufacturer's Literature:
        i. Descriptive and performance data of louvers, including standard drawings and louver-free area.

        ii. A: Seismic anchorage and bracing drawings and data sheets, as required by Section 01 88 15, Anchorage and Bracing.

2. Samples: Manufacturer's standard finishes and colors.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Factory test data.
3. Certificates of AMCA ratings.
4. Installation instructions.

5. Parts list, if applicable.
6. Maintenance procedures.
7. Special Guarantee.

1.4 SPECIAL GUARANTEE

A. Manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction, or at option of Owner, removal and replacement of special fluorocarbon or baked-on finish found defective during a period of 20 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Non-acoustical louver sizes are based on A: 50 percent free area and 800 fpm maximum velocity through free area. If louvers furnished do not meet these parameters, Contractor is responsible for resizing louvers and wall openings, and for making other adjustments to allow for larger openings.

B. Water Penetration Rate: No greater than 0.02 ounce per square foot.

C. Louvers: Rated and tested in accordance with AMCA 500-L.

D. Furnish louvers with interior duct collars.

2.2 FIXED DRAINABLE LOUVER (TYPE DB)

A. Frame: Extruded aluminum channel, 0.081 inch thick, 4 inches deep, interior duct collar, concealed mullions.

B. Blades: Extruded aluminum, minimum 0.081 inch thick, 35-degree to 45-degree pitch angles, with integral front drain gutter, spaced 3 inches to 4 inches on center.

C. Pressure Loss: AMCA certified rating of no greater than 0.10-inch WC.

D. Sizes: A: As scheduled B: As shown on Drawings.

E. Screen: Inside mounted, painted aluminum, 1/2-inch mesh.

F. Finish: Baked enamel or thermosetting acrylic coating in color as scheduled or selected

G. Manufacturers and Products:

1. Construction Specialties; Model A4097.
2. Ruskin; Model ELF375DX.

2.3 ACCESSORIES

A. Anchors and Fasteners: Stainless steel.

B. Flashings: Match louver frame.

C. Isolation Tape: Tremco 440, 3M EC1202, or Presstite 579.6.

D. Isolation Paint: ASTM D1187, bituminous coating.

E. Insulated Blank-Off Panels:

1. Panels: Urethane core faced on both sides with 0.032-inch stucco embossed 5005-H134 aluminum sheet in finish and color to match louvers.
2. Frames: 6063-T52 extruded aluminum sections 0.080 inch thick, with mitered corners.
3. Perimeter Gaskets: Closed-cell PVC, to ensure tight fit of panel to louver.
4. Thickness: 2 inches.

2.4 SOURCE QUALITY CONTROL

A. Factory Performance Tests:

1. Airflow versus pressure loss.
2. Rain penetration data.
3. A: Air infiltration leakage through closed operating louvers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check openings to ensure dimensions conform to Drawings.

B. Ensure openings are free of irregularities that would interfere with installation.

C. Do not install louvers until defects have been corrected.

3.2 INSTALLATION

A. Install louvers as shown on reviewed Shop Drawings. Coordinate with heating or ventilation ductwork to be connected.

B. Follow procedures in manufacturer's recommended installation instructions.

C. Install insulated blank-off panels where indicated, completely closing space between ducts and louver frames.

D. Separate aluminum from other metals with isolation tape or paint.

3.3 CLEANING

A. After erection, protect exposed portions from damage by machines, paint, lime, acid, cement, or other harmful compounds.

B. Remove protective materials and clean with plain water, water with soap, or household detergents.

3.4 SUPPLEMENTS

A. The supplement listed below, following "End of Section," is a part of this Specification.

1. Louver Schedule: A tabulation of louver characteristics for each opening numbered on Drawings. Provide items as scheduled.

END OF SECTION

LOUVER A: AND VENT SCHEDULE

LOUVER TYPES:

AC	Acoustical
AJ	Adjustable
BV	Block Vent
DB	Drainable
FX	Fixed
LD	Combination Louver/Damper
MO	Manually Operable
SP	Stormproof
TR	Transom

ABBREVIATIONS:

AL	Aluminum
AS	As Selected
FCTY	Factory
FRP	Fiber Reinforced Plastic
GALV	Galvanized Steel

NOTES:

No. 1	For details see A: Drawing No. . B: Design Details.
No. 2	Numbers in “Fnsh” column refer to paint systems in Specification Section 09 90 00.
No. 3	Codes in “Col” column refer to color list A: in Specification Section 09 06 00. B: on Drawings.

Opening			Louver				Details			Other Requirements
No.	Width	Height	Type	Matl	Fnsh	Col	Head	Jamb	Sill	

LOUVER A: AND VENT SCHEDULE (*EXAMPLE*)

LOUVER TYPES:

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No. 2	Numbers in "Fnsh" column refer to paint systems in Specification Section 09 90 00.
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Opening			Louver				Details			
No.	Width	Height	Type	Matl	Fnsh	Col	Head	Jamb	Sill	Other Requirements
L-1	4'-0"	4'-8"	DB	AL	FCTY	O-3	6	6 SIM	7	
L-2	6'-0"	3'-4"	DB	AL	FCTY	O-3	6	6 SIM	7	
L-3	1'-4"	8"	BV	AL	FCTY	O-3	10	10	10	

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   a. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot-Applied.
   b. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   c. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   d. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
2. Environmental Protection Agency (EPA).
3. NACE International (NACE): SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
4. NSF International (NSF): 61, Drinking Water System Components - Health Effects.
5. Occupational Safety and Health Act (OSHA).
6. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.
7. The Society for Protective Coatings (SSPC):
   a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
   b. PA 10, Guide to Safety and Health Requirements for Industrial Painting Projects.
   c. SP 1, Solvent Cleaning.
   d. SP 2, Hand Tool Cleaning.
   e. SP 3, Power Tool Cleaning.
   f. SP 5, White Metal Blast Cleaning.
   g. SP 6, Commercial Blast Cleaning.
   h. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
   i. SP 10, Near-White Blast Cleaning.
   j. SP 11, Power Tool Cleaning to Bare Metal.
   k. SP 16, Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
   l. SP 13, Surface Preparation of Concrete.

m. Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

1.2 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCl: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness, mils.
5. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
6. Mil: Thousandth of an inch.
7. PDS: Product Data Sheet.
8. PSDS: Paint System Data Sheet.
9. PVC: Polyvinyl Chloride.
10. SFPG: Square Feet per Gallon.
11. SFPGPC: Square Feet per Gallon per Coat.
12. SP: Surface Preparation.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Data Sheets:
      1) For each product, furnish a Product Data Sheet (PDS), the manufacturer's technical data sheets, and paint colors available (where applicable). The PDS form is appended to the end of this section.
      2) For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.
      3) Technical and performance information that demonstrates compliance with specification.
      4) Furnish copies of paint system submittals to the coating applicator.
      5) Indiscriminate submittal of only manufacturer's literature is not acceptable.
   b. Detailed chemical and gradation analysis for each proposed abrasive material.
2. Samples:
   a. Proposed Abrasive Materials: Minimum 5-pound sample for each type.

b. Reference Panel:
    1) Surface Preparation:
        a) Prior to start of surface preparation, furnish a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared to specified requirements.
        b) Provide panel representative of the steel used; prevent deterioration of surface quality.
        c) Panel to be reference source for inspection upon approval by Engineer.
    2) Paint:
        a) Unless otherwise specified, before painting work is started, prepare minimum 8-inch by 10-inch sample with type of paint and application specified on similar substrate to which paint is to be applied.
        b) Furnish additional samples as required until colors, finishes, and textures are approved.
        c) Approved samples to be the quality standard for final finishes.

B. Informational Submittals:

1. Coating manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services.
2. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
3. Manufacturer's written verification that submitted material is suitable for the intended use.
4. Coating for Faying Surfaces: Manufacturer's test results that show the proposed coating meets the slip resistance requirements of the AISC Specification for Structural Joints using ASTM A325 or ASTM A490 bolts.
5. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer's written confirmation that materials are compatible.
6. Manufacturer's written instructions and special details for applying each type of paint.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Experience in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.

2. Perform surface preparation and painting in accordance with recommendations of the following:
    a. Paint manufacturer's instructions.
    b. SSPC PA 10.
    c. Federal, state, and local agencies having jurisdiction.

C. Mockup:

1. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.
2. After Engineer approval, sample spaces or items shall serve as a standard for similar work throughout the Project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.
2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
2. Primed surfaces shall not be exposed to weather for more than 2 months before being top coated, or less time if recommended by coating manufacturer.

1.6 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.

B. Experience in manufacture of specified product.

C. Each of the following manufacturers is capable of supplying most of the products specified herein:

1. Benjamin Moore & Co.: www.benjaminmoore.com
2. Behr Process Corporation: www.behr.com
3. Dunn- Edwards Paints: www.dunn-edwards.com
4. PPG Paints: www.ppgpaints.com
5. Pratt & Lambert Paints: www.prattandlambert.com
6. Sherwin-Williams Company: www.sherwin-williams.com.

2.2 ABRASIVE MATERIALS

A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.3 PAINT MATERIALS

A. General:

1. Manufacturer's highest quality products suitable for intended service.
2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

B. Products:

Product	Definition
Acrylic Latex	Single-component, finish as required
Acrylic Latex (Flat)	Flat latex
Acrylic Sealer	Clear acrylic

Product	Definition
Block Filler	Primer-sealer designed for rough masonry surfaces, 100% acrylic emulsion
DTM Acrylic Primer	Surface tolerant, direct-to-metal water borne acrylic primer
DTM Acrylic Finish	Surface tolerant, direct-to-metal water borne acrylic finish coat
Elastomeric Polyurethane	100% solids, plural component, spray applied, high build, elastomeric polyurethane coating, suitable for the intended service
Epoxy Filler/Surfacer	100% solids epoxy trowel grade filler and surfacer, nonshrinking, suitable for application to concrete and masonry. Approved for potable water contact and conforming to NSF 61, where required
Epoxy Nonskid (Aggregated)	Polyamidoamine or amine converted epoxies aggregated; aggregate may be packaged separately
Epoxy Primer—Ferrous Metal	Anticorrosive, converted epoxy primer containing rust-inhibitive pigments
Epoxy Primer—Other	Epoxy primer, high-build, as recommended by coating manufacturer for specific galvanized metal, copper, or nonferrous metal alloy to be coated
High Build Epoxy	Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat
Inorganic Zinc Primer	Solvent or water based, having 85% metallic zinc content in the dry film; follow manufacturer's recommendation for topcoating
Latex Primer Sealer	Waterborne vinyl acrylic primer/sealer for interior gypsum board and plaster. Capable of providing uniform seal and suitable for use with specified finish coats
NSF Epoxy	Polyamidoamine epoxy, approved for potable water contact and conforming to NSF 61
Epoxy, High Solids	Polyamidoamine epoxy, 80% volume solids, minimum, suitable for immersion service
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish

Product	Definition
Organic Zinc Rich Primer	Epoxy or moisture cured urethane with 85-percent zinc content in the dry film, meeting the requirements of RCSC Specification for Structural Joints using High Strength Bolts, Class A or Class B, as required.
Rust-Inhibitive Primer	Single-package steel primers with anticorrosive pigment loading
Sanding Sealer	Co-polymer oil, clear, dull luster
Silicone/Silicone Acrylic	Elevated temperature silicone or silicone/acrylic based
Water Base Epoxy	Two-component, polyamide epoxy emulsion, finish as required

2.4 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

1. Colors: Per Owner's direction.

2.5 SHOP FINISHES

A. Shop Blast Cleaning: Reference Paragraph, Shop Coating Requirements.

B. Surface Preparation: Provide Engineer minimum 7 days' advance notice to start of shop surface preparation work and coating application work.

C. Shop Coating Requirements:

1. When required by equipment specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.

2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

D. Pipe:

1. Ductile Iron Pipe:
   a. Use SSPC standards as a guide for desired prepared surface. Follow recommendations of pipe and coating manufacturers for means and methods to achieve SSPC-equivalent surface.
   b. The surface preparation and application of the primer shall be performed by pipe manufacturer.
   c. For high performance (epoxy) coatings, follow additional recommendations of pipe and coating manufacturers.
   d. Prior to blast cleaning, grind smooth surface imperfections, including, but not limited to delaminating metal or oxide layers.
2. Steel Pipe:
   a. Surface preparation and application of primer shall be performed by pipe manufacturer.
   b. For pipe with epoxy lining, do not place end cap seals until pipe lining material has sufficiently dried.

PART 3 EXECUTION

3.1 GENERAL

A. Provide Engineer minimum 7 days' advance notice to start of field surface preparation work and coating application work.

B. Perform the Work only in presence of Engineer, unless Engineer grants prior approval to perform the Work in Engineer's absence.

C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

3.2 EXAMINATION

A. Factory Finished Items:

1. Schedule inspection with Engineer before repairing damaged factory-finished items delivered to Site.
2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.

B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.3 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.4 SURFACE PREPARATION

A. Field Abrasive Blasting:

1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.
2. Refer to coating systems for degree of abrasive blasting required.
3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.

B. Surface Contamination Testing:

1. A surface contamination analysis test shall be performed every 500 square feet by means of a Chlor Test CSN Salts or approved equal.
2. Surface with chloride levels exceeding 3 µg/square centimeter for submerged surfaces and 5 µg/square centimeter for exposed surfaces

shall be treated with a liquid soluble salt remover equivalent to CHLOR*RID (CHLOR*RID International) or equal.

3. Follow manufacturer's recommendations and procedures for the use of this product to remove the surface contamination.

C. Metal Surface Preparation:

1. Where indicated, meet requirements of SSPC Specifications summarized below:
   a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
   b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
   c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.
   d. SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.
   e. SP 11, Power Tool Cleaning to Bare Metal: Removal of visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power-assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.
   f. SP-16, Brush Blasting of Non-Ferrous Metals: A brush-off blast cleaned non-ferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. Bare metal substrates shall have a minimum profile of 19 micrometers (0.75 mil).
2. The words "solvent cleaning", "hand tool cleaning", "wire brushing", and "blast cleaning", or similar words of equal intent in these Specifications or in paint manufacturer's specification refer to the applicable SSPC Specification.
3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.

4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.
5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
7. Welds and Adjacent Areas:
    a. Prepare such that there is:
        1) No undercutting or reverse ridges on weld bead.
        2) No weld spatter on or adjacent to weld or any area to be painted.
        3) No sharp peaks or ridges along weld bead.
    b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
8. Preblast Cleaning Requirements:
    a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
    b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
    c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
9. Blast Cleaning Requirements:
    a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
    b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.
    c. Use only dry blast cleaning methods.
    d. Do not reuse abrasive, except for designed recyclable systems.
    e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
10. Post-Blast Cleaning and Other Cleaning Requirements:
    a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
    b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

D. Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation:

1. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.
2. Brush blast in accordance with SSPC SP 16.
3. Obtain and follow coating manufacturer's recommendations for additional preparation that may be required.

E. Concrete Surface Preparation:

1. Do not begin until 30 days after concrete has been placed.
2. Meet requirements of SSPC SP 13.
3. Remove grease, oil, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent, or other suitable cleaning methods.
4. Brush-off blast clean to remove loose concrete and laitance, and provide a tooth for binding. Upon approval by Engineer, surface may be cleaned by acid etching method. Approval is subject to producing desired profile equivalent to No. 80 grit flint sandpaper. Acid etching of vertical or overhead surfaces shall not be allowed.
5. Secure coating manufacturer's recommendations for additional preparation, if required, for excessive bug holes exposed after blasting.
6. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.

F. Masonry Surface Preparation:

1. Complete and cure masonry construction for 14 days or more before starting surface preparation work.
2. Remove oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent washing, or other suitable cleaning methods.
3. Clean masonry surfaces of mortar and grout spillage and other surface deposits using one of the following:
   a. Nonmetallic fiber brushes and commercial muriatic acid followed by rinsing with clean water.
   b. Brush-off blasting.
   c. Water blasting.
4. Do not damage masonry mortar joints or adjacent surfaces.
5. Leave surfaces clean and, unless otherwise required for proper adhesion, dry prior to painting.
6. Masonry Surfaces to be Painted: Uniform texture and free of surface imperfections that would impair intended finished appearance.
7. Masonry Surfaces to be Clear Coated: Free of discolorations and uniform in texture after cleaning.

G. Gypsum Board Surface Preparation: Typically, new gypsum board surfaces need no special preparation before painting.

1. Surface Finish: Dry, free of dust, dirt, powdery residue, grease, oil, or any other contaminants.

3.5 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
6. Repair or replace surface damaged by blast cleaning.

3.6 APPLICATION

A. General:

1. The intention of these Specifications is for new, interior, and exterior masonry, concrete, metal, and submerged metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise. Do not paint exterior concrete surfaces except where noted in these plans and specifications.
2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.
3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.
4. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
5. Sand wood lightly between coats to achieve required finish.
6. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

7. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
8. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
9. Water-Resistant Gypsum Board: Use only solvent type paints and coatings.
10. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
11. Keep paint materials sealed when not in use.
12. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Galvanized Metal, and Nonferrous Metal Alloys:

1. Concealed galvanized, copper, and nonferrous metal alloy surfaces (behind building panels or walls) do not require painting, unless specifically indicated herein.
2. Prepare surface and apply primer in accordance with System No. 10 specification.
3. Apply intermediate and finish coats of the coating system appropriate for the exposure.

C. Porous Surfaces, Such As Concrete and Masonry:

1. Filler/Surfacer: Use coating manufacturer's recommended product to fill air holes, bug holes, and other surface voids or defects.
2. Prime Coat: May be thinned to provide maximum penetration and adhesion.
    a. Type and Amount of Thinning: Determined by paint manufacturer and dependent on surface density and type of coating.
3. Surface Specified to Receive Water Base Coating: Damp, but free of running water, just prior to application of coating.

D. Film Thickness and Coverage:

1. Number of Coats:
    a. Minimum required without regard to coating thickness.
    b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
    a. Do not exceed coating manufacturer's recommendations.
    b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.

3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
   a. Perform with properly calibrated instruments.
   b. Recoat and repair as necessary for compliance with specification.
   c. Coats are subject to inspection by Engineer and coating manufacturer's representative.
4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.7 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

B. Coating and Lining for Steel and Ductile Iron Pipe, Fittings, Couplings, Adapters, and Valves.

All buried and exposed above ground ductile Iron piping, fittings, couplings, adapters, and valves shall be lined and coated with a fusion bonded epoxy system. Coating Systems 4, 5, 6, & 7 identified below are not applicable to ductile Iron pipe, fittings, couplings, adapters, and valves.

The lining and coating material shall be a 100 percent powder epoxy, certified as compliant with NSF Standard 61, applied in accordance with the ANSI/AWWA C213 "AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines," except that the surface preparation shall be as specified in the coating system schedule of this Section. The coating shall be applied using the fluidized bed or electrostatic spray process.

- Coating DFT = 16 mils, Scotchkote 134 (electrostatic) or 206N (fludized bed), or equal, applied in one coat.
- For coating of valves, DFT = 12 mils.
- For field repairs, the use of a liquid epoxy will be permitted, applied in one coat to provide a DFT of 15 mils. The liquid epoxy shall be Scotchkote 323 or as recommended by the powder epoxy manufacturer.

All epoxy coating and lining shall be shop applied to all pipe, fittings, couplings, valves, etc., and shall meet current Volatile Organic Compound (VOC) content regulations.

Test the lining and coating at the application ship with a low-voltage holiday detector. The lining shall be holiday free.

C. System No. 1 Submerged Metal—Potable Water:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 5, White Metal Blast Cleaning	NSF Epoxy	3 coats, 3 MDFTPC

1. Use on the following items or areas:
   a. Metal surfaces below a plane 1 foot above the maximum liquid surface; metal surfaces above the maximum liquid surface that are a part of the immersed equipment; surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel that are embedded in concrete.

D. System No. 2 Submerged Metal—Domestic Sewage:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 5, White Metal Blast Cleaning	Prime in accordance with manufacturer's recommendations	
	Coal-Tar Epoxy -OR- High Build Epoxy	2 coats, 16 MDFT 2 coats, 16 MDFT

1. Use on the following items or areas:
   a. Metal surfaces below a plane 1 foot above maximum liquid surface, metal surfaces above maximum liquid surface that are a part of immersed equipment, concrete embedded surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles.

E. System No. 3 Submerged Metal—Other:

1. Use on the following items or areas:
   a. Metal surfaces below a plane 1 foot above maximum liquid surface, metal surfaces above maximum liquid surface which are a part of immersed equipment.

F. System No. 4 Exposed Metal—Highly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	High Build Epoxy	1 coat, 4 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:
   a. Exposed metal surfaces, located inside or outside of structures and exposed to weather.

G. System No. 5 Exposed Metal—Mildly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:
   a. Exposed metal surfaces located inside or outside of structures and exposed to weather or in a highly humid atmosphere, such as pipe galleries and similar areas.

H. System No. 6 Exposed Metal—Atmospheric:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	Rust-Inhibitive Primer	1 coat, 2 MDFT
	Alkyd Enamel	2 coats, 4 MDFT

1. Use on the following items or areas:
   a. Exposed metal surfaces, located inside or outside of structures or exposed to weather, including metal doors and frames, vents, louvers, exterior metal ductwork, flashing, sheet metalwork and miscellaneous architectural metal trim, and the following specific surfaces:
      1) Inside duct stack heads behind diffusers, registers, and grilles with flat black.

2) Instrumentation and control systems exposed enclosures for process.

b. Apply surface preparation and primer to surfaces prior to installation. Finish coats need only be applied to surfaces exposed after completion of construction.

I. System No. 7 Concrete Encased Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	Coal-Tar Epoxy	2 coats, 16 MDFT
	High Build Epoxy	2 coats, 3.0 to 5.0 MDFT per coat

1. Use on the following items or areas:
   a. Use on concrete encased ferrous metals including wall pipes, pipe sleeves, access manholes, gate guides, and thimbles; and the following specific surfaces.

J. System No. 10 Galvanized Metal, and Nonferrous Metal Alloy Conditioning:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation	Epoxy Primer—Other	As recommended by coating manufacturer Remaining coats as required for exposure

1. Use on the following items or areas:
   a. Galvanized surfaces requiring painting
   b. After application of System No. 10, apply finish coats as required for exposure.

K. System No. 12 Skid-Resistant—Steel:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	Epoxy Nonskid (Aggregated)	1 coat, 16 MDFT

L. System No. 16 Elastomeric Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete: In accordance with Paragraph Concrete Surface Preparation -OR-Masonry: In accordance with Paragraph Masonry Surface Preparation -OR- Steel: SP 5, White Metal Blast Cleaning	Prime in accordance with manufacturer's recommendations	
	Elastomeric Polyurethane	1 coat, 32 SFPG

M. System No. 21 Skid-Resistant—Concrete:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Concrete Surface Preparation	Epoxy Nonskid (Aggregated)	1 coat, 160 SFPG

1. Use on the following items or areas:
   a. Concrete walkways and slabs with personnel access.

N. System No. 27 Aluminum and Dissimilar Metal Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1)	Prime in accordance with manufacturer's recommendations	

Surface Prep.	Paint Material	Min. Coats, Cover
	Bituminous Paint	1 coat, 10 MDFT

1. Use on aluminum surfaces embedded or in contact with concrete.

3.8 ARCHITECTURAL PAINT SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

- All exterior structural elements, exterior metal decking, gutters, downspouts, and exterior trim to be painted Vista Protec Metallic #9802 "Aluminum" or equal.

- All exterior CMU walls to be treated with graffiti-proofing.

- All interior doors and frames to be painted semi-gloss to match adjacent surface.

- All exterior doors and frames (including coiling doors) to be painted Vista Protec Metallic #9802 "Aluminum" or equal.

- Roof hatches to be Two-coat fluoropolymer; color to be selected by architect from manufacturer's full range of colors.

- All interior railings and interior hatches to be painted semi-gloss; Dunn Edwards #DE5308 "Orange Delight" or equal.

- Exterior guard rails to be painted Vista Protec Metallic #9802 "Aluminum" or equal.

- Metal louver at Electrical Building to be painted semi-gloss to match adjacent surface.

B. System No. 106 Galvanized Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation	Manufacturer's Recommended Primer	1 coat, as recommended by manufacturer

	Alkyd Enamel (Semigloss)	2 coats, 4 MDFT

1. Use on the following items or areas:
   a. Hollow metal frames and doors.

C. System No. 107 Metal Trim and Structural Steel:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	Rust-Inhibitive Primer	1 coat, 2 MDFT
	Alkyd Enamel (Semigloss)	2 coats, 4 MDFT

D. System No. 108 Masonry, Flat:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Masonry Surface Preparation	Block Filler	1 coat, 75 SFPG
	Acrylic Latex (Flat)	2 coats, 240 SFPGPC

E. System No. 109 Masonry, Semigloss A: Egg Shell:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Masonry Surface Preparation	Block Filler	1 coat, 75 SFPG
	Acrylic Latex (Semigloss B: Egg Shell)	2 coats, 240 SFPGPC

F. System No. 110 Masonry Sealer:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Masonry Surface Preparation	Acrylic Sealer	2 coats, 100 SFPGPC

G. System No. 121 Concrete, Skid-Resistant:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Concrete Surface Preparation	Epoxy Nonskid (Aggregated)	1 coat, 160 SFPG

3.9 COLORS

A. Provide as selected by Owner or Architect.

B. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.

C. Equipment Colors:

1. Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.
2. A: Paint equipment and piping one color as selected.
3. Paint non-submerged portions of equipment the same color as the piping it serves, except as itemized below:
   a. Dangerous Parts of Equipment and Machinery: OSHA Orange.
   b. Fire Protection Equipment and Apparatus: OSHA Red.
   c. Radiation Hazards: OSHA Purple.
   d. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.

D. Pipe Identification Painting:

1. Color code non submerged metal piping, except electrical conduit. Paint fittings and valves the same color as pipe, except equipment isolation valves.
2. Pipe Color Coding: As shown in table below.
3. On exposed stainless steel piping, apply color 24 inches in length along pipe axis at connections to equipment, valves, or branch fittings, at wall boundaries, and at intervals along piping not greater than 9 feet on center.
4. Pipe Supports: Painted light gray, as approved by Owner's Representative.
5. Fiberglass reinforced plastic (FRP) pipe, polyvinylidene fluoride (PVDF), and polyvinyl chloride (PVC) pipe located inside of buildings and enclosed structures will not require painting, except as noted or scheduled.

E. Pipe System Color Code:

Pipe System	Color
Air, Process	Federal Safety Green
Air, Instrument	Federal Safety Purple
Compressed Air	Federal Safety Purple
Carbon	Black
Drains and Sludge	Light Brown
Drains	Black
Overflow	Silver/Gray
Raw Sewage	Dark Gray
Scum	Light Brown
Sample	Medium Green
Seal Water	Federal Safety Blue

3.10 FIELD QUALITY CONTROL

A. Testing Equipment:

1. Provide calibrated electronic type dry film thickness gauge to test coating thickness specified in mils.

2. Provide low-voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high-build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1

3. Provide high-voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit as recommended by coating manufacturer.

B. Testing:

1. Thickness and Continuity Testing:
   a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.

   b. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE SP0188.

c. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE SP0188.

d. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

C. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.

D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
2. Remove rust and contaminants from metal surface. Provide surface cleanliness and profile in accordance with surface preparation requirements for specified paint system.
3. Feather edges and repair in accordance with recommendations of paint manufacturer.
4. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.11 MANUFACTURER'S SERVICES

A. In accordance with Section 01 43 33, Manufacturers' Field Services, coating manufacturer's representative shall be present at Site as follows:

1. On first day of application of any coating system.
2. A minimum of two additional Site inspection visits, each for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation.
3. As required to resolve field problems attributable to or associated with manufacturer's product.

4. To verify full cure of coating prior to coated surfaces being placed into immersion service.

3.12 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.

C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

END OF SECTION

SECTION 09 97 52
COLD-APPLIED WAX TAPE COATING

PART 1 - GENERAL

1.1 DESCRIPTION

This section includes materials and application of a three-part, cold-applied wax tape coating system for buried piping per AWWA Standard C217-16 Microcrystaline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe and Fittings.

1.2 RELATED WORK SPECIFIED ELSEWHERE (AWWA C105):

1. Section 09 90 00, Painting and Coating.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with the General Provisions Conditions.

B. Submit manufacturer's catalog data sheets and application instructions.

PART 2 - MATERIALS

2.1 PRIMER

A. Primer shall be a blend of petrolatums, plasticizers, and corrosion inhibitors having a paste-like consistency. The primer shall comply with AWWA STANDARD C217-16 and shall have the following properties:

1. Pour Point: 100°F to 110°F.

2. Flash Point: 350°F.

3. Coverage: 1 gallon per 100 square feet.

B. Primer shall be Trenton Wax Tape Primer, Denso Paste Primer, or equal.

2.2 WAX TAPE

A. Wax tape shall consist of a synthetic-fiber felt, saturated with a blend of microcrystalline wax, petrolatums, plasticizers, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces. The tape shall comply with AWWA STANDARD C217 and shall have the following properties:

1. Saturant Pour Point: 115°F to 120°F.

2. Thickness: 50 to 70 mils.

3. Tape Width: 6 inches.

B. Wax tapes used for pipe soil-to-air transitions shall be UV light stable so as not to degrade in the presence of sunlight.

C. Wax tape shall be Trenton No. 1 Wax Tape, Denso "Densyl Tape," or equal.

2.3 PLASTIC WRAPPER

A. Wrapper shall be a polyvinylidene chloride plastic with three 50-gauge plies wound together as a single sheet. The wrapper shall have the following properties:

1. Color: Clear.

2. Thickness: 1.5 mils.

3. Tape Width: 6 inches.

B. Plastic wrapper shall be Trenton Poly-Ply, Denso Tape PVC Self-Adhesive, or equal.

2.4 POLYETHYLENE SHEET COATING

Polyethylene Sheet Encasement: AWWA Standard C105 Linear low density polyethylene film, 8mils thick.

PART 3 - EXECUTION

3.1 WAX TAPE COATING APPLICATION

A. Surfaces shall be clean and free of dirt, grease, water, and other foreign material prior to the application of the primer and wax tape.

B. Apply primer by hand or brush to fitting surfaces. Work the primer into crevices and completely cover exposed metal surfaces.

C. Apply the wax tape immediately after the primer application. Work the tape into the crevices around fittings. Apply the wax tape by pressing and molding the tape into conformity with the surface so that it does not bridge over irregular surfaces configurations. Begin wrapping approximately 3 inches behind the area to be wrapped. If starting at a straight edge, wrap the tape spirally around the pipe while touching the end edge before starting the angle to begin the spiral. If

the previous roll is headed in a downward direction, tuck the next roll under the previous roll. Stretch each roll tight as wrapping continues to avoid air bubbles.

D. Wrap the wax tape spirally around the pipe and across the fitting. Use a minimum overlap of 50% of the tape width. Apply tape to flanges, mechanical and restrained joint bolts, nuts and glands, and grooved-end couplings to 6 inches beyond each side of the item.

E. Work the tape into the crevices and contours of irregularly shaped surfaces and smooth out so that there is a continuous protective layer with no voids or spaces under the tape.

F. After application, seal the overlap seams of the tape by hand by tapering and pressing the seam, attempting to create a continuous surface. There shall be no air pockets underneath the tape. The tape shall have direct intimate contact with the pipe surface.

G. On vertical sections of the piping, such as at pipe-to-soil transitions, wrap the pipe starting from the bottom and proceeding upward so that downward flowing water and backfill do not catch in a seam.

H. Overwrap the completed wax tape installation with the plastic wrapping material. Wrap spirally around the pipe and across the fitting. Use a minimum overlap of 55% of the tape width and apply two layers or applications of overwrap. Secure plastic wrapper to pipe with adhesive tape.

3.2 APPLICATION OF POLYETHYLENE SHEET COATING TO BURIED PIPING

Wrap completed wax tape coating system with polyethylene film per Section 09 97 54 and secure around the adjacent pipe circumference with adhesive tape

END OF SECTION

SECTION 10 14 00
SIGNAGE

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems.
2. ASTM International (ASTM):
   a. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   b. D709, Standard Specification for Laminated Thermosetting Materials.
3. The Chlorine Institute, Inc.: WC-1, Wall Chart: Handling Chlorine Cylinders and Ton Containers.
4. International Code Council (ICC):
   a. A117.1, Accessible and Usable Buildings and Facilities.
   b. International Fire Code (IFC): Chapter 27, Hazardous Materials-General Provisions.
5. National Fire Protection Association (NFPA):
   a. 704, Standard System for the Identification of the Hazards of Materials for Emergency Response.
   b. HAZ-01, Fire Protection Guide to Hazardous Materials.
6. Occupational Safety and Health Act (OSHA).
7. U.S. Department of Transportation, Federal Highway Administration: Manual on Uniform Traffic Control Devices for Streets and Highways.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Drawings showing layouts, actual letter sizes and styles, and Project-specific mounting details.
   b. Manufacturer's literature showing letter sizes and styles, sign materials, and standard mounting details.
2. Anchorage and bracing data sheets and drawings as required by Section 01 88 15, Anchorage and Bracing.
3. Samples: One full size for each type of nameplate, sign, and label specified.

B. Informational Submittals:

1. Manufacturer's installation instructions.
2. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

PART 2 PRODUCTS

2.1 FACILITY ENTRANCE MARKER

A. Precast Concrete: As detailed on Drawings.

B. Molds for Message:

1. Furnish plastic letter, numeral, and symbol molds for insertion into formwork.
2. Form with tapered sides for release without spalling concrete.

2.2 BUILDING NAME PLAQUE

A. Text Material: stainless steel.

B. Background Material: stainless steel

C. Size: 18 inches by 27 inches and minimum 1/4 inch thick.

D. Lettering and Trim: Raised 1/8 inch, minimum.

E. Finish:

1. Border Face and Edge, and Lettering Face: Fine satin hand finish.
2. Background: Dark statuary bronze, finely pebbled surface.

F. Lettering and Border Outlines: Hand-tool, clean, and sharp.

G. Lettering Style: Condensed block

H. Tablet Inscription Text: To be furnished by Owner or Engineer.

I. Fasteners: Stainless steel screws Concealed.

J. Manufacturer's name is allowed on backside.

2.3 DOOR NAMEPLATES

A. Material: Plastic with square corners to match directory

B. Thickness: 1/8 inch.

C. Height: 2 inches.

D. Finish: Nondirectional matte.

E. Background: Black.

F. Letters: Raised.

1. Size: 1 inch high.
2. Color: White.
3. Style: Helvetica Regular and lower case.
4. Message Text: As shown on Door and Hardware Schedule
5. Braille Text: Domed or rounded as required by ADA regulations, with 3/8-inch minimum clearance on all sides.

G. Manufacturers and Products:

1. Best Sign Systems, Montrose, CO; Graphic Blast.
2. Andco Industries Corp., Greensboro, NC; 1400 series.
3. Or Equal.

2.4 PICTORIAL SYMBOLS

A. Material: Plastic with square corners, B: match door nameplates.

B. Conform to ICC A117.1, Section 703.5. Provide Braille text as required by ADA regulation.

C. Manufacturers and Products:

1. Best Sign Systems, Montrose, CO; Graphic Blast.
2. Andco Industries Corp., Greensboro, NC; 1400 series.
3. Or Equal.

2.5 SIGN TYPES

A. Plastic Sign:

1. Exterior: Laminated plastic subsurface image type, 3/16 inch thick with high-gloss finish.
2. Interior: Plastic 1/8 inch thick with nondirectional matte finish and raised letters.
3. Rounded corners.

B. Metal Sign:

1. Material: Baked enamel finished 20-gauge (minimum) steel or 18-gauge (minimum) aluminum signs.
2. Manufacturers:
    a. Seton Identification Products.
    b. Nutheme Illustrated Safety Co.
    c. Or Equal.

C. Individual Letter and Number Signs (Type E): stainless steel.

1. Manufacturers:
    a. Eder Metal Letter Co., Milwaukee, WI.
    b. Spanjer Brothers, Inc., Chicago, IL.
    c. Andco Industries Corp., Greensboro, NC.
    d. Or Equal.

D. Exit Sign:

1. Material: Plastic 1/8 inch minimum thickness.
2. Letters:
    a. 6 inches high, with 3/4-inch stroke.
    b. 2 inches wide, except for letter "I", with spacing of 3/8 inch.
3. Colors: Red letters and direction arrows on white background.

E. Hazardous Material Sign (Type H):

1. Conform to NFPA 704 and NFPA HAZ-01.
2. Material: Fiberglass 1/8 inch thick. Reflective sheeting applied to 0.040-inch thick aluminum. Adhesive vinyl for curved surfaces.
3. Background, Letters, and Numbers: Die-cut vinyl with pressure sensitive adhesive.
4. Manufacturers:
    a. Brady Signmark.
    b. Emed Co., Inc.
    c. Or Equal.

2.6 IDENTIFICATION LABELS

A. Pipe Labels:

1. Snap-on, reversible type with lettering and directional arrows, sized for outside diameter of pipe and insulation.
2. Provided with ties or straps for pipes of 6 inches and over diameter.
3. Designed to firmly grip pipe so labels remain fixed in vertical pipe runs.
4. Material: Heavy-duty vinyl or polyester, suitable for exterior use, long lasting, and resistance to moisture, grease, and oils.
5. Letters and Arrows: Black on OSHA safety yellow background.

6. Color Field and Letter Height: Meet ASME A13.1.
7. Message: Piping system name as indicated on Piping Schedule.
8. Manufacturers and Products:
    a. Brady Signmark; B-915 BradySnap-On and Strap-On Pipe Markers.
    b. Seton Identification Products; Ultra-mark Pipe Markers.

B. Pipe Labels:

1. Labels: Self-adhesive tape, with separate directional flow arrows arrow banding tape.
2. Material: Pressure sensitive vinyl.
3. Letters and Arrows: Black on OSHA safety yellow background.
4. Color Field and Letter Height: ASME A13.1.
5. Message: Piping system name as indicated on Piping Schedule.
6. Manufacturers and Products:
    a. Brady Signmark; B-946 Self-Sticking Vinyl Pipe Markers and Vinyl Arrows Directional Flow Arrow Tape.
    b. Seton Identification Products; Opti-Code Markers and Directional Arrows Arrows-On-A-Roll Tape.

C. Equipment Labels:

1. Applies to equipment with assigned tag numbers, where specified.
2. Letters: Black bold face, White engraved, 3/4 inch minimum high.
3. Background: OSHA safety yellow. Black.
4. Materials:
    a. Aluminum or stainless steel with a baked-on finish suitable for use on wet, oily, exposed, abrasive, and corrosive areas.
    b. Fiberglass with encased lettering.
    c. Rigid laminate.
    d. Multi-layered acrylic.
5. Furnish 1-inch margin with holes at each end of label, for mounting. On fiberglass labels, furnish grommets at each hole.
6. Size:
    a. 2 inches minimum and 3 inches maximum high, by 14 inches minimum and 18 inches maximum long.
    b. Furnish same size base dimensions for all labels.
7. Message: Equipment names and tag numbers as used in sections where equipment is specified.
8. Manufacturers:
    a. Brady Signmark.
    b. Seton Identification Products.

2.7 ANCILLARY MATERIALS

A. Fasteners: Stainless steel screws or bolts of appropriate sizes.

B. Wood Posts: Preservative treated 4 by 4 wood as specified in Section 06 10 00, Rough Carpentry.

C. Pipe Posts: 2-1/2-inch galvanized steel pipe meeting ASTM A53/A53M, Type S, Grade B.

D. Chain: Type 304 stainless steel, No. 16 single jack chain or No. 2 double loop coil chain.

E. Manufacturer's standard brackets for wall mounting of two-sided exit signs.

PART 3 EXECUTION

3.1 INSTALLATION—GENERAL

A. In accordance with manufacturer's recommendations.

B. Mount securely, plumb, and level.

3.2 BUILDING NAME PLAQUE

A. Provide and install one 24" x 36" bronze plaque with names and artwork to be determined by the City of San Diego near the end of course of construction.

B. Mounting location to be determined by the City of San Diego near the end of course of construction.

C. Mount with concealed fasteners per manufacturer instructions.

3.3 DIRECTORY

A. Space 1/2 inch from wall with concealed mechanical fasteners.

3.4 DOOR NAMEPLATES AND PICTORIAL SYMBOLS

A. Attach to doors or walls adjacent to doors with Phillips head screws. See Door and Hardware Schedule for locations and messages.

B. Mount with bottom of nameplate at 5 feet 6 inches above floor.

3.5 SIGNS

A. General:

1. Fasten to walls or posts or hang as scheduled.
2. Anchor in place for easy removal and reinstallation with ordinary hand tools.

B. Information, Exit, and Safety Signs:

1. Install facing traffic. Locate for high visibility with minimum restriction of working area around walkways and equipment.
2. Install as scheduled.

C. Traffic Signs: Mount each sign on scheduled support using two 1/4-inch stainless steel bolts through sign and post. Install facing traffic at locations and in manner shown in U.S. Department of Transportation, Federal Highway Administration Manual on Uniform Traffic Control Devices for Streets and Highways.

D. Hazardous Material Sign:

1. Install where required by NFPA No. 704 and IFC, Chapter 27.
2. Install at entrances to spaces where hazardous materials are stored, dispensed, used, or handled, and on sides of stationary tanks.
3. Specific Materials:

3.6 IDENTIFICATION LABELS

A. Pipe Labels:

1. Locate at connections to equipment, valves, or branching fittings at wall boundaries.
2. At intervals along piping not greater than 18 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe.
3. At exposed piping not normally in view, such as above suspended ceilings and in closets and cabinets.
4. Supplementary Labels: Provide to Owner those listed on Piping Schedule that do not receive arrows.
5. Apply to pipe after painting in vicinity is complete, or as approved by Engineer.
6. Install in accordance with manufacturer's instructions.

B. Equipment Labels:

1. Locate and install on equipment or concrete equipment base as shown on Drawings.
2. Anchor to equipment or base for easy removal and replacement with ordinary hand tools.

END OF SECTION

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Factory Mutual FM.
2. Mine Safety and Health Administration MSHA.
3. National Fire Protection Association NFPA:
   a. 10, Standard for Portable Fire Extinguishers.
   b. 30, Flammable and Combustible Liquids Code.
4. National Institute for Occupational Safety and Health NIOSH.
5. Occupational Safety and Health Administration OSHA.
6. Underwriters Laboratories Inc. UL: Fire Protection Equipment Directory.

1.2 PERFORMANCE REQUIREMENTS

A. Conform to NFPA 10 and local applicable codes.

B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. or testing firm acceptable to authority having jurisdiction for purpose specified and indicated.

C. Provide fire rated fire extinguisher cabinets classified and labeled by Underwriters Laboratories Inc or testing firm acceptable to authority having jurisdiction for purpose specified and indicated.

D. Provide key boxes as required by the applicable code or by the fire marshal or code official having jurisdiction.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Fire Extinguishers: Manufacturer's product data for each item, including sizes, ratings, UL listings, or other certifications, and mounting information.
   b. Extinguisher Cabinets and Key Boxes: Indicate type of cabinet, cabinet physical dimensions, rough-in measurements for recessed and semi-recessed cabinets, location, mounting methods and

anchorage details, relationship of cabinet box and trim to surrounding construction, door type and hardware, trim style, panel style.

c. Product Data: Extinguisher operational features, color and finish, and anchorage details.

B. Informational Submittals:

1. Manufacturer's Installation Instructions:
   a. Special criteria and wall opening coordination requirements.
   b. Manufacturer's installation details for fire-rated cabinets.
2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
3. Operation and Maintenance Data: Submit test, refill or recharge schedules and recertification requirements.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Section 01 61 00, Common Product Requirements: Environmental conditions affecting products onsite.

B. Do not install extinguishers when ambient temperatures are capable of freezing extinguisher ingredients.

PART 2 PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS

A. Manufacturers:

1. JL Industries;
2. Larsen's Manufacturing Co.;
3. Nystrom Products Co.;
4. Potter Roemer;
5. Or Equal.

B. General:

1. Conform to NFPA 10 for fire extinguishers.
2. Furnish fire extinguishers and cabinets from one manufacturer.
3. UL listed, charged and ready for service.

C. Multipurpose Hand Extinguisher F. Ext-1:

1. Tri-class dry chemical extinguishing agent.
2. Pressurized, red enameled steel shell cylinder.

3. Activated by top squeeze handle.
4. Agent propelled through hose or opening at top of unit.
5. For use on A, B, and C class fires.
6. Minimum UL Rating: 4A-60B: C, 10-pound capacity.

2.2 FIRE EXTINGUISHER CABINETS

A. Manufacturers:

1. J. L Industries;
2. Larsen's Manufacturing Co.;
3. Modern Metal Products;
4. Or Equal.

B. Extinguisher Cabinet Type:

1. As shown.
2. Sized to accommodate accessories.
3. Metal: Formed sheet steel, galvanized; 0.036 thick base metal.
4. Trim Type: Returned to wall surface, with 1/4 inch projection 1-inch wide face.
5. Door: 0.016-inch thick, reinforced for flatness and rigidity; latch with break glass access.
6. Door Glazing: Glass, clear, 1/8-inch thick float.
7. Cabinet Mounting Hardware: Appropriate to cabinet and wall type.
8. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.
9. Hinge doors for 180-degree opening with two butt hinge. Furnish roller type catch.
10. Weld, fill, and grind components smooth.
11. Glaze doors with resilient channel gasket glazing.
12. Finishing Cabinet Exterior Trim and Door: Primed for field paint finish.
13. Finishing Cabinet Interior: White enamel.

2.3 KEY BOXES

A. Manufacturers and Products:

1. Knox Company, Phoenix, AZ.
2. Kidde Fire Safety; SupraSafe, Mebane, NC.
3. Or Equal.

B. Steel high-security commercial key vault, 6 inch wide by 6 inch tall with hinges door; UL listed; and resists moisture and weather by use of a gasketed exterior door. Unit is to be recessed into exterior wall using special mounting kit.

2.4 ACCESSORIES

A. Graphic Identification: Provide graphic identification marking for each fire extinguisher type. OSHA approved pictorial markings to indicate the extinguisher uses and non-uses on a single label.

B. Fasteners: Furnish necessary screws, bolts, brackets, and other fastenings of suitable type and size to secure items of fire and safety equipment in position.

1. Metal expansion shields for machine screws at concrete and masonry.
2. Interior: Rust-resistant.
3. Exterior: Stainless steel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify cabinets are correctly sized for fire extinguisher type.

B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install where indicated or directed and in accordance with manufacturer's recommendations.

B. Install cabinets plumb and level in wall openings, maximum 48 inches from finished floor to top of extinguisher handle.

C. Secure cabinets and brackets rigidly to structure.

D. Provide adequate backing for mounting surfaces.

E. Place extinguishers: in cabinets.

F. Position cabinet signage as required by authorities having jurisdiction.

END OF SECTION

SECTION 22 10 01
PLUMBING PIPING AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Gas Association (AGA):
    a. B109.1, Diaphragm Type Gas Displacement Meters (under 500 Cubic Feet Per Hour Capacity).
    b. B109.2, Diaphragm Type Gas Displacement Meters (500 Cubic Feet Per Hour Capacity and Over).
2. American National Standards Institute (ANSI).
3. American Public Works Association (APWA): Uniform Color Code.
4. American Society of Sanitary Engineering (ASSE):
    a. 1010, Performance Requirements for Water Hammer Arresters.
    b. 1050, Performance Requirements for Stack Air Admittance Valves for Sanitary Drainage Systems.
    c. 1070, Performance Requirements for Water Temperature Limiting Devices.
5. ASTM International (ASTM):
    a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
    b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    c. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
    d. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
    e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    f. A179/A179M, Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes.
    g. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
    h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
    i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
    j. A197/A197M, Standard Specification for Cupola Malleable Iron.

k. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
l. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
m. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
n. A518/A518M, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
o. A536, Standard Specification for Ductile Iron Castings.
p. A563, Standard Specification for Carbon and Alloy Steel Nuts.
q. A861, Standard Specification for High-Silicon Iron Pipe and Fittings.
r. A888, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
s. B32, Standard Specification for Solder Metal.
t. B61, Standard Specification for Steam or Valve Bronze Castings.
u. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
v. B75/B75M, Standard Specification for Seamless Copper Tube.
w. B88, Standard Specification for Seamless Copper Water Tube.
x. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
y. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
z. B139/B139M, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
aa. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
bb. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
cc. B306, Standard Specification for Copper Drainage Tube (DWV).
dd. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
ee. C1277, Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
ff. C1460, Standard Specification for Shielded Transition Couplings for use with Dissimilar DWV Pipe and Fittings Above Ground.
gg. C1540, Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
hh. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

ii. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
jj. D2000, Standard Classification System for Rubber Products in Automotive Applications.
kk. D2239, Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
ll. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
mm. D2513, Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
nn. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
oo. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
pp. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
qq. D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
rr. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
ss. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
tt. E438, Standard Specification for Glasses in Laboratory Apparatus.
uu. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
vv. F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
ww. F1412, Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems.
xx. F1924, Standard Specification for Plastic Mechanical Fittings for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing.
yy. F1973, Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems.

6. American Water Works Association (AWWA):
   a. C104/A21.4, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
   b. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.

c. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
d. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
e. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast.
f. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot-Applied.
g. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
h. C606, Grooved and Shouldered Joints.
i. C651, Disinfecting Water Mains.

7. Cast Iron Soil Pipe Institute (CISPI):
   a. 301, Standard Specification for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
   b. 310, Specification for Couplings for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Strom Drain, Waste, and Vent Piping Applications.
8. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
9. Plumbing and Drainage Institute (PDI): WH 201, Water Hammer Arresters Standard.

1.2 DESIGN REQUIREMENTS

A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:

1. Building Service Piping: ASME B31.9, as applicable.
2. Sanitary Building Drainage and Vent Systems: California Plumbing Code**.**

1.3 SUBMITTALS

A. Action Submittals:

1. Product data sheets.
2. Shop Drawings:
   a. Show Contractor recommended changes in location of fixtures or equipment.

b. Anchorage and bracing drawings and data sheets, as required by Section 01 88 15, Anchorage and Bracing.

3. Isometric riser diagrams.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Changes in location of equipment or piping that affect connecting or adjacent work, before proceeding with the work.
3. Complete list of products proposed for installation.
4. Test records produced during testing.
5. For Polyethylene (PE) Pipe:
   a. Certificates of qualification for persons to be fusing PE pipe.
   b. Experience and training record of persons to be fusing PE pipe.
   c. Testing Plan:
      1) Submit at least 15 days prior to testing; include following as a minimum:
         a) Testing dates.
         b) Piping systems and section(s) to be tested.
         c) Method of isolation.
         d) Method of conveying water from source to system being tested.
   d. Certifications of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
   e. Test report documentation.

PART 2 PRODUCTS

2.1 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.2 PIPING

A. Piping Material: Refer to Drawings.

B. Piping Material: Refer to Drawings.

2.3 HOSE VALVES AND HYDRANTS

A. Post Hydrant:

1. Bronze casing, 3/4-inch to 2-inch inlet and outlet.
2. Size as indicated on Drawings.
3. Manufacturers and Products:
   a. J. R. Smith; Figure 5910 Series.
   b. Wade, Division of Tyler Pipe; 8610 Series.
   c. Zurn; 1385 (3/4 inch to 1 inch) and 1390 (1-1/4 inch to 2 inch).

B. Wall Hydrant:

1. Non-freeze box type with chrome-plated face, integral vacuum breaker, bronze casing, T-handle key, and 3/4-inch inlet and hose connection.
2. Manufacturers and Products:
   a. J. R. Smith; Figure 5509.
   b. Josam; 71000 Series.

C. Hydrant:

1. Sill faucet with removable T-handle, polished chrome finish, and 3/4-inch inlet and hose connection.
2. Manufacturers and Products:
   a. Chicago; No. 387, with No. E27 vacuum breaker.
   b. Acorn; No. 8121.

D. Hose Valve:

1. Cast bronze globe valve with NPT screwed ends, union bonnet, rising stem, Teflon disc, hand wheel, and NPT by NST hose thread adapter outlet connection.
2. Rated 150-pound service water pressure, 300-pound WOG.
3. Manufacturers and Products:
   a. Nibco; Catalog No. T-235-Y, Angle No. T-335-Y.
   b. Crane Co.; Catalog No. 7TF, Angle No. 17TF.

E. YH-1, Sanitary Yard Hydrants:

1. As shown on the contract drawings.

2.4 PIPE HANGERS AND SUPPORTS

A. Refer to Section 40 05 15, Piping Support Systems.

B. Hangers:

1. Clevis Type: MSS SP 58 and SP 69, Type 1 or 6.
   a. Anvil; Figure 104 or 260, sizes 1/2 inch through 30 inches.
   b. B-Line; Figure B3198H or B3100, sizes 3/8 inch through 30 inches.
2. Hinged Split-Ring Pipe Clamp: MSS SP 58 and SP 69, Type 6 or 12.
   a. Anvil; Figure 104, sizes 3/4 inch through 8 inches.
   b. B-Line; Figure B3198H, sizes 3/8 inch through 3 inches.
3. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.
4. Attachments:
   a. I-Beam Clamp: Concentric loading type, MSS SP 58 and SP 69, Type 21, 28, 29, or 30, which engage both sides of flange.
   b. Concrete Insert: MSS SP 58 and SP 69, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.

C. Saddle Supports:

1. Pedestal Type: Schedule 40 pipe stanchion, saddle, and anchoring flange.
   a. Nonadjustable Saddle: MSS SP 58 and SP 69, Type 37 with U-bolt.
      1) Anvil; Figure 259, sizes 4 inches through 36 inches.
      2) B-Line; Figure B3090, sizes 2-1/2 inches through 36 inches.
   b. Adjustable Saddle: MSS SP 58 and SP 69, Type 38 without clamp.
      1) Anvil; Figure 264, sizes 2-1/2 inches through 36 inches.
      2) B-Line; Figure B3093, sizes 2-1/2 inches through 36 inches.

D. Wall Brackets:

1. Welded Steel Bracket: MSS SP 58 and SP 69, Type 33 (heavy-duty).
    a. Anvil; Figure 199, 3,000-pound rating.
    b. B-Line; Figure B3067, 3,000-pound rating.
2. One-Hole Clamp: Anvil; Figure 126, sizes 3/8 inch through 4 inches.
3. Channel Type:
    a. Unistrut.
    b. Anvil; Power-Strut.
    c. B-Line; Strut System.
    d. Aickinstrut (FRP).

E. Pipe Clamps:

1. Riser Clamp: MSS SP 58 and SP 69, Type 8.
    a. Anvil; Figure 261, sizes 3/4 inch through 24 inches.
    b. B-Line; Figure B3373, sizes 1/2 inch through 30 inches.

F. Channel Type Support Systems:

1. Channel Size: 12-gauge, 1-5/8-inch-wide minimum steel, 1-1/2-inch-wide minimum FRP.
2. Members and Connections: Design for all loads with safety factor of 5.
3. Manufacturers and Products:
    a. B-Line; Strut System.
    b. Unistrut.
    c. Anvil; Power-Strut.
    d. Aickinstrut (FRP System).

G. Accessories:

1. Insulation Shields:
    a. Type: Galvanized steel or stainless steel, MSS SP 58 and SP 69, Type 40.
    b. Manufacturers and Products:
        1) Anvil; Figure 167, sizes 1/2 inch through 24 inches.
        2) B-Line; Figure B3151, sizes 1/2 inch through 24 inches.
2. Welding Insulation Saddles:
    a. Type: MSS SP 58 and SP 69, Type 39.
    b. Manufacturers and Products:
    c. Anvil; Figure Series 160, sizes 1 inch through 36 inches.
    d. B-Line; Figure Series B3160, sizes 1/2 inch through 24 inches.

H. Galvanize hangers, rods, clamps, protective shields, and hanger accessories.

I. Trapeze Hangers:

1. Assembly consisting of structure attachments with rod size dependent upon total weight supported, and spacing of assemblies determined by minimum pipe size included in group supported.
2. Trapeze Horizontal: Structural angle or channel section of sufficient size to prevent measurable sag between rods.
3. Manufacturers and Products:
   a. Unistrut.
   b. B-Line; Strut System.
   c. Anvil; Power-Strut.
   d. Aickinstrut (FRP System).

2.5 VALVES

A. Refer to Section 40 27 02, Process Valves and Operators.

B. General:

1. Furnish complete with necessary operating hand wheels, chain wheels, extension stems, floor stands, worm and gear operators, operating nuts, chains, and wrenches.
2. Renewable Parts Including Discs, Packing, and Seats: Types as recommended by valve manufacturer for intended service.
3. Units shall have name of manufacturer and size of valve cast on body or bonnet or shown on a permanently attached plate in raised letters.

C. Design Features:

1. Brass and bronze components, including appurtenances in contact with water.
2. Alloys containing less than 16 percent zinc and 2 percent aluminum.
3. Alloys are of the following ASTM designations:
   a. B61, B62, B98/B98M (Alloy A, B, or D), B139 (Alloy A), B164, B194, and B127.
   b. Stainless steel Alloy 18-8 may be substituted for bronze as an option with approval of Engineer.
4. Gland Bolts on Iron Body Valves: Bronze, fitted with brass nuts.

D. Valve Operators:

1. Open by turning counterclockwise.
2. Worm and Gear Operators on Manually Operated Valves: Totally enclosed design, proportioned as to permit operation of valve under full operating head with maximum pull of 40 pounds on handwheel or crank.
3. Self-locking type to prevent the disc or plug from creeping.
4. Self-Locking Worm Gears:
   a. One-piece design of gear bronze material, accurately machine cut.

b. Worm: Hardened alloy steel, with thread ground and polished.
c. Reduction gearing shall run in a proper lubricant.

5. Galvanize handwheels.

E. Gate Valves:

1. Type V100, 3 Inches and Smaller for Water and Air Services:
   a. All-bronze with screwed bonnet, single solid wedge gate with nonrising stem, and handwheel operator.
   b. Rated 125-pound SWP, 200-pound WOG.
   c. Manufacturers and Products for Threaded Ends:
      1) Crane; No. 438.
      2) Nibco; Model No. T-113.
   d. Manufacturers and Products for Soldered Ends:
      1) Crane; No. 1701S.
      2) Nibco; Model No. S-113.
2. Type V101 Gate Valve 3 Inches and Smaller:
   a. All-bronze, screwed bonnet, packed gland, single solid wedge gate, rising stem, Class 125 rated 200 psi CWP, complies with MSS SP-80 Type 2.
   b. Manufacturers and Products:
      1) Crane; Figure 428, NPT threaded ends.
      2) Stockham; Figure B-100, NPT threaded ends.
      3) Crane; Figure 1334, soldered ends.
      4) Stockham; Figure B-108, soldered ends.
3. Type V102 Gate Valve 3 Inches and Smaller:
   a. All-bronze, screwed bonnet, packed gland, NPT threaded ends, single solid wedge gate, nonrising stem, Class 150 rated 150 psi SWP/300 psi CWP, complies with MSS SP-80 Type 1.
   b. Manufacturers and Products:
      1) Crane; Figure 437.
      2) Stockham; Figure B-128.
4. Type V103 Gate Valve 3 Inches and Smaller:
   a. All-bronze, screwed bonnet, packed gland, NPT threaded ends, single solid wedge gate, rising stem, Class 150 rated 150 psi SWP/300 psi CWP, complies with MSS SP-80 Type 2.
   b. Manufacturers and Products:
      1) Crane; Figure 431.
      2) Stockham; Figure B122.

5. Type V108, 4 Inches and Larger for Water and Air Services:
    a. Iron body, bronze mounted, with flanged ends, solid wedge gate with nonrising stem, and handwheel operator.
    b. Rated 125-pound SWP, 200-pound WOG.
    c. Manufacturers and Products:
        1) Crane; No. 461.
        2) Nibco; Model No. F-619.

F. Globe Valves:

1. Type V200 Globe Valve 3 Inches and Smaller:
    a. All-bronze, union bonnet, packed gland, inside screw, rising stem, TFE disc, Class 150 rated 150 psi SWP/300 psi CWP, complies with MSS SP-80 Type 2.
    b. Manufacturers and Products:
        1) Stockham; Figure B-22T, NPT threaded end.
        2) Crane Co.; Figure 7TF, NPT threaded end.
        3) Milwaukee; Model 1590T, soldered ends.
        4) NIBCO; Figure S-235-Y, soldered ends.
2. Type V201 Angle Pattern Valve 2 Inches and Smaller:
    a. All-bronze, NPT threaded ends, union bonnet, packed gland, inside screw, rising stem, TFE disc, Class 150 rated 150 psi SWP/300 psi CWP, complies with MSS SP-80 Type 2.
    b. Manufacturers and Products:
        1) Stockham; Figure B-222T.
        2) Crane Co.; Figure 17TF.
3. Type V235 Angle Type Hose Valve 3/4 Inch:
    a. 3/4-inch NPT female inlet, 3/4-inch male hose thread outlet, heavy rough brass body rated 125 psi, lockshield bonnet, removable handle, atmospheric vacuum breaker conforming to ASSE 1011 and IAPMO code.
    b. Manufacturers and Products:
        1) Acorn; 8126, surface pipe mount valve, bent nose without flange.
        2) Acorn; 8121, surface mount through wall valve, bent nose with flange.
        3) Acorn; 8131, pipe and pedestal mounted valve located above 6 inches, straightnose.
        4) Acorn; 8136, pedestal mounted valve located lower than 6 inches, inverted nose.

G. Ball Valves:

1. 2 Inches and Smaller for General Water and Air Service:

a. Three-piece body type, bronze body and end pieces, hard-chrome plated bronze or brass ball, full bore port, RTFE seats and packing, blowout-proof stem, zinc-plated steel hand lever operator with vinyl grip.
b. Rated 6-pound WOG, 150-psi SWP.
c. Manufacturers and Products:
1) Threaded Ends:
a) Milwaukee; BA-300.
b) Nibco; T-595-Y.
c) Conbraco Apollo; 82-100.
2) Soldered Ends:
a) Milwaukee; BA-350.
b) Nibco; S-595-Y.
c) Conbraco Apollo; 82-200.

2. 3 Inches and Smaller for Vacuum Service:
a. Brass body and trim, replaceable double TFE seals and seats.
b. Furnish screwed ends and rate for service to 0.01 micron.
c. Manufacturers and Products:
1) Jamesbury; Style A.
2) Worcester; Series 400.

3. Thermoplastic Ball Valves 2 Inches and Smaller for Water Service:
a. Rated 150 psi at 105 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride (PVC) body, ball, and stem.
b. End entry, double union design, with replaceable Teflon seats and Viton or Teflon O-ring stem seals.
c. Furnish with hand lever operator.
d. Single union ball valves with flanged ends drilled to 150-pound ANSI Standard are acceptable.
e. Manufacturers:
1) Asahi/America.
2) R&G Sloane Manufacturing Co., Inc.

H. Globe Valves:

1. 3 Inches and Smaller:
a. Bronze body, replaceable composition disc, screwed ends, union bonnet, inside screw rising stem, and TFE disc.
b. Rated 150-pound SWP, 300-pound WOG.
c. Manufacturers and Products:
1) Crane; No. 7TF.
2) Nibco; No. T-235-Y.

I. Plug Valve:

1. 2 Inches and Smaller for Natural Gas and Propane Gas Service:
   a. Eccentric type, nonlubricated, cast iron body, and bronze plug with Buna-N elastomer O-ring seal.
   b. UL listed and CSA (AGA-CGA) approved.
   c. Pressure Rating: ANSI 125, 175 psi.
   d. Threaded end connections.
   e. Manufacturers and Products:
      1) Milliken Valve Company, Inc.; Series 625.
      2) Key Port Valve; Series 400.
2. 2-1/2 Inches to 4 Inches for Natural Gas and Propane Gas Service:
   a. Eccentric type, nonlubricated, cast iron body and nickel plated cast iron plug with Buna-N elastomer O-ring seal.
   b. UL listed and CSA (AGA-CGA) approved.
   c. Pressure Rating: ANSI 125, 175 psi.
   d. End Connections:
      1) 2-1/2 Inches to 3 Inches: Threaded.
      2) 4 Inches: Flanged, ASME B16.1, Class 125/150.
   e. Manufacturers and Products:
      1) Milliken Valve Company, Inc.; Series 625.
      2) Key Port Valve; Series 400.

J. Angle Valves 3 Inches and Smaller:

1. Bronze body, threaded ends, union bonnet, and rising stem.
2. Rated 150-pound SWP and 300-pound WOG.
3. Manufacturers and Products for Threaded End:
   a. Crane; No. 17TF.
   b. Nibco; No. T-335-Y.

K. Check Valves 3 Inches and Smaller:

1. Bronze body, wye pattern, threaded ends and cap, regrinding seat, and swing type disc.
2. Rated 125-pound SWP, 200-pound WOG.
3. Manufacturers and Products:
   a. Crane; No. 37.
   b. Walworth Co.; Figure 406.

L. Backwater Check Valve 2 Inches to 8 Inches:

1. Coated cast iron backwater check valve, integral offset type swing-check assembly.
2. Manufacturers and Products:

a. J. R. Smith; Figure 7012.
b. Josam; Series 67500.
c. Zurn; Model Z-1095.

M. Balancing Valves (Recirculating Hot Water):

1. Bronze, calibrated balancing type with provisions for connecting a portable differential pressure meter. Meter connections shall have built-in check valves.
2. An integral pointer shall register degree of valve opening.
3. Construct with internal seals to prevent leakage around rotating element.
4. Rated for 125 psig working pressure at maximum temperature of 250 degrees F.
5. Furnish one pressure gauge type readout meter in carrying case.
6. Furnish with preformed polyurethane insulation valve enclosure, suitable for use on hot water systems.
7. Manufacturers and Products:
   a. Bell & Gossett; No. CB circuit setter.
   b. TACO; Series 790.

N. Water Pressure Reducing Valves 1/2 Inch Through 2-1/2 Inches:

1. Spring controlled, with a neoprene diaphragm.
2. Manufacturers and Products:
   a. Fisher; Type 75.
   b. Watts; No. 223.

O. Pressure Reducing Valve, Natural Gas and Propane, 2 psi to 11-Inch WC:

1. Direct diaphragm, spring controlled cast-iron body, spring aluminum diaphragm and spring case, nitrile disc/diaphragm/O-rings, internal relief, NPT thread ends, 125-psig rated.
2. Manufacturer and Product: Fisher; S201.

P. Pressure Reducing Valve, Natural Gas and Propane, High Pressure:

1. Direct diaphragm, spring controlled cast-iron body, spring aluminum diaphragm and spring case, nitrile disc/diaphragm/O-rings, internal relief, NPT thread ends, 125-psig rated.
2. Valve Body Size: 1/2 inch to 2 inches, as indicated.
3. Inlet pressure of 5 psig to 125 psig, as indicated.
4. Outlet Pressure: Set at 2 psig to 10 psig, as indicated.
5. Valve Orifice Size: 1/4 inch to 1-3/16 inches, as indicated.
6. Manufacturer and Product: Fisher Series 202 or equal.

Q. Gauge Cock Valves 1/8 Inch to 3/8 Inch:

1. Bronze body, hexagon male and female ends, and tee head.
2. Rated for 125-pound SWP.
3. Manufacturers and Product:
   a. Ernst Gage Co.
   b. Lunkenheimer.

R. Manual Air Vent Valves:

1. With coin-operated air vent.
2. Manufacturers and Products:
   a. Bell & Gossett; No. 4V.
   b. Dole; No. 9.

S. Solenoid Valves:

1. Two-way, full line size, normally psig body pressure, 250 psig operating differential, for use with cold water.
2. Suitable for 115-volt, 60-Hz, ac power supply.
3. Manufacturers:
   a. Automatic Switch Co.
   b. Skinner.

T. Point of Use Thermostatic Mixing Valve Assembly (3/8-inch Under Sink):

1. Function: Provide tempered water at 0.5 gpm to 2.25 gpm.
2. Listed per ASSE 1070. Bronze body, lead free construction rated to 150 psig maximum inlet pressure.
3. Inlets: One each, 3/8-inch compression fittings, cold and hot water.
4. Outlet: 3/8-inch compression fittings.
5. Self-contained; no electrical requirements.
6. Performance: With 120 degrees F to 180 degrees F hot inlet and 39 degrees F to 85 degrees F cold inlet, deliver 80 degrees F to 100 degrees F at inlet pressures between 30 psig and 100 psig.
7. Set outlet at 105 degrees F maximum unless otherwise noted.
8. Manufacturers and Products:
   a. Watts; LFUSG-B-M2.
   b. Powers; LFe480.
   c. Leonard Valve; Model 170-LF.

2.6 MISCELLANEOUS PIPING SPECIALTIES

A. Strainers for Water Service:

1. Iron body, Y-pattern, 125-pound rated, with screwed bronze or bolted iron cap.
2. Screen: Heavy-gauge stainless steel or monel, 30 mesh.
3. Manufacturers and Products:
   a. Crane; No. 988-1/2.
   b. Mueller; No. 758.

B. Flexible Connectors for Stainless Steel Gas Lines:

1. Corrugated, Type 316 stainless steel hose, with 10-inch live length and Type 316 stainless steel male NPT pipe connectors at each end.
2. Manufacturers and Product:
   a. Flexonics; Braided Rex-Weld.
   b. Kin-Line.

C. Vacuum Breakers 2 Inches and Smaller:

1. Angle type, as required.
2. Manufacturers:
   a. Febco.
   b. Watts.

D. Water Hammer Arresters:

1. Materials: ASSE 1010 certified, Type L copper tube, HHPP piston with two lubricated EPDM O-rings, FDA approved lubricant, rolled piston stop, wrought copper male thread adapter.
2. Manufacturers and Products:
   a. Sioux Chief Mfg. Co., Inc.; Series 650 and 660.
   b. Precision Plumbing Products, Inc.

E. Water Hose:

1. Furnish three 50-foot length(s) of 1-1/2-inch, EPDM black cover and EPDM tube, reinforced with two textile braids. Furnish each length with brass male and female NST hose thread couplings to fit hose nozzle(s) and hose valve(s) specified.
2. Rated minimum working pressure of 200 psi.
3. Manufacturers:
   a. Goodyear.
   b. Boston.

F. Hose Nozzles:

1. Furnish 1-1/2-inch cast brass satin finish nozzle(s) with adjustable fog, straight-stream, and shutoff features and rubber bumper. Provide nozzle(s) with female NST hose thread.
2. Manufacturers:
   a. Croker.
   b. Elkhart.

G. Sleeves:

1. Manufacturers and Products:
   a. J. R. Smith; Figure 1720.
   b. Josam; No. 26400.

H. Flashing Sleeves for Roof Penetrations:

1. Built-Up Bituminous Roofing: Fabricate of lead as specified in Section 07 62 00, Sheet Metal Flashing and Trim.
2. Single-Ply Membrane Roofing: Pipe seals as specified in Section 07 70 01, Roof Specialties and Accessories.

I. Insulating Dielectric Unions and Flanges:

1. Galvanically compatible with piping to which attached and pressure ratings suitable for system working pressures.
2. Unions 2 Inches and Smaller: Screwed or solder-joint type.
3. Unions 2-1/2 Inches and Larger: Flanged type, complete with bolt insulators, dielectric gasket, bolts, and nuts.
4. Manufacturers:
   a. Epco Sales, Inc., Cleveland, OH.
   b. Capitol Insulation Unions.

J. Air Admittance Valve (AAV):

1. PVC construction with internal air check valve and insect screen.
2. Unit shall meet ASSE 1051 for fixture and branch air admittance valves.
3. Unit shall bear seal of ASSE approval.
4. Manufacturer and Product: Studor, Inc., Dunedin, Florida; Maxi-Vent (2 inches to 4 inches).

K. Joint Solder: 95-5 wire solder, ASTM B32, Grade 95 TA. Lead free, NSF certified. Do not use cored solder.

L. Pipe Joint Sealer: Compound insoluble in water or Teflon tape; approved by NFS for use in potable water.

M. Rubber Gaskets: ASTM C564.

2.7 MEASURING DEVICES

A. Thermometers:

1. Adjustable angle, organic spirit type, blue in color, with 9-inch case and scale range in degrees F, as shown.
2. Furnish with 3-1/2-inch stem length and separable NPT brass thermowell.
3. Manufacturers and Product:
   a. Trerice Co.; Model A005.
   b. Weksler.

B. Pressure Gauges:

1. Construction: 3-1/2-inch gauge size, 0 kPa to 690 kPa, 0 psi to 160 psi range, steel case, glass crystal, brass movement, and 1/4-inch NPT lower connection.
2. Furnish with 1/4-inch brass gauge cock.
3. Manufacturers and Products:
   a. Ashcroft; Type 1008.
   b. Marsh; J80.
   c. Marshalltown.

PART 3 EXECUTION

3.1 GENERAL

A. Install plumbing systems to meet applicable plumbing code.

B. Field Obstructions:

1. Drawings do not attempt to show exact details of piping. Provide offsets around obstructions.
2. Do not modify structural components, unless approved by Engineer.

C. Sleeves:

1. Pipe sizes shown are nominal sizes, unless shown or specified otherwise.

2. Provide piping passing through walls, floors, or ceilings with standard-weight pipe sleeves.
3. Provide pipes passing through finished walls with chrome-plated canopy flanges.
4. Dry pack sleeves in existing work in-place and provide finished appearance.
5. Pack holes left by removal of existing piping with grout and finish to match adjacent surface.

D. Provide unions in piping systems at connections to equipment.

E. Provide shielded transition couplings, insulating dielectric unions and flanges between ferrous and nonferrous piping and where otherwise required for electrically insulated connection.

F. Pipe air release valves, water-lubricated bearings, and other appurtenances having water effluent with copper tubing to nearest drain.

G. Provide isolation valves and strainers at pressure regulators.

H. Trench Excavation and Backfill: As specified in Section 31 23 16, Excavation and Section 31 23 23.15, Trench Backfill**.**

3.2 INSTALLATION

A. Steel Pipe:

1. Ream, clean, and remove burrs and mill scale from piping before making up.
2. Seal joints with pipe joint sealer or Teflon tape.

B. Copper Tubing:

1. Cut tubing square and remove burrs.
2. Clean both inside of fittings and outside of tubing with steel wool and hydrochloric acid before soldering.
3. Prevent annealing of fittings and hard-drawn tubing when making connections.
4. Do not use mitered joints for elbows or notching of straight runs of pipe for tees.

C. Rigid PVC or CPVC:

1. Cut, make up, and install in accordance with pipe manufacturer's recommendations.

2. Ream, clean, and remove burrs from cut ends before joining pipe.
3. Lay in trench by snaking pipe from one side to other.
4. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and final use.
5. Do not lay pipe when temperature is below 40 degrees F or above 90 degrees F when exposed to direct sunlight.
6. Shield ends to be joined from direct sunlight prior to and during laying operation.
7. Use strap wrenches only for tightening threaded plastic joints. Do not over tighten fittings.

D. Polyethylene Piping for Natural Gas:

1. Join pipes, fittings, and flange connections by means of thermal butt-fusion.
2. Perform butt-fusion in accordance with pipe manufacturer's recommendations as to equipment and technique.
3. Lay pipe snaking from one side of trench to other.
4. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and during operation.
5. Do not lay pipe when temperature is below 40 degrees F or above 90 degrees F when exposed to direct sunlight.
6. Shield ends to be joined from direct sunlight prior to and during laying operation.
7. Joint Fusion:
    a. Measure and log each joint fusion by an electronic monitoring device (data logger) affixed to fusion machine capable of being retrieved electronically. Data to be logged shall include the following:
        1) Pipe size and dimensions.
        2) Machine model and size.
        3) Operator identification.
        4) Job identification number.
        5) Weld number.
        6) Fusion, heating, and drag pressure settings.
        7) Heater plate temperature.
        8) Time stamp showing when weld was performed.
        9) Heating and curing time of weld.
        10) Curing temperature readings and time stamps of readings.
        11) Error messages and warnings for out of range temperature or pressure settings.
    b. In addition to logged items above, the following shall be logged or annotated on report:

1) Location of fused joint by pipeline station or by reference to pipe Shop Drawing.
2) Ambient temperature and humidity.
3) If internal bead was removed.

E. Water System Balancing: Provide a qualified registered engineer or firm specializing in testing and balancing to adjust domestic water system. Balance system for required water flows at each plumbing fixture, terminal device, and recirculating hot water loop.

F. Water Hammer Arresters:

1. Install in piping systems where shown on Drawings and adjacent to pieces of equipment where quick closing valves are installed.
2. Install at all emergency safety showers and eyewashes.
3. Size and install in accordance with PDI-WH201.
4. Shock arresters to have access panels or to be otherwise accessible.

G. Valves: Install in accordance with manufacturer's recommendations.

H. Miscellaneous Piping Specialties: Install in accordance with manufacturer's recommendations.

I. Measuring Devices: Install in accordance with manufacturer's recommendations.

3.3 SANITARY AND WASTE DRAINS AND VENTS PIPING

A. Installation:

1. Set piping above floor slab true and plumb.
2. Set exposed risers as close to walls as possible.
3. Slope drain lines at minimum 2 percent slope, unless otherwise noted. Vent lines shall be installed level or sloped, with no low spots.
4. Where vent stacks pass through roof slab, fit with flashing sleeve secured to roof.
5. Extend vents minimum 1 foot above roof.
6. Provide cleanouts where shown and where required by code.

3.4 HVAC CONDENSATE PIPING

A. Set piping true and plumb.

B. Slope piping 1/8 inch per foot minimum.

3.5 WATER SUPPLY PIPING

A. Water supply piping includes potable W1, hot water (HW), and return hot water (RHW).

B. Flush water piping systems clean of internal debris, clean faucet aerators, and adjust plumbing fixture valves for manufacturer's recommended flow.

C. Do not run water piping through electrical rooms, stairwells, or immediately over or within a 3-foot horizontal clearance of electrical panels, motor starters, or environmental control panels.

D. Provide exterior water piping with minimum 3 feet of cover or install below frost line, whichever is greater.

E. Hose Valves and Hydrants: Attach handle with setscrew and provide manufacturer's recommended gravel fill around drain hole of post hydrants.

F. Provide valve operators with position indicators, where indicated, to show position of valve disc or plug.

G. Provide bypass with globe valve for emergency throttling around each reducing valve.

H. Protect buried copper and steel pipe and fittings with a single wrap of coal-tar saturated felt in accordance with AWWA C203.

I. Vacuum Breakers 2 Inches and Smaller: Install minimum 6 inches above flood line of equipment they serve.

J. Provide manual air vents at high points in domestic hot water system.

3.6 HANGERS AND SUPPORTS

A. In accordance with Section 40 05 15, Piping Support Systems**.**

B. Install pre-engineered support equipment in accordance with manufacturer's recommendations.

C. Hanger Rod Sizing and Spacing for:

1. Steel Pipe:

Pipe Size	Max. Hanger Spacing (feet)	Min. Rod Size (inches)
1 inch and smaller	6	1/4
1-1/4 through 2-1/2 inches	8	1/4
3 and 4 inches	10	3/8
6 inches	12	3/8
8 inches	12	1/2

2. Copper Pipe:
   a. Rod Size: Same as for steel pipe.
   b. Spacing: 2 feet less per size than for steel pipe, except pipe 1-1/4 inches and smaller shall be supported every 6 feet.
3. Cast Iron Pipe:
   a. Rod Size: Same as for steel pipe.
   b. Spacing: Locate hanger rods at each pipe joint and change of direction, 10-foot maximum spacing.
4. Plastic Pipe:
   a. Rod Size: Same as for steel pipe.
   b. Spacing: As recommended by manufacturer and required by applicable plumbing code for flow and temperature in pipe.
   c. No metal portion of hanger shall contact pipe directly.

D. Attach Support Rods for Horizontal Piping:

1. To steel beams with I-clamps.
2. To concrete with inserts or with flanges fastened with flush shells.
3. To wood with thickness of 2-1/2 inches or more with bolts or angle clips.

E. Trapeze Hangers:

1. Trapeze hangers may be used in lieu of individual hangers where horizontal piping is arranged with two or more parallel lines.
2. Attach lines to horizontal with U-bolts or one-hole clamps.

F. Vertical Piping:

1. Support by channel type support system and pipe clamps on 10-foot maximum centers.

2. Copper and Plastic Piping: Isolate from channels and pipe clamps with pipe isolators.

G. Insulated Piping: Furnish galvanized protection shield and oversized hangers under insulated piping.

3.7 INSTALLATION—CONCRETE ENCASED

A. Where horizontal piping is encased in concrete such as a floor or equipment slab, rigidly mount pipe to rebar and subbase to prevent lateral movement, sagging, and uplifting during concrete installation and finishing. Provide at least two temporary strut supports wired to rebar and supported from the engineered fill or subbase below for each section of pipe.

B. Where construction joints occur, or piping leaves concrete encasements at buildings, utility trenches, vaults, slabs and other structures, provide elastomeric foam insulation wrap around the pipe at the transition point.

1. Minimum Wrap: five pipe diameters of 1/2-inch-thick insulation on each side of the transition.

C. Provide flexible piping joints to coincide with structure joints to prevent excessive pipe stress and breakage.

3.8 INTERIM CLEANING

A. Prevent accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping during fabrication and assembly.

B. Examine piping to assure removal of foreign objects prior to assembly.

C. Conventional commercial cleaning methods of cleaning are acceptable if method and cleaning material does not corrode, deform, swell, or otherwise alter physical properties of material being cleaned.

3.9 TESTING

A. General:

1. Conduct pressure and leakage tests on newly installed pipelines.
2. Provide necessary equipment and material, and make taps in pipe, as required.
3. Owner Representative will monitor tests. Provide 24-hour advance notice of start of testing.

4. Test Pressures: As specified herein and in Piping Schedule.
5. Test Records: Make records of each piping system installation during test to document the following:
    a. Date of test.
    b. Description and identification of piping tested.
    c. Test fluid.
    d. Test pressure.
    e. Remarks, including:
        1) Leaks (type, location).
        2) Repairs made on leaks.
    f. Certification by Contractor and signed acknowledgment by Owner Representative that tests have been satisfactorily completed.

B. Testing New Pipe Connected to Existing Pipe: Isolate new pipe with grooved end pipe caps, spectacle blinds, or blind flanges.

C. Preparation and Execution:

1. Buried Pressure Piping:
    a. An initial service leak test may be conducted with a partially backfilled trench and the joints left open for inspection, if field conditions permit, as determined by Engineer.
    b. Expose joints for the acceptance test on buried pressure piping to be pneumatically tested or subjected to an initial service leak test.
    c. Conduct final hydrostatic acceptance tests after trench has been completely backfilled.
2. Exposed Piping: Conduct tests after piping has been completely installed including supports, hangers, and anchors, but prior to insulation.

D. Hydrostatic Leak Tests:

Equipment: Provide the following:

Amount	Description
2	Graduated containers
2	Pressure gauges
1	Hydraulic force pump
	Suitable hose and suction pipe as required

1. Procedure:
    a. Use water as the hydrostatic test fluid.
    b. Provide clean test water of such quality as to minimize corrosion of the materials in the piping system.
    c. Open vents at high points of the piping system to purge air pockets while the piping system is filling.
    d. Venting during filling of system may also be provided by loosening flanges with a minimum of four bolts or by the use of equipment vents.
    e. Test piping systems at test pressure specified in Piping Schedule.
    f. Maintain hydrostatic test pressure continuously for 30 minutes minimum and for such additional time as necessary to conduct examinations for leakage.
    g. Examine joints and connections for leakage.
    h. Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking.
    i. Correct visible leakage and retest to satisfaction of Owner Representative.
2. Buried Water Lines:
    a. A limited amount of leakage is permissible according to formula specified.
    b. Conduct hydrostatic testing as follows:
        1) Pipe with Concrete Thrust Blocking: Do not make pressure test until a minimum of 5 days after thrust blocking is installed.
        2) If high-early strength cement is used for thrust blocking, time may be reduced to 2 days.
    c. Cement-Lined Piping: Slowly fill test section with water and allow to stand for 24 hours under slight pressure to allow cement lining to absorb water.
    d. Expel air from piping system prior to testing.
    e. Apply and maintain specified test pressure with hydraulic force pump.
    f. Valve off the piping system when test pressure is reached.
    g. Conduct pressure test for 2 hours, reopening isolation valve only as necessary to restore test pressure.
    h. Accurately measure amount of water required to maintain test pressure by placing pump suction in a barrel or similar device, or by metering.
    i. The measurement represents leakage, defined as the quantity of water necessary to maintain the specified test pressure for the duration of the test period.

j. Determine maximum allowable leakage in gallons per hour from the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

where:

L = Allowable leakage, in gallons per hour
N = Number of joints in the length of pipe tested
D = Nominal diameter of pipe, in inches
P = Test pressure during the leakage test, in pounds per square inch

k. Correct leakage greater than the allowable determined under this formula, and retest to satisfaction of Owner Representative.

3. Test Pressure for Water: 1-1/2 times system pressure.
4. Gravity Sewers and Drains:
   a. Test by water or air exfiltration tests as prescribed by local or state plumbing codes and visually examine for leaks.
   b. Repair leaks and retest system until no further leakage is evident.

E. Pneumatic Leak Tests:

1. Perform on compressed air, natural gas, and vacuum piping.
   Equipment: Provide the following:

Amount	Description
1	Pneumatic compressor separator-dryer system capable of providing oil-free dry air and equipped with one or more full capacity safety relief valves set at a pressure of not more than 105 percent of the required primary test pressure
1	Calibrated test gauge

2. Procedure:
   a. Perform pneumatic testing using accurately calibrated instruments and oil-free, dry air.
   b. Perform tests only on exposed piping, after piping has been completely installed, including supports, hangers and anchors, and inspected for proper installation.
   c. Test piping system at test pressure specified in Piping Schedule.

d. Protect test personnel and Owner's operating personnel from hazards associated with air testing.
e. Secure piping to be tested to prevent damage to adjacent piping and equipment in event of a joint failure.
f. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by test.
g. Apply maximum 25 psig preliminary pneumatic test to piping system prior to final leak testing, to locate major leaks.
h. Examine joints and connections for leakage with soap bubbles.
i. Correct visible leaks and retest.
j. Gradually increase pressure in system to not more than one-half of test pressure.
k. Thereafter increase pressure in steps of approximately 1/10 of maximum test pressure until required test pressure is reached.
l. Maintain pneumatic test pressure continuously for minimum 10 minutes and for such additional time as necessary to conduct a soap bubble examination for leakage.
m. Piping system, exclusive of possible localized instances at pump or valve packing, shall show no evidence of leakage.
n. Correct visible leakage and retest to satisfaction of Engineer.
o. Following pneumatic testing, thoroughly purge lines that are to carry flammable gases with nitrogen to assure no explosive mixtures will be present in system during filling process.

3.10 CLEANING AND DISINFECTION

A. Prior to final acceptance, following assembly and testing, flush pipelines with water, except for plant process air lines and instrument air lines, and remove accumulated construction debris and other foreign matter.

B. Minimum Flushing Velocity: 5 feet per second.

C. Insert cone strainers in the connections to attached equipment and leave until cleaning has been accomplished.

D. Remove accumulated debris through drains 2 inches and larger or by dropping spools and valves.

E. Immediately after draining flushed lines, dry piping with compressed air.

F. Use compressed air to remove loose debris from plant process air and instrument air piping.

G. Disinfect potable water pipelines before placing in service:

1. Meet the requirements of AWWA C651, unless otherwise specified.
2. Disinfecting Mixture:
   a. A chlorine-water solution having a free chlorine residual of 40 ppm to 50 ppm.
   b. Prepare by injecting one of the following:
      1) Liquid chlorine gas-water mixture.
      2) Dry chlorine gas.
      3) Calcium or sodium hypochlorite and water mixture.
   c. Inject mixture into pipeline at a measured rate while freshwater is allowed to flow through the pipeline at a measured rate so the combined mixture of freshwater and chlorine solution or gas is of the specified strength.
   d. Apply liquid chlorine gas-water mixture by means of a chlorinating device.
   e. Feed dry chlorine gas through proper devices for regulating the rate of flow and providing effective diffusion of gas into water within pipe being treated.
   f. Chlorinating devices for feeding solutions of chlorine gas or gas itself must prevent backflow of water into chlorine cylinder.
   g. Calcium Hypochlorite: If this procedure is used, first mix dry powder with water to make a thick paste, then thin to approximately a 1 percent solution (10,000 ppm chlorine).
   h. Sodium Hypochlorite: If this procedure is used, dilute liquid with water to obtain a 1 percent solution.
   The following proportions of hypochlorite to water will be required:

Product	Quantity	Water
Calcium Hypochlorite1 (65 - 70 percent C1)	1 lb	7.5 gal
Sodium Hypochlorite2 (5.25 percent C1)	1 gal	4.25 gal
1 Comparable to commercial products known as HTH, Perchloron, and Pittchlor. 2 Known as liquid laundry bleach, Clorox, and Purex.		

H. Point of Application:

1. Inject chlorine mixture into pipeline to be treated at the beginning of the line through a corporation stop or suitable tap in the top of pipeline.
2. Control clean water from existing system or another source so it flows slowly into newly installed piping during chlorine application.

3. Manipulate valves so the strong chlorine solution in the line being treated will not flow back into line supplying the water. Use check valves, if necessary.

I. Retention Period:

1. Retain treated water in pipeline for a minimum of 24 hours or long enough to destroy nonspore-forming bacteria.
2. At the end of the retention period, the disinfecting mixture shall have strength of at least 10 ppm of chlorine.
3. Operate valves, hydrants, and other appurtenances during disinfection to assure disinfecting mixture is dispersed into all parts of the pipeline including dead ends, new services, and similar areas that otherwise may not receive the disinfecting solution.
4. Do not place concentrated quantities of commercial disinfectants in pipeline before filling with water.
5. After chlorination, flush water from permanent source of supply until water through pipeline is equal chemically and bacteriologically to permanent source of supply.

J. Disposal of Disinfecting Water:

1. Dispose of disinfecting water in accordance with permits and regulations. Protect the public and receiving waters from harmful or toxic concentrations of chlorine.
2. Do not allow disinfecting water to flow into a waterway without adequate dilution or other satisfactory method of reducing chlorine concentrations to a safe level.

3.11 PROTECTION OF INSTALLED WORK

A. Protective Covers:

1. Provide over floor and shower drains during construction, to prevent damage to drain strainers and keep foreign material from entering drainage system.
2. Cover roof drains and emergency overflow drains during roofing process so roofing material and gravel do not enter drain piping.
3. Remove at time of Substantial Completion.

END OF SECTION

SECTION 22 15 19
AIR COMPRESSOR

PART 1 GENERAL

1.1 SCOPE

The Contractor shall furnish all labor, materials, equipment and incidentals required to supply, modify, install, test and place in satisfactory operation one new vertical air compressor located at Maintenance Building.

1.2 DRAWINGS AND DATA

The information submitted by the Contractor in accordance with Section 01 33 00 shall include, but not be limited to, the following items:

A. Shop Drawings showing in detail, the installation of all equipment and appurtenances covered by this specification. Shop Drawings shall include, but not be limited to:

1. Anchoring details.
2. Details of support members.
3. Detailed assembly, installation, and start-up procedures.
4. Dimensions, elevations and materials for all equipment items and appurtenances listed in this specification.
5. Performance curves.
6. Motor Data - type and frame size, insulation and enclosure type, speed.
7. Seismic calculations for determining the anchoring requirements for the air receiver and compressor.

B. Operation and Maintenance Data: Submit Operations and Maintenance Manuals in accordance with Section 01 78 23.

C. Manufacturer's And Supplier's Field And Test Data: All test and field data collected by the manufacturers/suppliers of equipment during installation supervision and start-up services, where required in the Specifications, shall be submitted by the Contractor to the Engineer within fourteen (14) clays after the start-up services are complete.

D. The test and field data shall be submitted whether specified or not in the detailed equipment specifications and shall include but not be limited to tolerance and alignment measurements where applicable to certify equipment has been satisfactorily installed, and all other information collected by the manufacturers/suppliers to satisfy themselves that equipment has been properly installed. In cases where the manufacturer's/supplier's feel equipment is not

properly installed, he shall include with this submittal a punch list detailing the problems noted. The information required under this section shall be furnished for all equipment and devices requiring installation and start-up services as specified in the Specifications or as required for a complete and operable system.

E. Factory Test And Certification: All equipment, devices and systems requiring factory test and certification as required by these Specifications, may be witnessed by the District at the District's expense by reporting intent to do so to the Contractor.

F. The Contractor shall notify the District in writing, at least fourteen (14) calendar days prior to testing by the manufacturer. The written notifications, shall specify the exact date and location the tests shall be conducted, and all testing shall be performed during normal working hours.

1.3 QUALITY ASSURANCE

All equipment shall be new and of current manufacture. The filter equipment manufacturer shall be the source of information on all equipment and material furnished.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to insure uninterrupted progress of the work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time not to delay that work.

B. Packaging shall be as required to prevent damage during shipment and unloading.

C. Handle all equipment and materials very carefully. Damaged equipment and materials will not be acceptable. Protect all bolt threads, etc. from damage and corrosion. Protect all factory applied coatings from damage during shipment, unloading, storage and installation.

D. All material and equipment shall be covered or stored in a manner which will prevent entry of deleterious matter. Power cables shall be covered or stored in a manner which will protect them from dirt and abrasion.

1.5 GUARANTEE AND WARRANTY

A. The Contractor shall obtain from the manufacturer a warranty for all material, equipment, and appurtenances for one year from the date of substantial completion.

B. During the warranty period, the Contractor shall provide the services of a trained manufacturer's representative to make all adjustments, repairs and replace all defective material and equipment at no cost to the Owner.

C. The Contractor shall include all costs incurred by the manufacturer, including travel and expenses, under the terms of the warranty.

PART 2 PRODUCTS

2.1 GENERAL

A. Air Compressor: The new reciprocating air compressor shall operate with a free air delivery of 24 cfm at 175 psig. Compressor shall be 80-gallon vertical with 7.5 Hp open drip proof motor. The unit weight shall not exceed 500 pounds, and the overall dimensions of the unit shall not exceed 26 inches long by 38 inches wide by 70 inches high. Provide condensate drain, oil/water separator, and factory-supplied pressure controller. Compressor shall be rated for continuous duty in 115°F ambient conditions. Provide electric tank drain, low level oil switch, aftercooler, and oil sight glass. Provide packaged motor starter and ASME rated air receiver. Provide installation kit with vibration isolators.

At a distance of 1 meter from the compressor, the noise level of the compressor shall not exceed 80 dBA for the entire range of compressor operating conditions, both loaded and unloaded.

PART 3 EXECUTION

3.1 INSPECTION

A. Prior to installation, the Contractor shall provide for one site visit and up to 4 hours of time on-site by the compressor manufacturer's representative to provide the following services:

1. Ensure that the equipment shipped to the job-site has been handled according to the manufacturer's recommendations and has arrived in good working order.
2. Ensure that all equipment has been stored and protected according to the manufacturer's recommendations.

B. Inspect and verify the structures or surfaces on which the equipment will be installed have no defects which would adversely affect the installation.

C. The Contractor shall promptly report, in writing, defects which may affect the work to the Engineer. A copy of the manufacturer's field report shall be provided to the Engineer.

3.2 INSTALLATION

A. Install in a manner and to the tolerances recommended by the equipment manufacturer.

B. Installation shall include furnishing and applying an initial supply of grease and oil, recommended by the manufacturer.

C. Support piping independent of compressor.

3.3 START-UP AND FIELD TESTS

A. Contractor shall verify that structures, pipes and equipment are compatible.

B. Demonstrate that the completed installation meets specified requirements and that all controls and safety shutdowns are operational. Make adjustments required to place equipment in proper operating condition.

3.4 MANUFACTURER'S FIELD SERVICES

A. Retain factory trained manufacturer representatives with demonstrated ability and experience in the installation and operation of the pumps, and motors and accessories to perform the services listed below:

1. Provide technical assistance to Contractor during installation of compressor and appurtenances.
2. Instruct Owner's personnel in the operation and user maintenance of all components.

B. The manufacturer shall check and approve the installation during construction and prior to initial operation. Prior to initial start-up, a written statement shall be provided by the manufacturers stating the equipment has been installed by the Contractor in accordance with the Drawings, Specifications and manufacturer's shop drawings and is ready to be placed into operation. The manufacturer shall test operate the system in the presence of the Engineer and shall verify the equipment conforms with the specified requirements. The manufacturer shall re-visit the job-site as often as necessary until all deficiencies are corrected and the installation and operation is satisfactory to the Engineer.

C. Perform all tests (Vibration, Field Performance) in the presence of the Engineer and the manufacturer's representative.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Emergency Shower/Eye-Facewash System
   2. Emergency Shower Alarm System
   3. Water Heater
   4. Mixing Valve System

B. Related Sections:
   1. Division 22 Sections as Included.
   2. Plumbing Piping and Accessories: Section 22 10 01.

1.2 REFERENCES

A. The publications listed below form a part of the section to the extent referenced. The publications are referred to within the text by the basic definition only.

B. American Society of Mechanical Engineers (ASME) Pressure Vessel Code and Interpretations shall govern the quality and performance of certain Products as specified herein.

C. American Society of Sanitary Engineering, Standards ASSE 1010, 1011, 1012 and 1013.

D. National Electric Manufacturer's Association (NEMA) Standards as apply to specified Products.

E. National Fire Protection Association (NFPA)

F. Plumbing and Drainage Institute: Standard P.D.I. - WH201.

G. Underwriters' Laboratories, Inc. (UL) Listings and Labels shall govern the quality and performance of certain Products as specified herein.

H. Plumbing Fixture Fittings: ASME A112.6.1M

I. Electric Water Coolers: ARI 1010 and UL 399

J. Vitreous China Fixtures: ASME A112.19.2M

K. National Sanitation Foundation Construction: NSF-2

L. National Sanitation Foundation: Drinking Water System Components – Health Effects NSF-61.

1.3 SUBMITTALS

A. Product Data: Submittals required for the following items:
   1. Plumbing Fixtures and Trim
   2. Emergency Shower and Controls

B. Operations and Maintenance Data:
   1. Manufacturer's of plumbing fixtures, trim and fittings shall include complete instructions with their products giving directions for replacing renewable parts of their products as well as instructions for cleaning the finished surfaces of such products.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Accept equipment, materials, and other Products on site in factory containers, bundles, and shipping skids.

B. Delivery and Acceptance at Site:
   1. Deliver material in original packages, containers, skid loads, or bundles bearing brand names and identification of source of manufacture or supply.
   2. Inspect deliveries for damage.

C. Storage and Protection:
   1. Store materials inside under cover and in a dry location.
   2. Protect from weather, direct sunlight, surface damage, corrosion, and construction traffic and activity.
   3. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Handling:
   1. Handle material to prevent damage to edges, ends, surfaces, and finishes.

1.5 PROJECT CONDITIONS

A. Protection:
   1. Use non-marring tools when making up plated piping to prevent scarring or other surface damage.

2. Provide adequate protective covering on fixtures and trim to prevent damage or defacement. Maintain such protection until completed work is accepted by the Engineer.
3. Store fixtures and trim at the site and elsewhere, protected from the elements.
4. Protect motors and electrical apparatus from construction debris and water during plumbing work in the vicinity of such equipment. Such protection may be afforded by using impervious membrane material sheets or other impervious materials of Contractor's choosing.

PART 2 PRODUCTS

2.1 MATERIALS

A. Plumbing and Piping System Specifications: As specified in Section 22 10 01.

2.2 EMERGENCY SHOWER AND FACE/EYEWASH COMBINATION UNITS

A. Acceptable Manufacturers:
   1. Haws Drinking Faucet Co.
   2. Or Approved Equal

B. Emergency Shower and Eye/Facewash:
   1. Floor mounted design incorporating the following components; Model 8330.
   2. Drench Shower: Stainless steel showerhead with 20-GPM flow control.
   3. Valves: Eye/Face/Shower wash valves must all be made of Type 316 stainless steel.
   4. Corrosion resistant stainless-steel bowl, with a No. 2L bright finish on its exterior.
   5. Stand: 1-1/4" Type 316 Stainless Steel pipe and fittings along with cast finished stainless steel 9" diameter floor flange.
   6. Supply and Waste Sizes: 1 1/4-inch IPS connections.
   7. Identification Signs: Universal emergency sign.

2.3 EMERGENCY SHOWER AND EYEWASH FLOW SWITCH AND ALARM

A. Acceptable Manufacturers:
   1. Haws Drinking Faucet Co.
   2. Or Approved Equal

B. Emergency Shower Flow Switch Alarm:
   1. Automatic, audible and visual alarm system pre-assembled, NEMA 3, UL Listed. Horn - Rated at 78 to 105 decibels at 10 feet. 120 volts, Switch to turn horn off while strobe flashes and water flows, 1 1/4-inch IPS. Light - Strobe light, Amber. 12-feet of power cable or connected length as required, remote wiring contacts; Model S19-320.
   2. Flow Switch Assembly - Water tight, 125V, 5 Amps, double pole, double throw.

2.4 MIXING VALVE

A. Acceptable Manufacturers:
   1. Haws Drinking Faucet Co Or Approved Equal

B. Emergency Shower Eye/Face Wash Dual Thermostatic Mixing Valve:
   1. General: Bronze construction with rough bronze finish, 125 psi working pressure, factory assembled and tested. Valve shall meet ASSE Standard 1017 requirements and ANSI Z 358.1-1998.
   2. Primary Mixing Valve: Solid bi-metal thermostat directly linked to valve porting to control intake of hot and cold water and to compensate for supply temperature and pressure fluctuations. Valve can be set to correct outlet temperature. Locking type temperature regulator to prevent accidental movement set for 85 degrees F (29 degrees C). Valve designed to close down on failure of cold water supply and shall incorporate built-in cold water bypass capable of 1.25 gpm (4.731/min) at 30 psi (2.1 bar) upon the failure of hot water supply – adjustable high temperature limit stop.
   3. Secondary Mixing Valve: Wax encapsulated thermostat set to open at 85 degrees F (29 degrees C) to permit cold water to enter the outlet side of primary mixing valve. Valve remains closed until outlet temperature reaches 85 degrees F (29 degrees C). Valve will keep maximum temperature at 90 degrees F should primary valve permit water in excess of 90 degrees F (32 degrees C); exposed installation.

2.5 WATER HEATER

A. Acceptable Manufacturers:
   1. A.O. Smith
   2. RUUD
   3. State
   4. Or Approved Equal

B. Storage type UL listed electric water heater with ASME rated temperature and pressure relief valve.
   1. Shall meet the standby loss requirements of the U.S. Department of energy and current edition of ASHRAE/IES 90.1. Tank(s).
   2. Heater(s) shall have 150 psi working pressure.
   3. Equipped with extruded high density anode rod for corrosion protection.
   4. Internal surfaces of the heater(s) exposed to water shall be glass lined with an alkaline borosilicate composition that has been fused-to-steel.
   5. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. The outer jacket shall be of backed enamel finish and shall enclose the tank with foam insulation.

a. Control temperature range: 110 – 170 deg. F.

6. Electrical junction box with heavy duty terminal block shall be provided. The drain valve shall be located in the front for ease of servicing.

PART 3 EXECUTION

3.1 INSPECTION

A. Condition of Rough-Ins: Inspect rough-ins and determine exact fixture location with respect to the Drawings.

B. Do not proceed until fixture positions are verified, or any adjustment in fixture locations are approved by the Engineer.

3.2 PERFORMANCE

A. Installation Instructions: Install those Products, as specified previously under PART 2 and not specifically covered for installation herein under PART 3, in strict accordance with manufacturer's installation instructions and at locations indicated on the Drawings.
   1. Equipment support and anchoring as specified in Section 22 10 01.

B. Equipment Start-Up: Perform equipment start-up and insure its proper operation prior to acceptance of Work by the Engineer.

3.3 PLUMBING FIXTURE INSTALLATION

A. Fixture Supports: Securely anchor surface mounted fixture hangers and supports into the structure using Anchors and Fasteners as specified in Section 22 10 01.
   1. Install fixture Carriers according to manufacturer's installation instructions using Fasteners as previously referenced.
   2. Provide chrome-plated nuts, cap nuts, screw heads and washers where such are required in an exposed installation.

B. Fixture Installation:
   1. Install wall hung fixtures plumb and square with respect to the visible structure lines.
   2. Set floor mounted fixtures securely anchored in position symmetrical with the floor plan.
   3. Install water closets with sponge rubber closet flange gaskets; substitutes not permitted.
   4. Install bead of sealant between fixture and floor and wall.
   5. Fixture mounting height to correspond to the fixture schedule, located on the drawings, and/or ADA requirements.

6. Verify the alarm system for the emergency eyewash and showers operates on flow of water.
7. Provide thermostatic mixing valve for lavatory.

3.4 FIELD QUALITY CONTROL

A. Finished Plumbing Test:
   1. After fixtures are set and their traps filled with water perform final test on plumbing system for gas and water tightness.
   2. After filling all traps with water introduce a pungent, thick smoke into system until smoke exits roof vents, then plug vents and pressurize system equivalent to a 1-inch water column and maintain pressure until system inspection is completed.
   3. Where smoke test is not allowed a peppermint test may be substituted. After filling all traps place 2 ounces of oil of peppermint into roof vents followed immediately by 10 quarts of hot (160 degree) water and seal roof vents. Exclude persons having come in contact with peppermint from test area. A positive test (leakage) is detection of peppermint odor at any point in the system.
   4. When permitted by Engineer, or where code prohibits above test method, test system for gas and water-tightness by plugging roof vents and building drain, filling traps with water, and introducing air pressure into the system equivalent to 1-inch water column. Maintain pressure without introduction of additional air until system inspection is completed.

END OF SECTION

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART2 PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 23 05 17
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
3. Or Equal.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.
6. Or Equal.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel, Plastic, or Stainless steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Presealed Systems.
2. Or Equal.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
   a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves, Galvanized-steel-pipe sleeves, or Sleeve-seal fittings.
2. Interior Partitions:
   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION

SECTION 23 05 18
ESCUTCHEONS FOR HVAC PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:
    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
    f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
    h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
    j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 23 05 48
VIBRATION ISOLATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. ASTM International (ASTM):
   a. A36/A36M, Specification for Carbon Structural Steel.
   b. E488, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
3. American Welding Society (AWS): D1.1/D1.1M, Structural Welding Code—Steel.
4. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Seismic Restraint Manual: Guidelines for Mechanical Systems.
5. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

1.2 DEFINITIONS

A. AHJ: Authority Having Jurisdiction.

B. EPDM: Ethylene-Propylene-Diene Monomer.

C. OSHPD: Office of Statewide Health Planning and Development, for the State of California.

D. Withstand: Unit will remain in place without separation of any parts from the device when subjected to seismic forces specified and unit will be fully operational after the seismic event**.**

1.3 DESIGN REQUIREMENTS

A. Seismic Control:

1. Provide seismic control as required to maintain integrity of mechanical piping, ductwork, and equipment installed in this Project, so they will "withstand" seismic forces.

2. Design shall comply with requirements of this Specification, applicable codes, and requirements of Section 01 61 00, Common Product Requirements.
3. Design, size, and install for piping and equipment throughout facility, whether shown or not.
4. Designed by a registered Professional Engineer in the state where the Work is to be installed.
5. Seismic restraints shall conform to requirements of SMACNA's Seismic Restraint Manual: Guidelines for Mechanical Systems.

1.4 SUBMITTALS

A. Action Submittals:

1. Shop Drawings, Vibration Isolators:
   a. Include, as a minimum, basic equipment layout, length and width, installed operating weights of equipment to be isolated and distribution of weight at isolation points.
   b. Product Data:
      1) Manufacturer's product data including details of materials, construction, dimensions of individual components, installation details, and finishes.
      2) Schedule of vibration isolator type with location and static and dynamic load on each.
      3) Vibration Isolation Base Details:
         a) Detail fabrication, including anchorages and attachments to structure and to supported equipment.
         b) Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
2. Shop Drawings, Seismic Control Components:
   a. Include, as a minimum, basic equipment layout, length and width, installed operating weights of equipment to be isolated and distribution of weight at isolation points.
   b. Signed and sealed by a registered Professional Engineer registered in the state where the Project is located.
   c. Include, as a minimum, a tabulation of design data for each snubber, including specific anchorage details.
   d. Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

e. Product Data:
    1) Manufacturer's product data including details of materials, construction, dimensions of individual components, installation details, and finishes.
    2) Schedule of seismic control component type with location and static and dynamic load on each.
    3) Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
f. Seismic anchorage and bracing data sheets and drawings as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.
2. Certifications:
    a. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements**.**
    b. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
    c. Welding Certificates: Welding procedures and personnel.
    d. Manufacturer's Seismic Certification: Certification that specified equipment will withstand seismic forces. Include the following:
        1) Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
        2) Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
        3) Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
3. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Isolation materials, flexible connectors, and seismic restraints shall be same manufacturer. Select and certify using published or factory certified data.

C. Vibration isolation and seismic restraint manufacturer shall be a member of the Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

D. Seismic Control:

1. Designer Qualifications:
   a. Professional Engineer registered in state where Project resides.
   b. Experience certifying seismic snubber and anchorage details.
2. Components shall bear anchorage pre-approval "R" number, from OSHPD or other agency acceptable to AHJ, showing maximum seismic restraint ratings.
3. Horizontal and vertical load testing and analysis shall be performed according to OSHPD requirements.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below which match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Seismic Snubber Units: Furnish replacement neoprene inserts for snubbers.

PART 2 PRODUCTS

2.1 EQUIPMENT SCHEDULES

A. Refer to Drawings for product type and capacities.

2.2 VIBRATION ISOLATION

A. General:

1. Provide for mechanical piping, ductwork, and equipment as identified by this Specification.
2. Select in accordance with equipment, pipe, or duct weight distribution to produce reasonably uniform deflections.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 30 percent and 60 percent of maximum deflection.

B. Elastomeric Pad:

1. Oil-resistant and water-resistant elastomer or natural rubber waffle pads, arranged in single or multiple layers, molded with a nonslip pattern.
2. Waffle pads bonded each side of minimum 1/4-inch-thick galvanized steel separator plate.
3. Height of waffle ribs shall not exceed 0.7 times width.
4. Maximum Loading: 60 psi.
5. Minimum Single Layer Thickness: 1/4 inch.
6. Separator plate of sufficient stiffness for uniform loading over pad area.
7. Factory cut to size that matches requirements of supported equipment.
8. Waffle Pad Material: Standard neoprene.
9. Number of Layers: As required to support equipment load; refer to manufacturer's data for load capacities.

C. Elastomeric Mount:

1. Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements.
2. Factory-drilled, encapsulated top plate for bolting to equipment.
3. Baseplate for bolting to structure.

D. Open Spring Isolator:

1. Freestanding, laterally stable, open-spring isolators.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: 80 percent minimum of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplate:
    a. Factory drilled for bolting to structure and bonded to 1/4-inch thick rubber isolator pad attached to baseplate underside.
    b. Limit floor load to 100 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Restrained Spring Isolator:

1. Freestanding, steel, open-spring isolators with seismic restraint.
2. Housing: Steel with resilient vertical limit stops to prevent spring extension because of wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch-thick elastomeric isolator pad attached to

baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

3. Outside Spring Diameter: 80 percent minimum of compressed height of spring at rated load.
4. Minimum Additional Travel: 50 percent of required deflection at rated load.
5. Lateral Stiffness: 80 percent minimum of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Elastomeric Hanger:

1. Double-deflection type.
2. Molded, oil-resistant rubber or neoprene isolator elements bonded to steel housing.
3. Threaded connections for hanger rods.

G. Spring Hanger:

1. Combination coil spring and elastomeric insert hanger with spring and insert in compression.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: 80 percent minimum of compressed height of spring at rated load.
4. Minimum Additional Travel: 50 percent of required deflection at rated load.
5. Lateral Stiffness: 80 percent minimum of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element:
    a. Molded, oil-resistant rubber or neoprene.
    b. Steel washer reinforced cup to support spring and bushing projecting through bottom of frame.

H. Thrust Limit:

1. Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop.
2. Rod and angle iron brackets for attaching to equipment.
3. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

4. Outside Spring Diameter: 80 percent minimum of compressed height of spring at rated load.
5. Minimum Additional Travel: 50 percent of required deflection at rated load.
6. Lateral Stiffness: 80 percent minimum of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
9. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

I. Manufacturers:

1. Mason Industries, Inc.
2. Kinetics Noise Control, Inc.
3. California Dynamics Corp.
4. Isolation Technology, Inc.
5. M.W. Sausse & Co., Inc. (VIBREX).
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation Co., Inc.
8. The VMC Group.
9. Or Equal.

2.3 EQUIPMENT BASES

A. Structural Steel Base:

1. Factory-fabricated, welded, structural steel base and rail.
2. Design Requirements:
   a. Lowest possible mounting height with not less than 1-inch clearance above floor.
   b. Provide equipment anchor bolts and auxiliary motor slide bases or rails.
   c. Provide supports for suction and discharge elbows for pumps.
3. Structural Steel:
   a. Steel shapes, plates, and bars complying with ASTM A36/A36M.
   b. Bases shall have shape to accommodate supported equipment.
4. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

B. Concrete Inertia Base:

1. Factory-fabricated, welded, structural steel base and rail ready for cast-in-place concrete.
2. Design Requirements:
    a. Lowest possible mounting height with not less than 1-inch clearance above floor.
    b. Provide equipment anchor bolts and auxiliary motor slide bases or rails.
    c. Provide supports for suction and discharge elbows for pumps.
3. Structural Steel:
    a. Steel shapes, plates, and bars complying with ASTM A36/A36M.
    b. Bases shall have shape to accommodate supported equipment.
4. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
5. Fabrication:
    a. Fabricate steel templates to hold equipment anchor bolt sleeves and anchors in place during placement of concrete.
    b. Obtain anchor bolt templates from supported equipment manufacturer.
6. Concrete: 3,000 psi.

C. Rooftop Isolation Rails:

1. Factory-assembled, fully enclosed, insulated, airtight, and watertight curb rail designed to resiliently support equipment.
2. Lower Support Assembly:
    a. Sheet metal "Z" section containing adjustable and removable steel springs that support upper floating frame.
    b. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind and seismic forces.
    c. Provide means for attaching to building structure and a wood nailer for attaching roof materials.
    d. Insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
3. Isolators:
    a. Adjustable, restrained spring type, mounted on elastomeric vibration isolation pads.
    b. Provide access ports, for level adjustment, with removable waterproof covers at isolator locations.
    c. Locate so they are accessible for adjustment during life of installation without interfering with integrity of roof.
    d. Restrained Spring Isolators:
        1) Freestanding, steel, open spring isolators with seismic restraint.

2) Housing: Steel with resilient vertical limit stops and adjustable equipment mounting and leveling bolt.
3) Outside Spring Diameter: 80 percent minimum of compressed height of spring at rated load.
4) Minimum Additional Travel: 50 percent of required deflection at rated load.
5) Lateral Stiffness: 80 percent minimum of rated vertical stiffness.
6) Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

e. Elastomeric Isolator Pads:
1) Oil-resistant and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern.
2) Single Layer Thickness: Minimum 1/4 inch.
3) Galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to size that match requirements of supported equipment.
4) Material: Standard neoprene.
5) Number of Layers: As required to support equipment load; refer to manufacturer's data for load capacities.

4. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
5. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counter-flashed over roof materials.

D. Manufacturers:

1. Mason Industries, Inc.
2. Kinetics Noise Control, Inc.
3. California Dynamics Corp.
4. M.W. Sausse & Co., Inc. (VIBREX).
5. Thybar Inc.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation Co., Inc.
8. The VMC Group.
9. Or Equal.

2.4 FLEXIBLE CONNECTORS

A. Flexible Pipe Connectors:

1. Braided Nonferrous: For nonferrous piping systems, provide bronze hose covered with bronze wire braid with copper tube ends or bronze flanged ends, braze-welded to hose.
2. Braided Stainless Steel: For ferrous piping, provide stainless steel hose covered with Type 304 stainless steel wire braid with NPT steel nipples or 150-psi ANSI flanges, welded to hose.
3. Rubber:
    a. Neoprene or EDPM construction consisting of multiple piles of nylon tire cord fabric and elastomer, molded and cured in hydraulic rubber presses.
    b. Straight or elbow connector as indicated on Drawings, rated at 125 psi at 220 degrees F.
4. Manufacturers:
    a. Mason Industries, Inc.
    b. General Rubber.
    c. Kinetics Noise Control, Inc.
    d. Or Equal.

B. Flexible Duct Connectors: Refer to Section 23 31 13, Metal Ducts and Accessories.

2.5 SEISMIC RESTRAINTS

A. Resilient Isolation Washers and Bushings: One-piece, molded neoprene, having a durometer 60, plus or minus 5, with a flat washer face.

B. Seismic Snubbers: Factory fabricated using welded structural steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

C. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

D. Anchor Bolts:

1. Seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

E. Manufacturers:

1. California Dynamics Corp.
2. Kinetics Noise Control, Inc.

3. Loos & Co., Inc.; Cableware Technology Division.
4. Mason Industries, Inc.
5. M.W. Sausse & Co., Inc. (VIBREX).
6. TOLCO Incorporated.
7. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
8. Vibration Eliminator Co., Inc.
9. Vibration Isolation Co., Inc.
10. The VMC Group.
11. Or Equal.

2.6 SHOP/FACTORY FINISHING

A. Manufacturer's standard paint applied to factory-assembled and factory-tested equipment, before shipping.

1. Powder coating on springs and housings.
2. Electro-galvanized hardware.
3. Hot-dip galvanized metal components for exterior use.
4. Baked enamel coat metal components for interior use.

B. Color-code or otherwise mark vibration isolation and seismic control devices to indicate capacity range.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Install products in accordance with manufacturers' written instructions.

2. Connect wiring to isolated equipment with flexible hanging loop.
3. Install roof curbs, equipment supports, and roof penetrations as specified in Section 07 70 01, Roof Specialties and Accessories.
4. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.
5. Locate isolation hangers as near overhead support structure as possible.

B. Vibration Isolators:

1. Install spring hangers without binding.
2. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

C. Equipment Bases:

1. Adjust equipment level.
2. Bases with seismic snubbers shall have snubbers located close to isolators.
3. Structural Steel Bases: Set steel bases for 1-inch clearance between housekeeping pad and base.
4. Concrete Inertial Bases:
    a. Set concrete inertia bases for 2-inch clearance between housekeeping pad and base.
    b. Fill concrete inertia bases, after installing base frame, with concrete; trowel to a smooth finish.

D. Flexible Connectors: Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

E. Seismic Restraint Devices:

1. Notify local representative of seismic restraint materials manufacturer prior to installing seismic restraint devices.
2. No rigid connections between equipment and building structure shall be made which degrades seismic restraint system herein specified.
3. Electrical conduit to restrained equipment shall be looped to allow free motion of equipment without damage to electrical wiring.
4. Install seismic snubbers on isolated equipment.
5. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
6. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they

do not bend across sharp edges of adjacent equipment or building structure.

7. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers.
8. At trapeze anchor locations, shackle piping and equipment to trapeze.
9. Install resilient bolt isolation washers on equipment anchor bolts.
10. Upon completion of seismic restraint material installation and before startup of restrained equipment, clean debris from beneath protected equipment, leaving equipment free to contact snubbers.

3.3 FIELD QUALITY CONTROL

A. Testing:

1. Conduct the following field quality-control testing:
   a. Isolator deflection.
   b. Isolator seismic-restraint clearance.
   c. Snubber minimum clearances.

B. Seismic Control Component Inspection:

1. Conduct periodic inspections of material installation with assistance of manufacturer's representative. Report in writing deviations from good installation practice.
2. Upon completion of seismic restraint device installation inspect completed system with assistance of manufacturer's representative. Report in writing installation errors, improperly selected snubber devices, or other fault in the system that could affect performance of the system.

3.4 MANUFACTURER'S SERVICES:

A. Manufacturer's Representative: Present at Site or classroom designated by Owner for minimum person-days listed below, travel time excluded:

One person-days for installation assistance and inspection.

1. One person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
2. One person-days for facility startup.

3.5 ADJUSTING

A. Vibration Isolation Devices:

1. Adjust isolators after piping systems have been filled and equipment is at operating weight.
2. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height.
3. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
4. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
5. Adjust isolators to ensure units do not exceed rated operating deflections or bottom out under loading, and are not short circuited by other contacts or bearing points.
6. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

B. Seismic Control Components:

1. Adjust snubbers according to manufacturer's written recommendations.
2. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
3. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.6 CLEANING

A. After completing equipment installation, inspect vibration isolation and seismic control devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.025-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White or Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover or cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.5 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Stainless steel, 0.025-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire or Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels

with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Refrigerant Piping:
   a. Background Color: White.
   b. Letter Color: Black.

3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper

identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
   a. Refrigerant: 1-1/2 inches, round or square.
2. Valve-Tag Color:
   a. Refrigerant: Natural or Green.
3. Letter Color:
   a. Refrigerant: Black or White.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
   a. Constant-volume air systems.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 ACTION SUBMITTALS

A. TAB Report for Prerequisite EA 2: Documentation of work performed for ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB, or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB, or, TABB as a TAB technician.

B. TAB Conference: Owner or construction manager on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:
   a. The Contract Documents examination report.
   b. The TAB plan.
   c. Coordination and cooperation of trades and subcontractors.
   d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Owner or Construction Manager.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

J. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

L. Examine system pumps to ensure absence of entrained air in the suction piping.

M. Examine operating safety interlocks and controls on HVAC equipment.

N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
2. Measure fan static pressures as follows to determine actual static pressure:
    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
   a. Report the cleanliness status of filters and the time static pressures are measured.
4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Owner or Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.
   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.9 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.

15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.
2. Motor Data:
    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.

d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
a. Total air flow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Cooling-coil static-pressure differential in inches wg.
g. Return airflow in cfm.
h. Outdoor-air damper position.
i. Return-air damper position.
j. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:
a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
a. Air flow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Return-air, wet- and dry-bulb temperatures in deg F.
e. Entering-air, wet- and dry-bulb temperatures in deg F.
f. Leaving-air, wet- and dry-bulb temperatures in deg F.
g. Refrigerant expansion valve and refrigerant types.
h. Refrigerant suction pressure in psig.
i. Refrigerant suction temperature in deg F.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
a. System identification.

b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:
a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

H. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

3.11 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
    a. Measure airflow of at least 10 percent of air outlets.
    b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    c. Verify that balancing devices are marked with final balance position.
    d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner or Construction Manager.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner or Construction Manager.
3. Owner or Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 13
DUCT INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, exposed supply and outdoor air.
2. Indoor, exposed return located in unconditioned space.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 12 inches square.
2. Sheet Jacket Materials: 12 inches square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Friendly Feel Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap.
   e. Owens Corning; SOFTR All-Service Duct Wrap.
   f. Or Equal.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
   b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.
   c. Or Equal.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
   d. Or Equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Corning Corporation; 739, Dow Silicone.
   b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
   c. P.I.C. Plastics, Inc.; Welding Adhesive.
   d. Speedline Corporation; Polyco VP Adhesive.
   e. Or Equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749.
   c. Or Equal.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
   b. Eagle Bridges - Marathon Industries; 501.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
   d. Mon-Eco Industries, Inc.; 55-10.
   e. Or Equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
   b. Eagle Bridges - Marathon Industries; 550.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
   d. Mon-Eco Industries, Inc.; 55-50.
   e. Vimasco Corporation; WC-1/WC-5.
   f. Or Equal.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    b. Vimasco Corporation; 713 and 714.
    c. Or Equal.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
    b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    c. Mon-Eco Industries, Inc.; 44-05.
    d. Or Equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    b. Or Equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.
    b. Or Equal.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
    b. Vimasco Corporation; Elastafab 894.
    c. Or Equal.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and pre-sized a minimum of 8 oz./sq. yd.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.
    b. Or Equal.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.
e. Or Equal.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
   b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
   c. RPR Products, Inc.; Insul-Mate.
   d. Or Equal.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, and Temper H-14.
   a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   e. Or Equal.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ABI, Ideal Tape Division; 491 AWF FSK.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
   e. Or Equal.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.
   d. Or Equal.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ABI, Ideal Tape Division; 488 AWF.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.
e. Or Equal.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
   c. Or Equal
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
      5) Or Equal.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-

diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    1) AGM Industries, Inc.; CHP-1.
    2) GEMCO; Cupped Head Weld Pin.
    3) Midwest Fasteners, Inc.; Cupped Head.
    4) Nelson Stud Welding; CHP.
    5) Or Equal.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
        2) GEMCO; Perforated Base.
        3) Midwest Fasteners, Inc.; Spindle.
        4) Or Equal.
    b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, and securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        1) GEMCO; Nylon Hangers.
        2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
        3) Or Equal.
    b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.

c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, and securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
      2) GEMCO; Peel & Press.
      3) Midwest Fasteners, Inc.; Self Stick.
      4) Or Equal.
   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel, aluminum, or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.
      5) Or Equal.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be

incorporated into the Work include, but are not limited to, the following:

1) GEMCO.
2) Midwest Fasteners, Inc.
3) Or Equal.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. C & F Wire.
   b. Or Equal.

2.12 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

    1. Install insulation continuously through hangers and around anchor attachments.
    2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
    3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring

indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Fire stopping" and fire-resistive joint sealers.

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
   a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage or Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, exposed supply and outdoor air.
2. Indoor, exposed return located in unconditioned space.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Exposed, round and flat-oval, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Exposed, round and flat-oval, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Exposed, round and flat-oval, outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

D. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

E. Exposed, rectangular, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

F. Exposed, rectangular, outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Exposed:

1. None.
2. PVC: 20 mils thick.
3. Aluminum, Smooth, Corrugated, or Stucco Embossed: 0.020 inch thick.

END OF SECTION

SECTION 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.2 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. MS/TP: Master slave/token passing.

D. PC: Personal computer.

E. PID: Proportional plus integral plus derivative.

F. RTD: Resistance temperature detector.

1.3 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.

8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
    a. Space Temperature: Plus or minus 1 deg F.
    b. Ducted Air Temperature: Plus or minus 1 deg F.
    c. Outside Air Temperature: Plus or minus 2 deg F.
    d. Dew Point Temperature: Plus or minus 3 deg F.
    e. Temperature Differential: Plus or minus 0.25 deg F.
    f. Relative Humidity: Plus or minus 5 percent.
    g. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
    h. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
    i. Airflow (Terminal): Plus or minus 10 percent of full scale.
    j. Air Pressure (Space): Plus or minus 0.01-inch wg.
    k. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
    l. Carbon Monoxide: Plus or minus 5 percent of reading.
    m. Carbon Dioxide: Plus or minus 50 ppm.
    n. Electrical: Plus or minus 5 percent of reading.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Retain three subparagraphs below for DDC systems.
2. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
3. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
4. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.

4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:
    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:
    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

C. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.

D. Samples for Verification: For each color required, of each type of thermostat or sensor cover.

1.5 INFORMATIONAL SUBMITTALS

A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.

B. Qualification Data: For Installer and manufacturer.

C. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

D. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to

items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

B. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replacement Materials: One replacement diaphragm or relay mechanism for each unique valve motor, controller, thermostat, positioning relay.
2. Maintenance Materials: One thermostat adjusting key(s).

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ASHRAE 135 for DDC system components.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

CONTROL SYSTEM

E. Manufacturers:

1. Alerton Inc.
2. American Auto-Matrix.
3. Andover Controls Corporation.
4. Automated Logic Corporation.
5. Carel.
6. Delta Controls Inc.
7. EDA Controls Corp.
8. Electronic Systems USA, Inc.
9. Functional Devices Inc.
10. Heat-Timer Corporation.
11. Honeywell International Inc.; Home & Building Control.
12. Impact Energy Controls Corp.
13. Invensys Building Systems.
14. Johnson Controls, Inc.; Controls Group.
15. KMC Controls/Kreuter Manufacturing Company.
16. Luwa USA, Inc.; Textile Air Engineering.
17. MAMAC Systems, Inc.
18. McQuay International.
19. Pneuline Controls.
20. Sauter Controls Corporation.
21. Siemens Building Technologies, Inc.
22. Solidyne Corp.
23. Spence Engineering Company, Inc.
24. Staefa Control System Inc.; Siemens Building Technologies, Inc.
25. TAC Americas, INC.
26. TCS/Basys Controls.
27. tekmar Control Systems, Inc.
28. Teletrol Systems Incorporated.
29. Temco Controls Ltd. USA.

30. Tour & Andersson Control, Inc.
31. Trane; Worldwide Applied Systems Group
32. Triangle MicroSystems, Inc.
33. Voltec, Inc.
34. Or equal.

F. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

G. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

H. Control system shall include the following:

1. Building intrusion detection system specified in Section 281600 "Intrusion Detection."
2. Building clock control system specified in Section 275313 "Clock Systems."
3. Building lighting control system specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."
4. Fire alarm system specified in Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System."

DDC EQUIPMENT

I. Operator Workstation: One PC-based microcomputer(s) with minimum configuration as follows:

1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Graphics: Video adapter, minimum 1280 x 1024 pixels, 64-MB video memory, with TV out.
3. Monitor: 17 inches, LCD color.
4. Keyboard: QWERTY, 105 keys in ergonomic shape.
5. Hard-Disk Drive: 80 GB.
6. CD-ROM Read/Write Drive: 48x24x48.
7. Mouse: Three button, optical.
8. Uninterruptible Power Supply: 2 kVa.
9. Operating System: Microsoft Windows XP Professional with high-speed Internet access.

a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

10. Printer: Black-and-white, laser-jet type as follows:

    a. Print Head: 1200 x 1200 dpi resolution.
    b. Paper Handling: Minimum of 250 sheet trays.
    c. Print Speed: Minimum of 120 characters per second.

11. Printer: Color, ink-jet type as follows:

    a. Print Head: 4800 x 1200 dpi optimized color resolution.
    b. Paper Handling: Minimum of 100 sheets.
    c. Print Speed: Minimum of 17 ppm in black and 12 ppm in color.

12. Application Software:

    a. I/O capability from operator station.
    b. System security for each operator via software password and access levels.
    c. Automatic system diagnostics; monitor system and report failures.
    d. Database creation and support.
    e. Automatic and manual database save and restore.
    f. Dynamic color graphic displays with up to 10 screen displays at once.
    g. Custom graphics generation and graphics library of HVAC equipment and symbols.
    h. Alarm processing, messages, and reactions.
    i. Trend logs retrievable in spreadsheets and database programs.
    j. Alarm and event processing.
    k. Object and property status and control.
    l. Automatic restart of field equipment on restoration of power.
    m. Data collection, reports, and logs. Include standard reports for the following:

        1) Current values of all objects.
        2) Current alarm summary.
        3) Disabled objects.
        4) Alarm lockout objects.
        5) Logs.

    n. Custom report development.
    o. Utility and weather reports.
    p. Workstation application editors for controllers and schedules.
    q. Maintenance management.

13. Custom Application Software:

a. English language oriented.
b. Full-screen character editor/programming environment.
c. Allow development of independently executing program modules with debugging/simulation capability.
d. Support conditional statements.
e. Support floating-point arithmetic with mathematic functions.
f. Contains predefined time variables.

J. Diagnostic Terminal Unit: Portable notebook-style, PC-based microcomputer terminal capable of accessing system data by connecting to system network with minimum configuration as follows:

1. System: With one integrated USB 2.0 port, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Processor: Intel Pentium 4
3. Random-Access Memory: 128 MB.
4. Graphics: Video adapter, minimum 1024 x 768 pixels, 64-MB video memory.
5. Monitor: 17 inches, LCD color.
6. Keyboard: QWERTY 105 keys in ergonomic shape.
7. Floppy-Disk Drive: 1.44 MB.
8. Hard-Disk Drive: 800 MB.
9. CD-ROM Read/Write Drive: 48x24x48.
10. Pointing Device: Touch pad or other internal device.

K. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.
b. Discrete/digital, analog, and pulse I/O.
c. Monitoring, controlling, or addressing data points.
d. Software applications, scheduling, and alarm processing.
e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:

a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control

with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
    b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
    c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
    d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
    e. Remote communications.
    f. Maintenance management.
    g. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

L. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

M. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).

6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

N. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

O. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

1.2 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and **72**-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
4. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

1.3 ALARM PANELS

A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch-thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish. Provide common keying for all panels.

B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.

1. Alarm Condition: Indicating light flashes and horn sounds.
2. Acknowledge Switch: Horn is silent and indicating light is steady.
3. Second Alarm: Horn sounds and indicating light is steady.
4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
5. Contacts in alarm panel allow remote monitoring by independent alarm company.

1.4 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.

1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig.
2. Proportional band shall extend from 2 to 20 percent for 5 psig.
3. Authority shall be 20 to 200 percent.

4. Air-supply pressure of 18 psig, input signal of 3 to 15 psig, and output signal of zero to supply pressure.
5. Gages: 2-1/2 inches in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

1.5 TIME CLOCKS

A. Manufacturers:

1. ATC-Diversified Electronics.
2. Grasslin Controls Corporation.
3. Paragon Electric Co., Inc.
4. Precision Multiple Controls, Inc.
5. SSAC Inc.; ABB USA.
6. TCS/Basys Controls.
7. Theben AG - Lumilite Control Technology, Inc.
8. Time Mark Corporation.
9. Or equal.

B. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.

C. Solid-state, programmable time control with 4 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

1.6 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:

a. BEC Controls Corporation.
b. Ebtron, Inc.
c. Heat-Timer Corporation.
d. I.T.M. Instruments Inc.

e. MAMAC Systems, Inc.
f. RDF Corporation.
g. Or equal.

2. Accuracy: Plus or minus 0.5 deg F at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
5. Averaging Elements in Ducts: 36 inches; use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Exposed.
    b. Set-Point Indication: Exposed.
    c. Thermometer: Red-reading glass.
    d. Orientation: Vertical or Horizontal.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:

1. Manufacturers:

    a. BEC Controls Corporation.
    b. MAMAC Systems, Inc.
    c. RDF Corporation.
    d. Or equal.

2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
5. Averaging Elements in Ducts: 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Exposed.
    b. Set-Point Indication: Exposed.
    c. Thermometer: Exposed.

d. Orientation: Vertical or Horizontal.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:

a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.
g. Or equal.

2. Accuracy: 5 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.

a. Set-Point Adjustment: Exposed.
b. Set-Point Indication: Exposed.
c. Thermometer: Concealed or Exposed.
d. Orientation: Vertical or Horizontal.

5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F.
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Manufacturers:

a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.
g. Or equal.

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

    a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    b. Output: 4 to 20 mA.
    c. Building Static-Pressure Range: 0- to 0.25-inch wg.
    d. Duct Static-Pressure Range: 0- to 5-inch wg.

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Exposed.
2. Set-Point Indication: Exposed.
3. Thermometer: Concealed or Exposed.
4. Orientation: Vertical or Horizontal.

G. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.
2. Guards: Locking, solid metal, ventilated.
3. Adjusting Key: As required for calibration and cover screws.

1.7 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

1.8 THERMOSTATS

A. Manufacturers:

1. Erie Controls.
2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
3. Heat-Timer Corporation.
4. Sauter Controls Corporation.
5. tekmar Control Systems, Inc.
6. Theben AG - Lumilite Control Technology, Inc.
7. Or equal.

B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.

1. Label switches "FAN ON-OFF".
2. Mount on single electric switch box.

C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:

    a. Time of day.
    b. Actual room temperature.

c. Programmed temperature.
d. Programmed time.
e. Duration of timed override.
f. Day of week.
g. System mode indications include "heating," "off," "fan auto," and "fan on."

D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
2. Selector Switch: Integral, manual on-off-auto.

F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.
3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

G. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, and the following:

1. Reset: Manual.
2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.

H. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

I. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

J. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

K. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

L. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

1.9 HUMIDISTATS

A. Manufacturers:

1. MAMAC Systems, Inc.
2. ROTRONIC Instrument Corp.
3. Or equal.

B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

1.10 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring

mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Manufacturers:

    a. Belimo Aircontrols (USA), Inc.
    b. Or equal.

2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers: Size for running torque calculated as follows:

    a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
    d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
    f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return): 24-V or 120-V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F.
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
12. Run Time: 12 seconds open, 5 seconds closed.

1.11 DAMPERS

A. Manufacturers:

1. Air Balance Inc.
2. Don Park Inc.; Autodamp Div.
3. TAMCO (T. A. Morrison & Co. Inc.).
4. United Enertech Corp.
5. Vent Products Company, Inc.
6. Or equal.

B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch-minimum thick, galvanized-steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

1.12 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Section 271500 "Communications Horizontal Cabling."

PART 2 - EXECUTION

2.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

2.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

E. Install automatic dampers according to Section 233300 "Air Duct Accessories."

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."

H. Install refrigerant instrument wells, valves, and other accessories according to Section 232300 "Refrigerant Piping."

I. Install duct volume-control dampers according to Section 233113 "Metal Ducts."

J. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

2.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."

B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

2.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
5. Test each point through its full operating range to verify that safety and operating control set points are as required.
6. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
7. Test each system for compliance with sequence of operation.
8. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
6. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
7. Check temperature instruments and material and length of sensing elements.
8. Check control valves. Verify that they are in correct direction.
9. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
10. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

2.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.

e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

   a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
   b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
   b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

2.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 23 09 00

SECTION 23 23 00
REFRIGERANT PIPING

PART1 GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 1/4 inch equals 1 foot.
2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.8 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations as shown on drawings.

PART 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L or ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; Type, Grade, and wall thickness as selected in Part 3 piping applications articles.

B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.

C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.

D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Flanged Unions:

1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 and ductile iron for NPS 2 to NPS 3. Apply rust-resistant finish at factory.
2. Gasket: Fiber asbestos free.
3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
5. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
6. Pressure Rating: Factory test at minimum 400 psig.
7. Maximum Operating Temperature: 330 deg F.

F. Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket
2. End Connections:
   a. NPS 2 and Smaller: With threaded-end connections.

b. NPS 2-1/2 and Larger: With flanged-end connections.

3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch – long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig.

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.

1. Body, Bonnet, and Seal Cap: Ductile iron or steel.

2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Equalizer: Internal or External.
7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24V ac coil.
8. End Connections: Socket.
9. Throttling Range: Maximum 5 psig.
10. Working Pressure Rating: 500 psig.
11. Maximum Operating Temperature: 240 deg F.

I. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

J. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

K. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

L. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.

2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

M. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

N. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

O. Receivers: Comply with ARI 495.

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

P. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.

2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.4 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.
5. Or Equal.

C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Suction Lines NPS 2 to NPS 3-1/2 for Conventional Air-Conditioning Applications: Copper, Type ACR or L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, L, or K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

D. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, L, or K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless or packed-angle valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Install refrigerant piping in protective conduit where installed belowground.

L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

M. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

N. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

O. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:

1. Shot blast the interior of piping.
2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Identify refrigerant piping and valves according to Section 23 05 53 "Identification for HVAC Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products should be provided as required.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.

4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
2. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
3. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
4. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.

E. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.

d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 13
METAL DUCTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related Sections:

1. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Lindab Inc.
    b. McGill AirFlow LLC.
    c. SEMCO Incorporated.
    d. Sheet Metal Connectors, Inc.
    e. Spiral Manufacturing Co., Inc.
    f. Or Equal.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: Black or White.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.
9. Or Equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts

designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or

duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Exhaust Ducts: Seal Class C.
3. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.

4. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
5. Unconditioned Space, Exhaust Ducts: Seal Class C.
6. Unconditioned Space, Return-Air Ducts: Seal Class B.
7. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
8. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
9. Conditioned Space, Exhaust Ducts: Seal Class B.
10. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." And ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09 90 00 "Painting and Coating".

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:
    a. All ducts: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

B. All Ducts:

1. Pressure Class: Positive 2-inch wg.
2. Minimum SMACNA Seal Class: A.
3. SMACNA Leakage Class for Rectangular: 3.
4. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. PVC-Coated Ducts:
   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Galvanized.

D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Velocity 1000 fpm or Lower:
      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 without vanes.
   b. Velocity 1000 to 1500 fpm:
      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
   c. Velocity 1500 fpm or Higher:
      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.

2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 31 16.16
THERMOSET FIBERGLASS-REINFORCED PLASTIC DUCTS AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air Movement and Control Association (AMCA): 500-D, Laboratory Methods of Testing Dampers for Rating.
2. American National Standards Institute (ANSI).
3. American Society of Mechanical Engineers (ASME):
   a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
   b. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24.
   c. B18.22.1, Plain Washers.
4. ASTM International (ASTM):
   a. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
   b. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   c. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment.
   d. D3982, Standard Specification for Contact Molded "Fiberglass" (Glass Fiber Reinforced Thermosetting Resin) Duct and Hoods.
   e. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
5. Sheet Metal and Air Conditioning Contractors' National Association, Inc., (SMACNA): Thermoset FRP Duct Construction Manual.

1.2 SUBMITTALS

A. Action Submittals:

1. Duct:
   a. Statement of resins and reinforcing proposed for use.
   b. Pressure, vacuum, and temperature rating of duct.
   c. Dimensions of subassemblies to be shipped.

d. Manufacturer's data and descriptive literature for duct accessories.
e. Drawings showing layout, support, and joint details.
f. Stamped and signed structural engineering design calculations.
g. Information, details, and requirements for installation and support of duct and torque values for flange bolting.
h. Name of manufacturer.

2. Supports:
   a. Location plan.
   b. Type and details.
   c. Materials of construction.
   d. Stamped and signed structural engineering design calculations for special supports.
3. Expansion Joints/Flexible Connectors:
   a. Type and model.
   b. Materials of construction.
   c. Force required for expansion/contraction.
   d. Name of manufacturer.
4. Butterfly Dampers and Blast Gates:
   a. Statement of resins and reinforcing proposed for use.
   b. Pressure, vacuum, and temperature rating.
   c. Materials of construction.
   d. Total weight including operator.
   e. Drawings showing overall dimensions and connection size.
   f. Type and model.
   g. Name of manufacturer.
5. Acoustical Insulation and Jacketing:
   a. Type and Model.
   b. Material.
   c. Name of Manufacturer.
6. Vibration Isolation Devices:
   a. Type and Model.
   b. Material.
   c. Name of Manufacturer.
   d. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Qualifications:
   a. Fabricator: List of references substantiating experience.
   b. Installer: Manufacturer's certification that installer is qualified for installation work.
2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements**.**

3. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
4. Manufacturer's factory inspection report.
5. Manufacturer's installation instructions.
6. Detailed information on structural, mechanical, electrical, or other modifications necessary to adapt the arrangement or details shown to the ductwork installation.
7. Damper and Blast Gate: AMCA 500-D leakage test results by AMCA-approved laboratory.
8. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Joint Installer: Manufacturer certified.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Do not ship ducting by nesting small diameter components inside larger diameter components.
2. Protect flanged sections by bolting to wooden blinds 2 inches greater than outside diameter of flange.
3. For nonflanged components, use either rigid plugs inside ends to prevent deflection or protect with wooden boxes.
4. Crate materials whenever practical prior to shipment.
5. Firmly fasten and pad components shipped to prevent shifting or flexing of components while in transit.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Temperature: Make field joints only when ambient temperature is above 55 degrees F and below 100 degrees F.

PART 2 PRODUCTS

2.1 MATERIALS

A. Resin:

1. Resin System: Premium corrosion-resistant, fire-retardant vinylester, or other qualified thermosetting resin. Resin to be selected by fabricator, subject to approval of Engineer, and suitable for intended service with no fillers or thixotropic agents.
2. Liner Resin: Premium grade and corrosion resistant.
3. Structural wall resin may be of different chemical resistance, subject to conditions of service and approval of Engineer.
4. Add ultraviolet absorbers to surfacing resin to improve weather resistance.
5. Color: Use no dyes, pigments, or colorants except in exterior gel coat. Exterior gel coat shall be white.
6. For interior duct, final coat shall be factory applied intumescent coating to achieve designated results for low smoke development.

B. Reinforcement:

1. Veil: Chemical surfacing mat, polyester fabric, 12 mils thick to 16 mils thick with finish and binder compatible with lay-up resin.
2. Corrosion Barrier: Resin-rich interior surface of nominal 100 mils to 120 mils thick, using chopped strand mat backing the veil. Use no additive in corrosion barrier.
3. Chopped Strand Mat: Type E glass, minimum 1-1/2 ounces per square foot, with silane finish and styrene soluble binder.
4. Continuous Roving for Chopper Gun Spray-Up: Type E glass.
5. Woven Roving: Type E glass, nominal 24 ounces per square yard, 4 by 5 weave, with silane type finish.
6. Continuous Roving for Filament Winding: Type E glass with silane type finish.

C. Fasteners:

1. Bolts: ASTM A193/A193M, Type 316 stainless steel, ANSI coarse thread series, Grade B 8M hex head.
2. Nuts: ASTM A194/A194M, Type 316 stainless steel, Grade 8M.
3. Washers: ASME B18.22.1, flat, Type 316 stainless steel.

2.2 DUCTWORK

A. Design Requirements:

1. Conform to ASTM D3982**.**
2. Duct manufacturer's design for round section, including duct wall thickness and stiffeners.

3. Take into account expansion from seasonal temperature variations.

B. Service Conditions:

1. System Maximum Pressure: 10 inches of water column.
2. System Maximum Vacuum: 12 inches of water column.
3. Ambient Temperature: 60 degrees F to 100 degrees F.
4. Seismic Requirements**:** California Zone 4.

2.3 FABRICATION

A. Physical Properties: Meet or exceed requirements of ASTM D3982 and ASTM C582.

B. Squareness of ends, fittings, elbows, and butt joints shall meet or exceed requirements of ASTM D3982.

C. Keep use of flanges to a minimum; butt joints are preferred method of joining sections of duct.

D. Butt joints shall only be permitted in duct sections that are accessible for inside overlay. Internal overlay shall be installed where possible, and will consist of two layers of 1-1/2 ounce per square foot of fiberglass mat followed by one layer of surfacing veil, as a minimum.

E. Flanges for Duct to Duct Connections and Duct Wall Thicknesses: ASTM D3982, rated for specified pressure and vacuum.

F. Flange dimensions (except thickness) and drilling patterns for flanges that connect to equipment, valves, or dampers are to correspond to ASME B16.5, Class 150 or ASME B16.1, Class 125.

G. Furnish gussets on flanged nozzles from ducts.

H. Back Face of Flanges: Spot-faced, flat and parallel to flange face, and of sufficient diameter to accept ANSI metal washer under bolt head or nut.

I. Laminate:

1. Reinforce inner surface of ducts with resin-rich surfacing veil 10 mils thick to 20 mils thick.
2. Construct interior layer of resin reinforced with at least two plies of chopped strand mat; thickness at least 100 mils.
3. Glass content of combined inner surface and interior layer shall be 27 percent plus or minus 5 percent.

J. Duct and Fittings:

1. Type: Contact molded or filament wound, meeting requirements of ASTM D3982.

2. Joints: Butt wrapped except flanged at connections to expansion joints, butterfly valves, blast gates, or mechanical equipment.
3. Fittings: Plain end or flanged, manufacturer's standard sizes.
4. Gaskets: EPDM, 3/16-inch thick, full-face, Type A Durometer of 50-60.

K. Manufacturers:

1. Perry Fiberglass Products, Inc.
2. M.K. PLASTICS
3. Spunstrand
4. Or Equivalent

L. Supports:

1. Supports for FRP ductwork shall be provided per Section 40 05 15, Piping Support Systems.
2. Maximum Duct Deflection: 1/2 inch, including special sections at road crossings.
3. Support Spacing:
   a. 24 Inch Diameter and Larger: 20 feet, maximum.
   b. 20 Inch Diameter and Smaller: 15 feet, maximum.

M. Marking:

1. Identify each duct component with fabricator's name, resin, minimum thickness, and date of manufacture.
2. Use permanent marking. Seal decals and labels into laminate exterior with resin.
3. For piece marking used for installation, use oil-based paint for easy removal.

N. Cure products to at least 90 percent of minimum Barcol hardness specified by resin manufacturer.

O. Expansion Joints/Flexible Connections:

1. Provide where indicated on Drawings or as required for proper duct installation.
2. Type: W-design configuration with integral flanges suitable for service with FRP duct.
3. Material: EPDM.
4. Backing Rings: 3/8 inch thick, 2 inches wide, Type 316 stainless steel. ASME B16.1, Class 25 diameter and drilling.
5. Length: 12 inches flange-to-flange.
6. Thickness: 1/4 inch, minimum.

7. Manufacturer and Product: Holz Rubber Company, Inc.; Style 945.

P. Butterfly Dampers:

1. Dampers:
   a. Single-blade type, complete with channel-type frame, close-fitting axle, and bearings.
   b. Same inside diameter as connecting ductwork.
   c. Axles not less than 3/4 inch in diameter and shall be continuous through damper.
   d. When used for isolation service, shall be furnished with blade seal and shaft seal.
   e. When used for balancing only, shall be furnished with full circumference molded in blade stop.
2. Design Requirements:
   a. Each damper shall be designed for the following conditions:
      1) Air Temperature Range: 50 degrees F to 75 degrees F.
      2) Differential Pressure: 10-inch WC.
3. Materials:
   a. FRP materials for dampers shall be same resin as used in ductwork.
   b. Requirements for flame spread and smoke development shall be same as required for ductwork.
4. Construction:
   a. Frames: Fiberglass reinforced plastic with resin as described herein.
   b. Blades: Fiberglass reinforced plastic with resin as described herein. Blade thickness and stiffeners as required to meet design conditions.
   c. Axles: Continuous FRP rod with resin as described herein. Axle to extend 6 inches beyond frame.
   d. Bearings: Molded PTFE.
   e. Blade Stops: FRP with resin as described herein.
   f. Blade Seals: Neoprene.
   g. Shaft Seals: Neoprene.
   h. Flanges: As specified to match ductwork flanges.

2.4 SOURCE QUALITY CONTROL

A. Factory Inspection: Inspect fabrications for required construction, intended function and conformance with referenced standards.

B. Inspection of products is required prior to shipment, unless specifically waived in writing by Engineer.

C. Notify Engineer 1 week prior to estimated date of inspection.

D. Repairs authorized by Engineer shall be reinspected before final acceptance, unless specifically waived.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify dimensions and conditions in field.
B. Layout routing in straight lines parallel to building lines.
C. Coordinate support locations with layout and joints.

3.2 INSTALLATION

A. Ductwork:

1. Cut, fit, and install in accordance with duct manufacturer's recommendations. The SMACNA manual may be used for guidance, but duct manufacturer's recommendations shall take precedence.
2. Seal cut edges with compatible resin.
3. Ductwork shall be free of vibration when in operation. Vibration isolation devices shall be provided and installed by Contractor.
4. Install plumb and straight and in proper alignment.
5. Provide for expansion and contraction of ductwork and fittings.
6. Anti-seize thread compound shall be applied to all nuts and bolts.
7. Flange bolts shall be tightened to torque values specified by manufacturer. Install flat washer under each nut and bolt head.

B. Field Joints:

1. Provide material in kit form; one kit for one joint.
2. Make joints only when ambient temperature is above 55 degrees F and below 100 degrees F.
3. Made by manufacturer certified installer.

C. Dampers: Unless otherwise necessary for proper operation of damper, axles shall be installed in horizontal position.

3.3 FIELD TESTING

A. Field test ductwork after installation and before concealment or burying, with air test to 90 percent of maximum working pressure for a period of 4 hours. Leaks shall be corrected and duct retested until no further leaks appear.

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner for minimum person-days listed below, travel time excluded:

1. Two person-days for installation assistance, including pre-installation training of Contractor personnel in joint assembly, and inspection.
2. Two person-days for functional and performance testing and completion

of Manufacturer's Certificate of Proper Installation.

B. See Section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Testing, Integration, and Startup**.**

3.5 CLEANING

A. Blow ductwork clean using system fans; purged continuously for not less than 48 hours at a flow rate not less than design flow rate. If required, system fan shall be throttled on inlet side to prevent motor overload. Temporary screen shall be installed on system fan inlet to protect fan from entering debris.

B. Dampers shall be smooth, clean, and free of dirt when installed.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Combination fire and smoke dampers.
5. Flange connectors.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
   a. Special fittings.
   b. Manual volume damper installations.
   c. Control-damper installations.
   d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
   e. Duct security bars.

f. Wiring Diagrams: For power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. Nailor Industries Inc.
7. NCA Manufacturing, Inc.
8. Pottorff.
9. Ruskin Company.
10. Vent Products Company, Inc.
11. Or Equal.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 1-inch wg.

E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, 0.063-inch-thick extruded aluminum, or 0.05-inch-thick stainless steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, center pivoted, off-center pivoted, or end pivoted, maximum 6-inch width, 0.050-inch- thick aluminum sheet with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Vinyl foam, Extruded vinyl, mechanically locked, or Neoprene, mechanically locked.

I. Blade Axles:

1. Material: Galvanized steel or Stainless steel.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum or Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
   a. Sleeve Thickness: 20 gage minimum.
   b. Sleeve Length: 6 inches minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel or Aluminum.
8. Screen Type: Bird.
9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. McGill AirFlow LLC.
   d. Nailor Industries Inc.
   e. Pottorff.
   f. Ruskin Company.
   g. Trox USA Inc.
   h. Vent Products Company, Inc.
   i. Or Equal.
2. Comply with AMCA 500-D testing for damper rating.

3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames:
    a. Hat, U, or Angle shaped.
    b. 0.094-inch-thick, galvanized sheet steel or 0.05-inch-thick stainless steel.
    c. Mitered and welded corners.
    d. Flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:
    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized, roll-formed steel, 0.064 inch thick.
7. Blade Axles: Galvanized steel, Stainless steel, or Nonferrous metal.
8. Bearings:
    a. Oil-impregnated bronze, Molded synthetic, Oil-impregnated stainless-steel sleeve, or Stainless-steel sleeve].
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
9. Blade Seals: Vinyl or Neoprene.
10. Jamb Seals: Cambered stainless steel or aluminum.
11. Tie Bars and Brackets: Galvanized steel or Aluminum.
12. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

2.5 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. McGill AirFlow LLC.
7. Metal Form Manufacturing, Inc.
8. Nailor Industries Inc.

9. NCA Manufacturing, Inc.
10. Pottorff.
11. Ruskin Company.
12. Vent Products Company, Inc.
13. Young Regulator Company.
14. Or Equal.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat, U, or Angle shaped.
2. 0.05-inch-thick stainless steel].
3. Mitered and welded or Interlocking, gusseted corners.

D. Blades:

1. Multiple blade with maximum blade width of 6 inches.
2. Parallel- and opposed-blade design.
3. Galvanized-steel, Stainless steel, or Aluminum.
4. 0.064 inch thick single skin or 0.0747-inch-thick dual skin.
5. Blade Edging:[Closed-cell neoprene or PVC.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-diameter; galvanized steel or stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Oil-impregnated bronze, Molded synthetic, Oil-impregnated stainless-steel sleeve, or Stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axle's full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.
7. Or Equal.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 2-inch wg static pressure class and minimum 1000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded, interlocking, gusseted or mechanically attached corners and mounting flange.

F. Heat-Responsive Device: Resettable or Replaceable, 212 deg F rated, fusible links.

G. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

H. Smoke Detector: Integral, factory wired for single-point connection.

I. Blades: Roll-formed, horizontal, interlocking or overlapping, 0.034-inch-thick, galvanized sheet steel.

J. Leakage: Class I.

K. Rated pressure and velocity to exceed design airflow conditions.

L. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

M. Master control panel for use in dynamic smoke-management systems.

N. Damper Motors: two-position action.

O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

2.7 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
4. Or Equal.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.

2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
7. Or Equal.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.9 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Pottorff.
10. Ventfabrics, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
12. Or Equal.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:
    a. Double wall, rectangular.
    b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    c. Vision panel.
    d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
    a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    b. Access Doors up to 18 Inches Square: Two hinges or Continuous and two sash locks.
    c. Access Doors up to 24 by 48 Inches: Three hinges or Continuous and two compression latches.
    d. Access Doors Larger Than 24 by 48 Inches: Four hinges or Continuous and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0- to 8.0-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.10 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.
4. Or Equal.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.

D. Fasteners: Carbon or Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.11 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Ventfabrics, Inc.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
6. Or Equal.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.

2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.12 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
4. Or Equal.

B. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

2.13 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART3 EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream and downstream from turning vanes.
9. Control devices requiring inspection.
10. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

O. Install duct test holes where required for testing and balancing purposes.

P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 34 00
HVAC FANS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Acoustical Society of America (ASA): S2.19, Mechanical Vibration—Balance Quality Requirements of Rigid Rotors—Part 1, Determination of Permissible Residual Unbalance.
2. Air Movement and Control Association International (AMCA):
   a. 99, Standards Handbook.
   b. 201, Fans and Systems.
   c. 203, Field Performance Measurement of Fan Systems.
   d. 204, Balance Quality and Vibration Levels for Fans.
   e. 210, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
   f. 300, Reverberant Room Method for Sound Testing of Fans.
   g. 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
3. American Bearing Manufacturers Association (ABMA): 9, Load Ratings and Fatigue Life for Ball Bearings.
4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
5. ASTM International (ASTM):
   a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
   b. D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
   c. D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
   d. D3363, Standard Test Method for Film Hardness by Pencil Test.
   e. D4167, Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.
   f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
6. National Electrical Manufacturers Association (NEMA).
7. National Fire Protection Association (NFPA): 45, Standard on Fire Protection for Laboratories Using Chemicals.
8. Occupational Safety and Health Act (OSHA).
9. Society for Protective Coatings (SSPC):

a. SP 3, Power Tool Cleaning.
b. SP 5, White Metal Blast Cleaning.
c. SP 6, Commercial Blast Cleaning.
d. SP 10, Near-White Blast Cleaning.

10. Underwriters Laboratories Inc. (UL): 507, Safety Standard for Electric Fans.

1.2 DEFINITIONS

A. The following is a list of abbreviations which may be used in this section:

1. AC: Alternating Current.
2. CISD: Chemical Industry, Severe-Duty.
3. dB: Decibel.
4. DWDI: Double Width, Double Inlet.
5. FRP: Fiberglass Reinforced Plastic.
6. hp: Horsepower.
7. ODP: Open Drip Proof.
8. SWSI: Single Width, Single Inlet.
9. TEFC: Totally Enclosed, Fan Cooled.
10. UV: Ultra Violet
11. XP: Explosion Proof.

1.3 SUBMITTALS

A. Action Submittals:

1. Provide following for specified products:
   a. Identification as referenced in Contract Documents.
   b. Manufacturer's name and model number.
   c. Descriptive specifications, literature, and drawings.
   d. Dimensions and weights.
   e. Fan sound power level data (reference 10 to power minus 12 watts) at design operating point.
   f. Fan Curves:
      1) Performance Curves Indicating:
         a) Relationship of flow rate to static pressure for various fan speeds.
         b) Brake horsepower curves.
         c) Acceptable selection range (surge curves, maximum revolutions per minute).
         d) Static pressure, capacity, horsepower demand and overall efficiency required at duty point, including drive losses.

2) For variable air volume applications, indicate operating points at 100, 80, 60 and 40 percent of design capacity on fan curves including data to indicate effect of capacity control devices such as inlet vanes on flow, pressure, and brake horsepower.

g. Capacities and ratings.
h. Construction materials.
i. Fan type, size, class, drive arrangement, discharge, rotation, and bearings.
j. Wheel type, diameter, maximum revolutions per minute for fan class, operating revolutions per minute, and tip speed.
k. Motor data, including service factor and operating horsepower, as specified in Section 26 20 00, Low-Voltage AC Induction Motors.
l. Fan shaft first critical speed.
m. Belt service factor.
n. Drive assembly horsepower rating.
o. Sheave horsepower rating.
p. Power and control wiring diagrams, including terminals and numbers.
q. Factory run test and vibration test reports.
r. Vibration isolation.
s. Factory finish system.
t. Color selection charts where applicable.
u. Corrosion protection coating product data.
v. Fiberglass Material: Statement of resins and reinforcing proposed for use.

2. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
3. "Or Equal" Equipment:
   a. Where submitted equipment results in change to fan inlet or outlet ductwork configuration shown on Drawings, submit system effect factor calculations indicating increased static pressure requirements as described in AMCA 201.
   b. Where submitted equipment results in change to ductwork and equipment configuration shown on Drawings, submit detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement to equipment furnished.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Recommended procedures for protection and handling of products prior to installation.

3. Manufacturer's installation instructions.
4. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
    a. Motors specified to be premium efficient type.
    b. FRP fans.
5. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
6. Test reports.
7. Operation and maintenance data in conformance with Section 01 78 23, Operation and Maintenance Data. Include as-built version of equipment schedules.

C. LEED Submittals:

1. Equipment and materials for Maintenance Building.
2. Engineer reserves right to reject products and assemblies based on incomplete or noncompliance with LEED certification requirements.
3. Documentation required indicating compliance with Optimize Energy Performance—EA Credit 1.
4. Documentation required indicating compliance with Minimum IAQ Performance—EQ Prerequisite 1.
5. Documentation required indicating compliance with Low-Emitting Materials, Adhesives and Sealants—EQ Credit 4.1.

1.4 QUALITY ASSURANCE

A. Performance Ratings: Tested in accordance with AMCA 210.

B. Sound Ratings: Tested in accordance with AMCA 300.

C. Fabrication: In accordance with AMCA 99.

1.5 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the spare parts, special tools, and materials as specified by the manufacturer.

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 EQUIPMENT SCHEDULES

A. Some specific equipment requirements are listed in Equipment Schedule. Refer to Drawings.

2.2 GENERAL

A. Spark Resistant Construction: Fans required to be spark resistant shall comply with requirements of AMCA 99-0401.

B. Operating Limits: Fans designated to meet a specified fan class shall comply with requirements of AMCA 99-2408.

C. Acoustical Levels: Equipment selections shall produce sound power levels in each octave band no greater than shown in Equipment Schedule.

D. Fan Drives:

1. Drive assembly shall be sized for a minimum 140 percent of fan motor horsepower rating.
2. Furnish multiple drive belts where motor horsepower is 2 hp or larger.
3. Sheaves:
    a. Capable of providing 150 percent of motor horsepower.
    b. Unless otherwise noted, furnish belt-driven fans with cast iron or flanged steel sheaves.
4. Drive Adjustment:
    a. When fixed-pitch sheaves are furnished, accomplish system air balancing by either trial of different fixed-pitch sheaves or use of temporary adjustable-pitch sheaves.
    b. Provide trial and final sheaves, as well as drive belts, as required.
5. Fan Shafts: First critical speed of at least 125 percent of fan maximum operating speed.
6. Provide speed test openings at shaft locations.
7. Belts: Oil and heat resistant, nonstatic type.
8. Motors:
    a. Motors 20 hp or Smaller:
        1) Variable pitch V-belt sheaves allowing at least 20 percent speed variation.
        2) Final operating point shall be at approximate sheave midpoint.
    b. Motors Larger than 20 hp: Fixed-pitch sheaves.
    c. Furnish motors for V-belt drives with adjustable rails or bases.
9. Weather Cover: For outdoor applications, factory fabricated drive assembly of same material as fan housing, unless specified otherwise.

10. Belt and Shaft Guards:
    a. Easily removable and to enclose entire drive assembly, meeting federal, OSHA, and State of California requirements.
    b. Guard faces of expanded metal having minimum 60 percent free area for ventilation.
    c. Bright yellow finish.

E. Finishes:

1. Carbon Steel Parts: Factory finish as follows, unless indicated otherwise.
    a. Parts cleaned and chemically pretreated with phosphatizing process.
    b. Alkyd enamel primer.
    c. Air dry enamel topcoat.
2. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.
3. Stainless Steel Parts: Finished smooth and left unpainted.
4. Fiberglass Parts: Finished in accordance with Paragraph Fiberglass Material.

2.3 UTILITY BLOWER, CENTRIFUGAL SWSI, FIBERGLASS

A. General:

1. Factory-assembled utility blower; including housing, fan wheel, drive assembly, motor and accessories.
2. Fiberglass Construction: In accordance ASTM D4167.
3. Suitable to convey air at temperatures up to 250 degrees F.
4. Fan Performance: AMCA 99-2408 Class as scheduled.
5. Airstream Hardware: Type 316 stainless steel.

B. Fiberglass Material:

1. Construction: Resin reinforced fiber cloth and mat.
2. Resin:
    a. Vinyl ester or other qualified thermosetting resin.
    b. Selected by fabricator, subject to approval by Engineer and suitable for intended service with no fillers or thixotropic agents.
    c. Premium grade and corrosion resistant.
    d. Structural wall resin may be of different chemical resistance, subject to conditions of service and approval by Engineer.
    e. For outdoor locations, add ultraviolet absorbers to surfacing resin to improve weather resistance.
    f. Color:

1) Use no dyes, pigments, or colorants, except in exterior gel coat.
2) Exterior gel coat shall be white.

g. For interior locations, final coat shall be factory-applied intumescent coating to achieve designated results for low smoke development.

3. Reinforcement:
   a. Veil: Chemical surfacing mat, Type C (chemical) glass veil**,** Nexus Surface Veil.
   b. Chopped Strand Mat: Type E glass, minimum 1-1/2 ounces per square foot, with silane finish and styrene soluble binder.
   c. Continuous Roving for Chopper Gun Spray-Up: Type E glass.
   d. Woven Roving: Type E glass, nominal 24 ounces per square yard, 4 by 5 weave, with silane type finish.
4. Laminate:
   a. Inner Surface (Veil):
      1) Resin rich, veil reinforced, 10 mils to 20 mils thick.
      2) Use no additives.
      3) Finish and binder compatible with lay-up resin.
      4) Reinforcement Content: Not more than 20 percent.
   b. Interior (Corrosion) Layer:
      1) Resin rich, at least two plies of chopped strand mat, nominal 100 mils to 120 mils thick.
      2) Use no additives.
      3) Construct interior layer of resin reinforced with at least two plies of chopped strand mat backing the veil.
      4) Reinforcement Content: 25 plus or minus 5 percent.
   c. Exterior (Structural) Layer:
      1) Resin with mat, cloth, woven roving or chopped strand glass reinforcement.
      2) Enough resin present to prevent surface fiber show.
      3) Exterior surface relatively smooth, with no exposed fibers or sharp projections.
   d. Wall Thickness: As required for equipment structural integrity, but no less than 3/16 inch.

C. Housing:

1. Material: Fiberglass.
2. Construction:
   a. Curved scroll configuration.
   b. Integral flanges to ensure housing concentricity and housing strength.
   c. Flanged outlet to permit duct connection.
   d. Drain connection located at lowest point of fan housing.

e. Inlet:
    1) Die-formed bell mouth of fiberglass construction.
    2) Fiberglass supports.
    3) Bolted to housing to permit wheel removal.
f. Shaft Seal: Viton construction, located at shaft penetration of housing.

3. Base/Pedestal: All-welded heavy gauge steel

D. Wheel:

1. Material: Fiberglass.
2. Fan wheel speed not to exceed 90 percent of manufacturer's listed safe fan speed.
3. Centrifugal, one-piece, non-overloading, backward curved blades.
4. Wheel hub permanently bonded to shaft and completely encapsulated in fiberglass.

E. Shaft, Bearings, Drive:

1. Shafts:
    a. Turned, ground, and polished Type 316 stainless steel.
    b. Ends drilled and tapped for wheel installation.
    c. Keyed for sheave installation.
2. Bearings:
    a. Grease lubricated, precision antifriction ball, self-aligning type.
    b. Mounted in cast iron pillow block housing.
    c. Selected for average life (ABMA 9 L_{50}) of not less than 200,000 hours operation at maximum cataloged operating speed.
3. Drives:
    a. In accordance with Paragraph Fan Drives.
    b. Factory set to specified fan revolutions per minute.
    c. Type: Direct.
    d. Arrangement: As scheduled in Equipment Schedule.

F. Accessories: Provide as follows:

1. Housing Access Doors: Bolted and gasketed.
2. Curb Base: Molded one-piece fiberglass, seamless construction.
3. Disconnect: Factory installed, nonfused, NEMA Type as scheduled.
4. Flanged Inlet: Heavy fiberglass construction, factory drilled and flanged.
5. Shaft Seal: Fiberglass and neoprene construction, located at shaft penetration of housing.
6. Belt Guard: OSHA type, carbon steel sheet metal, for complete coverage of belts and sheaves.

7. Shaft and Bearing Guard: Carbon steel sheet metal for complete coverage of shaft and bearings.
8. Motor and Drive Cover:
    a. Factory fabricated; OSHA type.
    b. Carbon steel sheet metal construction.
    c. Vented, openings sufficient size for proper motor cooling.
9. Inlet Screen: Removable 1-inch mesh screen of coated steel construction over exposed inlets.
10. Unitary Subbase:
    a. Structural metal subbase, same material as fan housing.
    b. Bolted to bottom of fan base/pedestal.
    c. Drilled for field installation of vibration isolators.
11. Spark Resistant Construction:
    a. Carbon fiber veil impregnated in housing and wheel fiberglass resin corrosion barrier.
    b. Static grounding.
    c. Classification: AMCA 99-0401 Type A
12. Corrosion Protection Coating:
    a. Provide factory-applied corrosion protection coating on fan steel components.
    b. Coating system shall be baked epoxy and shall be in accordance with Article Corrosion Protection Coating.
    c. Coating system shall be in accordance with Section 09 90 00, Painting and Coating.

G. Manufacturers and Products:

1. Greenheck BCSW-FRP
2. Aerovent; Model RBF.
3. Hartzell; Series 41.
4. Or Equivalent

2.4 WALL FAN, CENTRIFUGAL (Maintenance Building)

A. General:

1. Factory-assembled centrifugal wall fan; including housing, fan wheel, drive assembly, motor and accessories.
2. Bearing AMCA Certified Ratings Seal for sound and air performance.

B. Housing:

1. Construction: Spun-formed aluminum, minimum 16-gauge marine alloy.
2. Windband: Finish with rolled bead.
3. Cap: Motor access via quick release latches.

4. Motor completely sealed from exhaust air stream.
5. Motor cooling via air breather tubes.
6. Integral conduit chase for wiring.
7. Fan Inlet:
    a. Full inlet cone of aluminum construction.
    b. Match inlet shroud.
8. Wall Flange: Aluminum construction, with prepunched key slot holes.

C. Fan Wheels:

1. Aluminum construction, backward inclined centrifugal, non-overloading type.
2. Machined, cast aluminum hub.
3. Matched to deep spun inlet venturi.

D. Shaft, Bearings, Drive:

1. Shaft:
    a. Turned, ground, and polished carbon steel.
    b. Keyed for sheave installation.
    c. Zinc-phosphate coated and oil emulsion-dipped.
2. Bearings:
    a. Grease lubricated, precision antifriction ball, self-aligning, pillow block style.
    b. Selected for average life (ABMA 9 L_{50}) of not less than 200,000 hours operation at maximum cataloged operating speed.
    c. Terminate with zerk fittings.
3. Drives:
    a. In accordance with Paragraph Fan Drives.
    b. Factory set to specified fan revolutions per minute.
    c. Type: Belt or direct, as indicated in Equipment Schedule.

E. Accessories: Provide as follows:

1. Gravity Backdraft Damper: Gravity operation, adjustable counterweight, aluminum construction.
2. Bird Screen: Aluminum construction.
3. Disconnect: Factory installed, nonfused, NEMA Type 4X.
4. Bearing Lubrication Lines:
    a. Extended to outside of fan housing.
    b. Type 316 stainless steel construction.
    c. Terminate with zerk fittings.
5. Spark Resistant Construction: Classification: AMCA 99-0401 Type A.
6. Corrosion Protection Coating:

a. Provide factory-applied corrosion protection coating on these fan components:
    1) Wheel.
    2) Housing.
    3) Accessories.
    4) Interior surfaces in contact with airstream.
b. Coating system shall be baked epoxy phenolic and shall be in accordance with Article Corrosion Protection Coating.
c. Coating system shall be in accordance with Section 09 90 00, Painting and Coating.

F. Manufacturers and Products:

1. Cook; Model ACWD (Direct Drive); ACWB (Belt Drive).
2. Greenheck; Model CW (Direct Drive); CWB (Belt Drive).
3. ACME; Model PDU (Direct Drive); PNU (Belt Drive).
4. Aerovent; Model AWX.
5. Twin City; Model TCWX.

2.5 CORROSION PROTECTION COATING

A. General:

1. Factory-applied corrosion protection coating for application to fan components and accessories, where required by this section.
2. Quality Control:
    a. Verify dry film thickness before final baking.
    b. Finished coating system shall be free from voids, checks, cracks, and blisters.
3. Surface Cleaning: Clean parts to be coated as follows:
    a. Immerse parts in heated cleaning solution to remove lubricants, machining oils, and residual factory contamination.
    b. Follow with immersion in potable water bath to neutralize and remove cleaning solution.
    c. Chemical Pretreatment: Immerse parts in heated chemical solution, iron phosphate for steel, clear/yellow chromate for aluminum.

B. Baked Enamel:

1. Material: Alkyd modified urea-melamine single component baking enamel.
2. Surface Preparation: Clean surface to SSPC SP 3.
3. Application: Standard air-pressurized spray equipment.
4. Curing: Oven baked at a metal temperature not to exceed 300 degrees F.
5. Finished Thickness: 1-mil to 2-mil dry film thickness.

6. Performance: Coating shall meet or exceed following criteria:
    a. Impact Resistance: 10-inch pounds, ASTM D2794 test method.
    b. Pencil Hardness: 2H, ASTM D3363 test method.
    c. Service Temperature: Maximum 230 degrees F, continuous.

C. Baked Polyester:

1. Material: Polyester.
2. Surface Preparation: Sandblast surface to SSPC SP 5.
3. Application: Electrostatic spray.
4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
5. Finished Thickness: 1.5-mil to 2.5-mil dry film thickness.
6. Performance: Coating shall meet or exceed following criteria:
    a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
    b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
    c. Impact Resistance: 100-inch pounds, ASTM D2794 test method.
    d. Pencil Hardness: 2H, ASTM D3363 test method.
    e. Service Temperature: Maximum 230 degrees F, continuous.

D. Air-Dry Epoxy:

1. Material: Two-part catalyzed epoxy.
2. Surface Preparation: Clean surface to SSPC SP 3.
3. Application: Standard air-pressurized spray equipment.
4. Curing: Air dry.
5. Finished Thickness: 4-mil to 6-mil dry film thickness.
6. Performance: Coating shall meet or exceed following criteria:
    a. Salt Spray Test: Minimum 1,500-hour duration, ASTM B117 test method.
    b. Pencil Hardness: H-2H, ASTM D3363 test method.
    c. Service Temperature: Maximum 150 degrees F, continuous.

E. Baked Epoxy:

1. Material: Epoxy.
2. Surface Preparation: Sandblast surface to SSPC SP 10.
3. Application: Electrostatic spray.
4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
5. Finished Thickness: 2.5-mil to 3.5-mil dry film thickness.
6. Performance: Coating shall meet or exceed following criteria:
    a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.

b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
c. Impact Resistance: 100-inch pounds, ASTM D2794 test method.
d. Pencil Hardness: 2H, ASTM D3363 test method.
e. Service Temperature: Maximum 230 degrees F, continuous.

F. Air Dry Phenolic:

1. Material:
   a. Phenolic resin, Heresite VR-500 Series or equal.
   b. For outdoor applications, apply an UV resistant topcoat, Heresite UC-5500 or equal.
2. Surface Preparation: Sandblast surface to SSPC SP 6.
3. Application: Standard air-pressurized spray equipment.
4. Curing: Air dry.
5. Finished Thickness: 4-mil to 6-mil dry film thickness.
6. Performance: Coating shall meet or exceed following criteria:
   a. Salt Spray Test: Minimum 500-hour duration, ASTM B117 test method.
   b. Humidity Resistance: Minimum 500-hour duration, ASTM D2247 test method.
   c. Service Temperature: Maximum 180 degrees F, continuous.

G. Baked Phenolic:

1. Material: Phenolic resin, Heresite P-403 or equal.
2. Surface Preparation: Sandblast surface to SSPC SP 5.
3. Application: Standard air-pressurized spray equipment.
4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
5. Finished Thickness: 5-mil to 7-mil dry film thickness.
6. Performance: Coating shall meet or exceed following criteria:
   a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
   b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
   c. Impact Resistance: 100-inch pounds, ASTM D2794 test method.
   d. Pencil Hardness: 2H, ASTM D3363 test method.
   e. Service Temperature: Maximum 250 degrees F, continuous.

H. Baked Epoxy Phenolic:

1. Material:
   a. Baking cross-linked epoxy-phenolic.
   b. For outdoor applications, apply an UV-resistant topcoat.
2. Surface Preparation: Sandblast surface to SSPC SP 5.

3. Application: Electrostatic or conventional compressed air spray equipment.
4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
5. Finished Thickness: 6-mil to 8-mil dry film thickness.
6. Performance: Coating shall meet or exceed following criteria:
    a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
    b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
    c. Impact Resistance: 160-inch pounds, ASTM D2794 test method.
    d. Pencil Hardness: 3H, ASTM D3363 test method.
7. Service Temperature: Maximum 350 degrees F, continuous.

2.6 MOTORS

A. General:

1. Fan motors shall comply with provisions of Section 26 20 00, Low-Voltage AC Induction Motors.
2. Provide integral self-resetting overload protection on single-phase motors.
3. Motors for fans specified for use with variable frequency drives shall be inverter duty type.
4. Motors shall not operate into service factor in any case.

B. Motor requirements shall be as follows, unless designated otherwise on Equipment Schedule:

1. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
2. Winding Thermal Protection: None.
3. Space Heater: No.
4. Number of Speeds: Single.
5. Number of Windings: One.
6. Motor Efficiency: Energy efficient.
7. Shaft Type: Solid, carbon steel.
8. Mounting: As required for fan arrangement.
9. Service Factor: 1.15.

2.7 ACCESSORIES

A. Equipment Identification Plates: Furnish 16-gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear 3/8-inch high engraved block type equipment identification number and letters indicated in this Specification**.**

B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

2.8 SOURCE QUALITY CONTROL

A. General:

1. Fan shall operate at single stable point as indicated by fan curve. Fans having two potential operating points are not acceptable.
2. Fan and motor combination shall be capable of delivering 110 percent of scheduled air quantity and static pressure. Motor shall not operate into motor service factor in any listed case.
3. Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA 203, Appendix L.

B. Testing Provisions:

1. Provide tachometer access holes large enough to accept standard tachometer drive shaft.
2. Center punch fan shaft to accommodate tachometer readings.

C. Acoustical Levels:

1. Perform noise tests in accordance with AMCA 300 and AMCA 301.
2. Fan sound power levels (dB, Reference 10^{-12} Watts) shall be no greater than scheduled values.

D. Balancing:

1. Unless noted otherwise, each fan wheel shall be statically and dynamically balanced to ASA S2.19 Grade G6.3.
2. Fans controlled by variable frequency drives shall be dynamically balanced at speeds 25 percent, 50 percent, 75 percent, and 100 percent of design revolutions per minute.

E. Vibration Test:

1. Each fan furnished with 5-horsepower or larger motor shall have factory run vibration test, including vibration signatures taken on each bearing in horizontal, vertical, and axial direction.
2. Vibration reading as measured at scheduled rotational speed shall not exceed the following values when fan is rigidly mounted:
    a. Belt Drive (except Vane Axial): 0.15 inch per second peak velocity.
    b. Belt Drive Vane Axial: 0.08 inch per second peak velocity.

c. Direct Drive: 0.08 inch per second peak velocity.

3. Written records of run test and vibration test shall be made available upon request.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install fans level and plumb.

B. Scroll Drains: Pipe drain connection through running trap to floor drain.

C. Labeling:

1. Label fans in accordance with Article Accessories.
2. Mark exhaust fans serving fume hoods with arrows to indicate proper direction of rotation, in accordance with NFPA 45.

D. Service Access: Locate units to provide access spaces required for motor, drive, bearing servicing, and fan shaft removal.

E. Equipment Support and Restraints:

1. Refer to Section 23 05 48, Vibration Isolation and Seismic Control.
2. Install floor-mounted units on concrete bases designed to withstand, without damage to equipment, the seismic force required by code.
3. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
4. Seismic Restraint Snubbers: Install with sufficient clearance so unit isolators are not restricted for proper free isolation, but do limit movement in all directions.

F. Connections:

1. Refer to Section 23 31 16.16, Thermoset Fiberglass-Reinforced Plastic Ducts and Accessories.
2. Isolate duct connections to fans.
3. Install ductwork adjacent to fans to allow proper service and maintenance.

3.2 FIELD QUALITY CONTROL

A. Functional Tests:

1. Verify blocking and bracing used during shipping are removed.
2. Verify fan is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.

3. Verify proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Verify cleaning and adjusting are complete.
5. Disconnect fan drive from motor; verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation.
6. Reconnect fan drive system; align and adjust belts and install belt guards.
7. Verify lubrication for bearings and other moving parts.
8. Verify manual and automatic volume control and fire and smoke dampers in connected ductwork are in fully open position.

B. Performance Tests:

1. Starting Procedures:
   a. Energize motor and adjust fan to indicated revolutions per minute.
   b. Measure and record motor voltage and amperage.
2. Operational Test:
   a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
   c. Test and adjust control safeties.
   d. Replace damaged and malfunctioning controls and equipment.

3.3 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at site or classroom designated by Owner**s** for minimum person-days listed below, travel time excluded:

1. **2** person-days installation assistance and inspection.
2. **3** person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. **1** person-days for facility startup.
4. **1** person-days for post-startup training of Owner's personnel.

B. Refer Section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Testing, Integration, and Startup.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

D. Balancing:

1. Perform air system balancing as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
2. Replace fan and motor sheaves as required to achieve design airflow.

E. Vibration Testing:

1. Perform field testing on rotating equipment, where specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC, to determine actual operating vibration.
2. If vibration limits described therein are exceeded, rebalance equipment in-place until design tolerances are met.
    a. Vibration readings as measured at actual rotational speed shall not exceed the following values:
        1) Belt Drive, Flexibility Mounted: 0.25 inch per second peak velocity.
        2) Belt Drive, Rigidly Mounted: 0.16 inch per second peak velocity.

3.5 CLEANING

A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

B. On completion of installation, internally clean fans according to manufacturers' written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

END OF SECTION

SECTION 23 34 13
AXIAL HVAC FANS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tubeaxial fans.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, furnished specialties, and accessories for each fan.
2. Certified fan performance curves with system operating conditions indicated.
3. Certified fan sound-power ratings.
4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
5. Material thickness and finishes, including color charts.
6. Dampers, including housings, linkages, and operators.
7. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support

locations, type of support, and weight on each support. Indicate and certify field measurements.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For axial fans to include in emergency, operation, and maintenance manuals.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AMCA Compliance:

1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
2. Operating Limits: Classify according to AMCA 99.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Capacities and Characteristics (Electrical Building System):

1. Airflow: 4272 cfm.
2. External Static Pressure: 0.5 inches wg.
3. Brake Horsepower: 2.26.
4. Drive Type: Direct.
5. Fan Rpm: 3500.
6. Motor:
    a. Efficiency: Premium efficient.
    b. NEMA Design: 1.
    c. Electrical Characteristics:
        1) Motor Size: 3 hp.
        2) Motor Rpm: 3500.
        3) Volts: 460.
        4) Phase: Poly.
        5) Hertz: 60.
7. Vibration Isolators: Spring isolators having a static deflection of 1 inch.

2.2 TUBEAXIAL FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Greenheck Fan Corporation or a comparable product by one of the following:

1. Greenheck Fan Corporation.
2. Aerovent; a Twin City Fan company.
3. Airmaster Fan Company.
4. American Coolair Corporation.
5. American Fan Company; part of Flakt Woods Americas.
6. Breidert Air Products.
7. Carnes Company.
8. Chicago Blower Corporation.
9. Cincinnati Fan.
10. CML Northern Blower Inc.
11. Hartzell Fan Incorporated.
12. Howden Buffalo Inc.
13. Howden Buffalo Inc.; New Philadelphia Division.
14. Lau Industries.
15. Loren Cook Company.
16. Madison Manufacturing.
17. New York Blower Company (The).
18. PennBarry.
19. Strobic Air Corporation.
20. Trane Inc.; a subsidiary of Ingersoll-Rand Company.
21. Or Equal.

B. Description: Fan wheel and housing, factory-mounted motor with direct drive, an inlet cone section, and accessories.

C. Housings: Steel with flanged inlet and outlet connections.

D. Wheel Assemblies: Cast or extruded aluminum with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.

E. Wheel Assemblies: Fiberglass-reinforced plastic cured under pressure with airfoil-shaped blades keyed to stainless-steel shaft.

F. Wheel Assemblies: Cast aluminum, machined and fitted to shaft.

G. Accessories:

1. Companion Flanges: Rolled flanges of same material as housing.
2. Inspection Door: Bolted door allowing limited access to internal parts of fan, of same material as housing.
3. Propeller Access Section Door: Short duct section bolted to fan inlet and outlet allowing access to internal parts of fan for inspection and cleaning, of same material as housing.
4. Swingout Construction: Assembly allowing entire fan section to swing out from duct for cleaning and servicing, of same material as housing.

5. Mounting Clips: Vertical mounting clips welded to fan housing, of same material as housing.
6. Vertical Support: Short duct section with welded brackets bolted to fan housing, of same material as housing.
7. Inlet Screen: Wire-mesh screen on fans not connected to ductwork, of same material as housing.
8. Outlet Screen: Wire-mesh screen on fans not connected to ductwork, of same material as housing.
9. Backdraft Dampers: Butterfly style, for bolting to the discharge of fan or outlet cone, of same material as housing.
10. Shaft Seal: Elastomeric seal and Teflon wear plate, suitable for up to 300 deg F.
11. Motor Cover: Cover with side vents to dissipate motor heat, of same material as housing.
12. Inlet Vanes: Adjustable; with peripheral control linkage operated from outside of airstream, bronze sleeve bearings on each end of vane support, and provision for manual or automatic operation of same material as housing.
13. Inlet Bell: Curved inlet for when fan is not attached to duct, of same material as housing.
14. Inlet Cone: Round-to-round transition of same material as housing.
15. Outlet Cone: Round-to-round transition, of same material as housing.
16. Stack Cap: Vertical discharge assembly with backdraft dampers, of same material as housing.
17. Direct-Driven Units: Encase motor in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing. Extend lubrication lines to outside of casing and terminate with grease fittings.

H. Factory Finishes:

1. Sheet Metal Parts: Prime coat before final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.
3. Coatings: Corrosion-resistant
    a. Apply to finished housings.
    b. Apply to fan wheels.

2.3 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 EXECUTION

3.1 INSTALLATION

A. Install axial fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

E. Install units with clearances for service and maintenance.

F. Label fans according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."

B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 880, Air Terminals.
2. Underwriters Laboratories Inc. (UL).

1.2 DEFINITIONS

A. NC: Noise Criteria; background sound rating method for indoor sound.

B. VAV: Variable air volume.

C. WC: Water column.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Manufacturer's data and descriptive literature for products specified.
   b. Furnish the following information for each type of diffuser, register, and grille furnished.
      1) NC sound data.
      2) Static pressure loss data.
      3) Throw data.
2. Samples: Finish color samples.

B. Informational Submittals:

1. List of recommended spare parts for products specified.

PART 2 PRODUCTS

2.1 SUPPLY GRILLES AND REGISTERS

A. Supply Grilles and Registers (SG1, SR1):

1. Construction: As follows:
    a. Material: Steel.
    b. Finish: Baked white enamel
    c. SR Register Accessories:
        1) Gang-operated opposed-blade volume control damper.
        2) Material to match grille.
2. Adjustable front horizontal and rear vertical vanes on 3/4-inch centers.
3. Continuous sponge rubber gasket at face flange.
4. 1-inch minimum flat rectangular frame.
5. Performance: As follows:
    a. Maximum Pressure Drop: 0.40 inches WC.
    b. Sound: Maximum NC 42
6. Manufacturers and Products:
    a. Krueger; 880/5880 Series.
    b. Titus; 300 Series.
    c. Or Equivalent

B. High Capacity Return, Exhaust and Transfer Grilles and Registers (RG3, RR3, EG3, ER3, TG3):

1. Construction: As follows:
    a. Square aluminum eggcrate construction.
    b. Baked white enamel finished frame.
    c. RR and ER Register Accessories: Aluminum gang-operated opposed-blade volume control damper.
2. Extruded 1-1/4-inch flat frame with concealed fasteners.
3. Fixed louver grid with 1/2-inch by 1/2-inch by 1/2-inch louver spacing.
4. Manufacturers and Products:
    a. Krueger; Model EGC5.
    b. Carnes; Type RAPAF.
    c. Or Equivalent

PART 3 EXECUTION

3.1 INSTALLATION

A. Refer to architectural reflected ceiling plans for coordination of locations of ceiling-mounted air outlets and inlets with ceiling grids and lighting. Where locations of devices shown on mechanical drawings do not agree with locations that are shown on architectural reflected ceiling plans, reflected ceiling plans shall take precedence. If air outlets or inlets are shown on mechanical drawings, but are not shown on architectural reflected ceiling plans, devices shall be located as near as possible to locations shown on mechanical drawings when coordinating with ceiling.

B. Install diffusers, grilles, and registers tight on their respective mounting surfaces, level, plumb, and true with room dimensions.

END OF SECTION

SECTION 23 81 26
SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set for each air-handling unit.
2. Gaskets: One set for each access door.
3. Fan Belts: One set for each air-handling unit fan.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:
   a. For Compressor: Five year(s) from date of Substantial Completion.
   b. For Parts: Five year(s) from date of Substantial Completion.
   c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, Daikin or comparable product by one of the following:

1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
2. Coleman Company Inc. (The).
3. First Operations LP.
4. Friedrich Air Conditioning Company.
5. Koldwave, Inc.; a Mestek company.
6. Lennox International Inc.
7. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
8. Mitsubishi Electric Sales Canada Inc.
9. Mitsubishi Heavy Industries America, Inc.
10. SANYO North America Corporation; SANYO Fisher Company.
11. Trane; a business of American Standard companies.
12. YORK; a Johnson Controls company.
13. Or Equal.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
   c. Enclosure Type: Totally enclosed, fan cooled.
   d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.

e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
f. Mount unit-mounted disconnect switches on exterior or interior of unit.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Condensate Drain Pans:
   a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      1) Length: Extend drain pan downstream from leaving face.
      2) Depth: A minimum of 1 inch deep.
   b. Single-wall, stainless-steel sheet.
   c. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
   d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end or both ends of pan.
      1) Minimum Connection Size: NPS 1.
   e. Pan-Top Surface Coating: Asphaltic waterproofing compound.
7. Air Filtration Section:
   a. General Requirements for Air Filtration Section:
      1) Comply with NFPA 90A.
      2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
      3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
   b. Disposable Panel Filters:
      1) Factory-fabricated, viscous-coated, flat-panel type.
      2) Thickness: min 1 inch.
      3) Media: Interlaced glass fibers sprayed with nonflammable adhesive.
      4) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 INDOOR UNITS (6 TONS OR MORE)

A. Floor-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
   a. Discharge Grille: Steel with surface-mounted frame.
   b. Insulation: Faced, glass-fiber duct liner.
2. Condensate Drain Pans:
   a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      1) Length: Extend drain pan downstream from leaving face.
      2) Depth: A minimum of 2 inches deep.
   b. Single-wall, stainless-steel sheet.
   c. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
   d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end or both ends of pan.
      1) Minimum Connection Size: NPS 1.
   e. Pan-Top Surface Coating: Asphaltic waterproofing compound.
   f. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
   c. Enclosure Type: Totally enclosed, fan cooled.
   d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
   e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
   f. Mount unit-mounted disconnect switches on exterior or interior of unit.

6. Air Filtration Section:
    a. General Requirements for Air Filtration Section:
        1) Comply with NFPA 90A.
        2) Minimum Arrestance: According to ASHRAE 52.1 and a MERV according to ASHRAE 52.2.
        3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
    b. Disposable Panel Filters:
        1) Factory-fabricated, viscous-coated, flat-panel type.
        2) Thickness: 1 inch.
        3) Initial Resistance: <Insert inches wg.
        4) Recommended Final Resistance: <Insert inches wg.
        5) Arrestance according to ASHRAE 52.1: 80.
        6) Merv according to ASHRAE 52.2: 8.
        7) Media: Interlaced glass fibers sprayed with nonflammable adhesive.
        8) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

B. Variable-Frequency Controllers:

1. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, three-phase induction motor by adjusting output voltage and frequency.
2. Output Rating: Three-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
3. Unit Operating Requirements:
    a. Input ac voltage tolerance of 208 V, plus or minus 5 percent.
    b. Input-frequency tolerance of 06/11 Hz, plus or minus 6 percent.
    c. Minimum Efficiency: 96 percent at 60 Hz, full load.
    d. Minimum Displacement Primary-Side Power Factor: 96 percent.
    e. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
    f. Starting Torque: 100 percent of rated torque or as indicated.
    g. Speed Regulation: Plus or minus 1 percent.
4. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
5. Internal Adjustability Capabilities:
    a. Minimum Speed: 5 to 25 percent of maximum rpm.
    b. Maximum Speed: 80 to 100 percent of maximum rpm.

c. Acceleration: 2 seconds to a minimum of 22 seconds.
d. Deceleration: 2 seconds to a minimum of 22 seconds.
e. Current Limit: 50 percent to a minimum of 110 percent of maximum rating.

6. Self-Protection and Reliability Features:
   a. Input transient protection by means of surge suppressors.
   b. Under voltage and overvoltage trips; inverter over temperature, overload, and overcurrent trips.
   c. Adjustable motor overload relays capable of NEMA ICS 2, Class 10 performance.
   d. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
   e. Instantaneous line-to-line and line-to-ground overcurrent trips.
   f. Loss-of-phase protection.
   g. Reverse-phase protection.
   h. Short-circuit protection.
   i. Motor over temperature fault.
7. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional auto speed search shall be capable of starting into rotating loads, spinning in either direction, and returning motor to set speed in proper direction, without damage to controller, motor, or load.
8. Power-Interruption Protection: Prevents motor from re-energizing after a power interruption until motor has stopped.
9. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
10. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back, based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
11. Door-mounted, digital status lights shall indicate the following conditions:
    a. Power on.
    b. Run.
    c. Overvoltage.
    d. Line fault.
    e. Overcurrent.
    f. External fault.
12. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual-speed-control potentiometer and elapsed-time meter.

13. Meters or digital readout devices and selector switch, mounted flush in controller door and connected, to indicate the following controller parameters:
    a. Output frequency (Hertz).
    b. Motor speed (rpm).
    c. Motor status (running, stop, fault).
    d. Motor current (amperes).
    e. Motor torque (percent).
    f. Fault or alarming status (code).
    g. Proportional-integral-derivative feedback signal (percent).
    h. DC-link voltage (volts dc).
    i. Set-point frequency (Hertz).
    j. Motor output voltage (volts).
14. Control Signal Interface:
    a. Electric Input Signal Interface: A minimum of two analog inputs (0 to 10 V or 0/4-20 mA) and six programmable digital inputs.
    b. Remote signal inputs capable of accepting any of the following speed-setting input signals from the control system:
        1) 0 to 10-V dc.
        2) 0-20 or 4-20 mA.
        3) Potentiometer using up/down digital inputs.
        4) Fixed frequencies using digital inputs.
        5) RS485.
        6) Keypad display for local hand operation.
    c. Output signal interface with a minimum of one analog output signal (0/4-20 mA), which can be programmed to any of the following:
        1) Output frequency (Hertz).
        2) Output current (load).
        3) DC-link voltage (volts dc).
        4) Motor torque (percent).
        5) Motor speed (rpm).
        6) Set-point frequency (Hertz).
    d. Remote indication interface with a minimum of two dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
        1) Motor running.
        2) Set-point speed reached.
        3) Fault and warning indication (overtemperature or overcurrent).
        4) High- or low-speed limits reached.
15. Communications: RS485 interface allows VFC to be used with an external system within a multidrop LAN configuration. Interface shall

allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.

16. Integral Disconnecting Means: NEMA KS 1, fusible switch with lockable handle.
17. Accessories:
    a. Devices shall be factory installed in controller enclosure unless otherwise indicated.
    b. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
    c. Standard Displays:
        1) Output frequency (Hertz).
        2) Set-point frequency (Hertz).
        3) Motor current (amperes).
        4) DC-link voltage (volts dc).
        5) Motor torque (percent).
        6) Motor speed (rpm).
        7) Motor output voltage (volts).

2.4 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
    a. Compressor Type: Scroll.
    b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant Charge: R-410A.
    d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Polyethylene.

2.5 OUTDOOR UNITS (6 TONS (21 KW) OR MORE)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
   a. Compressor Type: Scroll.
   b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
   c. Refrigerant Charge: R-410A.
   d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Polyethylene.

2.6 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

E. Drain Hose: For condensate.

F. Additional Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

2.7 CAPACITIES AND CHARACTERISTICS

A. Refer to equipment schedules.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install unit’s level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports. Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s).
2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
3. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Perform or engage startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.4 DEMONSTRATION

A. Train or Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 26 05 02
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
2. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. Z535.4, Product Safety Signs and Labels.
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
4. Underwriters Laboratories, Inc. (UL).

1.3 ELECTRIC AND TELEPHONE SERVICE DIVISION OF RESPONSIBILITY

A. Incoming underground electrical service facilities provided by the serving utility as part of its normal obligation to customers is work provided outside this Contract. Under this Contract provide customer required service provisions and electrical work including, but not limited to, primary trench and backfill, primary duct system, metering components and associated conduit. Schedule and coordinate work of serving utility as required to provide electric service to the Work.

B. Incoming telephone service facilities provided by the serving utilities as part of their normal obligation to customers is work provided outside this Contract. Under this Contract provide customer required service provisions and electrical work.

C. Interior telecommunications central and station equipment (telephone instruments, telephone switches, data switches, and hubs, servers, software, etc.) is work provided outside this Contract. Under this Contract provide raceways, outlet and junction boxes, cover plates, pull wires, as indicated.

D. City will pay any electrical or telephone service fees.

1.4 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
   a. Electrical service components.
   b. Telephone service components.
   c. Nameplates, signs, and labels.

1.5 QUALITY ASSURANCE

A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark or label.

C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

1.6 ENVIRONMENTAL CONDITIONS

A. The following areas are classified hazardous Class I, Division 1, Group D, due to the potential for occurrence of hazardous concentrations of combustible gases, and for exposure to corrosive environment. Use materials and methods required for such areas.

1. None.

B. The following areas are classified hazardous, Class I, Division 2, Group D, due to the potential for accumulation of hazardous concentrations of combustible gases, and for exposure to corrosive environment. Use materials and methods required for such areas.

1. Enclosed, below grade valve and metering vaults with closed piping systems containing wastewater.
2. Inside wet well containing wastewater**.**
3. Inside screening building.
4. Within three feet of odor control equipment.

C. The following areas are classified nonhazardous and wet. Use materials and methods required for such areas.

1. Outdoor abovegrade areas not covered above.
2. Belowgrade vaults.

D. The following areas are classified as indoor and dry:

1. Electrical Building.
2. Maintenance Building.

PART 2 PRODUCTS

2.1 GENERAL

A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.

C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range stated in Section 01 61 00, Common Product Requirements.

D. Equip panels installed outdoors in direct sun with sun shields.

2.2 EQUIPMENT FINISH

A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with light gray color finish as approved by Owner.

2.3 NAMEPLATES

A. Material: Laminated plastic.

B. Attachment Screws: Stainless steel.

C. Color: White, engraved to a black core.

D. Letter Height:

1. Pushbuttons/Selector Switches: 1/8 inch.
2. Other electrical equipment: 1/4 inch.

2.4 SIGNS AND LABELS

A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

PART 3 EXECUTION

3.1 GENERAL

A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.

B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.

C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Keep openings in boxes and equipment closed during construction.

E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

3.2 ANCHORING AND MOUNTING

A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements for seismic zone criteria given in Section 01 61 00, Common Product Requirements.

3.3 COMBINING CIRCUITS INTO COMMON RACEWAY

A. Homerun circuits shown on Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:

1. Analog control circuits from devices in same general area to same destination.

a. No power or AC discrete control circuits shall be combined in same conduit with analog circuits.
b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.
c. Analog circuits shall be continuous from source to destination. Do not add TJB, splice, or combine into a multi-pair cable without authorization of Engineer.
d. Raceway fill shall not exceed 40 percent.
e. Changes shall be documented on record drawings.

2. Discrete control circuits from devices in the same general area to the same destination.
   a. No power or analog control circuits shall be combined in same conduit with discrete circuits.
   b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.
   c. Raceway fill shall not exceed 40 percent.
   d. Changes shall be documented on record drawings.
3. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).
   a. Lighting Circuits: Combine no more than three circuits to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
   b. Receptacle Circuits, 120-Volt Only: Combine no more than three circuits to a single raceway. Provide a separate neutral conductor for each circuit. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
   c. All Other Power Circuits: Do not combine power circuits without authorization of Engineer.

3.4 NAMEPLATES, SIGNS, AND LABELS

A. Arc Flash Protection Warning Signs:

1. Field mark switchboards, motor control centers, panelboards and variable frequency drives to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.
2. Use arc flash hazard boundary, energy level, PPE level and description, shock hazard, bolted fault current, and equipment name from study required in Section 26 05 70, Electrical Systems Analysis as basis for warning signs.

B. Multiple Power Supply Sign: Install permanent plaque or directory at each service disconnect location denoting other services, feeders, and branch circuits supplying the building, and the area served by each.

C. Equipment Nameplates:

1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.
3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

3.5 LOAD BALANCE

A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.

C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.6 CLEANING AND TOUCHUP PAINTING

A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.

B. Touchup Paint:

1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.7 PROTECTION FOLLOWING INSTALLATION

A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.

B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

END OF SECTION

SECTION 26 05 04
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
   b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
2. Canadian Standards Association (CSA).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. C12.1, Code for Electricity Metering.
   c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
   d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
   e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
   f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. UL:
   a. 98, Standard for Enclosed and Dead-Front Switches.
   b. 248, Standard for Low Voltage Fuses.
   c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
   d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   e. 508, Standard for Industrial Control Equipment.
   f. 810, Standard for Capacitors.

g. 943, Standard for Ground-Fault Circuit-Interrupters.
h. 1059, Standard for Terminal Blocks.
i. 1479, Fire Tests of Through-Penetration Fire Stops.
j. 1778, Uninterruptible Power Systems

1.2 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
   a. Control devices.
   b. Control relays.
   c. Circuit breakers.
   d. Fused switches.
   e. Nonfused switches.
   f. Timers.
   g. Fuses.
   h. Magnetic contactors.
   i. Intrinsic safety barriers.
   j. Firestopping.
   k. Enclosures: Include enclosure data for products having enclosures.
2. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals: Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

PART 2 PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

A. General:

1. Type: Molded case.
2. Trip Ratings: 15 amps to 800 amps.
3. Voltage Ratings: 120, 240, 277, 480, and 600V ac.
4. Suitable for mounting and operating in any position.
5. UL 489.

B. Operating Mechanism:

1. Overcenter, trip-free, toggle type handle.
2. Quick-make, quick-break action.

3. Locking provisions for padlocking breaker in OPEN position.
4. ON/OFF and TRIPPED indicating positions of operating handle.
5. Operating handle to assume a CENTER position when tripped.

C. Trip Mechanism:

1. Individual permanent thermal and magnetic trip elements in each pole.
2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
3. Two and three pole, common trip.
4. Automatically opens all poles when overcurrent occurs on one pole.
5. Test button on cover.
6. Calibrated for 40 degrees C ambient, unless shown otherwise.
7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.

D. Short Circuit Interrupting Ratings:

1. Equal to, or greater than, available fault current or interrupting rating shown.
2. Series Connected Ratings: Do not apply series connected short circuit ratings.

E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).

1. Ground fault sensor shall be rated same as circuit breaker.
2. Push-to-test button.

F. Magnetic Only Type Breakers: Where shown; instantaneous trip adjustment which simultaneously sets magnetic trip level of each individual pole continuously through a 3X to 10X trip range.

G. Accessories: Shunt trip, auxiliary switches, handle lock ON devices, mechanical interlocks, key interlocks, unit mounting bases, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.

H. Connections:

1. Supply (line side) at either end.
2. Mechanical wire lugs, except crimp compression lugs where shown.

3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
5. Use bolted bus connections, except where bolt-on is not compatible with existing breaker provisions.

I. Enclosures for Independent Mounting:

1. See Article Enclosures.
2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

2.2 FUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

A. UL 98 listed for use and location of installation.

B. NEMA KS 1.

C. Short Circuit Rating: 200,000 amps rms symmetrical with Class R, Class J, or Class L fuses installed.

D. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

E. Connections:

1. Mechanical lugs, except crimp compression lugs where shown.
2. Lugs removable/replaceable.
3. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.

F. Fuse Provisions:

1. 30-amp to 600-amp rated shall incorporate rejection feature to reject all fuses except Class R.
2. 601-amp rated and greater shall accept Class L fuses, unless otherwise shown.

G. Enclosures: See Article Enclosures.

H. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.3 NONFUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

A. NEMA KS 1.

B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

C. Lugs: Suitable for use with 75 degrees C wire at NEC 75 degrees C ampacity.

D. Auxiliary Contact:

1. Operation: Make before power contacts make and break before power contacts break.
2. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.

E. Enclosures: See Article Enclosures.

F. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.4 FUSE, 250-VOLT AND 600-VOLT

A. Power Distribution, General:

1. Current-limiting, with 200,000 ampere rms interrupting rating.
2. Provide to fit mountings specified with switches.
3. UL 248.

B. Power Distribution, Ampere Ratings 1 Amp to 600 Amps:

1. Class: RK-1.
2. Type: Dual element, with time delay.
3. Manufacturers and Products:
   a. Bussmann; Types LPS-RK (600 volts) and LPN-RK (250 volts).
   b. Littelfuse; Types LLS-RK (600 volts) and LLN-RK (250 volts).

C. Power Distribution, Ampere Ratings 601 Amps to 6,000 Amps:

1. Class: L.
2. Double O-rings and silver links.
3. Manufacturers and Products:
   a. Bussmann; Type KRP-C.

b. Littelfuse, Inc.; Type KLPC.

D. Cable Limiters:

1. 600V or less; crimp to copper cable, bolt to bus or terminal pad.
2. Manufacturer and Product: Bussmann; K Series.

E. Ferrule:

1. 600V or less, rated for applied voltage, small dimension.
2. Ampere Ratings: 1/10 amp to 30 amps.
3. Dual-element time-delay, time-delay, or nontime-delay as required.
4. Provide with blocks or holders as indicated and suitable for location and use.
5. Manufacturers:
   a. Bussmann.
   b. Littlefuse, Inc.

2.5 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.

B. Selector Switch Operating Lever: Standard.

C. Indicating Light: LED, full voltage, push-to-test.

D. Pushbutton Color:

1. ON or START: Black.
2. OFF or STOP: Red.

E. Pushbutton and selector switch lockable in OFF position where indicated.

F. Legend Plate:

1. Material: Aluminum.
2. Engraving: Enamel filled in high contrasting color.
3. Text Arrangement: 11-character/spaces on one line, 14-character/spaces on each of two lines, as required, indicating specific function.
4. Letter Height: 7/64 inch.

G. Manufacturers and Products:

1. Heavy-Duty, Oil-Tight Type:
   a. General Electric Co.; Type CR 104P.

b. Square D Co.; Type T.
c. Eaton/Cutler-Hammer; Type 10250T.

2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
   a. Square D Co.; Type SK.
   b. General Electric Co.; Type CR 104P.
   c. Eaton/Cutler-Hammer; Type E34.
   d. Crouse-Hinds; Type NCS.

2.6 TERMINAL BLOCK, 600 VOLTS

A. UL 486E and UL 1059.

B. Size components to allow insertion of necessary wire sizes.

C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.

D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.

E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.

F. Yoke shall guide all strands of wire into terminal.

G. Current bar shall ensure vibration-proof connection.

H. Terminals:

1. Capable of wire connections without special preparation other than stripping.
2. Capable of jumper installation with no loss of terminal or rail space.
3. Individual, rail mounted.

I. Marking system, allowing use of preprinted or field-marked tags.

J. Manufacturers:

1. Weidmuller, Inc.
2. Ideal.
3. Electrovert USA Corp.

2.7 MAGNETIC CONTROL RELAY

A. Industrial control with field convertible contacts rated 10 amps continuous, 7,200VA make, 720VA break.

B. NEMA ICS 2, Designation: A600 (600 volts).

C. Time Delay Relay Attachment:

1. Pneumatic type, timer adjustable as shown.
2. Field convertible from ON delay to OFF delay and vice versa.

D. Latching Attachment: Mechanical latch, having unlatching coil and coil clearing contacts.

E. Manufacturers and Products:

1. Eaton/Cutler-Hammer; D26 Type M.
2. General Electric Co.; Type CR120A.
3. Square D; Type X.

2.8 TIME DELAY RELAY

A. Industrial relay with contacts rated 5 amps continuous, 3,600VA make, 360VA break.

B. NEMA ICS 2 Designation: B150 (150 volts).

C. Solid-state electronic, field convertible ON/OFF delay.

D. One normally open and one normally closed contact (minimum).

E. Repeat accuracy plus or minus 2 percent.

F. Timer adjustment from 1 second to 60 seconds, unless otherwise indicated on Drawings.

G. Manufacturers and Products:

1. Square D Co.; Type XO.
2. Eaton/Cutler-Hammer; Type D26MR.
3. General Electric Co.; Type CR120.

2.9 ELAPSED TIME METER

A. Drive: Synchronous motor.

B. Range: 0 hour to 99,999.9 hours, nonreset type.

C. Mounting: Semiflush panel.

D. Manufacturers and Products:

1. General Electric Co.; Type 240, 2-1/2-inch Big Look.
2. Eagle Signal Controls; Bulletin 705.

2.10 MAGNETIC CONTACTOR

A. UL listed.

B. Electrically operated, electrically held.

C. Main Contacts:

1. Power driven in one direction with mechanical spring dropout.
2. Silver alloy with wiping action and arc quenchers.
3. Continuous-duty, rated as shown.
4. Poles: As shown.

D. Control: As shown.

E. Auxiliary Contacts: Quantity as shown, rated 7200VA make, 720VA break, at 600V, A600 per NEMA ICS 5.

F. Enclosures: See Article Enclosures.

G. Manufacturers and Products:

1. Eaton/Cutler-Hammer; Class A201.
2. General Electric Co.; CR 353.
3. Square D Co.; Class 8910.

2.11 PHASE MONITOR RELAY

A. Features:

1. Voltage and phase monitor relay shall drop out on low voltage, voltage unbalance, loss of phase, or phase reversal.
2. Contacts: Single-pole, double-throw, 10 amperes, 120/240V ac. Where additional contacts are shown or required, provide magnetic control relays.
3. Adjustable trip and time delay settings.
4. Transient Protection: 1,000V ac.
5. Mounting: Multipin plug-in socket base.

B. Manufacturer and Product: Automatic Timing and Controls; SLD Series.

2.12 MAGNETIC LIGHTING CONTACTOR

A. Comply with NEMA ICS 2; provide UL 508 listing.

B. Electrically operated by dual-acting, single coil mechanism.

C. Inherently interlocked and electrically held in CLOSED position.

D. Main Contacts:

1. Double-break, continuous-duty, rated 30 amperes, 600 volts, withstand rating of 22,000 amps rms symmetrical at 250 volts, 14,000 amps rms symmetrical at 480 volts.
2. Marked for electric discharge lamps, tungsten, and general purpose loads.
3. Position not dependent on gravity, hooks, latches, or semipermanent magnets.
4. Capable of operating in any position.
5. Visual indication for each contact.

E. Auxiliary contact relay for Form 3 control.

F. Fully rated neutral terminal.

G. Provision for remote pilot lamp with use of auxiliary contacts.

H. Clamp type, self-rising terminal plates for solderless connections.

I. Enclosures: See Article Enclosures.

J. Manufacturers and Products:

1. ASCO.
2. Eaton/Cutler-Hammer; Class A202.
3. General Electric Co.; Class 360 (electrically held).
4. Square D; Class 8903, Type L (electrically held).

2.13 SUPPORT AND FRAMING CHANNELS

A. Carbon Steel Framing Channel:

1. Material: Rolled, mild strip steel, 12-gauge minimum, ASTM A1011/ A1011M, Grade 33.
2. Finish: Hot-dip galvanized after fabrication.

B. Paint Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.

C. PVC-Coated Framing Channel: Carbon steel framing channel with 40-mil polyvinyl chloride coating.

D. Stainless Steel Framing Channel: Rolled, Type 316 stainless steel, 12-gauge minimum.

E. Extruded Aluminum Framing Channel:

1. Material: Extruded from Type 6063-T6 aluminum alloy.
2. Fittings fabricated from Alloy 5052-H32.

F. Nonmetallic Framing Channel:

1. Material: Fire retardant, fiber reinforced vinyl ester resin.
2. Channel fitting of same material as channel.
3. Nuts and bolts of long glass fiber reinforced polyurethane.

G. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.
3. Aickinstrut.

2.14 INTRINSIC SAFETY BARRIER

A. Provides a safe energy level for exposed wiring in a Class I, Division 1 or Division 2 hazardous area when circuit is connected to power source in nonhazardous area.

B. Rating: Power source shall be rated 24V dc or 120V ac as shown on Drawings, with not more than 250 volts available under fault conditions.

C. Contact Rating: 5 amps, 250V ac.

D. Mounting: Rail or surface.

E. Manufacturers and Products:

1. MTL, Inc.; Series 2000 or Series 3000.
2. R. Stahl, Inc.

2.15 FIRESTOPS

A. General:

1. Provide UL 1479 classified hourly fire rating equal to, or greater than, the assembly penetrated.
2. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.
3. Sealants and accessories shall have fire-resistance ratings as established by testing identical assemblies in accordance with ASTM E814, by UL, or other testing and inspection agency acceptable to authorities having jurisdiction.

B. Firestop System:

1. Formulated for use in through-penetration firestopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.
2. Fill, Void, or Cavity Material: 3M Brand Fire Barrier Caulk CP25, Putty 303, Wrap/Strip FS195, Composite Sheet CS195 and Penetration Sealing Systems 7902 and 7904 Series.
3. Two-Part, Foamed-In-Place, Silicone Sealant: Dow Corning Corp. Fire Stop Foam, General Electric Co.; Pensil 851.
4. Fire Stop Devices: See Section 26 05 33, Raceway and Boxes, for raceway and cable fittings.

2.16 UNINTERRUPTIBLE POWER SUPPLY SYSTEM (UPS-2 AND 3)

A. General:

1. Function: Provides isolated, regulated uninterrupted ac output power during a complete or partial interruption of incoming line power.
2. Type: Continuous-duty, online, double conversion, power isolated.
   a. Major Parts: Rectifier, inverter, battery charger, sealed batteries, bypass switch, AC circuit breakers, control and monitor electronics.

B. Performance:

1. Capacity: 3kVA, 0.9 power factor minimum.
2. Input Power:
   a. 120/208V ac single-phase, three-wire plus ground, 60-Hz.
   b. Connections: Hardwired.
3. Output Power:
   a. 120/240V ac single-phase, three-wire plus ground, 60-Hz.
   b. Connections: Hardwired.

4. Online Efficiency: 88 percent minimum; 97% in power saver mode.
5. Backup Runtime:
    a. Full Load: 132 minutes minimum.
    b. Half load: 324 minutes minimum.
    c. Include provisions for future expansion of battery capacity via manufacturer's standard battery packages.
6. Continuous no-break power with no measurable transfer time.
7. Sine-Wave Output Voltage Total Harmonic Distortion (THD): Plus or minus 5 percent or less.
8. Input Voltage Range: 176V ac to 276V ac.
9. Output Voltage Regulation: Plus or minus 3 percent nominal.
10. Operating Temperature: 0 degree C to 40 degrees C (32 degrees F to 104 degrees F).
11. Operating Relative Humidity: 5 percent to 95 percent without condensation.
12. Lightning and Surge Protection: Pass lightning standard IEEE C62.41, Categories A and B tests.
13. Features:
    a. Common Fail Signal Output: Provide 120V rated contact with closes upon any UPS failure.
14. Enclosures: Tower.

15. Manufacturer and Product: Eaton Powerware; 9170.

2.17 UNINTERRUPTIBLE POWER SUPPLY SYSTEM (UPS-1)

A. GENERAL:

1. Function: Provides isolated, regulated uninterrupted ac output power during a complete or partial interruption of incoming line power.
2. Type: Continuous-duty, online, double conversion, power isolated.
    a. Major Parts: Rectifier, inverter, battery charger, sealed batteries, bypass switch, AC circuit breakers, control and monitor electronics.

B. Performance:

1. Capacity: 15kVA, 0.9 power factor, minimum.
2. Input Power:
    a. 480V ac three-phase, three-wire plus ground, 60-Hz.
    b. Connections: Hardwired.
3. Output Power:
    a. 480/277V ac three-phase, four-wire plus ground, 60-Hz.
    b. Connections: Hardwired.

4. Online Efficiency: 91 percent minimum.
5. Backup Runtime:
    a. Full Load: 4 minutes minimum.
    b. 20% load: 38 minutes minimum.
    c. Include provisions for future expansion of battery capacity via manufacturer's standard battery packages.
6. Continuous no-break power with no measurable transfer time.
7. Sine-Wave Output Voltage Total Harmonic Distortion (THD): Plus or minus 5 percent or less.
8. Input Voltage Range: 480V ac, nominal.
9. Output Voltage Regulation: Plus or minus 3 percent nominal.
10. Operating Temperature: 0 degree C to 40 degrees C (32 degrees F to 104 degrees F).
11. Operating Relative Humidity: 5 percent to 95 percent without condensation.
12. Lightning and Surge Protection: Pass lightning standard IEEE C62.41, Categories A and B tests.
13. Features:
    a. Common Fail Signal Output: Provide 120V rated contact with closes upon any UPS failure.
14. Enclosures: Tower.
15. Manufacturer and Product: Eaton 9355.

2.18 GENERATOR PLUG PANEL

A. NEMA 4X, 316 stainless steel hinged enclosure with provisions for padlock.

B. 480/277v, 4-pole plus ground plug panel within enclosure.

C. Cam-lock quick connect receptacles

D. Crouse-Hinds J-Series, ASCO Series 3QC, or equal.

2.19 ENCLOSURES

A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.

B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.

C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

D. Enclosure Selections: Except as shown otherwise, provide electrical enclosures according to the Area Classification and Material Selection Table on Drawings.

PART 3 EXECUTION

3.1 GENERAL

A. Install equipment in accordance with manufacturer's recommendations.

3.2 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, unless otherwise shown.

B. Install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas, unless otherwise shown.

3.3 SUPPORT AND FRAMING CHANNEL

A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.

B. Channel type shall be as indicated in the Area Classification and Material Selection Table on Drawings.

C. Paint cut ends prior to installation with the following:

1. Carbon Steel Channel: Zinc-rich primer.
2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
3. Nonmetallic Channel: Epoxy resin sealer.
4. PVC-Coated Channel: PVC patch.

3.4 INTRINSIC SAFETY BARRIERS

A. Install in compliance with ISA RP12.06.01.

B. Arrange conductors such that wiring from hazardous areas cannot short to wiring from nonhazardous area.

C. Stencil "INTRINSICALLY SAFE CIRCUIT" on all boxes enclosing barriers.

3.5 FIRESTOPS

A. Install in strict conformance with manufacturer's instructions. Comply with installation requirements established by testing and inspecting agency.

B. Sealant: Install sealant including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION

SECTION 26 05 05
CONDUCTORS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
2. ASTM International (ASTM):
   a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   b. B3, Standard Specification for Soft or Annealed Copper Wire.
   c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV Through 500 kV.
   b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
   c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500000 V.
4. Insulated Cable Engineer's Association, Inc. (ICEA):
   a. S-58-679, Standard for Control Cable Conductor Identification.
   b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
   c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
5. National Electrical Manufacturers' Association (NEMA):
   a. CC 1, Electric Power Connectors for Substations.
   b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
   c. WC 70, Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
   d. WC 71, Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy.

e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.

6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
7. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
8. Underwriters Laboratories Inc. (UL):
   a. 13, Standard for Safety for Power-Limited Circuit Cables.
   b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
   c. 62, Standard for Safety for Flexible Cord and Cables.
   d. 83, Thermoplastic-Insulated Wires and Cables
   e. 486A-486B, Standard for Safety for Wire Connectors.
   f. 486C, Standard for Safety for Splicing Wire Connectors.
   g. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
   h. 854, Standard for Safety for Service-Entrance Cables.
   i. 1072, Standard for Safety for Medium-Voltage Power Cables.
   j. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
   k. 1569, Standard for Safety for Metal-Clad Cables.
   l. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data:
   a. Wire and cable.
   b. Wire and cable accessories.
   c. Cable fault detection system.

2. Cable Pulling Calculations:
   a. Ensure submitted and reviewed before cable installation.
   b. Provide for the following cable installations:
      1) Medium voltage cable runs that cannot be hand pulled.
      2) Multiconductor 600-volt cable sizes larger than 2 AWG that cannot be hand pulled.

B. Informational Submittals:

1. Journeyman lineman or electrician splicing credentials.
2. Factory Test Report for conductors 600 volts and below.

3. Factory Test Report per AEIC CS 8, including AEIC qualification report for conductors above 600 volts.

1.3 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark.

B. Terminations and Splices for Conductors above 600 Volts: Work shall be done by journeyman lineman with splicing credentials or electrician certified to use materials approved for cable splices and terminations.

PART 2 PRODUCTS

2.1 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 70.

B. Conductor Type:

1. 120-Volt and 277-Volt Lighting, 10 AWG and Smaller: Solid copper.
2. 120-Volt Receptacle Circuits, 10 AWG and Smaller: Solid copper.
3. All Other Circuits: Stranded copper.

C. Insulation: Type THHN/THWN-2, except for sizes No. 6 and larger, with XHHW-2 insulation.

D. Flexible Cords and Cables:

1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

2.2 CONDUCTORS ABOVE 600 VOLTS

A. EPR Insulated Cable:

1. Extrusion: Single-pass, triple-tandem, of conductor screen, insulation, and insulation screen.

2. Type: 5and 15 kV, shielded, UL 1072, Type MV-105 as noted on Drawings.
3. Conductors: Copper, concentric lay Class B round stranded in accordance with ASTM B3, ASTM B8, and ASTM B496.
4. Conductor Screen: Extruded, semiconducting ethylene-propylene rubber in accordance with NEMA WC 71 and AEIC CS 8.
5. Insulation: 133 percent insulation level, ethylene-propylene rubber (EPR) containing no polyethylene, in accordance with NEMA WC 71, and AEIC CS 8.
6. Insulation Thickness: 115-mil, 5 kV, 220-mil, 15 kV, nominal.
7. Insulation Screen: Thermosetting, semiconducting ethylene-propylene rubber (EPR), extruded directly over insulation in accordance with NEMA WC 74 and AEIC CS 8.
8. Metallic Shield: Uncoated, 5-mil, copper shielding tape, helically applied with 12-1/2percent minimum overlap.
9. Jacket: Extruded polyvinyl chloride (PVC) compound applied in accordance with NEMA WC 71 or NEMA WC 74.
10. Operating Temperature: 105 degrees C continuous normal operations, 130 degrees C emergency operating conditions, and 250 degrees C short-circuit conditions.
11. Manufacturers:
    a. Okonite Co.
    b. Pirelli Wire and Cable.
    c. General Cable.
    d. Southwire Co.

2.3 600-VOLT RATED CABLE

A. General:

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Multiconductor Control Cable:

1. Conductors:
    a. 14 AWG, seven-strand copper.
    b. Insulation: 15-mil PVC with 4-mil nylon.

c. UL 1581 listed as Type THHN/THWN rated VW-1.
d. Conductor group bound with spiral wrap of barrier tape.
e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.

2. Cable: Passes the ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	0.83	60
25	1.00	60
37	1.15	80

4. Manufacturers:
   a. Okonite Co.
   b. Southwire.

C.

C. Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

1. Outer Jacket: 45-mil nominal.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
3. Dimension: 0.32-inch nominal OD.
4. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8, 18 AWG.
   b. 20 AWG, seven-strand, tinned copper drain wire.
   c. Insulation: 15-mil nominal PVC.
   d. Jacket: 4-mil nylon.
   e. Color Code: Triad conductors black, red, and blue.
5. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.
   c. Belden.

D. Multitwisted Shielded Pair Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 57 requirements.

1. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8, 18 AWG.
   b. Tinned copper drain wires.
   c. Drain wire size AWG 20.
   d. Insulation: 15-mil PVC.
   e. Jacket: 4-mil nylon.
   f. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.
   g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.
2. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.
   c. Belden.

2.4 300-VOLT RATED CABLE

A. General:

1. Type PLTC, meeting requirements of UL 13 and NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 105 degrees C.
5. Passes Vertical Tray Flame Test.
6. Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Twisted Pair Fire Alarm Cable, Nonshielded: Power limited fire protective signaling circuit cable meeting requirements of NFPA 70, Article 760.

1. Cable: Pass NFPA 262, 70,000 Btu flame test and listed by California State Fire Marshall.
2. Outer Jacket: Red in color, identified along its entire length as fire protective signaling circuit cable.
3. Conductors:

a. Solid, tinned, or bare copper.Insulation: 15-mil PVC.

4. Cable Sizes:

Wire Size	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Inches)
12	0.36	0.042
14	0.32	0.042
16	0.26	0.037
18	0.23	0.037

5. Manufacturers:
   a. West Penn Wire.
   b. Coleman Cable, Inc.

2.5 SPECIAL CABLES

A. Unshielded Twisted Pair (UTP) Telephone and Data Cable, 300V:

1. Category 6 UTP, UL listed, and third party verified to comply with TIA/EIA 568-C Category 6 requirements.
2. Suitable for high speed network applications including gigabit ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
3. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket.
4. NFPA 70 Plenum (CMP) rated; comply with flammability plenum requirements of NFPA 70 and NFPA 262.
5. Cable shall withstand a bend radius of 1-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
6. Manufacturer and Product: Belden; 7852A.

B. RS232/RS422 Cable, 300V:

1. Outer Jacket: PVC.
2. Shield: Aluminum foil-polyester tape, 24 AWG tinned copper drain wire, 100% coverage.
3. Braid: Tinned copper, 65% coverage.
4. Conductors:
   a. 24 AWG stranded tinned copper.
   b. Insulation: polyethylene.
5. Manufacturer and Product: Belden; 9829.

2.6 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.

B. Direct Buried: Bare stranded copper.

2.7 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape:

1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
3. Arc and Fireproofing:
   a. 30-mil, elastomer.
   b. Manufacturers and Products:
      1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
      2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.

B. Identification Devices:

1. Sleeve:
   a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
   b. Manufacturers and Products:
      1) Raychem; Type D-SCE or ZH-SCE.
      2) Brady, Type 3PS.
2. Heat Bond Marker:
   a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
   b. Self-laminating protective shield over text.
   c. Machine printed black text.
   d. Manufacturer and Product: 3M Co.; Type SCS-HB.
3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
4. Tie-On Cable Marker Tags:
   a. Chemical-resistant white tag.
   b. Size: 1/2 inch by 2 inches.
   c. Manufacturer and Product: Raychem; Type CM-SCE.
5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
    a. Manufacturers and Products:
        1) Thomas & Betts; Sta-Kon.
        2) Burndy; Insulug.
        3) ILSCO.
2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
    a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
    b. Seamless.
    c. Manufacturers and Products:
        1) Thomas & Betts; Sta-Kon.
        2) Burndy; Insulink.
        3) ILSCO; ILSCONS.
3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
    a. UL 486C.
    b. Plated steel, square wire springs.
    c. Manufacturers and Products:
        1) Thomas & Betts.
        2) Ideal; Twister.
4. Self-Insulated, Set Screw Wire Connector:
    a. Two piece compression type with set screw in brass barrel.
    b. Insulated by insulator cap screwed over brass barrel.
    c. Manufacturers:
        1) 3M Co.
        2) Thomas & Betts.
        3) Marrette.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Uninsulated Crimp Connectors and Terminators:
    a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
    b. Manufacturers and Products:
        1) Thomas & Betts; Color-Keyed.
        2) Burndy; Hydent.
        3) ILSCO.
4. Uninsulated, Bolted, Two-Way Connectors and Terminators:
    a. Manufacturers and Products:
        1) Thomas & Betts; Locktite.
        2) Burndy; Quiklug.
        3) ILSCO.

E. Cable Ties:

1. Nylon, adjustable, self-locking, and reusable.
2. Manufacturer and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation:

1. Thermally stabilized cross-linked polyolefin.
2. Single wall for insulation and strain relief.
3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.
4. Manufacturers and Products:
   a. Thomas & Betts; SHRINK-KON.
   b. Raychem; RNF-100 and ES-2000.

G. Data Cable Accessories: Terminators, connectors, and junctions necessary for a complete DeviceNet, Profibus PA,or Profibus DP system, as applicable.

2.8 ACCESSORIES FOR CONDUCTORS ABOVE 600 VOLTS

A. Molded Splice Kits:

1. Components necessary to provide insulation, metallic shielding and grounding systems, and overall jacket.
2. Capable of making splices with a current rating equal to, or greater than cable ampacity, conforming to IEEE 404.
3. Class 5 and 15 kV, with compression connector, EPDM molded semiconductive insert, peroxide-cured EPDM insulation, and EPDM molded semiconductive outer shield.
4. Premolded splice shall be rejacketed with a heat shrinkable adhesive-lined sleeve to provide a waterproof seal.
5. Manufacturers:
   a. Elastimold.
   b. Cooper Industries.

B. Heat Shrinkable Splice Kits:

1. Components necessary to provide insulation, metallic shielding and grounding systems, and overall jacket.
2. Capable of making splices with a current rating equal to, or greater than, cable ampacity, conforming to IEEE 404.
3. Class 5 and 15 kV, with compression connector, splice insulating and conducting sleeves, stress-relief materials, shielding braid and mesh, and abrasion-resistant heat shrinkable adhesive-lined rejacketing sleeve to provide a waterproof seal.
4. Manufacturers:
   a. Raychem.
   b. 3M Co.

C. Termination Kits:

1. Capable of terminating 5 and 15 kV, single-conductor, polymeric-insulated shielded cables plus a shield ground clamp.
2. Capable of producing a termination with a current rating equal to, or greater than, cable ampacity meeting Class 1 requirements of IEEE 48.
3. Capable of accommodating cable shielding or construction without need for special adapters or accessories.
4. Manufacturers:
    a. Raychem.
    b. 3M Co.

D. Elbow Connector Systems:

1. Molded, peroxide-cured, EPDM-insulated, Class 15 kV, 95 kV BIL, 600A, 40,000 rms nonload-break elbows having copper current-carrying parts in accordance with IEEE 386.
2. Protective Caps: Class 15 kV, 95 kV BIL, 600 amperes, with molded EPDM insulated body.
3. Insulated Standoff Bushings: Class 15 kV, 95 kV BIL, 600 amperes, complete with EPDM rubber body, stainless steel eyebolt with brass pressure foot, and stainless steel base bracket.
4. Bushing Inserts: Class 15 kV, 95 kV BIL, 600A, nonload-break with EPDM rubber body and all-copper, current-carrying parts.
5. Mounting Plates: Two-way, ASTM A167 stainless steel, complete with universal mounting brackets, grounding lugs and two parking stands.
6. Manufacturers:
    a. Cooper Industries.
    b. Elastimold.

E. Cable Lugs:

1. In accordance with NEMA CC1.
2. Rated 5 and 15 kV of same material as conductor metal.
3. Manufacturers and Products, Uninsulated Compression Connectors and Terminators:
    a. Burndy; Hydent.
    b. Thomas & Betts; Color-Keyed.
    c. ILSCO.
4. Manufacturers and Products, Uninsulated, Bolted, Two-Way Connectors and Terminators:
    a. Thomas & Betts; Locktite.
    b. ILSCO.

2.9 CABLE FAULT DETECTION SYSTEM

A. One fault sensor for each phase conductor prewired with lead cable extending to remote indicator target.

B. Magnetically operated, automatic indicator target.

C. Nonresettable, unless all three phases are fault free.

D. Sensor/indicator target sealed for submersible operation.

E. Trip Rating: 600 amperes.

F. Fault powered with a normal current flow rating in excess of 5 amperes.

G. Portable, Handheld Cable Fault Tester: One.

H. Equip each sensor with auxiliary relay contacts for future use.

I. Manufacturers and Products:

1. Cooper Industries; Type CR3.
2. AB Chance.

2.10 PULLING COMPOUND

A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.

B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.

C. Approved for intended use by cable manufacturer.

D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

E. Manufacturers:

1. Ideal Co.
2. Polywater, Inc.
3. Cable Grip Co.

2.11 WARNING TAPE

A. As specified in Section 26 05 33, Raceway and Boxes.

2.12 SOURCE QUALITY CONTROL

A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.

B. Conductors Above 600 Volts: Test in accordance with NEMA WC 71 and AEIC CS 8 partial discharge level test for EPR insulated cable.

PART 3 EXECUTION

3.1 GENERAL

A. Conductor installation shall be in accordance with manufacturer's recommendations.

B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.

C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

D. Terminate conductors and cables, unless otherwise indicated.

E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors.

F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

G. Bundling: Where single conductors and cables in manholes, handholes, vaults, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches on center.

H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.

3.2 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
2. 8 AWG and Smaller: Provide colored conductors.
3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts, Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts, Three-Phase, Four-Wire, Delta, Center Tap, Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

B. Conductors Above 600 Volts:

1. Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
2. Colors:
   a. Grounded Neutral: White.
   b. Phase A: Brown.
   c. Phase B: Orange.
   d. Phase C: Yellow.

3.3 CIRCUIT IDENTIFICATION

A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.

B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations.

C. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.
2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

D. Method:

1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables and Conductors 2 AWG and Larger:
   a. Identify with marker plates or tie-on cable marker tags.
   b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.4 CONDUCTORS 600 VOLTS AND BELOW

A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.

B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Engineer.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.

5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
7. Place no more than one conductor in any single-barrel pressure connection.
8. Install crimp connectors with tools approved by connector manufacturer.
9. Install terminals and connectors acceptable for type of material used.
10. Compression Lugs:
    a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
    b. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Insulate uninsulated connections.
2. Indoors: Use general purpose, flame retardant tape or single wall heat shrink.
3. Outdoors, Dry Locations: Use flame retardant, cold- and weather-resistant tape or single wall heat shrink.
4. Below Grade and Wet or Damp Locations: Use dual wall heat shrink.

F. Cap spare conductors with UL listed end caps.

G. Cabinets, Panels, and Motor Control Centers:

1. Remove surplus wire, bridle and secure.
2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
4. Where connections of cables installed under this section are to be made under Section 40 90 00, Instrumentation and Control for Process Systems, leave pigtails of adequate length for bundled connections.
5. Cable Protection:

a. Under Infinite Access Floors: May install without bundling.
b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2 inch in diameter.
c. Maintain integrity of shielding of instrumentation cables.
d. Ensure grounds do not occur because of damage to jacket over shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.5 CONDUCTORS ABOVE 600 VOLTS

A. Do not splice unless specifically indicated or approved by Engineer.

B. Make joints and terminations with splice and termination kits, in accordance with kit manufacturer's instructions.

C. Install splices or terminations as continuous operation in accessible locations under clean, dry conditions.

D. Single Conductor Cable Terminations: Provide heat shrinkable stress control and outer nontracking insulation tubings, high relative permittivity stress relief mastic for insulation shield cutback treatment, and a heat-activated sealant for environmental sealing plus a ground braid and clamp.

E. Install terminals or connectors acceptable for type of conductor material used.

F. Provide outdoor rain skirts for outdoor switchgear terminations.

G. Provide shield termination and grounding for terminations.

H. Provide necessary mounting hardware, covers, and connectors.

I. Where elbow connectors are specified, install in accordance with manufacturer's instructions.

J. Connections and Terminations:

1. Install uninsulated crimp connectors and terminators for power circuit conductors 4 AWG and larger.
2. Install uninsulated, bolted, two-way connectors for motor circuit conductors No. 12 and larger.

K. Give 2 working days' notice to Engineer prior to making splices or terminations.

3.6 CONDUCTOR ARC AND FIREPROOFING

A. Install arc and fireproofing tape on 5 kV cables in pull boxes.

B. Wrap conductors of same circuit entering from separate conduit together as single cable.

C. Follow tape manufacturer's installation instructions.

D. Secure tape with bands of tapebinder. Each band to consist of a minimum of two wraps directly over each other.

3.7 CABLE FAULT DETECTION SYSTEM

A. Install remote indicator target externally exposed, on side of equipment enclosure in which cable terminates.

B. Mounting Height: Minimum 36 inches, maximum 60 inches from floor.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product data for the following:
      1) Exothermic weld connectors.
      2) Mechanical connectors.
      3) Compression connectors.

1.3 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.1 GROUND ROD

A. Material: Copper-clad.

B. Diameter: Minimum 5/8 inch.

C. Length: 10 feet.

2.2 GROUND CONDUCTORS

A. As specified in Section 26 05 05, Conductors.

2.3 CONNECTORS

A. Exothermic Weld Type:

1. Outdoor Weld: Suitable for exposure to elements or direct burial.
2. Indoor Weld: Utilize low-smoke, low-emission process.
3. Manufacturers:
   a. Erico Products, Inc. Cadweld and Cadweld Exolon.
   b. Thermoweld.

B. Compression Type:

1. Compress-deforming type; wrought copper extrusion material.
2. Single indentation for conductors 6 AWG and smaller.
3. Double indentation with extended barrel for conductors 4 AWG and larger.
4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.
5. Manufacturers:
   a. Burndy Corp.; Hyground Irreversible Compression.
   b. Thomas and Betts Co.
   c. ILSCO.

C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

1. Manufacturers:
   a. Burndy Corp.
   b. Thomas and Betts Co.

2.4 GROUNDING WELLS

A. Ground rod box complete with cast iron riser ring and traffic cover marked GROUND ROD.

B. Manufacturers and Products:

1. Christy Co. No. G5.
2. Lightning and Grounding Systems, Inc. I-R Series.

PART 3 EXECUTION

3.1 GENERAL

A. Grounding shall be in compliance with NFPA 70 and IEEE C2.

B. Ground electrical service neutral at service entrance equipment with grounding electrode conductor to grounding electrode system.

C. Ground each separately derived system neutral with common grounding electrode conductor to grounding electrode system.

D. Bond together all grounding electrodes that are present at each building or structure served to form one common grounding electrode system.

E. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

F. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.

G. Shielded Instrumentation Cables:

1. Ground shield to ground bus at power supply for analog signal.
2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
3. Do not ground instrumentation cable shield at more than one point.

3.2 WIRE CONNECTIONS

A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.

B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Connect ground conductors to raceway grounding bushings.

D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.

E. Connect enclosure of equipment containing ground bus to that bus.

F. Bolt connections to equipment ground bus.

G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

I. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amps use minimum 5/16-inch diameter bolt.

3.3 MOTOR GROUNDING

A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.

B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Motors Less Than 10 hp: Use furnished ground lug in motor connection box; if none furnished, provide compression, spade-type terminal connected to conduit box mounting screw.

D. Motors 10 hp and Above: Use furnished ground lug in motor connection box; if none furnished, tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.

E. Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

3.4 GROUND RODS

A. Install full length with conductor connection at upper end.

B. Install with connection point below finished grade, unless otherwise shown.

C. Space multiple ground rods by one rod length.

3.5 GROUNDING WELLS

A. Install for ground rods located inside buildings, asphalt and paved areas, and where shown on Drawings.

B. Install riser ring and cover flush with surface.

C. Place 12 inches of crushed rock in bottom of each well.

3.6 CONNECTIONS

A. General:

1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
2. Belowgrade Connections: Install exothermic weld or compression type connectors.
3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
4. Notify Engineer prior to backfilling ground connections.

B. Exothermic Weld Type:

1. Wire brush or file contact point to bare metal surface.
2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
3. Avoid using badly worn molds.
4. Mold to be completely filled with metal when making welds.
5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Compression Type:

1. Install in accordance with connector manufacturer's recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer's compression tool having proper sized dies and operate per manufacturer's instructions.

D. Mechanical Type:

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
2. Install in accordance with connector manufacturer's recommendations.
3. Do not conceal mechanical connections.

3.7 METAL STRUCTURE GROUNDING

A. Bond metal sheathing and exposed metal vertical structural elements to grounding system.

B. Bond electrical equipment supported by metal platforms to the platforms.

C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.8 MANHOLE AND HANDHOLE GROUNDING

A. Install one ground rod inside each manhole and handhole larger than 24-inch by 24-inch inside dimensions.

B. Ground Rod Floor Protrusion: 4 inches to 6 inches above floor.

C. Make connections of grounding conductors fully visible and accessible.

D. Connect all noncurrent-carrying metal parts, and any metallic raceway grounding bushings to ground rod with 6 AWG copper conductor.

3.9 TRANSFORMER GROUNDING

A. Bond neutrals of transformers within buildings to system ground network, and to any additional indicated grounding electrodes.

B. Bond neutrals of pad-mounted transformers to locally driven ground rods and buried ground wire encircling transformer and system ground network.

3.10 LIGHTNING PROTECTION SYSTEMS

A. Bond lightning protection system ground terminals to building or structure grounding electrode system.

3.11 SURGE PROTECTION EQUIPMENT GROUNDING

A. Connect surge arrestor ground terminals to equipment ground bus.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges.
2. ASTM International (ASTM):
   a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
   b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   e. D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
3. Telecommunications Industry Association (TIA): 569B, Commercial Building Standard for Telecommunications Pathways and Spaces.
4. National Electrical Contractor's Association, Inc. (NECA): Installation standards.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. C80.1, Electrical Rigid Steel Conduit (ERSC).
   c. C80.3, Steel Electrical Metallic Tubing (EMT).
   d. C80.6, Electrical Intermediate Metal Conduit (EIMC).
   e. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   f. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.
   g. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   h. TC 6, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. Underwriters Laboratories Inc. (UL):
   a. 1, Standard for Safety for Flexible Metal Conduit.

b. 5, Standard for Safety for Surface Metal Raceways and Fittings.
c. 6, Standard for Safety for Electrical Rigid Metal Conduit – Steel.
d. 6A, Standard for Safety for Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless.
e. 360, Standard for Safety for Liquid-Tight Flexible Steel Conduit.
f. 514B, Standard for Safety for Conduit, Tubing, and Cable Fittings.
g. 651, Standard for Safety for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
h. 651A, Standard for Safety for Type EB and A Rigid PVC Conduit and HDPE Conduit.
i. 797, Standard for Safety for Electrical Metallic Tubing – Steel.
j. 870, Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings.
k. 1242, Standard for Safety for Electrical Intermediate Metal Conduit – Steel.
l. 1660, Standard for Safety for Liquid-Tight Flexible Nonmetallic Conduit.
m. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway.

1.2 SUBMITTALS

A. Action Submittals:

1. Manufacturer's Literature:
   a. Rigid galvanized steel conduit.
   b. Intermediate metal conduit.
   c. Electric metallic tubing.
   d. PVC Schedule 40 conduit.
   e. PVC Schedule 80 conduit.
   f. PVC-coated rigid galvanized steel conduit.
   g. Flexible metal, liquid-tight conduit.
   h. Flexible metal, nonliquid-tight conduit.
   i. Conduit fittings.
   j. Wireways.
   k. Surface metal raceway.
   l. Device boxes for use in hazardous areas.
   m. Junction and pull boxes used at or below grade.
   n. Large junction and pull boxes.
   o. Terminal junction boxes.
2. Precast Handholes:
   a. Dimensional drawings and descriptive literature.
   b. Traffic loading calculations.
   c. Accessory information.

3. Equipment and machinery proposed for bending metal conduit.
4. Method for bending PVC conduit less than 30 degrees.
5. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
6. Conduit Layout:
    a. Provide drawings for underground and concealed conduits including, but not limited to ductbanks, under floor slabs, concealed in floor slabs, and concealed in walls.
    b. Provide plan and section showing arrangement and location of conduit and duct bank required for:
        1) Low and medium voltage feeder and branch circuits.
        2) Instrumentation and control systems.
        3) Communications systems.
        4) Empty conduit for future use.
    c. Reproducible; scale not greater than 1 inch equals 20 feet.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection and Testing.
3. Manufacturer's certification of training for PVC-coated rigid galvanized steel conduit installer.

1.3 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

B. PVC-Coated, Rigid Galvanized Steel Conduit Installer: Certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

PART 2 PRODUCTS

2.1 CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of NEMA C80.1 and UL 6.
2. Material: Hot-dip galvanized with chromated protective layer.

B. Intermediate Metal Conduit (IMC):

1. Meet requirements of NEMA C80.6 and UL 1242.
2. Material: Hot-dip galvanized with chromated and lacquered protective layer.

C. Electric Metallic Tubing (EMT):

1. Meet requirements of NEMA C80.3 and UL 797.
2. Material: Hot-dip galvanized with chromated and lacquered protective layer.

D. PVC Schedule 40 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
3.

E. PVC Schedule 80 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

F. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of NEMA RN 1 and ETL.
2. Material:
   a. Meet requirements of NEMA C80.1 and UL 6.
   b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
   c. Interior finish: Urethane coating, 2-mil nominal thickness.
3. Threads: Hot-dipped galvanized and factory coated with urethane.
4. Bendable without damage to interior or exterior coating.

G. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Galvanized steel with extruded PVC jacket.

H. Flexible Metal, Nonliquid-Tight Conduit:

1. Meet requirements of UL 1.
2. Material: Galvanized steel.

I. Innerduct:

1. Resistant to spread of fire, per requirements of UL 2024.
2. Smooth or corrugated HDPE.
3. Textile Manufacturer: Maxcell.

2.2 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit:

1. General:
   a. Meet requirements of UL 514B.
   b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.
2. Bushing:
   a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
   b. Manufacturers and Products:
      1) Appleton; Series BU-I.
      2) O-Z/Gedney; Type HB.
3. Grounding Bushing:
   a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
   b. Manufacturers and Products:
      1) Appleton; Series GIB.
      2) O-Z/Gedney; Type HBLG.
4. Conduit Hub:
   a. Material: Malleable iron with insulated throat with bonding screw.
   b. UL listed for use in wet locations.
   c. Manufacturers and Products:
      1) Appleton, Series HUB-B.
      2) O-Z/Gedney; Series CH.
      3) Meyers; ST Series.
5. Conduit Bodies:
   a. Sized as required by NFPA 70.
   b. Manufacturers and Products (For Normal Conditions):
      1) Appleton; Form 35 threaded unilets.
      2) Crouse-Hinds; Form 7 or Form 8 threaded condulets.

3) Killark; Series O electrolets.
4) Thomas & Betts; Form 7 or Form 8.

c. Manufacturers (For Hazardous Locations):
1) Appleton.
2) Crouse-Hinds.
3) Killark.

6. Couplings: As supplied by conduit manufacturer.
7. Unions:
a. Concrete tight, hot-dip galvanized malleable iron.
b. Manufacturers and Products:
1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.
2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.
8. Conduit Sealing Fitting:
a. Manufacturers and Products:
1) Appleton; Type EYF, EYM, or ESU.
2) Crouse-Hinds; Type EYS or EZS.
3) Killark; Type EY or Type EYS.
9. Drain Seal:
a. Manufacturers and Products:
1) Appleton; Type EYD.
2) Crouse-Hinds; Type EYD or Type EZD.
10. Drain/Breather Fitting:
a. Manufacturers and Products:
1) Appleton; Type ECDB.
2) Crouse-Hinds; ECD.
11. Expansion Fitting:
a. Manufacturers and Products:
1) Deflection/Expansion Movement:
a) Appleton; Type DF.
b) Crouse-Hinds; Type XD.
2) Expansion Movement Only:
a) Appleton; Type XJ.
b) Crouse-Hinds; Type XJ.
c) Thomas & Betts; XJG-TP.
12. Cable Sealing Fitting:
a. To form watertight nonslip cord or cable connection to conduit.
b. For Conductors with OD of 1/2 inch or Less: Neoprene bushing at connector entry.
c. Manufacturers and Products:
1) Appleton; CG-S.
2) Crouse-Hinds; CGBS.

B. Electric Metallic Tubing:

1. Meet requirements of UL 514B.
2. Type: Steel body and locknuts with steel or malleable iron compression nuts. Set screw and drive-on fittings not permitted.
3. Electro zinc-plated inside and out.
4. Raintight.
5. Coupling Manufacturers and Products:
    a. Appleton; Type 95T.
    b. Crouse-Hinds.
    c. Thomas & Betts.
6. Connector Manufacturers and Products:
    a. Appleton; Type ETP.
    b. Crouse-Hinds.
    c. Thomas & Betts.

C. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC 3.
2. Type: PVC, slip-on.

D. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of UL 514B.
2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
3. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
4. Finish: 40-mil PVC exterior, 2-mil urethane interior.
5. Overlapping pressure-sealing sleeves.
6. Conduit Hangers, Attachments, and Accessories: PVC-coated.
7. Manufacturers:
    a. Robroy Industries.
    b. Ocal.
8. Expansion Fitting:
    a. Manufacturer and Product: Ocal; OCAL-BLUE XJG.

E. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
2. Insulated throat and sealing O-rings.
3. Manufacturers and Products:
    a. Thomas & Betts; Series 5331.
    b. O-Z/Gedney; Series 4Q.

F. Flexible Metal, Nonliquid-Tight Conduit:

1. Meet requirements of UL 514B.
2. Body: Galvanized steel or malleable iron.
3. Throat: Nylon insulated.
4. 1-1/4-Inch Conduit and Smaller: One screw body.
5. 1-1/2-Inch Conduit and Larger: Two screw body.
6. Manufacturer and Product: Appleton; Series 7400.

G. Flexible Coupling, Hazardous Locations:

1. Approved for use in atmosphere involved.
2. Rating: Watertight and UL listed for use in Class I, Division 1 and 2 areas.
3. Outer bronze braid and an insulating liner.
4. Conductivity equal to a similar length of rigid metal conduit.
5. Manufacturers and Products:
   a. Crouse-Hinds; Type ECGJH or Type ECLK.
   b. Appleton; EXGJH or EXLK.

H. Watertight Entrance Seal Device:

1. New Construction:
   a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
   b. Manufacturer and Product: O-Z/Gedney; Type FSK or Type WSK, as required.
2. Cored-Hole Application:
   a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
   b. Manufacturer and Product: O-Z/Gedney; Series CSM.

2.3 OUTLET AND DEVICE BOXES

A. Sheet Steel: One-piece drawn type, zinc-plated or cadmium-plated.

B. Cast Metal:

1. Box: Malleable iron or Cast ferrous metal.
2. Cover: Gasketed, weatherproof, malleable iron, or cast ferrous metal, with stainless steel screws.
3. Hubs: Threaded.
4. Lugs: Cast Mounting.
5. Manufacturers and Products, Nonhazardous Locations:
   a. Crouse-Hinds; Type FS or Type FD.
   b. Appleton; Type FS or Type FD.
   c. Killark.
6. Manufacturers and Products, Hazardous Locations:

a. Crouse-Hinds; Type GUA or Type EAJ.
b. Appleton; Type GR.

C. PVC-Coated Cast Metal:

1. Type: One-piece.
2. Material: Malleable iron or cast ferrous metal.
3. Coating:
   a. Exterior Surfaces: 40-mil PVC.
   b. Interior Surfaces: 2-mil urethane.
4. Manufacturers:
   a. Robroy Industries.
   b. Ocal.

D. Nonmetallic:

1. Box: PVC.
2. Cover: PVC, weatherproof, with stainless steel screws.
3. Manufacturer and Product: Carlon; Type FS or Type FD, with Type E98 or Type E96 covers.

2.4 JUNCTION AND PULL BOXES

A. Outlet Box Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.

B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.

C. Large Sheet Steel Box:

1. NEMA 250, Type 1.
2. Box: Code-gauge, galvanized steel.
3. Cover: Full access, screw type.
4. Machine Screws: Corrosion-resistant.

D. Large Cast Metal Box:

1. NEMA 250, Type 4.
2. Box: Cast malleable iron, with drilled and tapped conduit entrances and exterior mounting lugs.
3. Cover: Nonhinged with screws.
4. Gasket: Neoprene.
5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
6. Manufacturers and Products, Surface Mounted Nonhinged Type:
   a. Crouse-Hinds; Series W.
   b. O-Z/Gedney; Series Y.

E. Large Cast Metal Box, Hazardous Locations:

1. NEMA 250 Type 7 or Type 9 as required for Class, Division, and Group involved.
2. Box: Cast ferrous metal, electro-galvanize finished with drilled and tapped conduit entrances.
3. Cover: Nonhinged with screws.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Manufacturers and Products:
    a. Crouse-Hinds; Type EJB.
    b. Appleton; Type AJBEW.

F. Large Stainless Steel Box:

1. NEMA 250 Type 4X.
2. Box: 14-gauge, ASTM A240/A240M, Type 316 stainless steel.
3. Cover: Nonhinged with screws.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Manufacturers:
    a. Hoffman Engineering Co.
    b. Robroy Industries.
    c. Wiegman.

G. Large Steel Box:

1. NEMA 250 Type 12.
2. Box: 12-gauge steel, with white enamel painted interior and gray primed exterior, over phosphated surfaces. Provide gray finish as approved by Engineer.
3. Cover: Hinged with screws.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Manufacturers:
    a. Hoffman Engineering Co.
    b. Robroy Industries.
    c. Wiegman.

H. Concrete Box, Nontraffic Areas:

1. Box: Reinforced, cast concrete with extension.
2. Cover: Steel diamond plate with locking bolts.
3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
4. Size: 10 inches by 17 inches, minimum.
5. Manufacturers and Products:
    a. Utility Vault Co.; Series 36-1017.
    b. Christy, Concrete Products, Inc.; N9.
    c. Quazite; “PG” Style.

I. Concrete Box, Traffic Areas:

1. Box: Reinforced, cast concrete with extension and bottom slab.
2. Cover: Steel checked plate; H/20 loading with screw down.
3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
4. Manufacturers and Products:
   a. Christy, Concrete Products, Inc.; B1017BOX.
   b. Utility Vault Co.; 3030 SB.

2.5 TELEPHONE BACKBOARD

A. Material: 4'W x 8'H x 3/4-inch fire-resistant plywood backboard, meeting requirements of telephone service provider.

2.6 TELEPHONE AND DATA OUTLET

A. Provide outlet boxes and cover plates meeting requirements of TIA 569B.

2.7 TERMINAL JUNCTION BOX

A. Cover: Hinged, unless otherwise shown.

B. Interior Finish: Paint with white enamel or lacquer.

C. Terminal Blocks:

1. Separate connection point for each conductor entering or leaving box.
2. Spare Terminal Points: 25 percent, minimum.

2.8 METAL WIREWAYS

A. Meet requirements of UL 870.

B. Type: Steel-enclosed, lay-in type.

C. Cover: Removable, screw type.

D. Rating: Indoor.

E. Finish: Rust inhibiting phosphatizing primer and gray baked enamel.

F. Hardware: Plated to prevent corrosion; screws installed toward the inside protected by spring nuts or otherwise guarded to prevent wire insulation damage.

G. Knockouts: Without knockouts, unless otherwise indicated.

H. Manufacturers:

1. Circle AW.
2. Hoffman.
3. Square D.

2.9 TELECOMMUNICATIONS PATHWAY CABLE TRAY

A. Meet requirements of NEMA VE 1.

B. Type: Ladder, of welded construction.

C. Material: Copper-free aluminum alloy 6063-T6 finish.

D. Dimensions: Unless otherwise indicated, 18 inches wide, with 4-inch NEMA nominal inside fill depth and fittings with 24-inch bending radius.

E. Fittings of same material as cross-sectional tray area and hardware of same material as cable tray. Include dropouts for cable exits from bottom of tray as required.

F. Tray Grounding: Conform to NFPA 70 and NEMA VE 1.

G. Warning Signs: 1-1/2-inch (40-mm) high black lettering on yellow background with legend, "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

H. Design Loads: 15 pounds per linear foot with less than 1-inch deflection, and maximum 50 pounds per linear foot, when supported on 12-foot centers.

I. Furnish cable tray with no sharp edges, burrs, or weld projections.

J. Manufacturers:

1. B-Line Systems, Inc.
2. Square-D.
3. P.W. Industries.

2.10 PRECAST HANDHOLES/PULLBOXES

A. Concrete Strength: Minimum, 3,000 psi compressive, in 28 days.

B. Loading: AASHTO, H-20 in accordance with ASTM C857.

C. Drainage:

1. Slope floors toward drain points, leaving no pockets or other nondraining areas.
2. Provide drainage outlet or sump at low point of floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and a minimum 4-inch outlet and outlet pipe.

D. Raceway Entrances:

1. Provide on all four sides.
2. Provide knockout panels or precast individual raceway openings.
3. At entrances where raceways are to be installed by others, provide minimum 12-inch-high by 24-inch-wide knockout panels for future raceway installation.

E. Embedded Pulling Iron:

1. Material: 3/4-inch-diameter stock, fastened to overall steel reinforcement before concrete is placed.
2. Location:
   a. Wall: Opposite each raceway entrance and knockout panel for future raceway entrance.
   b. Floor: Centered below handhole cover.

F. Cable Racks:

1. Arms and Insulators: Adjustable, of sufficient number to accommodate cables for each raceway entering or leaving handhole, including spares.
2. Wall Attachment:
   a. Adjustable inserts in concrete walls. Bolts or embedded studs not permitted.
   b. Insert Spacing: Maximum 3 feet on center for inside perimeter of handhole.
   c. Arrange in order that spare raceway ends are clear for future cable installation.

G. Handhole Frames and Covers:

1. Material: Steel, hot-dipped galvanized.
2. Cover Type: Solid, bolt-on of checkered design.
3. Cover Loading: AASHTO H-20.
4. Cover Designation: Burn by welder, on upper side in integral letters, minimum 2 inches in height, appropriate titles:
   a. 600 Volts and Below: ELECTRIC LV.
   b. TELEPHONE.

H. Hardware: Steel, hot-dip galvanized.

I. Furnish knockout for ground rod in each handhole.

J. Manufacturers:

1. Utility Vault Co.
2. Penn-Cast Products, Inc.
3. Concrete Conduit Co.
4. Associated Concrete Products, Inc.
5. Pipe, Inc.

2.11 ACCESSORIES

A. Duct Bank Spacers:

1. Modular Type:
   a. Nonmetallic, interlocking, for multiple conduit sizes.
   b. Suitable for all types of conduit.
   c. Manufacturers:
      1) Underground Device, Inc.
      2) Carlon.
2. Template Type:
   a. Nonmetallic, custom made one-piece spacers.
   b. Suitable for all types of conduit.
   c. Material: HDPE or polypropylene, 1/2-inch minimum thickness.
   d. Conduit openings cut 1 inch larger than conduit outside diameter.
   e. Additional openings for stake-down, rebar, and concrete flow through as required.
   f. Manufacturer and Product: SP Products; Quik Duct.

B. Identification Devices:

1. Raceway Tags:
   a. Material: Permanent, nonferrous metal.
   b. Shape: Round.
   c. Raceway Designation: Pressure stamped, embossed, or engraved.
   d. Tags relying on adhesives or taped-on markers not permitted.
2. Warning Tape:
   a. Material: Polyethylene, 4-mil gauge with detectable strip.
   b. Color: Red.
   c. Width: Minimum 6 inches.
   d. Designation: Warning on tape that electric circuit is located below tape.
   e. Identifying Letters: Minimum 1-inch-high permanent black lettering imprinted continuously over entire length.
   f. Manufacturers and Products:
      1) Panduit; Type HTDU.

2) Reef Industries; Terra Tape.

3. Buried Raceway Marker:
   a. Material: Sheet bronze, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
   b. Designation: Engrave to depth of 3/32 inch; ELECTRIC CABLES, in letters 1/4-inch high.
   c. Minimum Dimension: 1/4 inch thick, 10 inches long, and 3/4 inch wide.

C. Raceway Coating: Clean and paint in accordance with Section 09 90 00, Painting and Coating.

D. Heat Shrinkable Tubing:

1. Material: Heat-shrinkable, cross-linked polyolefin.
2. Semi-flexible with meltable adhesive inner liner.
3. Color: Black.
4. Manufacturers:
   a. Raychem.
   b. 3M.

E. Wraparound Duct Band:

1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
2. Width: 50 mm minimum.
3. Manufacturer and Product: Raychem; Type TWDB.

PART 3 EXECUTION

3.1 GENERAL

A. Comply with NECA Installation Standards.

B. Crushed or deformed raceways not permitted.

C. Maintain raceway entirely free of obstructions and moisture.

D. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.

E. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.

F. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

G. Group raceways installed in same area.

H. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.

I. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.

J. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.

K. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.

L. Install watertight fittings in outdoor, underground, or wet locations.

M. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.

N. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.

O. Do not install raceways in concrete equipment pads, foundations, or beams without Engineer approval.

P. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.

Q. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

R. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of TIA 569B.

3.2 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

A. Minimum Cover: 2 inches, including fittings.

B. Conduit placement shall not require changes in reinforcing steel location or configuration.

C. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.

D. Conduit larger than 1 inch shall not be embedded in concrete slabs, walls, foundations, columns, or beams unless approved by Engineer.

E. Slabs and Walls (Requires Engineer Approval):

1. Trade size of conduit not to exceed one-fourth of slab or wall thickness.
2. Install within middle two-fourths of slab or wall.
3. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.
4. Separate conduit 2-inch and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
5. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1 inch.
6. Separate conduit by a minimum six times the outside dimension of expansion/deflection fittings at expansion joints.
7. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.

F. Columns and Beams (Requires Engineer Approval):

1. Trade size of conduit not to exceed one-fourth of beam thickness.
2. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

3.3 CONDUIT APPLICATION

A. Diameter: Minimum 3/4 inch.

B. Exterior, Exposed:

1. Rigid galvanized steel.
2. Intermediate metal.
3. PVC-coated rigid galvanized steel.

C. Interior, Exposed:

1. Rigid galvanized steel.
2. Intermediate metal.
3. Electric metallic tubing for ceiling portion of lighting circuits.
4. PVC-coated rigid galvanized steel.

D. Interior, Concealed (Not Embedded in Concrete):

1. Rigid galvanized steel.
2. Intermediate metal.
3. Electric metallic tubing.

E. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors:

1. Rigid galvanized steel.
2. Intermediate metal.

F. Direct Earth Burial:

1. PVC Schedule 40.
2. PVC Schedule 80.
3. PVC-coated rigid galvanized steel.

G. Concrete-Encased Ductbank:

1. Rigid galvanized steel.
2. Intermediate metal.
3. PVC Schedule 40.
4. PVC Schedule 80.

H. Under Slabs-On-Grade:

1. PVC-coated rigid galvanized steel.

I. Transition from Underground or Concrete Embedded to Exposed: PVC-coated rigid steel conduit.

J. Under Equipment Mounting Pads: Rigid galvanized steel conduit.

K. Exterior Light Pole Foundations: PVC-coated rigid steel conduit.

L. Corrosive Areas:

1. PVC-coated rigid galvanized steel.

M. Hazardous Gas Areas:

1. Rigid galvanized steel.

3.4 FLEXIBLE CONNECTIONS

A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other locations approved by Engineer where flexible connection is required to minimize vibration:

1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.
2. Conduit Size Over 4 Inches: Nonflexible.
3. Wet or Corrosive Areas: flexible metal liquid-tight.

4. Dry Areas: Flexible, metallic liquid-tight.
5. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.

B. Suspended Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.

C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

D. Flexible Conduit Length: 18 inches minimum, 60 inches maximum; sufficient to allow movement or adjustment of equipment.

3.5 PENETRATIONS

A. Make at right angles, unless otherwise shown.

B. Notching or penetration of structural members, including footings and beams, not permitted.

C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating as specified in Section 26 05 04, Basic Electrical Materials and Methods.

D. Apply heat shrinkable tubing or single layer of wraparound duct band to metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface.

E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.

F. Entering Structures:

1. General: Seal raceway at first box or outlet with oakum or expandable plastic compound to prevent entrance of gases or liquids from one area to another.
2. Concrete Roof or Membrane Waterproofed Wall or Floor:
   a. Provide a watertight seal.
   b. Without Concrete Encasement: Install watertight entrance seal device on each side.
   c. With Concrete Encasement: Install watertight entrance seal device on accessible side.
   d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
   e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.

3. Heating, Ventilating, and Air Conditioning Equipment:
    a. Penetrate equipment in area established by manufacturer.
    b. Terminate conduit with flexible metal conduit at junction box or condulet attached to exterior surface of equipment prior to penetrating equipment.
    c. Seal penetration with Type 5 sealant, as specified in Section 07 92 00, Joint Sealants.
4. Corrosive-Sensitive Areas:
    a. Seal conduit entering equipment panel boards and field panels containing electronic equipment.
    b. Seal penetration with Type 5 sealant, as specified in Section 07 92 00, Joint Sealants.
5. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.
6. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
    a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
    b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.
7. Handholes:
    a. Metallic Raceways: Provide insulated grounding bushings.
    b. Nonmetallic Raceways: Provide bell ends flush with wall.
    c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.6 SUPPORT

A. Support from structural members only, at intervals not exceeding NFPA 70 requirements. Do not exceed 10 feet in any application. Do not support from piping, pipe supports, or other raceways.

B. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 30 percent extra space for future conduit.

C. Application/Type of Conduit Strap:

1. Rigid Steel or EMT Conduit: Zinc coated steel, pregalvanized steel or malleable iron.
2. PVC-Coated Rigid Steel Conduit: PVC-coated metal.

D. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

1. Wood: Wood screws.
2. Hollow Masonry Units: Toggle bolts.

3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
4. Steelwork: Machine screws.
5. Location/Type of Hardware:
    a. Dry, Noncorrosive Areas: Galvanized.
    b. Wet, Noncorrosive Areas: Stainless steel.
    c. Corrosive Areas: 316 Stainless steel.

E. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.7 BENDS

A. Install concealed raceways with a minimum of bends in the shortest practical distance.

B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.

C. Install with symmetrical bends or cast metal fittings.

D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.

E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

G. PVC Conduit:

1. Bends 30 Degrees and Larger: Provide factory-made elbows.
2. 90-Degree Bends: Provide rigid steel elbows, PVC-coated where direct buried.
3. Use manufacturer's recommended method for forming smaller bends.

H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.8 EXPANSION/DEFLECTION FITTINGS

A. Provide on raceways at structural expansion joints and in long tangential runs.

B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.

C. Install in accordance with manufacturer's instructions.

3.9 PVC CONDUIT

A. Solvent Welding:

1. Apply manufacturer recommended solvent to joints.
2. Install in order that joint is watertight.

B. Adapters:

1. PVC to Metallic Fittings: PVC terminal type.
2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.

C. Belled-End Conduit: Bevel unbelled end of joint prior to joining.

3.10 PVC-COATED RIGID STEEL CONDUIT

A. Install in accordance with manufacturer's instructions.

B. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.

C. Provide PVC boot to cover exposed threading.

3.11 WIREWAYS

A. Install in accordance with manufacturer's instructions.

B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.

C. Applications:

1. Metal wireway in indoor dry locations.

3.12 TERMINATION AT ENCLOSURES

A. Cast Metal Enclosure: Install manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. Nonmetallic, Cabinets, and Enclosures:

1. Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.
2. Metallic Conduit: Provide ground terminal for connection to maintain continuity of ground system.

C. Sheet Metal Boxes, Cabinets, and Enclosures:

1. General:
   a. Install insulated bushing on ends of conduit where grounding is not required.
   b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
   c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.
   d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
   e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.
2. Rigid Galvanized or Intermediate Conduit:
   a. Provide one lock nut each on inside and outside of enclosure.
   b. Install grounding bushing at source enclosure.
   c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.
3. Electric Metallic Tubing: Provide gland compression, insulated connectors.
4. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
5. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.

D. Motor Control Center, Switchboard, Switchgear, and Free-Standing Enclosures:

1. Terminate metal conduit entering bottom with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.

3.13 UNDERGROUND RACEWAYS

A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one handhole, or pull box to the next, or from a high point between them, depending on surface contour.

B. Cover: Maintain minimum 2-foot cover above conduit and concrete encasement, unless otherwise shown.

C. Provide concrete encasement for all underground conduits except conduit for lighting, access gates, cameras, and individual runs to fans and instruments at screening facility may be direct buried.

D. Make routing changes as necessary to avoid obstructions or conflicts.

E. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.

F. Union type fittings not permitted.

G. Spacers:

1. Provide preformed, nonmetallic spacers designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.

H. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.

I. Transition from Underground to Exposed: PVC-coated rigid steel conduit.

J. Installation with Other Piping Systems:

1. Crossings: Maintain minimum 12-inch vertical separation.
2. Parallel Runs: Maintain minimum 12-inch separation.
3. Installation over valves or couplings not permitted.

K. Provide expansion fittings that allow minimum of 4 inches of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.

L. Provide expansion/deflection fittings in conduit runs that exit building or structure belowgrade. Conduit from building wall to fitting shall be PVC-coated rigid steel.

M. Concrete Encasement:

1. As specified in Section 03 30 00, Cast-in-Place Concrete.
2. Concrete Color: Red.

N. Backfill:

1. As specified in Section 31 23 23.15, Trench Backfill.
2. Do not backfill until inspected by Engineer.

3.14 UNDER SLAB RACEWAYS

A. Make routing changes as necessary to avoid obstructions or conflicts.

B. Support raceways so as to prevent bending or displacement during backfilling or concrete placement.

C. Install raceways with no part embedded within slab and with no interference with slab on grade construction.

D. Raceway spacing, in a single layer or multiple layers:

1. 3 inches clear between adjacent 2-inch or larger raceway.
2. 2 inches clear between adjacent 1-1/2-inch or smaller raceway.

E. Multiple Layers of Raceways: Install under slab on grade in trench below backfill zone, as specified in Section 31 23 23.15, Trench Backfill.

F. Individual Raceways and Single Layer Multiple Raceways: Install at lowest elevation of backfill zone with spacing as specified herein. Where conduits cross at perpendicular orientation, installation of conduits shall not interfere with placement of under slab fill that meets compaction and void limitations of earthwork specifications.

G. Under slab raceways that emerge from below slab to top of slab as exposed, shall be located to avoid conflicts with structural slab rebar. Coordinate raceway stub ups with location of structural rebar.

H. Fittings:

1. Union type fittings are not permitted.
2. Provide expansion/deflection fittings in raceway runs that exit building or structure below slab. Locate fittings 18 inches, maximum, beyond exterior wall. Raceway type between building exterior wall to fitting shall be PVC-coated rigid steel.
3. Couplings: In multiple raceway runs, stagger so couplings in adjacent runs are not in same traverse line.

3.15 OUTLET AND DEVICE BOXES

A. General:

1. Install plumb and level.

2. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.
3. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.
4. Install galvanized mounting hardware in industrial areas.

B. Size:

1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
   a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
2. Ceiling Outlet: Minimum 4-inch octagonal device box, unless otherwise required for installed fixture.
3. Switch and Receptacle: Minimum 2-inch by 4-inch device box.

C. Locations:

1. Drawing locations are approximate.
2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.
3. Light Fixture: Install in symmetrical pattern according to room layout, unless otherwise shown.

D. Mounting Height:

1. General:
   a. Dimensions given to centerline of box.
   b. Where specified heights do not suit building construction or finish, adjust up or down to avoid interference.
   c. Do not straddle CMU block or other construction joints.
2. Light Switch:
   a. 48 inches above floor.
   b. When located next to door, install on lock side of door.
3. Thermostat: 54 inches above floor.
4. Telephone Outlet:
   a. 15 inches above floor.
   b. 6 inches above counter tops.
   c. Wall Mounted: 52 inches above floor.
5. Convenience Receptacle:
   a. General Interior Areas: 15 inches above floor.
   b. General Interior Areas (Counter Tops): Install device plate bottom or side flush with top of backsplash, or 6 inches above counter tops without backsplash.
   c. Industrial Areas, Workshops: 48 inches above floor.

d. Outdoor Areas: 24 inches above finished grade.

6. Special-Purpose Receptacle: 48 inches above floor or as shown.
7. Switch, Motor Starting: 48 inches above floor, unless otherwise indicated on Drawings.

E. Flush Mounted:

1. Install with concealed conduit.
2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
3. Holes in surrounding surface shall be no larger than required to receive box.

F. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
   a. Wood: Wood screws.
   b. Concrete or Brick: Bolts and expansion shields.
   c. Hollow Masonry Units: Toggle bolts.
   d. Steelwork: Machine screws.
3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
4. Provide plaster rings where necessary.
5. Boxes embedded in concrete or masonry need not be additionally supported.

G. Install separate junction boxes for flush or recessed lighting fixtures where required by fixture terminal temperature.

H. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

3.16 JUNCTION AND PULL BOXES

A. General:

1. Install plumb and level.
2. Installed boxes shall be accessible.
3. Do not install on finished surfaces.
4. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
5. Use conduit bodies as junction and pull boxes where no splices are required and allowed by applicable codes.

6. Install pull boxes where necessary in raceway system to facilitate conductor installation.
7. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
8. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

B. Flush Mounted:

1. Install with concealed conduit.
2. Holes in surrounding surface shall be no larger than required to receive box.
3. Make edges of boxes flush with final surface.

C. Mounting Hardware:

1. Noncorrosive Dry Areas: Galvanized.
2. Noncorrosive Wet Areas: 316 Stainless steel.
3. Corrosive Areas: 316 Stainless steel.

D. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
   a. Wood: Wood screws.
   b. Concrete or Brick: Bolts and expansion shields.
   c. Hollow Masonry Units: Toggle bolts.
   d. Steelwork: Machine screws.
3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
4. Boxes embedded in concrete or masonry need not be additionally supported.

E. At or Below Grade:

1. Install boxes for below grade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
3. Obtain Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.
4. Use boxes and covers suitable to support anticipated weights.

3.17 TELEPHONE AND DATA OUTLET

A. Provide empty 4-11/16-inch square, deep outlet box.

B. Provide blank single gang raised device cover if cables are not installed.

3.18 HANDHOLES

A. Excavate, shore, brace, backfill, and final grade in accordance with Section 31 23 16, Excavation, and Section 31 23 23.15, Trench Backfill.

B. Do not install until final raceway grading has been determined.

C. Install such that raceway enters at nearly right angle and as near as possible to end of wall, unless otherwise shown.

D. Grounding: As specified in Section 26 05 26, Grounding and Bonding for Electrical Systems.

E. Identification: Field stamp covers with handhole number as shown. Stamped numbers to be 1-inch minimum height.

3.19 EMPTY RACEWAYS

A. Provide permanent, removable cap over each end.

B. Provide PVC plug with pull tab for underground raceways with end bells.

C. Provide nylon pull cord.

D. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.20 IDENTIFICATION DEVICES

A. Raceway Tags:

1. Identify Raceway Schedule designation.
2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every 50 feet, whether in ceiling space or surface mounted.
3. Install tags at each terminus for concealed raceways.
4. Provide noncorrosive wire for attachment.

B. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of run.

C. Buried Raceway Marker:

1. Install at grade to indicate direction of underground raceway.
2. Install at bends and at intervals not exceeding 100 feet in straight runs.
3. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.

3.21 PROTECTION OF INSTALLED WORK

A. Protect products from effects of moisture, corrosion, and physical damage during construction.

B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.

C. Touch up painted conduit threads after assembly to cover nicks or scars.

D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

END OF SECTION

SECTION 26 05 70
ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
   b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
   c. 399, Recommended Practice for Industrial and Commercial Power System Analysis.
   d. 1584, Guide for Performing Arc Flash Hazard Calculations.
3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
4. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70E, Standard for Electrical Safety in the Workplace.
5. Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910 Subpart S, Electrical.

1.2 SUBMITTALS

A. Action Submittals:

1. Short circuit study.
2. Protective Device Coordination Study: Submit within 90 days after approval of short circuit study.
3. Arc Flash Study: Submit initial study with protective Device Coordination Study. Submit final study prior to equipment energization.
4. Arc flash warning labels; submit sample with initial study.
5. Electronic files of final studies including all engineering software input files, output reports, and libraries.

1.3 QUALITY ASSURANCE

A. Short circuit and protective device coordination and arc flash studies shall be prepared by manufacturer furnishing switchgear or a professional electrical engineer registered in the State of California.

1.4 SEQUENCING AND SCHEDULING

A. Initial complete short circuit study shall be submitted and reviewed before Engineer will review Shop Drawings for switchgear equipment.

B. Initial complete protective device coordination and arc flash studies shall be submitted within 90 days after approval of initial short circuit study.

C. Initial complete arc flash study shall be submitted and accepted prior to energization of the electrical equipment.

D. Revised short circuit, protective device coordination, and arc flash studies, and arc flash labels shall be submitted 10 days before energizing electrical equipment.

E. Final short circuit, protective device coordination, and arc flash studies shall be completed prior to Project Substantial Completion. Final version of study shall include as-installed equipment, materials, and parameter data or settings entered into equipment based on study.

F. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to Project Substantial Completion.

1.5 GENERAL STUDY REQUIREMENTS

A. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on Drawings.

B. Perform studies using one of the following electrical engineering software packages:

1. SKM Power Tools for Windows.
2. ETAP.
3. Paladin.
4. Easy Power.

C. Perform complete fault calculations for each proposed source combination.

1. Source combination may include present and future power company supply circuits, large motors, or generators.

D. Utilize proposed load data for study obtained from Contract Documents.

E. Device coordination time-current curves for medium and low voltage distribution system; include individual protective device time-current characteristics.

1.6 SHORT CIRCUIT STUDY

A. General:

1. Prepare in accordance with IEEE 399.
2. Use cable and bus resistances calculated at 25 degrees C.
3. Use medium-voltage cable reactances based on use of typical dimensions of shielded cables with 133 percent insulation levels.
4. Use 600-volt cable reactances based on use of typical dimensions of XHHW conductors.
5. Use transformer impedances 92.5 percent of "nominal" impedance based on tolerances specified in IEEE C57.12.00.

B. Provide:

1. Calculation methods and assumptions.
2. Typical calculation.
3. Tabulations of calculated quantities.
4. Results, conclusions, and recommendations.
5. Selected base per unit quantities.
6. One-line diagrams.
7. Source impedance data, including electric utility system and motor fault contribution characteristics.
8. Impedance diagrams.
9. Zero-sequence impedance diagrams.

C. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault at each:

1. Electric utility's supply termination point.
2. Main switchgear.
3. Variable frequency drives.
4. Motor control centers.
5. Standby generator.
6. Branch circuit panelboards.

D. Provide bolted line-to-ground fault current study for areas as defined for three-phase bolted fault short circuit study.

E. Provide bolted line-to-line fault current study for areas as defined for three-phase bolted fault short circuit study.

F. Verify:

1. Equipment and protective devices are applied within their ratings.
2. Adequacy of switchgear and motor control centers bus bars to withstand short circuit stresses.
3. Adequacy of transformer windings to withstand short circuit stresses.
4. Cable and busway sizes for ability to withstand short circuit heating, in addition to normal load currents.

G. Tabulations:

1. General Data:
   a. Short circuit reactances of rotating machines.
   b. Cable and conduit material data.
   c. Bus data.
   d. Transformer data.
   e. Circuit resistance and reactance values.
2. Short Circuit Data (for each source combination):
   a. Fault impedances.
   b. X to R ratios.
   c. Asymmetry factors.
   d. Motor contributions.
   e. Short circuit kVA.
   f. Symmetrical and asymmetrical fault currents.
3. Equipment Evaluation:
   a. Equipment bus bracing, equipment short circuit rating, transformer, cable, busway.
   b. Maximum fault current available.

H. Written Summary:

1. Scope of studies performed.
2. Explanation of bus and branch numbering system.
3. Prevailing conditions.
4. Selected equipment deficiencies.
5. Results of short circuit study.
6. Comments or suggestions.

I. Suggest changes and additions to equipment rating and/or characteristics.

J. Notify Engineer in writing of existing circuit protective devices improperly rated for new fault conditions.

K. Revise data for “as-installed” condition.

1.7 PROTECTIVE DEVICE COORDINATION STUDY

A. General:

1. Prepare in accordance with IEEE 242.
2. Proposed protective device coordination time-current curves for distribution system, graphically displayed on conventional log-log curve sheets.
   a. Provide separate curve sheets for phase and ground fault coordination for each scenario.
   b. Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet. Limit number of devices shown to four to six.
   c. Identify device associated with each curve by manufacturer type, function, and, if applicable, recommended tap, time delay, instantaneous and other settings recommended.
   d. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
   e. Apply motor protection methods that comply with NFPA 70.

B. Plot Characteristics on Curve Sheets:

1. Electric utility's relays.
2. Electric utility's fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
3. Medium-voltage equipment relays.
4. Medium-voltage and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
5. Low-voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
6. Pertinent transformer full-load currents at 100 percent.
7. Transformer magnetizing inrush currents.
8. Transformer damage curves; appropriate for system operation and location.
9. ANSI transformer withstand parameters.
10. Significant symmetrical and asymmetrical fault currents.
11. Motor overload relay settings for motors greater than 40 hp.
12. Ground fault protective device settings.
13. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center.

C. Primary Protective Device Settings for Delta-Wye Connected Transformer:

1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within transformer's characteristics curve, including a point equal to 58 percent of IEEE C57.12.00 withstand point.
2. Secondary Line-to-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.

D. Separate medium voltage relay characteristics curves from curves for other devices by at least 0.4-second time margin.

E. Tabulate Recommended Protective Device Settings:

1. Relays:
   a. Current tap.
   b. Time dial.
   c. Instantaneous pickup.
   d. Electronic settings data file.
2. Circuit Breakers:
   a. Adjustable pickups.
   b. Adjustable time-current characteristics.
   c. Adjustable time delays.
   d. Adjustable instantaneous pickups.
   e. I^2t In/Out.
   f. Zone interlocking.
   g. Electronic settings data file.

F. Written Summary:

1. Scope of studies performed.
2. Summary of protective device coordination methodology.
3. Prevailing conditions.
4. Selected equipment deficiencies.
5. Results of coordination study.
6. Appendix of complete relay and circuit breaker electronic setting files. Submit electronic data files from manufacturer's software.
7. Comments or suggestions.

1.8 ARC FLASH STUDY

A. Perform arc flash hazard study after short circuit and protective device coordination study has been completed, reviewed and accepted.

B. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.

C. Base Calculation: For each major part of electrical power system, determine the following:

1. Flash hazard protection boundary.
2. Limited approach boundary.
3. Restricted approach boundary.
4. Incident energy level.
5. Glove class required.

D. Produce arc flash warning labels that list items in Paragraph Base Calculation and the following additional items.

1. Bus name.
2. Bus voltage.

E. Produce bus detail sheets that list items in Paragraph Base Calculation and the following additional items:

1. Bus name.
2. Upstream protective device name, type, and settings.
3. Bus line-to-line voltage.

F. Produce arc flash evaluation summary sheet listing the following additional items:

1. Bus name.
2. Upstream protective device name, type, settings.
3. Bus line-to-line voltage.
4. Bus bolted fault.
5. Protective device bolted fault current.
6. Arcing fault current.
7. Protective device trip/delay time.
8. Breaker opening time.
9. Solidly grounded column.
10. Equipment type.
11. Gap.
12. Arc flash boundary.
13. Working distance.
14. Incident energy.

G. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 8 cal/cm^2. Propose approaches to reduce energy levels.

H. Prepare report summarizing arc flash study with conclusions and recommendations which may affect integrity of electric power distribution system. As a minimum, include the following:

1. Equipment manufacturer's information used to prepare study.
2. Assumptions made during study.
3. Reduced copy of one-line drawing; 11 inches by 17 inches maximum.
4. Arc flash evaluations summary spreadsheet.
5. Bus detail sheets.
6. Arc flash warning labels printed in color on thermally bonded adhesive backed UV and weather-resistant labels.

PART 2 PRODUCTS

2.1 ARC FLASH WARNING LABELS

A. Arc flash warning labels printed in color on thermally bonded adhesive backed, UV- and weather-resistant labels. An example label is located following end of section in Figure 1.

PART 3 EXECUTION

3.1 GENERAL

A. Adjust relay and protective device settings according to values established by coordination study.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify Engineer in writing of required major equipment modifications.

D. Provide laminated one-line diagrams (minimum size 11 inches by 17 inches) to post on interior of electrical room doors.

E. Provide arc flash warning labels on equipment as specified in this section.

3.2 SUPPLEMENTS

A. The supplement listed below, following "End of Section," is a part of this Specification:

1. Figure 1: Example Arc Flash Label.

END OF SECTION

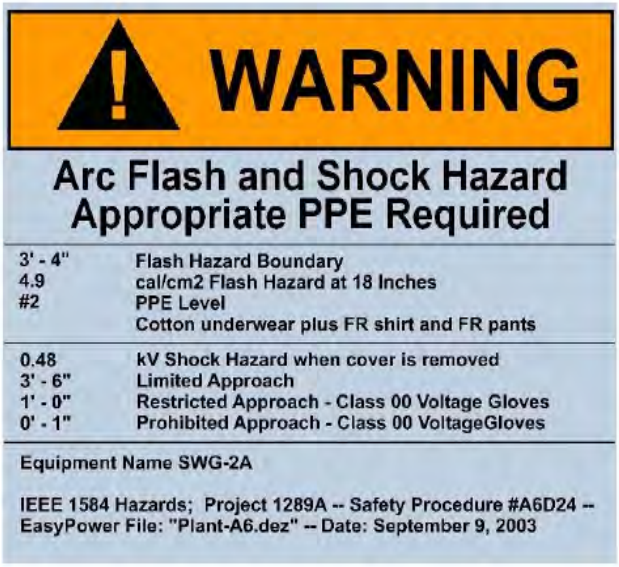

Figure 1
Example Arc Flash Label

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
    a. D877, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
    b. D923, Standard Practice for Sampling Electrical Insulating Liquids.
    c. D924, Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
    d. D971, Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
    e. D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
    f. D1298, Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
    g. D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
    h. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.
    i. D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.
    j. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.
2. Institute of Electrical and Electronics Engineers (IEEE):
    a. 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.
    b. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminators Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5kV through 500kV.
    c. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
    d. 95, Recommended Practice for Insulation Testing of AC Electric Machinery (2300V and Above) with High Direct Voltage.

e. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
f. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems.
g. 450, Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
h. C2, National Electrical Safety Code.
i. C37.20.1, Standard for Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.
j. C37.20.2, Standard for Metal-Clad Switchgear.
k. C37.20.3, Standard for Metal-Enclosed Interrupter Switchgear.
l. C37.23, Standard for Metal-Enclosed Bus.
m. C62.33, Standard Test Specifications for Varistor Surge-Protective Devices.

3. Insulated Cable Engineers Association (ICEA):
   a. S-93-639, 5-46 kV Shielded Power Cables for Use in the Transmission and Distribution of Electric Energy.
   b. S-94-649, Concentric Neutral Cables Rated 5 through 46 kV.
   c. S-97-682, Standard for Utility Shielded Power Cables Rated 5 through 46 kV.
4. National Electrical Manufacturers Association (NEMA):
   a. AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
   b. PB 2, Deadfront Distribution Switchboards.
   c. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
5. InterNational Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70B, Recommended Practice for Electrical Equipment Maintenance.
   c. 70E, Standard for Electrical Safety in the Workplace.
   d. 101, Life Safety Code.
7. National Institute for Certification in Engineering Technologies (NICET).
8. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.2 SUBMITTALS

A. Informational Submittals:

1. Submit 30 days prior to performing inspections or tests:
   a. Schedule for performing inspection and tests.
   b. List of references to be used for each test.
   c. Sample copy of equipment and materials inspection form(s).
   d. Sample copy of individual device test form.
   e. Sample copy of individual system test form.
2. Energization Plan: Prior to initial energization of electrical distribution equipment; include the following:
   a. Owner's representative sign-off form for complete and accurate arc flash labeling and proper protective device settings for equipment to be energized.
   b. Staged sequence of initial energization of electrical equipment.
   c. Lock-Out-Tag-Out plan for each stage of the progressive energization.
   d. Barricading, signage, and communication plan notifying personnel of newly energized equipment.
3. Submit test or inspection reports and certificates for each electrical item tested within 30 days after completion of test:
4. Operation and Maintenance Data:
   a. In accordance with Section 01 78 23, Operation and Maintenance Data.
   b. After test or inspection reports and certificates have been reviewed by Engineer and returned, insert a copy of each in Operation and Maintenance Manual.
5. Programmable Settings: At completion of Performance Demonstration Test, submit final hardcopy printout and electronic files on compact disc of as-left setpoints, programs, and device configuration files for:
   a. Protective relays.
   b. Intelligent overload relays.
   c. Variable frequency drives.
   d. Power metering devices.
   e. Uninterruptible power supplies.
   f. Electrical communications modules.

1.3 QUALITY ASSURANCE

A. Testing Firm Qualifications:

1. Corporately and financially independent organization functioning as an unbiased testing authority.

2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
4. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA.
5. Technicians certified by NICET or NETA.
6. Assistants and apprentices assigned to Project at ratio not to exceed two certified to one noncertified assistant or apprentice.
7. Registered Professional Engineer to provide comprehensive Project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
8. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories or a full member company of NETA.

B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.

C. Test instrument calibration shall be in accordance with NETA ATS.

1.4 SEQUENCING AND SCHEDULING

A. Perform inspection and electrical tests after equipment listed herein has been installed.

B. Perform tests with apparatus de-energized whenever feasible.

C. Inspection and electrical tests on energized equipment shall be:

1. Scheduled with Engineer prior to de-energization.
2. Minimized to avoid extended period of interruption to the operating plant equipment.

D. Notify Engineer at least 24 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. Perform tests in accordance with requirements of Section 01 91 14, Testing, Integration, and Startup.

B. Tests and inspections shall establish:

1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
2. Installation operates properly.
3. Equipment is suitable for energization.
4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.

C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

D. Set, test, and calibrate protective relays, circuit breakers, fuses, power monitoring meters, and other applicable devices in accordance with values established by short circuit and coordination studies as specified in Section 26 05 70, Electrical Systems Analysis.

E. Adjust mechanisms and moving parts of equipment for free mechanical movement.

F. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.

G. Verify nameplate data for conformance to Contract Documents and approved Submittals.

H. Realign equipment not properly aligned and correct unlevelness.

I. Properly anchor electrical equipment found to be inadequately anchored.

J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETA ATS.

K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

L. Provide proper lubrication of applicable moving parts.

M. Inform Engineer of working clearances not in accordance with NFPA 70.

N. Investigate and repair or replace:

1. Electrical items that fail tests.
2. Active components not operating in accordance with manufacturer's instructions.

3. Damaged electrical equipment.

O. Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Vacuum and wipe clean enclosure interior.
3. Remove corrosion found on metal surfaces.
4. Repair or replace, as determined by Engineer door and panel sections having dented surfaces.
5. Repair or replace, as determined by Engineer poor fitting doors and panel sections.
6. Repair or replace improperly operating latching, locking, or interlocking devices.
7. Replace missing or damaged hardware.
8. Finish:
   a. Provide matching paint and touch up scratches and mars.
   b. If required because of extensive damage, as determined by Engineer, refinish entire assembly.

P. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

Q. Replace transformer insulating oil not in compliance with ASTM D923.

3.2 CHECKOUT AND STARTUP

A. Voltage Field Test:

1. Check voltage at point of termination of power company supply system to Project when installation is essentially complete and is in operation.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
3. Unbalance Corrections:
   a. Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.
   b. Obtain written certification from responsible power company official that voltage variations and unbalance are within their normal standards if corrections are not made.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.

2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
3. If phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.3 SWITCHGEAR ASSEMBLIES

A. Visual and Mechanical Inspection:

1. Insulator damage and contaminated surfaces.
2. Proper barrier and shutter installation and operation.
3. Proper operation of indicating devices.
4. Improper blockage of air-cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check door and device interlocking system by:
   a. Closure attempt of device when door is in OFF or OPEN position.
   b. Opening attempt of door when device is in ON or CLOSED position.
8. Check key interlocking systems for:
   a. Key captivity when device is in ON or CLOSED position.
   b. Key removal when device is in ON or CLOSED position.
   c. Closure attempt of device when key has been removed.
   d. Correct number of keys in relationship to number of lock cylinders.
   e. Existence of Other Keys Capable of Operating Lock Cylinders: Destroy duplicate sets of keys.
9. Check nameplates for proper identification of:
   a. Equipment title and tag number with latest one-line diagram.
   b. Pushbutton.
   c. Control switch.
   d. Pilot light.
   e. Control relay.
   f. Circuit breaker.
   g. Indicating meter.
10. Verify fuse and circuit breaker ratings, sizes, and types conform to those specified.
11. Check bus and cable connections for high resistance by low resistance ohmmeter, calibrated torque wrench, and thermographic survey applied to bolted joints.
    a. Ohmic value to be zero.
    b. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.

c. Thermographic survey temperature gradient of 2 degrees C or less.

12. Check operation and sequencing of electrical and mechanical interlock systems by:
    a. Closure attempt for locked open devices.
    b. Opening attempt for locked closed devices.
    c. Key exchange to operate devices in OFF-NORMAL positions.
13. Verify performance of each control device and feature.
14. Control Wiring:
    a. Compare wiring to local and remote control and protective devices with elementary diagrams.
    b. Proper conductor lacing and bundling.
    c. Proper conductor identification.
    d. Proper conductor lugs and connections.
15. Exercise active components.
16. Perform phasing check on double-ended equipment to ensure proper bus phasing from each source.

B. Electrical Tests:

1. Insulation Resistance Tests:
    a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
    b. Each phase of each bus section.
    c. Phase-to-phase and phase-to-ground for 1 minute.
    d. With breakers open.
    e. With breakers closed.
    f. Control wiring except that connected to solid state components.
    g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Overpotential Tests:
    a. Applied ac or dc voltage and test procedure in accordance with IEEE C37.20.1 and NEMA PB 2. Alternatively use NETA ATS, Table 100.2.
    b. Each phase of each bus section.
    c. Phase-to-phase and phase-to-ground for 1 minute.
    d. Test results evaluated on a pass/fail basis.
3. Current Injection Tests:
    a. For entire current circuit in each section.
    b. Secondary injection for current flow of 1 ampere.
    c. Test current at each device.
4. Control Wiring:
    a. Apply secondary voltage to control power and potential circuits.

b. Check voltage levels at each point on terminal boards and each device terminal.

5. Operational Test:
   a. Initiate control devices.
   b. Check proper operation of control system in each section.

3.4 PANELBOARDS

A. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
5. Perform visual and mechanical inspection for overcurrent protective devices.

B. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
   b. Each phase of each bus section.
   c. Phase-to-phase and phase-to-ground for 1 minute.
   d. With breakers open.
   e. With breakers closed.
   f. Control wiring except that connected to solid state components.
   g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Ground continuity test ground bus to system ground.

3.5 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Physical and insulator damage.
2. Proper winding connections.

3. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
4. Defective wiring.
5. Proper operation of fans, indicators, and auxiliary devices.
6. Removal of shipping brackets, fixtures, or bracing.
7. Free and properly installed resilient mounts.
8. Cleanliness and improper blockage of ventilation passages.
9. Verify tap-changer is set at correct ratio for rated output voltage under normal operating conditions.
10. Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.5 for each:
      1) Winding-to-winding.
      2) Winding-to-ground.
   b. Test Duration: 10 minutes with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
   c. Results temperature corrected in accordance with NETA ATS, Table 100.14.
   d. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
   e. Insulation resistance test results to compare within 1 percent of adjacent windings.
2. Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.

3.6 LIQUID FILLED TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Physical and insulator damage.
2. Proper winding connections.
3. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
4. Defective wiring.
5. Proper operation of fans, indicators, and auxiliary devices.
6. Effective core and equipment grounding.
7. Removal of shipping brackets, fixtures, or bracing.
8. Tank leaks and proper liquid level.
9. Integrity and contamination of bus insulation system.

10. Verify tap-changer is set at correct ratio for rated voltage under normal operating conditions.
11. Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.5 for each:
      1) Winding-to-winding.
      2) Winding-to-ground.
   b. Test Duration: 10 minutes with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
   c. Results temperature corrected in accordance with NETA ATS, Table 100.14.
   d. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
   e. Insulation resistance test results to compare within 1 percent of adjacent windings.
2. Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.
3. Sample insulating oil in accordance with ASTM D923 and have laboratory test for:
   a. Dielectric breakdown voltage in accordance with ASTM D877 or ASTM D1816.
   b. Acid neutralization number in accordance with ASTM D974.
   c. Interfacial tension in accordance with ASTM D971.
   d. Color in accordance with ASTM D1500.
   e. Visual condition in accordance with ASTM D1524.
   f. Specific gravity in accordance with ASTM D1298.
   g. Water content, in parts per million, in accordance with ASTM D1533.
   h. Dielectric fluid test results in accordance with NETA ATS, Table 100.4.
   i. Power factor at 25 degrees C and at 100 degrees, in accordance with ASTM D924.
   j. Maximum power factor, corrected to 20 degrees C, in accordance with manufacturer's specifications.

3.7 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed power cable No. 4 and larger for:
    a. Physical damage.
    b. Proper connections in accordance with single-line diagram.
    c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
    d. Color coding conformance with specification.
    e. Proper circuit identification.
2. Mechanical Connections For:
    a. Proper lug type for conductor material.
    b. Proper lug installation.
    c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
3. Shielded Instrumentation Cables For:
    a. Proper shield grounding.
    b. Proper terminations.
    c. Proper circuit identification.
4. Control Cables For:
    a. Proper termination.
    b. Proper circuit identification.
5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 4 and Larger:

1. Insulation Resistance Tests:
    a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors.
    b. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
    c. Evaluate ohmic values by comparison with conductors of same length and type.
    d. Investigate values less than 50 megohms.
2. Continuity test by ohmmeter method to ensure proper cable connections.

C. Low-voltage cable tests may be performed by installer in lieu of independent testing firm.

3.8 MEDIUM-VOLTAGE CABLES, 15 KV MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed cable for:
    a. Physical damage plus jacket and insulation condition.

b. Proper connections in accordance with single-line diagram or approved Submittals.
c. Proper shield grounding.
d. Proper cable support.
e. Proper cable termination.
f. Cable bends not in conformance with manufacturer's minimum allowable bending radius.
g. Proper arc and fireproofing in common cable areas.
h. Proper circuit and phase identification.

2. Mechanical Connections:
   a. Proper lug type for conductor material.
   b. Proper lug installation.
   c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturers.
3. Conductors Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Utilize 2,500-volt megohmmeter for 5 kV conductors and 5,000-volt megohmmeter for 15 kV conductors.
   b. Test each cable individually with remaining cables and shields grounded.
   c. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
   d. Evaluate ohmic values by comparison with conductors of same length and type.
   e. Investigate values less than 50 megohms.
2. Shield Continuity Tests:
   a. By ohmmeter method on each section of conductor.
   b. Investigate values in excess of 10 ohms per 1,000 feet of conductors.
3. Acceptance Tests:
   a. In accordance with IEEE 400, ICEA S-93-639, NEMA WC 74, ICEA S-94-649, and ICEA S-97-682 for insulated conductors.
   b. Each conductor section tested with:
      1) Splices and terminations in place but disconnected from equipment.
      2) Remaining conductors and shields grounded in accordance with IEEE 400.
   c. Apply maximum test voltage per NETA ATS, Table 100.6, based on method (DC, AC, PD or VLF) used.
   d. Measure only leakage current associated with conductor.

e. Utilize guard ring or field reduction sphere to suppress corona at disconnected terminations.
f. Maximum test voltage shall not exceed limits for terminators specified in IEEE 48, IEEE 386, or manufacturer's specifications.
g. Apply test voltage in a minimum of five equal increments until maximum acceptable test voltage is reached.
    1) Increments not to exceed ac voltage rating of conductor.
    2) Record dc leakage current at each step after a constant stabilization time consistent with system charging current.
h. Raise conductor to specified maximum test voltage and hold for 15 minutes or as specified by conductor manufacturer. Record leakage current at 30 seconds and 1 minute, and at 1-minute intervals, thereafter.
i. Immediately following test, ground conductor for adequate time period to drain insulation stored charge.
j. Test results evaluated on a pass/fail basis.

3.9 SAFETY SWITCHES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Proper blade pressure and alignment.
2. Proper operation of switch operating handle.
3. Adequate mechanical support for each fuse.
4. Proper contact-to-contact tightness between fuse clip and fuse.
5. Cable connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Proper phase barrier material and installation.
7. Verify fuse sizes and types correspond to one-line diagram or approved Submittals.
8. Perform mechanical operational test and verify mechanical interlocking system operation.

B. Electrical Tests:

1. Insulation Resistance Tests:
    a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
    b. Phase-to-phase and phase-to-ground for 1 minute on each pole.
    c. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Contact Resistance Tests:
    a. Contact resistance in microhms across each switch blade and fuse holder.

b. Investigate deviation of 50 percent or more from adjacent poles or similar switches.

3.10 MOLDED AND INSULATED CASE CIRCUIT BREAKERS

A. General: Inspection and testing limited to circuit breakers rated 100 amperes and larger and to motor circuit protector breakers rated 50 amperes and larger.

B. Visual and Mechanical Inspection:

1. Proper mounting.
2. Proper conductor size.
3. Feeder designation according to nameplate and one-line diagram.
4. Cracked casings.
5. Connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Operate breaker to verify smooth operation.
7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.

C. Electrical Tests:

1. Insulation Resistance Tests:
   a. Utilize 1,000-volt dc megohmmeter for 480-volt and 600-volt circuit breakers and 500-volt dc megohmmeter for 240-volt circuit breakers.
   b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
   c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
   d. Test values to comply with NETA ATS, Table 100.1.
2. Contact Resistance Tests:
   a. Contact resistance in microhms across each pole.
   b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
3. Primary Current Injection Test to Verify:
   a. Long-time minimum pickup and delay.
   b. Short-time pickup and delay.
   c. Ground fault pickup and delay.
   d. Instantaneous pickup by run-up or pulse method.

e. Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
f. Trip times shall be within limits established by NEMA AB 4, Table 5-3. Alternatively, use NETA ATS, Table 100.7.
g. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4. Alternatively, use NETA ATS, Table 100.8.

3.11 LOW VOLTAGE POWER CIRCUIT BREAKERS

A. Visual and Mechanical Inspection:

1. Proper mounting, cell fit, and element alignment.
2. Proper operation of racking interlocks.
3. Check for damaged arc chutes.
4. Proper contact condition.
5. Bolt torque level in accordance with NETA ATS, Table 100.12.
6. Perform mechanical operational and contact alignment tests in accordance with manufacturer's instructions.
7. Check operation of closing and tripping functions of trip devices by activating ground fault relays, undervoltage shunt relays, and other auxiliary protective devices.
8. Verify primary and secondary contact wipe, gap setting, and other dimensions vital to breaker operation are correct.
9. Check charging motor, motor brushes, associated mechanism, and limit switches for proper operation and condition.
10. Check operation of electrically operated breakers in accordance with manufacturer's instructions.
11. Check for adequate lubrication on contact, moving, and sliding surfaces.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Utilize 1,000-volt dc megohmmeter for 480-volt and 600-volt circuit breakers.
   b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
   c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
   d. Test values to comply with NETA ATS, Table 100.1.
2. Contact Resistance Tests:
   a. Contact resistance in microhms across each pole.

b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.

3. Primary Current Injection Test to Verify:
   a. Long-time minimum pickup and delay.
   b. Short-time pickup and delay.
   c. Ground fault pickup and delay.
   d. Instantaneous pickup by run-up or pulse method.
   e. Trip characteristic when adjusted to setting sheet parameters shall be within manufacturer's published time-current tolerance band.

3.12 MEDIUM-VOLTAGE VACUUM CIRCUIT BREAKERS

A. Visual and Mechanical Inspection:

1. Check for proper element alignment.
2. Check for proper operation of cubicle shutters and racking mechanism.
3. Bolt torque level in accordance with NETA ATS, Table 100.12.
4. Perform mechanical operational tests on breaker and its operating mechanism in accordance with manufacturer's instructions, plus check:
   a. Pull rod adjustment.
   b. Trip latch clearance.
   c. Overtravel stops.
   d. Wipe and gap setting.
5. Perform breaker travel and velocity analysis in accordance with manufacturer's instructions; values shall be in accordance with manufacturer's acceptable limits.
6. Check contact erosion indicators in accordance with manufacturer's instructions.
7. With breaker in TEST position:
   a. Trip and close breaker with control switch.
   b. Trip breaker by manually operating each protective relay.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Utilize 2,500-volt dc megohmmeter for 5-kV and 15-kV circuit breakers.
   b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
   c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
   d. Test values to comply with NETA ATS, Table 100.1.
2. Contact Resistance Tests:

a. Between the line and load stab of closed contact resistance in microhms across each pole.
b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.

3. Overpotential Tests:
   a. Maximum applied ac or dc voltage in accordance with NETA ATS, Table 100.19.
   b. Each pole-to-ground with other poles grounded and contacts closed for 1 minute.
   c. Test results evaluated on pass/fail basis.
4. Minimum pickup voltage tests on trip and close coils.
5. Control Wiring Tests:
   a. Insulation resistance test at 1,000-volt dc on control wiring, except that connected to solid state components.
   b. Insulation resistance to be 1 megohm minimum.
6. Vacuum bottle overpotential integrity test across each vacuum bottle with breaker in OPEN position, in accordance with manufacturer's instructions.
7. Power Factor Test (Each Phase):
   a. With breaker in both OPEN and CLOSED position.
   b. Compare power factor and arc chute watt loss with adjacent poles or manufacturer's published data.
8. Power Factor Test (Each Bushing):
   a. Utilize conductive straps and hot collar procedures if bushings are not equipped with power factor tap.
   b. Power factor and capacitance test results within nameplate rating of bushings.

3.13 PROTECTIVE RELAYS

A. Visual and Mechanical Inspection:

1. Visually check each relay for:
   a. Tight cover gasket and proper seal.
   b. Unbroken cover glass.
   c. Condition of spiral spring and contacts.
   d. Disc clearance.
   e. Condition of case shorting contacts if present.
2. Mechanically check each relay for:
   a. Freedom of movement.
   b. Proper travel and alignment.
3. Verify each relay:
   a. Complies with Contract Documents, approved Submittal, and application.

b. Is set in accordance with recommended settings from Coordination Study.

B. Electrical Tests:

1. Insulation resistance test on each circuit to frame, except for solid state devices.
2. Test on nominal recommended setting for:
   a. Pickup parameters on each operating element.
   b. Timing at three points on time-current curve.
   c. Pickup target and seal-in units.
   d. Special tests as required to check operation of restraint, directional, and other elements in accordance with manufacturer's instruction manual.
3. Phase angle and magnitude contribution tests on differential and directional relays after energization to vectorially verify proper polarity and connections.
4. Current Injection Tests:
   a. For entire current circuit in each section.
   b. Secondary injection for current flow of 1 ampere.
   c. Test current at each device.

3.14 INSTRUMENT TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Visually check current, potential, and control transformers for:
   a. Cracked insulation.
   b. Broken leads or defective wiring.
   c. Proper connections.
   d. Adequate clearances between primary and secondary circuit wiring.
2. Verify Mechanically:
   a. Grounding and shorting connections have good contact.
   b. Withdrawal mechanism and grounding operation, when applicable, operate properly.
3. Verify proper primary and secondary fuse sizes for potential transformers.

B. Electrical Tests:

1. Current Transformer Tests:
   a. Insulation resistance test of transformer and wiring-to-ground at 1,000 volts dc for 30 seconds.
   b. Polarity test.

2. Potential Transformer Tests:
    a. Insulation resistance test at test voltages in accordance with NETA ATS, Table 100.9, for 1 minute on:
        1) Winding-to-winding.
        2) Winding-to-ground.
    b. Polarity test to verify polarity marks or H1-X1 relationship as applicable.
3. Insulation resistance measurement on instrument transformer shall not be less than that shown in NETA ATS, Table 100.5.

3.15 METERING

A. Visual and Mechanical Inspection:

1. Verify meter connections in accordance with appropriate diagrams.
2. Verify meter multipliers.
3. Verify meter types and scales conform to Contract Documents.
4. Check calibration of meters at cardinal points.
5. Check calibration of electrical transducers.

3.16 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in motor control center, panelboards, and switchgear assemblies for proper connection and tightness.
2. Ground bus connections in motor control center, panelboards, and switchgear assemblies for proper termination and tightness.
3. Effective transformer core and equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-of-Potential Test:
    a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
    b. Main ground electrode system resistance to ground to be no greater than 5 ohm(s).
2. Two-Point Direct Method Test:
    a. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.

b. Equipment ground resistance shall not exceed main ground system resistance by 0.25 ohm.

3. Neutral Bus Isolation:
   a. Test each neutral bus individually with neutral bonding jumper removed at service entrance or separately derived system.
   b. Evaluate ohmic values by measuring resistance between ground bus and neutral bus.
   c. Investigate values less than 50 megohms.

3.17 GROUND FAULT SYSTEMS

A. Inspection and testing limited to:

1. Zero sequence grounding systems.
2. Residual ground fault systems.

B. Visual and Manual Inspection:

1. Neutral main bonding connection to ensure:
   a. Zero sequence sensing system is grounded ahead of neutral disconnect link.
   b. Ground strap sensing system is grounded through sensing device.
   c. Neutral ground conductor is solidly grounded.
2. Verify control power has adequate capacity for system.
3. Manually operate monitor panels for:
   a. Trip test.
   b. No trip test.
   c. Nonautomatic rest.
4. Zero sequence system for symmetrical alignment of core balance transformers about current carrying conductors.
5. Relay check for pickup and time under simulated ground fault conditions.
6. Verify nameplate identification by device operation.

C. Electrical Tests:

1. Test system neutral insulation resistance with neutral ground link removed; minimum 1 megohm.
2. Determine relay pickup by primary current injection at the sensor. Relay pickup current within plus or minus 10 percent of device dial or fixed setting.
3. Test relay timing by injecting 300 percent of pick-up current or as specified by manufacturer. Relay operating time in accordance with manufacturer's time-current characteristic curves.
4. Test system operation at 55 percent rated control voltage, if applicable.

5. Test zone interlock system by simultaneous sensor current injection and monitoring zone blocking functions.

3.18 AC INDUCTION MOTORS

A. General: Inspection and testing limited to motors rated 1 horsepower and larger.

B. Visual and Mechanical Inspection:

1. Proper electrical and grounding connections.
2. Shaft alignment.
3. Blockage of ventilating air passageways.
4. Operate motor and check for:
    a. Excessive mechanical and electrical noise.
    b. Overheating.
    c. Correct rotation.
    d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionability and proper operation.
    e. Excessive vibration, in excess of values in NETA ATS, Table 100.10.
5. Check operation of space heaters.

C. Electrical Tests:

1. Insulation Resistance Tests:
    a. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 100.1 for:
        1) Motors above 200 horsepower for 10-minute duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
        2) Motors 200 horsepower and less for 1-minute duration with resistances tabulated at 30 seconds and 60 seconds.
    b. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.
2. Calculate polarization index ratios for motors above 200 horsepower. Investigate index ratios less than 1.5 for Class A insulation and 2.0 for Class B insulation.
3. Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.
4. Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes.
5. Overpotential Tests:
    a. Applied dc voltage in accordance with IEEE 95.

b. Limited to 4,000-volt motors rated 500 horsepower and greater.
c. Test results evaluated on pass/fail basis.

3.19 LOW-VOLTAGE MOTOR CONTROL

A. Visual and Mechanical Inspection:

1. Proper barrier and shutter installation and operation.
2. Proper operation of indicating and monitoring devices.
3. Proper overload protection for each motor.
4. Improper blockage of air-cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check door and device interlocking system by:
   a. Closure attempt of device when door is in OPEN position.
   b. Opening attempt of door when device is in CLOSED position.
8. Check key interlocking systems for:
   a. Key captivity when device is in CLOSED position.
   b. Key removal when device is in OPEN position.
   c. Closure attempt of device when key has been removed.
   d. Correct number of keys in relationship to number of lock cylinders.
   e. Existence of other keys capable of operating lock cylinders; destroy duplicate sets of keys.
9. Check nameplates for proper identification of:
   a. Equipment title and tag number with latest one-line diagram.
   b. Pushbuttons.
   c. Control switches.
   d. Pilot lights.
   e. Control relays.
   f. Circuit breakers.
   g. Indicating meters.
10. Verify fuse and circuit breaker sizes and types conform to Contract Documents.
11. Verify current and potential transformer ratios conform to Contract Documents.
12. Check bus connections for high resistance by low-resistance ohmmeter, calibrated torque wrench applied to bolted joints and thermographic survey:
13. Ohmic value to be zero.
    a. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
    b. Thermographic survey temperature gradient of 2 degrees C, or less per NETA ATS, Table 100.18.

14. Check operation and sequencing of electrical and mechanical interlock systems by:
    a. Closure attempt for locked open devices.
    b. Opening attempt for locked closed devices.
    c. Key exchange to operate devices in OFF-NORMAL positions.
15. Verify performance of each control device and feature furnished as part of motor control center.
16. Control Wiring:
    a. Compare wiring to local and remote control, and protective devices with elementary diagrams.
    b. Check for proper conductor lacing and bundling.
    c. Check for proper conductor identification.
    d. Check for proper conductor lugs and connections.
17. Exercise active components.
18. Inspect contactors for:
    a. Correct mechanical operations.
    b. Correct contact gap, wipe, alignment, and pressure.
    c. Correct torque of connections.
19. Compare overload heater rating with full-load current for proper size.
20. Compare motor protector and circuit breaker with motor characteristics for proper size.
21. Perform phasing check on double-ended motor control centers to ensure proper bus phasing from each source.

B. Electrical Tests:

1. Insulation Resistance Tests:
    a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
    b. Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.
    c. Contactor phase-to-ground and across open contacts for 1 minute on each phase.
    d. Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.
    e. Test values to comply with NETA ATS, Table 100.1.
2. Current Injection through Overload Unit at 300 Percent of Motor Full-Load Current and Monitor Trip Time:
    a. Trip time in accordance with manufacturer's published data.
    b. Investigate values in excess of 120 seconds.
3. Control Wiring Tests:
    a. Apply secondary voltage to control power and potential circuits.
    b. Check voltage levels at each point on terminal board and each device terminal.

c. Insulation resistance test at 1,000 volts dc on control wiring, except that connected to solid state components; 1 megohm minimum insulation resistance.

4. Operational test by initiating control devices to affect proper operation.

3.20 AUTOMATIC TRANSFER SWITCHES

A. Visual and Mechanical Inspection:

1. Check doors and panels for proper interlocking.
2. Check connections for high resistance by low-resistance ohmmeter and calibrated torque wrench applied to bolted joints.
3. Check positive mechanical and electrical interlock between normal and alternate sources.
4. Check for proper operation:
   a. Manual transfer function switch.
   b. Generator under load and nonload conditions.
   c. Auto-exerciser of generator under load and no-load conditions.
5. Verify settings and operation of control devices.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1, for each phase with switch CLOSED in both source positions.
   b. Phase-to-phase and phase-to-ground for 1 minute.
   c. Test values in accordance with manufacturer's published data.
2. Contact Resistance Test:
   a. Contact resistance in microhms across each switch blade for both source positions.
   b. Investigate values exceeding 500 micro-ohms.
   c. Investigate values deviating from adjacent pole by more than 50 percent.
3. Set and calibrate in accordance with Specifications and manufacturer's recommendations.
   a. Voltage and frequency sensing relays.
   b. Time delay relays.
   c. Engine start and shutdown relays.
4. Perform automatic transfer tests by:
   a. Simulating loss of normal power.
   b. Return to normal power.
   c. Simulating loss of alternate power.

d. Simulating single-phase conditions for normal and alternate sources.

5. Monitor and verify operation and timing of:
   a. Normal and alternate voltage sensing relays.
   b. Engine-start sequence.
   c. Timing delay upon transfer and retransfer.
   d. Engine cool down and shutdown.
   e. Interlocks and limit switch functions.
   f. Engine cool down and shutdown feature.

3.21 BATTERY SYSTEM

A. Visual and Mechanical Inspection:

1. Physical damage and electrolyte leakage.
2. Evidence of corrosion.
3. Intercell bus link integrity.
4. Battery cable insulation damage and contaminated surfaces.
5. Operating conditions of ventilating equipment.
6. Visual check of electrolyte level.

B. Electrical Tests:

1. Measure:
   a. Bank charging voltage.
   b. Individual cell voltage.
   c. Electrolyte specific gravity in each cell.
   d. Measured test values to be in accordance with manufacturer's published data.
2. Verify during recharge mode:
   a. Charging rates from charger.
   b. Individual cell acceptance of charge.
3. Load tests for integrity and capacity; test values in accordance with IEEE 450.

3.22 LOW VOLTAGE SURGE ARRESTORS

A. Visual and Mechanical Inspection:

1. Adequate clearances between arrestors and enclosures.
2. Ground connections to ground bus.

B. Electrical Tests:

1. Varistor Type Arrestors:

a. Clamping voltage test.
b. Rated RMS voltage test.
c. Rated dc voltage test.
d. Varistor arrestor test values in accordance with IEEE C62.33, Section 4.4 and Section 4.9.

3.23 MEDIUM-VOLTAGE SURGE ARRESTORS AND SURGE CAPACITORS

A. Visual Inspection:

1. Ground connections to ground bus.
2. Shortest practical jumper connections to line.

B. Electrical Tests:

1. Grounding electrode resistance test in accordance with IEEE 81, Section 8.2.1.5 using three-point fall-of-potential method.
2. Insulation power factor.
3. Insulation resistance.
4. RF noise test using Stoddart noise test set with applied voltage of 1.18 times maximum continuous operating voltage.
5. Insulation power factor leakage current, watts loss, and insulation resistance test in accordance with manufacturer's test values. RIV value not to exceed 10 microvolts above background noise.
6. Leakage current and watts loss tests.

3.24 THERMOGRAPHIC SURVEY

A. Provide thermographic survey per NETA ATS Table 100.18 of connections associated with incoming service conductors, bus work, and branch feeder conductors No. 4 and larger at each:

1. Medium voltage switchgear.
2. Low voltage motor control center.
3. Panelboard.
4. Variable frequency drive.

B. Provide thermographic survey of feeder conductors No. 4 and larger terminating at:

1. Motors rated 50 hp and larger.
2. Low voltage disconnect switches.
3. Transfer switches.

C. Remove necessary enclosure metal panels and covers prior to performing survey.

D. Perform with equipment energized during periods of maximum possible loading per NFPA 70B, Section 20.17.

E. Do not perform survey on equipment operating at less than 40 percent of rated load. If plant load is insufficient, perform test with supplemental load bank producing rated load on item being measured.

F. Utilize thermographic equipment capable of:

1. Detecting emitted radiation.
2. Converting detected radiation to visual signal.
3. Detecting 1 degree C temperature difference between subject area and reference point of 30 degrees C.

G. Temperature Gradients:

1. 3 degrees C to 7 degrees C indicates possible deficiency that warrants investigation.
2. 7 degrees C to 15 degrees C indicates deficiency that is to be corrected as time permits.
3. 16 degrees C and above indicates deficiency that is to be corrected immediately.

H. Provide written report of:

1. Areas surveyed and the resultant temperature gradients.
2. Locations of areas having temperature gradients of 3 degrees C or greater.
3. Cause of heat rise and actions taken to correct cause of heat rise.
4. Detected phase unbalance.

END OF SECTION

SECTION 26 09 13
POWER MEASUREMENT AND CONTROL

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. Institute for Electrical and Electronics Engineers, Inc. (IEEE):
   a. C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
   b. C37.90.1, Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
   c. C57.13, Standard Requirements for Instrument Transformers.
3. International Electrotechnical Commission (IEC):
   a. 60255-5, Electrical Relays—Part 5: Insulation Coordination for Measuring Relays and Protection Equipment—Requirements and Tests.
   b. 60255-22-4, Measuring Relays and Protection Equipment—Part 22-4: Electrical Disturbance Tests—Electrical Fast Transient/Burst Immunity Tests.
   c. 60688, Electrical Measuring Transducers for Converting a.c. Electrical Quantities to Analogue or Digital Signals.
   d. 60870-5-104, Telecontrol Equipment and Systems—Part 5-104: Transmission Protocols—Network Access for IEC 60870-5-101 Using Standard Transport Profiles.
   e. 61850, Communication Network and Systems in Substations.
4. Telecommunications Industry Association (TIA):
   a. 232-F, Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
   b. 485-A, Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems.
5. National Electrical Manufacturers Association (NEMA):
   a. C12.1, Electric Meters Code for Electricity Metering.
   b. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.2 DEFINITIONS

A. AFD: Adjustable Frequency Drive.

B. CT: Current Transformer.

C. DNP: Distributed Network Protocol.

D. LCD: Liquid Crystal Display.

E. LED: Light Emitting Diode.

F. MPR: Motor Protection Relay.

G. PLC: Programmable Logic Controller.

H. RTD: Resistance Temperature Detectors.

I. UCA: Utility Communications Architecture.

J. VT: Voltage Transformer.

1.3 SUBMITTALS

A. Action Submittals:

1. Instruction manuals for each type of device.
2. Special features, licensed programming software.
3. Potential and current schematic diagrams.
4. Control and metering schematic diagrams.
5. Interconnection wiring diagrams.
6. Installation and mounting requirements.
7. Complete descriptive literature and renewal parts data.

B. Informational Submittals:

1. Programming software used to configure devices, along with settings files necessary to reload or revise settings as left by Contractor.
2. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 MAIN MANAGEMENT RELAY (MMR)

A. MMR shall provide primary protection and management of distribution feeders. Protection shall include:

1. Complete time overcurrent (51P, 51N, 51G), including sensitive ground.
2. Complete instantaneous overcurrent (50P, 50N, 50G), including sensitive ground.
3. Directional overcurrent (67P, 67N, 67G, 67_2).
4. Bus and Line undervoltage and overvoltage (27/59).

5. Negative sequence voltage (47).
6. Undervoltage automatic restoration (27/79).
7. Bus under-frequency (81U) with voltage and current level monitoring.
8. Bus over-frequency (81O) with voltage and current level monitoring.
9. Frequency rate-of-change (81D) monitoring.
10. Under-frequency automatic restoration (81/79).
11. Neutral displacement overvoltage (59N) used to give line to ground fault coverage on high impedance grounded or ungrounded systems, which are isolated.

B. Provide drawout construction to facilitate testing, maintenance, and interchange flexibility.

C. Operate with either wye-connected (four-wire) or open-delta-connected (three-wire) potential transformers, and three-phase, four-wire connected current transformers.

D. Control shall include manual close control, cold load pickup control, programmable logic inputs, two breaker control relay outputs, internal failure relay output, programmable relay outputs, solid state trip output, analog transducer input, and analog transducer outputs.

E. Relay shall provide a built-in automatic transfer scheme. With use of up to three feeder relays, user shall be able to implement an automatic transfer scheme intended for application to a set of three circuit breakers on a main-tie-main arrangement, two of which (incomers one and two) connect sources of electrical energy to two busses, which could be paralleled through bus tie breaker.

F. Monitoring and metering functions shall include:

1. Current: Phase A RMS current, Phase B RMS current, Phase C RMS current.
2. Voltage: Phase A-N (A-B) voltage, Phase B-N (B-C) voltage, Phase C-N (C-A) voltage.
3. Frequency.
4. Symmetrical components.
5. Three-phase power factor.
6. Three-phase real power.
7. Three-phase reactive power.
8. Three-phase apparent power.
9. Watt-hours.
10. VAR-hours.

11. Demand Measurement: Rolling demand, time interval, programmed to 5, 10, 15, 20, 30, or 60 minutes. A fault locator with a record of last 10 faults.
12. Event Recorder: Record last 512 events, time tagged.
13. Waveform Capture: Relay shall store up to 256 cycles of data, captured for analog current and voltage inputs as well as digital data for output relays and input contact states. Amount of data to capture and trigger point shall be user configurable.
14. Data logger.
15. Latest Trip Report: Containing date and time, cause, phase, ground, sensitive ground, and neutral currents, line-line and line-ground voltages, neutral voltage, frequency, and analog Input.
16. Operation counter and accumulated interrupted currents per phase.
17. Coil (trip/close) monitoring inputs for detection of failed circuit regardless of breaker state.

G. User interfaces shall include:

1. Large 40-character display, navigation keys, and keypad.
2. Indicator LEDs on front panel which provide a quick visual indication of status.
3. Front panel RS232 serial port that provides easy computer access.
4. Two rear RS485 ports, one of which can be configured as a RS422 port.
5. Relay programmed to communicate using Modbus Protocol through one of its ports.
6. RJ45 Ethernet port to allow 10BaseT Ethernet connectivity to local or wide area networks.
7. Relay capable of being set by Windows-based, easy to use setup graphical terminal interface.

H. Manufacturers and Products:

1. General Electric; GE F60.
2. Schweitzer Engineering Laboratories; SEL-351.

2.2 FEEDER MANAGEMENT RELAY (FMR)

A. Feeder protection shall be provided using a single static drawout relay. Protection features shall include:

1. Three-phase (51) and ground (51G) time overcurrent.
2. Three-phase (50) and ground (50G) instantaneous overcurrent.
3. Independent phase and ground curves; ANSI, IAC (AC Phase and Ground Relay), or IEC/BS142 curve shapes: definite time, moderately inverse, normal inverse, very inverse, extremely inverse.
4. Forty “time dials” for phase and ground time overcurrent curves.

5. Separate pickup level and output relay for each protection element.
6. Three Outputs: Trip, auxiliary trip, and service.
7. Eight additional output relays shall be an option, one for each protection element.
8. Trip Record: Display of last five trips.
9. Relay 86 lockout.

B. Front Panel LED Indicators:

1. Cause of trip, pickup, relay in service, relay malfunction.
2. Clear key shall be available to clear cause of trip indicators.
3. Phase current indicator shall be provided on front panel.
4. Relay shall be able to communicate via an RS485 port. Information available over this port shall include:
    a. Settings, phase, and ground current as a percent of CT, status.
    b. Simulation of trips.

C. User interfaces shall include:

1. Relay programmed to communicate using Modbus Protocol through one of its ports.
2. RJ45 Ethernet port to allow 10BaseT Ethernet connectivity to local or wide area networks.

D. Relay shall comply with surge withstand capability (SWC) standards IEEE C37.90 and IEC 60255-22-4.

E. Manufacturers and Products:

1. General Electric; GE F35.
2. Schweitzer Engineering Laboratories; SEL-751A.

2.3 LOCKOUT RELAY (ANSI DEVICE 86)

A. Ratings:

1. Voltage: Up to 600 volts.
2. Current: 30 amps continuous.
3. Interrupt Rating: 3 amps at 125V dc.
4. Contact Resistance: 0.01 ohm maximum.

B. Manufacturer and Product: Electroswitch; Series 24.

2.4 VIBRATION MONITORING SYSTEM

A. Program, test, calibrate, fully configure, and place into operation as indicated herein.

B. Features:

1. Microprocessor based system with programmable firmware options.
2. Programmable operating range.
3. Programmable alarm delays.
4. Two individually adjustable alarm set points per channel.
5. Dual channel modules.
6. AND or OR danger voting logic.
7. Timed OK/Channel defeat.
8. RS-422 interface to the pump station control system.
9. Slot Racks, quantity and size as required for ten pumps/motors.
    a. Power supply module.
    b. Transient data interface module.
    c. Radial shaft vibration monitoring modules, quantity as required.
    d. Thrust (axial) position monitoring module, quantity as required.
    e. Velocity monitoring modules, quantity as required.
    f. Keyphasor (timing) monitoring modules, quantity as required.
10. 15-inch VGA display.

C. Monitor bearings and shafts of pumps and pump motors by use of transducers as specified for pumps in individual pump specification as specified in Section 44 42 56.09, Non-Clog Dry-Pit Centrifugal Pumps, and for motors as specified in Section 26 19 00, Medium Voltage Induction Motors.

D. Connect to Work Station WS1 via an Ethernet port Modbus data link.

1. Data link shall effectively communicate data relevant to operating purpose of each vibration monitoring system.
2. Provide data configuration software and documentation to allow communication.

E. Alarm Contacts: Configured to be normally closed, open in alarm condition, and open on loss of power.

F. Cables requiring special calibration for optimum performance shall be calibrated by vibration system supplier.

G. Provide a NEMA 12, pad-mounted enclosure to house racks with VGA display on front door.

H. Manufacturers and Products:

1. Bently Nevada Corporation; 3500 Series.
2. Rockwell Automation Entek; 6600.

2.5 POWER METER (PM)

A. General:

1. Solid state device with LED displays.
2. Direct voltage input up to 600V ac.
3. Current input via current transformer with 5-ampere secondary.
4. Programmable current and potential transformer ratios.
5. Programmable limits to activate up to four alarms.
6. Selectable Voltage Measurements: Line-to-line or line-to-neutral and wye or delta.
7. Ethernet capable.

B. Simultaneous Display:

1. Volts, three-phase.
2. Amperes, three-phase.
3. Kilowatts.
4. Kilowatt hours.
5. Power factor.
6. Frequency.
7. kW Demand with programmable period intervals.
8. kVA.
9. kVAR.
10. Input Voltage Rating: 99V ac to 264V ac.
11. Manufacturers and Products:
    a. Allen Bradley; Model 1400 Series.
    b. Eaton; IQ DP-4000.

2.6 INSTRUMENT TRANSFORMERS

A. Current Transformer (CT), 600 Volts and Below:

1. Type: Molded bar or donut.
2. Accuracy: 0.3 at burden imposed by meters and instruments.
3. Shorting type terminal boards for current transformer leads.

B. Potential Transformer (PT), 600 Volts and Below:

1. Type: Molded.
2. Accuracy Classification: 0.3 at burden imposed by meters and instruments, including future.
3. Primary Fuses: Two, current-limiting.
4. Secondary Fuses: One, current-limiting.

C. Current Transformer (CT), Over 600 Volts:

1. Type:
    a. Insulated dry indoor.
    b. Window type for relaying and ground sensing.
    c. Wound type for metering.
2. Transformer Accuracy: In accordance with IEEE C57.13.
3. Class C20 or greater for relaying.
4. Class 1.2 maximum for imposed burden for metering.
5. Rating: 5kVand 15kVas indicated.
6. Mechanical Rating: Equal to interrupting rating of circuit breakers.
7. Thermal Rating: 100 times normal, 1 second.
8. Size to operate continuously at rated primary current without insulation damage.
9. Identify polarity with standard mark or symbol.
10. Secondary Wiring: Install in conduit, PVC tubing or wiring trough.
11. Isolate from adjacent components and circuits by removable insulating or metal barriers.
12. Window type CTs accessible for replacement without removing high voltage insulated connections.

D. Potential Transformer (PT), Over 600 Volts:

1. Type: Insulated dry, indoor.
2. Rating: 4,200 and 12,000/120-volt, single-phase with 60 and 110 kV BIL rating, respectively.
3. Three transformers connected phase-to-ground.
4. Thermal Capacity: Minimum 55 degrees rise above 30 degrees C ambient.
5. Mechanical Rating: Equal to short-time current carrying capability of circuit breaker.
6. Accuracy classification in accordance with IEEE C57.13 for connected burden.
7. Primary Protection: Two, integral mounted current-limiting fuses.
8. Secondary Protection: Single, separately mounted current-limiting fuse.
9. Identify polarity with standard marking or symbols.
10. Mount on drawout carriage installed in metering module, complete with secondary wiring.
11. Primary and secondary terminals to be disconnected and primary fuses grounded when rollout carriage is in open position.

2.7 TEST SWITCH MODULE

A. Function: Multipole switch bank for instrument transformer testing.

1. Allows current injection for each phase.
2. CT inputs short when current switches are open.

3. Ability to visually isolate (open) trip relay output circuits.
4. Cover provided.

B. Manufacturers and Products:

1. ABB; Type FT-1 Flexitest.
2. GE; Multilin 515.

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. As defined in Section 26 08 00, Commissioning of Electrical Systems.

3.2 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at distribution equipment factory, Site, and classroom designated by Owner, for the minimum person-days listed below, travel time excluded:

1. 2 person-days to enter, confirm, and assist in testing protective relay settings and communications configuration at the distribution equipment. Device settings to be based on values generated in the device coordination study.
2. 2 person-days for initial energization and start-up of distribution system equipment.
3. 2 person-days for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the Engineer.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Testing, Integration, and Startup.

END OF SECTION

SECTION 26 12 02
OIL-FILLED PAD MOUNTED TRANSFORMERS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. ASTM International (ASTM): D3487, Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus.
   2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
      b. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
      c. C57.12.22, Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers with High-Voltage Bushings, 2,500 kVA and Smaller.
      d. C57.12.26, Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High Voltage Connectors.
      e. C57.12.28, Switchgear and Transformers—Pad-Mounted Equipment, Enclosure Integrity.
      f. C57.12.90, Standard Test Code for Liquid Immersed Distribution, Power, and Regulating Transformers.
      g. C57.106, Guide for Acceptance and Maintenance of Insulating Oil in Equipment.
      h. C62.11, Metal-Oxide Surge Arrestors for Alternating-Current Power Circuits (>1 kV).
   3. National Electrical Manufacturers Association (NEMA):
      a. TR 1, Transformers, Regulators, Reactors.
      b. TP 1, Guide for Determining Energy Efficiency for Distribution Transformers.
   4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
   5. Underwriters Laboratories Inc. (UL).

1.2 SUBMITTALS

A. Action Submittals:
   1. Descriptive information.
   2. Dimensional drawings.

3. Transformer nameplate data.
4. Schematic and connection diagrams.
5. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:
1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection and Testing.
3. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
4. Factory test reports, certified.

1.3 QUALITY ASSURANCE

A. Design, test, and assemble in accordance with applicable standards of NEMA TR 1, IEEE C57.12.00, IEEE C57.12.22, IEEE C57.12.26, and IEEE C57.12.90.

1.4 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:
1. One quart of paint to match color and quality of equipment final shop finish.
2. Two spare fuse links for each replaceable fuse size.
3. Pentahead socket for 1/2-inch socket drive.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Cutler-Hammer.

B. Square D Co.

C. General Electric.

D. Cooper Power System.

2.2 GENERAL

A. Integral Unit: Compartmental type unit consisting of transformer, oil-filled tank, and high and low voltage terminating compartments, assembled on a common structural base.

B. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications.

2.3 TRANSFORMER

A. kVA Rating: As shown.

B. Primary Voltage: 12.47 kV line-to-line, three-phase, 60-Hz.

C. Secondary Voltage: 4160/2400 volts, three-phase, four-wire, 60 Hz.

D. BIL Rating:
   1. 95 BIL for 15 kV insulation class transformers.
   2. 60 BIL for secondary.

E. Temperature Rise: 65 degrees C above 30 degrees average ambient with maximum ambient not to exceed 40 degrees C.

F. Impedance:
   1. 5.75 percent for transformers rated 750 kVA and above.

G. Efficiency: Meet or exceed values in Table 4-1 of NEMA TP 1.

H. Dielectric Coolant: Fully biodegradable, nontoxic, and nonbio-accumulating fluid, qualifying as "less flammable" per NEC 450.23; Factory Mutual Approved or UL Classified..

I. Primary Taps:
   1. Full capacity, two 2-1/2 percent below and two 2-1/2 percent above, rated voltage.
   2. Externally operated no-load tap changer.
   3. Provisions for locking handle in any position.

J. Coil Conductors: Copper windings.

K. Sound Level: In accordance with manufacturer's standards.

2.4 ENCLOSURE

A. In accordance with IEEE C57.12.28 requirements.

B. Welded carbon steel transformer tank, with cooling panels when required, and lifting eyes.

C. 12-gauge sheet steel terminal compartment enclosure having no exposed screws, bolts, or other fasteners that are externally removable.

D. Color: Provide green finish as approved by Engineer.

2.5 TERMINAL COMPARTMENTS

A. General: IEEE C57.12.28, enclosed high and low voltage compartments side by side, separated by steel barrier, bolted to transformer tank.
   1. Doors:
      a. Individual, full-height, air-filled.
      b. Low voltage door with three-point latching mechanism, vault type handle, and single padlocking provision.
      c. High voltage door fastenings inaccessible until low voltage door has been opened.
      d. Door Bolts: Penta-head type.
      e. Lift-off, stainless steel hinges and door stops.
      f. Removable front sill to facilitate rolling or skidding over conduit stubs.
      g. Recessed lock pocket, with steel door release bolt adjacent to secondary compartment door handle.

B. High Voltage Compartment:
   1. Deadfront in accordance with IEEE C57.12.26 type construction.
   2. Protective fuses.
   3. High voltage bushings.
   4. Transformer grounding pad.
   5. Surge arrestors.

C. Low Voltage Compartment:
   1. Livefront in accordance with IEEE C57.12.26 type construction.
   2. Low voltage bushings.
   3. Grounding pad.
   4. Stainless steel equipment nameplate.
   5. Liquid level gauge.
   6. 1-inch upper filter press and filling plug.
   7. Drain valve with sampling device.
   8. Dial type thermometer.
   9. Pressure relief valve.
   10. Pressure relief device, self-resealing with indicator.
   11. Pressure-vacuum gauge.
   12. Mounting provision for current and potential transformers.
   13. Nameplate.

2.6 BUSHINGS

A. High Voltage:
   1. Deadfront Termination:

a. Universal bushing well rated at 15 kV in accordance with IEEE 386.
b. Bushings externally clamped and front removable.
c. Rated for 600 amperes continuous, 95 kV BIL.
d. Standoff brackets located adjacent to bushings.

B. Low Voltage:
1. 1200 ampere porcelain bushings clamped to tank with 4 hole spade type terminals.
2. Rated 150 percent of continuous full-load current, 60 BIL, 4160/2400 volts.
3. Internally connected neutral extending to neutral bushing.

2.7 SURGE ARRESTORS

A. Metal-Oxide, Varistor Type:
1. Insulated body, elbow type, 9 kV in accordance with IEEE C62.11.
2. Installed in high voltage compartment.
3. Connected to transformer high voltage terminals.

2.8 TANK GROUNDING PADS

A. High and Low Voltage Compartments:
1. Connected together with bare No. 2/0 stranded copper conductors.
2. Wye-wye high and low voltage neutrals internally connected with link and brought out to insulated low voltage bushing externally grounded to tank.
3. Low voltage neutral connected to externally mounted insulating bushing in low voltage compartment and grounded to tank with removable strap.

2.9 TAP CHANGER WARNING SIGN

A. Red laminated plastic, engraved to white core.

B. Engrave to read: DO NOT OPERATE WHEN TRANSFORMER ENERGIZED.

C. Mount above tap changer handle.

2.10 FACTORY TESTS

A. Production tests in accordance with IEEE C57.12.90 and IEEE C57.12.00, Section 8 and Table 16.

B. Dielectric test in accordance with IEEE C57.12.26.

PART 3 EXECUTION

3.1 GENERAL

A. Secure to mounting pads with anchor bolts.

B. Install plumb and longitudinally in alignment with pad or adjacent building wall.

C. Ground enclosures in accordance with applicable codes.

3.2 ADJUSTMENTS

A. Adjust voltage taps to obtain rated output voltage under normal operating load conditions.

END OF SECTION

SECTION 26 13 13
MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C37.04, Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
   b. C37.06, AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis Preferred Ratings and Related Required Capabilities.
   c. C37.09, Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
   d. C37.20.2, Metal-Clad and Station Type Cubicle Switchgear.
   e. C57.13, Standard Requirements for Instrument Transformers.
   f. C62.11, Metal-Oxide Surge Arrestors for Alternating Current Power Circuits (>1KV).
2. National Electrical Manufacturers Association (NEMA):
   a. LA 1, Surge Arrestors.
   b. SG 4, Alternating-Current High-Voltage Circuit Breakers.
   c. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.2 SUBMITTALS

A. Action Submittals:

1. Descriptive product information.
2. Dimensional drawings.
3. Itemized bill of material.
4. Protective device time-current characteristics on transparencies.
5. Operational description.
6. Installation instructions.
7. Bus data.
8. One-line, three-line, and control schematic drawings.
9. Connection and interconnection drawings.
10. Conduit entrance locations.

11. Mimic bus layout.
12. Anchoring instructions and details.
13. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection and Testing.
3. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
4. Certified factory test reports.

1.3 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

B. UL listing mark for Category A enclosure requirements of IEEE C37.20.2, Appendix A.

1.4 PACKING AND SHIPPING

A. Shipping Splits: Established by Contractor to facilitate ingress of equipment to final installation location within the building.

1.5 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:

1. 2 Each-Spare fuse, both power and control, of every size and type used.
2. 5 LED assemblies for each color.

3. 2 Each-Breaker test cabinet for facilitation of operation of a circuit breaker out of its cubicle for test purposes.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. General Electric.

B. Eaton.

C. Square D.

D. Siemens.

E. ABB.

2.2 GENERAL

A. Furnish switchgear that is the product of a single manufacturer. Assembled units with component parts of several manufacturers will not be acceptable with the exception that such minor items as protective relaying, terminal blocks, test switches, fuses, wiring, etc., may be manufactured by others.

B. Design, test, and assemble in accordance with IEEE C37.04, IEEE C37.06, and IEEE C37.20.2, and NEMA SG4.

C. Suitable for 4,160 and 12,470 volts, three-phase, three-wire solid grounded-wye electrical service as shown on Drawings and having an available short-circuit current at line terminals as shown on Drawings. Switchgear voltage ratings shall be 5kv and 15kV respectively.

D. Rated at 60kV BIL for 5kV switchgear and 95 kV BIL for 15kV switchgear.

E. Operating Conditions:

1. Ambient Temperature: Maximum 40 degrees C.
2. Equipment shall be fully rated without derating for the above operating conditions.

F. Equipment and devices weighing in excess of 100 pounds shall have lifting lugs.

2.3 STATIONARY STRUCTURE

A. Type: Indoor for 5kV switchgear and aisleless outdoor for 15kV switchgear consisting of pull sections with cable terminations, metering, breakers, transition, and auxiliary sections assembled to form a rigid, self-supporting, metal enclosed structure.

B. Material: 11-gauge minimum cold-rolled steel, formed with reinforced steel members.

C. Grounded metal barriers between each breaker, main bus, branch cabling, and instrumentation/control.

D. Breaker compartments to have blocking devices to prevent installation of breaker with lower ampacity or interrupting capacity into compartment designed for a higher rated breaker.

E. Each breaker compartment shall contain:

1. Housing for vacuum circuit breakers.
2. Manually operated drawout mechanism with automatic shutters and safety interlocks.
3. Hinged front panel.
4. Primary and secondary disconnect devices.
5. Control circuit cutout devices.
6. Main bus with connections.
7. Extended ground bus.
8. Terminal block, small wiring, control bus, and cable supports.

F. Each auxiliary compartment shall contain:

1. Front Panel: Hinged.
2. Main bus and connections.
3. Extended ground bus.
4. Drawout potential transformers and associated primary fuses.
5. Relays, meters, and instrumentation.
6. Terminal block, small wiring, control bus, and cable supports.

G. Rear accessible cable compartments shall contain:

1. Provisions for cable entry from bottom.
2. Insulated bushings for primary disconnecting devices.
3. Current transformers
4. Ground bus extending full width of switchgear.

5. Cable terminators for 5 and 15 kV conductors.

H. Main bus compartment, rear accessible via removal of interior steel barriers, shall contain:

1. Insulated bus and support system.
2. Primary disconnects.

I. Bus transition sections shall be isolated from main bus section.

2.4 ENCLOSURE

A. Finish: Baked enamel applied over rust-inhibiting, phosphated base coating.

1. Color:
   a. Exterior: Gray.
   b. Interior: White.
   c. Unpainted Parts: Plated for corrosion resistance.

B. Indoor Enclosure:

1. NEMA 250, Type 1, with formed edges on hinged and nonhinged panels.
2. Rear, two half-height, bolt-on panels for each enclosure section.
3. Cable Termination Access: Padlock provision.

C. Aisleless Outdoor Enclosure:

1. NEMA 250, Type 3R, enclosing NEMA 250, Type 1 enclosed switchgear.
2. Hinged, full height doors with three-point latch operated by vault type handle with multiple padlocking provisions for each front switchgear section.
3. Sufficient clearance between exterior door and front of interior switchgear doors to prevent impinging on any devices mounted on the interior door.
4. Gasketed doors, rear panels, end panels, and sloped roof.
5. Support assembly on two 6-inch high I-beams or C-channels running parallel to switchgear length.
6. Steel bottom enclosure and support assembly undercoated with a coal-tar emulsion.
7. 120-Volt Receptacle: Ground fault interrupter, mounted inside front door.
8. Ventilating louvers with filters in front door and rear panels.

9. Space Heaters: Thermostatically controlled 250-watt, 120-volt, in each switchgear vertical section in accordance with UL 1025.
10. Adjustable thermostat for temperature range of 50 degrees F to 70 degrees F.
11. Provide 120-volt control power transformer within switchgear to power receptacle and space heaters.

2.5 BUS BARS AND INTERCONNECTIONS

A. Continuous Current Rating: 1,200 amperes with sufficient cross-section to limit temperature rise at rated current to 65 degrees C.

B. Phase Arrangement: Phases A-B-C, left-to-right, top-to-bottom, and front-to-rear as viewed from switchgear front.

C. Main Bus:

1. Totally enclosed by metal plates.
2. Material: Bar, rounded edge, flat silver-plated copper.
3. Braced and supported on high dielectric BIL-rated glass polyester flame-retardant and track-resistant insulators.
4. Insulate with powered epoxy, applied by fluidized bed process.

D. Ground Bus:

1. Material: Same as main bus.
2. Current Rating: 25 percent of main bus rating.
3. Length: Extend entire width of switchgear.
4. Bolted to ground contact in each breaker compartment and auxiliary section.
5. Pads or terminals at each end for connection to building ground grid as shown.

E. Control Bus:

1. 600-volt insulated copper conductors.
2. Maximum current rating determined by application.
3. Extend from control power source to terminal boards in each unit of grouped lineup.

F. Potential Bus:

1. 600-volt insulated copper conductors.
2. Maximum current rating determined by application.

3. Connected to terminal boards mounted inside enclosure.

G. Bus Bar Connections:

1. Material:
   a. Joints, Splice Plates, and Bar Ends: Silver-plated copper.
   b. High Pressure Line Contacts: Silver-to-silver.
2. Bolts: Steel, with Belleville washers for joints, splice plates, and connections.
3. Insulate bolted connections with preformed, molded, polyvinyl boots held in place with nylon hardware.

2.6 CIRCUIT BREAKERS

A. Type: Vacuum. Interrupter equipped with contact erosion indicators.

B. Rating: 4,760 and 15,000 volts, 60-Hz as applicable.

C. Continuous Current Rating: 1,200 amperes.

D. Interrupting Rating: 40kA for 5kV breakers and 50kA for 15kV breakers.

E. Drawout Type Breaker:

1. Three-pole, single-throw.
2. Electrically charged.
3. Mechanically and electrically trip-free.
4. Position indicator.
5. Operational counter.
6. Auxiliary switches.
7. Primary and secondary devices.
8. Breaker Operation: 120-volt ac close and ac capacitor trip.
9. Primary Contacts:
   a. Breaker mounted stud.
   b. Stationary sockets.
   c. Silver-plated pressure line contacts.
   d. Nonmagnetic, corrosion-resistant leaf springs.
10. Secondary Contacts:
    a. Breaker mounted multiple plug coupler.
    b. Stationary receptacles.
    c. Silver-to-silver contacts.
11. Auxiliary Contacts:
    a. Rated 10 amperes, 120 volts, ac.
    b. One Type “a” contact to indicate CLOSED position.

c. Two Type "b" contacts to indicate OPEN position and trip operation.
d. Provide space for twoadditional Type a-b contacts.

12. Contacts closing speed independent of control voltage and operator.
13. Mechanically interlock to prevent breaker movement to or from operating position when primary contacts are engaged.
14. Breakers of equal rating to be completely interchangeable.

F. Interlocking Scheme Between Selected Breakers: Mechanical key.

2.7 CURRENT TRANSFORMER (CT)

A. Types:

1. Insulated dry indoor.
2. Window type for relaying and ground sensing.
3. Bar type for metering.

B. Transformer accuracy in accordance with IEEE C57.13:

1. Class C20 or greater for relaying.
2. Class 1.2 maximum for imposed burden for metering.

C. Rating: 5 and 15 kV as applicable.

D. Mechanical Rating: Equal to short-time current carrying capability of circuit breakers.

E. Thermal Rating: Maximum 55 degrees rise above 30 degrees C ambient.

F. Size to operate continuously at rated primary current without insulation damage.

G. Identify polarity with standard mark or symbol.

H. Secondary Wiring: Install in conduit and wiring trough.

I. Isolate from adjacent components and circuits by removable insulating or metal barriers.

J. Window type CTs accessible for replacement without removing high voltage insulated connections.

2.8 POTENTIAL TRANSFORMER (PT)

A. Type: Insulated dry, indoor.

B. Rating: 4,200 and 12,470/120-volt, single-phase with 60 and 75kV BIL rating as applicable.

C. Thermal Capacity: Minimum 55 degrees rise above 30 degrees C ambient.

D. Mechanical Rating: Equal to short-time current carrying capability of circuit breaker.

E. Accuracy classification in accordance with IEEE C57.13 for connected burden.

F. Primary Protection: Two, integral mounted current-limiting fuses.

G. Secondary Protection: Single, separately mounted current-limiting fuse.

H. Identify polarity with standard marking or symbols.

I. Mount on drawout carriage installed in separate steel compartment.

J. Primary and secondary terminals to be disconnected and the primary fuses grounded when drawout carriage is in OPEN position.

2.9 TERMINAL BLOCKS

A. Rating: 600 volts, 30-ampere minimum.

B. Type:

1. One-piece barrier with strap screws.
2. Shorting type for current transformer leads.
3. Pull-apart control wiring terminal boards on drawout units.

C. Provide for:

1. Conductors connecting to circuits external to switchgear.
2. Internal circuits crossing shipping splits.
3. Equipment parts requiring replacement and maintenance.

D. Spares: Minimum 20 percent spare unused terminals.

E. Grouped together terminal blocks for external circuit wiring leads.

F. 6-inch minimum space between columns of terminal blocks.

G. Permanently identify each terminal and columns of terminal blocks.

H. Manufacturer and Product: G.E.; Type EB-5, or equivalent

2.10 CONTROL WIRING

A. NFPA 70, Type SIS, single-conductor, Class B, stranded copper, rated 600 volts for control, instrumentation, and power circuits.

B. Individual seven-strand, copper conductors, twisted and covered with a 100 percent aluminum, polyester shield with tinned copper drain wire and overall outer jacket, rated 600 volts, 90 degrees C minimum for transducer output and analog circuits.

C. Conductor Lugs: Preinsulated, self-locking, spade type with reinforced sleeves.

D. Wire Markers: Each wire individually identified with permanent markers at each end.

E. Internal circuit wiring crossing shipping splits to have plug connectors.

F. Splices: Not permitted.

2.11 METERS AND INSTRUMENTS

A. As specified in Section 26 09 13, Power Measurement and Control.

2.12 SURGE PROTECTION – 12KV SERVICE SWITCHGEAR

A. In accordance with IEEE C62.11 and NEMA LA 1.

B. Connect to line side of main power circuit breaker and ground to switchgear ground bus.

C. Class: Intermediate.

D. Rating: 9 kV for 12 kV system.

2.13 SURGE PROTECTION – MAIN SWITCHGEAR

A. In accordance with IEEE C62.11 and NEMA LA 1.

B. Connect to load side of main power circuit breaker and ground to switchgear ground bus.

C. Class: Distribution, rated 3 kV for 4.16kV.

D. Surge capacitors.

E. Current limiting fuses.

2.14 ACCESSORIES

A. One each, manual racking crank.

B. One each, manual spring charging crank.

C. One each, spanner nut wrench for main contact removal or replacement.

D. One set, test plugs, cables, and jumper for drawout relays, meters, and electrically operated circuit breakers.

E. One each, drawout, manual ground and test device.

F. Breaker Handling Equipment:

1. One each, breaker lift device to remove breaker from the switchgear cubicle and to transport the breaker.
2. One each, portable dolly or 5th wheel to transport the breaker while out of the switchgear cubicle.

2.15 KEY INTERLOCKS

A. Mechanical lock cylinder within main and tie breaker compartments.

B. Kirk type keys and lock cylinders.

C. Keys to be captive when breakers are closed.

D. Two main and one tie breaker arrangement.

E. Two keys available for each group of locks.

2.16 MIMIC BUS

A. One-line displaying bus arrangement, circuit protective devices, and branch circuit extensions.

B. Breaker Status Indicating Lights: Push-to-test type, red for breaker closed, green for breaker open.

C. Buses: 3/8-inch wide, with red colored strips.

D. Devices: 3/8-inch wide, with red colored strips.

E. Strips: Self-sticking plastic tape, applied to face of switchgear.

F. Nameplates to identify incoming lines, protective devices, and feeder circuits.

2.17 EQUIPMENT IDENTIFICATION

A. Master Nameplate:

1. Deep etched aluminum with manufacturer's name and model number.
2. Riveted to main vertical section.

B. Section Identification:

1. Engraved metallic, riveted to each vertical section.
2. Serial number, bus rating, and section reference number.
3. Size: Manufacturer's standard.

C. Nameplate:

1. Engraved, phenolic for each circuit breaker cubicle and door mounted device.
2. White with black block type characters.
3. Character Height: 1/4 inch.
4. Size: Manufacturer's standard.
5. Inscriptions: As shown on one-line diagram.
6. Blank plates for future spaces.
7. Attachment Screws: Stainless steel panhead.

D. Cubicle Labels:

1. Nonmetallic, applied inside each cubicle compartment.
2. Device serial number, rating, and description.

E. Metering Instruments: Meter type identified on meterface below pointer or dial.

F. Control Switches: Deep etched, aluminum escutcheon plate.

G. Relays and Devices:

1. Stamped metallic, riveted to instrument case.
2. Manufacturer's name, model number, relay type, and rating data.

H. Switchgear Signs:

1. Two signs each on front and back of switchgear.
2. Size: Manufacturer's standard.
3. Engraved, phenolic.
4. Color: Red with white.
5. Inscription: DANGER/HIGH VOLTAGE/KEEPOUT.
6. Characters: Gothic type, 1 inches high.
7. Attachment: Four rivets each sign.

2.18 FACTORY TESTING

A. Switchgear assembly production tested in accordance with IEEE C37.20.2.

B. Circuit breakers production tested in accordance with IEEE C37.09.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions and recommendations.

B. Secure equipment to floor with anchor bolts of sufficient size and number adequate for specified seismic conditions.

C. Install equipment plumb and in longitudinal alignment with wall.

D. Tighten current-carrying bolted bus connections and enclosure framing and panel bolts to manufacturer's recommendations.

E. Coordinate terminal connections with installation of secondary feeders.

3.2 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. Two person-days for installation assistance and inspection.

2. One person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. One person-day for prestartup classroom or Site training.
4. One person-day for facility startup.
5. One person-day for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Engineer.

B. See Section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Testing, Integration and Startup.

END OF SECTION

SECTION 26 19 00
MEDIUM-VOLTAGE INDUCTION MOTORS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers Association (ABMA).
2. American Petroleum Institute (API):
   a. 541, Form-Wound Squirrel-Cage Induction Motors—500 Horsepower and Larger.
   b. 670, Vibration, Axial Position, and Bearing Temperature Monitoring Systems.
3. Institute of Electrical and Electronics Engineers (IEEE):
   a. 43, Recommended Practice for Testing Insulation Resistance of Rotating Machinery.
   b. 112, Standard Test Procedures for Polyphase Induction Motors and Generators.
4. National Electronics Manufacturers Association (NEMA): MG 1, Motors and Generators.

1.2 DEFINITIONS

A. CT: Current Transformer.

B. IPS RMS: Inches Per Second, Root Mean Squared.

C. PIV: Peak Inverse Voltage.

D. RTD: Resistance temperature detector.

1.3 SUBMITTALS

A. Action Submittals:

1. Submit complete motor data with driven equipment Shop Drawings.
2. Induction motor name and specification number of driven equipment.
3. Rated motor horsepower.
4. Voltage, phase and frequency ratings.
5. Design full load current at rated horsepower for utilization (motor) voltage.
6. Number of poles and full-load speed.
7. Service factor.
8. Power factor at full, 3/4-load and 1/2-load.

9. Locked rotor, pull-up, breakdown, and full-load torque.
10. Guaranteed minimum full-load efficiency, include nominal efficiencies at 1/2-load and 3/4-load.
11. Maximum number of successive cold and hot starts.
12. Code letter for locked-rotor kVA/HP.
13. Locked-rotor inrush in percent of full-load current.
14. Motor thermal performance—hot and cold start curves.
15. Winding insulation class and temperature rise class.
16. Frame size.
17. Enclosure.
18. Motor type/model and dimension drawing. Include motor component weights.
19. Motor terminal box, RTD box, vibration detector box, and space heater box dimensions, location on motor, and wiring.
20. Motor lead termination support insulators.
21. Schematic wiring diagram for motor and for devices such as resistance temperature detectors, vibration sensors, space heaters, as applicable.
22. Bearing Data:
    a. Identify type and manufacturer of antifriction bearings to be installed and thrust bearing to be installed.
    b. Specify proposed bearing insulation materials and methods and recommended bearing lubricant(s).
    c. Bearing protection data including for vertical motors, axial position probes, and resistance temperature detectors, as applicable.
23. Complete lube oil and grease system requirements.
24. Anticipated maximum maintenance weights for rotors and removable housing elements.
25. Assembly clearances; this requirement includes, but is not limited to diametrical bearing clearances, air gap, coupling interference fit to shaft and bearing housing interference fit**.**
26. Shaft radial and axial runout tolerances at various lateral locations.
27. Shaft mass elastic diagram.
28. Motor rotor wk2, and load wk2, as obtained from driven machinery manufacturer.
29. Motor shaft grounding pickup method shall be via readily accessible, spring-loaded contact brush.
30. Instrumentation, including but not limited to, vibration transducers and RTDs. Provide detailed catalog information indicating complete model number derivation and wiring diagrams.
31. Water or oil cooling if required for motor thrust bearings.
32. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Manufacturers shall have qualifying experience in the production of medium voltage Induction motors.
2. Lateral and torsional analysis report.
3. Driven equipment and motor manufacturers' detailed mass elastic data.
4. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
5. Name, address, telephone number, and contact name for factory-trained and authorized service organization representing synchronous motor manufacturer.
6. Written installation, connection, and commissioning instructions for specific motor(s) to be furnished.
7. Factory test results.
8. Component and attachment testing seismic certificate of compliance.
9. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Production Facility: Motor manufacturer shall produce the medium voltage, induction motors at a facility manufacturer owns or operates under its own supervision.

B. Service Organizations: Synchronous motor manufacturer shall have a factory-owned or authorized service organization.

1.5 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of Work specified in this Specification section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. General Electric.
2. TECO-Westinghouse Motor Company.
3. WEG Electric Motors Corp.

2.2 GENERAL

A. Provisions of this Section apply to induction motors larger than 500 hp and rated 2,300 volts through 13,200 volts.

B. Electric motors driving identical machines shall be identical.

C. Maximum motor loading at any point on driven load operating curve shall in no case exceed nameplate horsepower rating, exclusive of service factor and as verified with approved submittal data of driven machinery. Motor shall be required to conform to NEMA standard ratings.

D. Lateral and Torsional Analysis:

1. Driven equipment supplier with system responsibility shall perform a complete lateral and torsional analysis of each distinct equipment-coupling motor system provided on Project.
2. Identify lateral critical(s) plus torsional critical(s) speeds.
3. Produce critical speed maps; no active critical speed shall be allowed within 20 percent of operating speed range.
4. Analysis shall be performed, submitted, reviewed, and approved by Engineer prior to fabrication of machinery.
5. Mass Elastic Data: Used for independent evaluation of lateral and torsional natural frequency analysis. Encroachment by plus or minus 20 percent of any active critical speeds upon operating speed range must be eliminated to satisfaction of Engineer.

E. Motors driven by AFDs shall be rated and labeled as suitable for inverter duty, and rated for continuous operation at 40 degrees C ambient temperature running on AFD output at any frequency from 30 Hz to 60 Hz.

F. Vertical motor dimensions shall conform to the following:

1. Maximum motor height from base plate to top of motor shall not exceed 83 inches.
2. Regardless of the limits on motor dimensions specified herein, all vertical motors and appurtenances shall be configured such that a minimum of 3 feet of horizontal clearance is provided to any adjacent motor or motor appurtenance.

2.3 DESIGN REQUIREMENTS

A. Electric motors shall be in accordance with NEMA MG 1, Part 31. In no case shall locked rotor, pull-up or breakdown torque be less than value specified in NEMA MG 1. Provide inverter-duty rated motor.

B. Motor Voltage Ratings: 4,000 volts, three-phase, 60 Hz, for use on a 4,160-volt (nominal), three-phase, 60-Hz system as indicated.

C. Service Factor: 1.15 sine-wave, 1.0 inverter.

D. Insulation: Furnish motors with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C, and at an altitude of 3,300 feet above sea level, without exceeding Class B temperature rise limits stated in NEMA MG 1-20.8 at rated full load and service factor.

E. Motor Leads and Terminations:

1. Provide three main leads fitted with solderless lug terminals with two holes minimum each.
2. Hole spacing and size shall meet NEMA standards.
3. Leads shall be brought out to main terminal box for all motors.

F. Rotor Bars:

1. Copper or copper alloy; designed to meet starting and accelerating torque characteristics of NEMA MG 1-20.4.3.1 for Variable Torque Linear applications.
2. Select materials and processes used for fabricated rotor bars to minimize hydrogen embrittlement.
3. Size to assure tight bar construction to eliminate bar vibration.
4. Replaceable without damage to air passages or laminations.

G. Stator:

1. Iron laminations shall utilize C5 core-plate minimum, on both sides, capable of withstanding 1,400 degrees F without deterioration.
2. Brace and support to eliminate any detrimental winding movement.

H. Shafts:

1. Material: Hot-rolled C1045, minimum.
2. Stiff-shaft design.
3. Shaft Dimensions: Manufacturer's standard.
4. Provide extended shaft, tapered shaft, double shaft, or short shaft as required.

5. Permanently mark shaft on drive end and indicate magnetic center with a pointed indicator mounted off drive-end bearing cap.
6. Include reference measurement to locate magnetic center in the event of a broken pointer on motor outline drawing.
7. Provide drive shaft extension with open-ended keyway and key.

I. Torque:

1. Motor manufacturer shall review start-up load curve for driven equipment to determine minimum motor capabilities for locked-rotor torque, pull-up torque, and breakdown torque.
2. Motor speed-torque curve shall exceed driven equipment speed-torque curve by a minimum margin of 10 percent at all points from zero speed to pull-up speed.
3. Motor shall also be able to start and accelerate, to rated-speed of driven equipment during a 20 percent under-voltage or reduced voltage start condition.

J. wk^2:

1. Motors shall be capable of accelerating driven equipment without excessive temperature rises.
2. Approximate total load wk^2 of the combined driver/load is given in Section 43 23 15 of Specifications.

K. Number of Starts: Each motor shall be capable of two successive cold starts or one hot start according to NEMA MG 1.

L. Power Factor: 0.95 minimum, combined for VFD and motor.

M. Motor Efficiency:

1. Guaranteed Minimum Efficiency**:** 95.0% at full load.
2. Stamp nameplate with tested efficiency.
3. In accordance with IEEE 112.

N. Capable of operating at 120 percent of full-speed in reverse rotation direction, with no power applied to motor.

O. Starting: Motors shall be suitable for full-voltage starting.

P. Enclosures:

1. Mechanical protection and method of ventilation or cooling as listed below and as defined in NEMA MG 1-25 for Open Machines and NEMA MG 1-26 for Totally Enclosed Machines.
2. Open Drip-Proof, Guarded (ODPG):

a. Check spaces, dimensions, and arrangement to ensure heat exhaust of one motor is not fed as air intake to an adjacent motor.
b. Provide removable, antirodent type, screens fabricated from stainless steel expanded metal or SST wire mesh.

3. Cooling Air:
   a. Internal cooling air shall circulate from end(s) of motor towards center of rotor and stator lamination stacks, then through vents in rotor and stator laminations (symmetrical cooling) to exhaust openings.
   b. Internal air shall circulate through rotor and stator in a symmetrical manner to minimize hotspots.
4. Hardware: Stainless steel hardware for screens and associated fasteners.
5. Provide openings in stator endplates with access covers for checking motor air gap.

2.4 ACCESSORIES

A. Connection Box:

1. Cast or fabricated steel connection box.
2. Fabricated steel connection boxes shall have hinged covers secured by knurled screws.
3. Gasketed and provisions for grounding.

B. Main Terminal Boxes:

1. Size:
   a. For three main leads, incoming cable glands, and accessories.
   b. To accommodate components and accept power supply conductors, all per NEMA requirements.
2. Construction comparable with degree of enclosure indicated for motor itself.
3. Allot space for mounting of auxiliary devices such as stress cones.

C. Equipment Grounding Lugs: Provide within main terminal box, suitable to terminate equipment ground wire, sized as indicated. Ground path shall be direct to stator frame.

D. Auxiliary Terminal Boxes:

1. Provide separate boxes for termination of space heaters, stator and bearing RTD or thermocouple leads, vibration probe leads, and other factory-mounted instrumentation.
2. Space heater terminations shall be in a terminal box that is separate from control signal terminations.
3. Wire devices to auxiliary terminal boxes and terminate on suitable terminal blocks.

E. Space Heaters:

1. Provide to keep motor windings at least 5 degrees C to 10 degrees C above dew point during de-energized conditions.
2. Grid type in base of stator with easy access for maintenance.
3. Rated for 240V ac, single-phase power, but suitable for use on 120V ac, single-phase power.
4. Prewired to terminal junction box mounted on motor.
5. Provide warning label on space heater junction box and motor indicating space heater wiring is energized when motor is not running.

F. Equipment Identification Plates: Provide 16-gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component in a readily visible location. Plate shall bear 1/4-inch high engraved or die-stamped block type black enamel filled equipment identification number and letters indicated in this Specification and as shown.

G. Frame Grounding Pads: Provide two stainless steel faced grounding pads and locate on opposite sides of motor frame diagonally apart. Grounding pads shall feature a tapped 1/2-inch national coarse (NC) thread drilling into motor frame.

H. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.

2.5 MOTOR BEARINGS

A. Bearings shall conform to provisions of driven equipment Specification, except as supplemented or modified by requirements of this Specification. Antifriction bearings shall be used for vertical machines provided the following conditions are met:

1. dN factor is less than 300,000.
2. Antifriction bearings meet ABMA L10 rating life of 100,000 hours with continuous operation at rated conditions or 50,000 hours at maximum axial and radial loads and rated speed.
3. Antifriction thrust bearings for vertical machines shall be rated for ABMA L10 life of 5,000 hours.

B. Vertical Motor Thrust Bearings:

1. Provide plate type, load-equalizing, thrust bearings located in oil reservoir at top of motor frame. Bearings shall be Kingsbury, Renk, or Waukesha.
2. Bearing Capacity: Rated for weight of pump motor rotating assembly plus maximum hydraulic down-thrust developed by pump. Capable of

operating at this rating in either direction of rotation up to runaway speed.

3. Up-thrust Capacity: As required for any operating condition.
4. Oil Lubrication System:
    a. Self-contained and self-circulating.
    b. Oil Reservoir:
        1) Cooling Coils:
            a) Sized to maintain a 40 degrees C, maximum, oil temperature rise.
            b) 90/10 Cu-Ni tube.
            c) Design for 30 degrees C, inlet water at 50 psig, and 0.001 fouling factor.
            d) 90/10 Cu-Ni threaded pipe connections.
        2) Contain an RTD to sense oil temperature.
        3) Water-cooling shall only be used with approval of Engineer.
5. Provide oil level sight glass, and threaded oil fill and drain plugs.
6. High Pressure Lift System:
    a. Provide where required to pressurize thrust bearing at startup and shutdown to reduce starting torque and minimize bearing wear.
    b. Mount oil pump, circulating piping and associated components on motor.
    c. Energize prior to motor start and stop end run for an adjustable time period.
    d. Operation of pumping unit without lift system shall not damage thrust bearing.
    e. Oil Pump: Three-phase, 460-volt, 60-Hz, no greater than 3 hp.
7. Thrust Bearing Temperature Elements:
    a. Provide each bearing with two 100-ohm platinum RTD each which shall be prewired to a terminal junction box mounted on motor.
    b. Elements shall be installed in two opposite thrust shoes of thrust bearing.
    c. Metal of bearings and mountings shall be drilled, milled, and tapped to place element at hottest points of bearings and within 1/16 inch of bearing metal.

C. Vertical Motor Guide Bearings:

1. Upper Guide Bearing: Sleeve type lubricated by oil in reservoir for thrust bearing.

2. Lower Guide Bearing: Split sleeve type with oil reservoir, oil level sight glass, and threaded oil fill and drain plugs. Lubrication system shall be self-contained and self-circulating.

3. Upper and lower bearings shall have spring-loaded RTDs to sense bearing metal temperature.

D. Hydrodynamic Radial Bearing Temperature: 93 degrees C, maximum.

E. Bearing Insulation: Electrically insulated in a manner to prevent circulating currents from passing through bearing surfaces. Provide grounding device in bearing housing on drive end.

2.6 VIBRATION MONITORING

A. Provide transducers and cables for each medium voltage induction motor, for installation into the vibration monitoring panel. See Section 26 09 13.

B. Vibration Transducers:

1. Timing Transducer:
   a. Consisting of a Bently Nevada Corporation Proximity Probe, calibrated extension cable, and Proximitor Sensor.
   b. Provide Keyphasor timing probe for motors; Bently Nevada Corporation Series 3300 XL 8mm radial Proximity Probe similar to radial vibration transducers permanently installed by motor manufacturer. Probe shall contain a minimum 8-millimeter tip diameter mounted in a 0.375-inch by 24 threads per inch stainless body.
   c. Proximitor Sensor: Bently Nevada Corporation Series 3300 XL Proximitor Sensor, linear range from 10 mils to 90 mils, plus or minus 6.5 percent accuracy.
   d. Cable: Bently Nevada Corporation Series 3300 XL Extension Cable, 75 Ω, 69.9 pF/m shielded, triaxial.
   e. Elements shall be fully protected in sealed weatherproof conduit and housings.
2. Radial Shaft Vibration Transducers:
   a. Each transducer shall consist of a Bently Nevada Corporation Series 3300 XL 8mm Proximity Probe, calibrated extension cable, and Proximitor Sensor.
   b. Provide permanently installed radial shaft displacement proximity probes on motors with sleeve bearings.
   c. Use Orthogonal X-Y Bently Nevada Corporation Series 3300 XL Proximity Probes at each radial bearing housing.
   d. Mount probes at plus or minus 45 degrees from true vertical centerline.
   e. Probes to contain a minimum 8-millimeter tip diameter mounted in a 0.375-inch by 24 threads per inch stainless steel body.
   f. Proximitor Sensor: Bently Nevada Corporation Series 3300 XL Proximitor Sensor, linear range from 10 mils to 90 mils, plus or minus 6.5 percent accuracy.
   g. Cable: Bently Nevada Corporation Series 3300 XL Extension Cable, 75 Ω, 69.9 pF/m shielded, triaxial.

h. Elements shall be fully protected in sealed weatherproof conduit and housings.

3. Bearing Housing Velocity Transducers:
   a. Use antifriction bearings and bearing housing velocity transducers permanently installed by motor manufacturer.
   b. Locate transducers at each bearing, measuring in axial, horizontal direction.
   c. Minimum rated operating frequency shall be less than minimum motor operating speed.
   d. Vibration element shall include shielded signal cable and enclosed in a NEMA 4X housing.
   e. Manufacturer and Product: Bently Nevada Corporation; Velomitor, piezo-velocity sensor.
4. Thrust Position Transducer:
   a. Each transducer shall consist of a Bently Nevada Corporation Series 3300 XL 8mm Proximity Probe, calibrated extension cable, and Proximitor Sensor.
   b. Use vertical synchronous motors, permanently installed axial shaft displacement proximity probes.
   c. Probes shall observe thrust collar or top end of shaft.
   d. Probes shall contain a minimum 8-millimeter tip diameter mounted in a 0.375-inch by 24 threads per inch stainless steel body.
   e. Proximitor Sensor: Bently Nevada Corporation Series 3300 XL Proximitor Sensor, linear range from 10 mils to 90 mils, plus or minus 6.5 percent accuracy.
   f. Cable: Bently Nevada Corporation Series 3300 XL Extension Cable, 75 Ω, 69.9 pF/m shielded, triaxial.
   g. Elements external to motor enclosure shall be fully protected in sealed weatherproof conduit and housings.
   h. Manufacturer and Product: Bently Nevada Corporation; Series 3300 series probes or latest model at each thrust bearing.
5. Motor Casing Velocity Transducers:
   a. For vertical motors over 250 horsepower, permanently installed velocity transducers.
   b. Each element shall be a velocity transducer with a velocity output in IPS RMS.
   c. Minimum rated operating frequency shall be less than minimum pump operating speed.
   d. Vibration element shall include shielded signal cable and enclosed in NEMA 4X housing.
6. Vibration transducer and timing transducer shall be prewired to terminal junction box mounted on motor.
7. Provide cables with transducers or as required by manufacturer.

2.7 MOTOR TEMPERATURE DETECTION

A. RTDs:

1. 100 ohm, 3 wire, platinum, and prewired to terminal junction box mounted on motor base.
2. Provide two bearing RTDs (one per bearing) and six stator winding RTDs (two per phase).
3. For motors with thrust bearings, provide two RTDs per thrust bearing.
4. For water-cooled motors, provide one air circuit RTD.

2.8 FACTORY TESTING

A. General:

1. Factory test motors in conformance with IEEE 112, IEEE 43, and NEMA MG 1.
2. Notify Engineer a minimum of 5 weeks prior to test.
3. No equipment shall be shipped until Engineer has approved test data.
4. Witnessed by Engineer and Owner's Representative.
5. Acceptance:
   a. In the event motor fails to meet above requirements or efficiencies make necessary modifications, repairs, or replace entire motor.
   b. Retest motor until found satisfactory.
6. Test Reports:
   a. Include documentation and results.
   b. Indicate test procedure and instrumentation used to measure and record data.
   c. Certified, signed, and dated by motor manufacturer's test personnel and responsible engineers.

B. Tests:

1. Routine:
   a. Measurement of winding resistance.
   b. No-load motoring readings of current, power, and speed at rated voltage and frequency.
   c. Measure and record air gap during assembly.
   d. Visually inspect bearing and bearing insulation.
   e. High potential test in accordance with NEMA MG 1-20.17.
2. Surge: Test stator coils individually after insertion into stator core, but prior to coil-to-coil connection, to ensure no turn-to-turn shorts. Repeat surge test after coil-to-coil connections are complete.
3. High Potential: High pot stator coils individually after insertion into stator core, but prior to coil-to-coil connection, to ensure no turn-to-turn shorts. Repeat high potential test after all coil-to-coil connections are complete.

4. Efficiency and Loss: Use any IEEE 112 Method B only. Included the following in determining efficiency per NEMA MG 1–20.21.
    a. Stator I^2R.
    b. Rotor I^2R.
    c. Core loss.
    d. Stray load losses.
    e. Friction and windage loss.
5. Phase Rotation:
    a. Apply phase sequence as called for on outline drawing and check for correct direction of rotation.
    b. Record direction of rotation and phase sequence.
6. Temperature:
    a. Perform heat run tests on motors via embedded detector, using either of the IEEE 112 8.2.3 methods of loading.
    b. Record stator and bearing temperatures every 30 minutes until machine reaches constant temperature.
    c. Determine temperature rise for service factor loading.
7. Blocked Rotor Test: With rotor blocked, take the following readings at highest voltage possible: line voltage, current, kW, torque, and induced field current.
8. Noise:
    a. In accordance with NEMA MG 1, Part 9.
    b. Mean A-weighted sound pressure level measured at one meter from major machine surface shall not exceed 85 dB (A) with motor operating at no-load, and rated frequency and voltage applied.
9. Vibration:
    a. Radial Shaft at Full Operating Speed: 2.0 mils peak-to-peak, maximum.
    b. Take vibration data at cold and hot operating conditions, at no-load during factory testing.
    c. Transient Shaft Vibration: 3.5 mils peak-to-peak, maximum, throughout normal startup and shutdown speed range.
    d. Values shall include shaft surface runout sensed by probes.
    e. Bearing Housing Vibration:
        1) At full operating speed shall be 0.15 inches per second (RMS), maximum.
        2) Take vibration data at cold and hot conditions, at no-load.
        3) Transient Vibration: 0.5 IPS RMS, maximum, throughout normal startup and shutdown speed range.
    f. Vibration Frequency:
        1) Record during vibration testing at cold and hot conditions.
        2) Record frequencies up to seven times line frequency.
        3) When operated uncoupled at rated speed, machinery shall not exhibit unusual or abnormal frequency components on either shaft or casing vibration measurements.

4) Normal frequency components are defined as excitations such as rotational speed, synchronous and multiples of synchronous frequency, or blade passing frequency that are inherent with mechanical construction of machinery.
5) Unusual or abnormal frequency components are excitations that are nonsynchronous or not related to known geometry of machinery.

10. Starting Characteristics: Determine speed-torque characteristics using any of the four IEEE 112-7.3.2 recommended methods.
11. Final Factory AC High Potential Test:
    a. Perform after above tests are completed to assure no damage to insulation during setup and testing.
    b. Apply 1,000 volts plus twice rated machine voltage across stator insulation and 2,500 volts across rotor insulation for one minute, per NEMA MG 1, Part 3.
12. Final Insulation Resistance: Take reading of armature insulation with mega-ohmmeter for one minute after high potential test has been completed.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with motor manufacturer's written recommendations and written requirements of manufacturer of driven equipment.

B. Perform electrical work involving connections, controls, and switches in accordance with the applicable Sections of Division 26.

3.2 FIELD TESTING

A. Functional Tests: Perform the following prior to connection to driven equipment:

1. Check electrical supply at motor feeder cable terminations for any deviation from rated voltage, phase, or frequency.
2. Visually inspect motor mounting and coupling to driven equipment.
3. Visually check for proper phase and ground connections. Verify multi-voltage motors are connected for proper voltage.
4. Test insulation of all winding and bearing temperature detectors and space heaters.
5. Bump motor to test for proper rotation.
6. Test motor insulation in accordance with NEMA MG 1.
7. Take vibration data at no-load and maximum available load.
   Test motors for proper noise, temperature, and vibratory behavior following no less than 4 hours at maximum available load and full operating speed. Noise and vibration limits used for factory testing with

temporary machinery support shall also be applicable to field testing condition with proper rigid support structure below machinery.

END OF SECTION

SECTION 26 19 23
MEDIUM-VOLTAGE ADJUSTABLE FREQUENCY DRIVE SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. The Sub-supplier shall provide five 1,500 hp, air-cooled, active front end (AFE), pulse width modulated (PWM) variable frequency drive (VFD) units, designed, manufactured, assembled and tested to operate and be fully compatible with the specified induction motors and pumps. Each VFD shall power two 750 hp induction pump motors and operate both at same speed with same VFD output. Each VFD shall consist of an integral lineup of all the components listed herein and shall not exceed 236 inches wide, 50 inches deep, and 120 inches high (assembled). The VFD shipping height shall not exceed 104 inches. Liquid-cooled VFDs will be considered provided they are supplied with the liquid-to-air heat exchanger as an integral part of the VFD and require no external cooling water or air connection other than those described herein. The dimensions of the VFD and integral heat exchanger, including any required clearance between the two shall not exceed the above dimensions, no exceptions.

B. The variable frequency drives shall be furnished by the Supplier, as specified in Section 43 23 15, for unit responsibility.

C. Each variable frequency drive shall be manufactured, assembled and tested by the Sub-supplier at a facility owned or operated by the Sub-supplier, and under its direct supervision and control.

D. The Supplier shall coordinate and provide for all requirements and features of the induction motor with the VFD Sub-supplier.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards:
   1. American National Standards Institute/National Fire Protection Association (ANSI/NFPA): 70, National Electrical Code (NEC).
   2. Institute of Electrical and Electronics Engineers (IEEE): 519, Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems.
   3. National Electrical Manufacturers Association (NEMA): ICS 7, Industrial Control and System – Adjustable Speed Drives.
   4. Underwriters Laboratories (UL):
      a. 347 High Voltage Industrial Control Equipment

b. 347A Medium Voltage Power Conversion Equipment Preliminary Standard

1.3 SUBMITTALS

A. Action Submittals:

1. Preliminary harmonic analysis described in Article 2.2, Paragraph C, Item 2, Subitem b.
2. Record of calculations and measurements per Article 2.2, Paragraph C, Item 1 for VFD efficiencies at 60 and 100 percent speed.
3. Maximum continuous current and fault current withstand ratings of drive.
4. Complete outline description of proposed factory test procedure and sketch of test setup.
5. Harmonic analysis and results.
6. VFD output pulse maximum peak voltage, pulse rise time and pulse rate of rise. Include motor Sub-supplier certification that motor insulation shall operate continuously from the VFD output waveform throughout the specified speed range without overheating.
7. Complete system rating, including all nameplate data, continuous operation load capability throughout speed range of 10 percent to 100 percent rated speed.
8. Complete unit lineup dimensional drawings, weight, and information on size and location of space for incoming and outgoing power and control cables or conduit.
9. Maximum heat dissipation from enclosure, exhaust air flow requirements, location and dimensions of exhaust duct interface opening(s).
10. Layout of controller section face showing pushbuttons, switches, instruments, indicating lights, HMI display unit, etc.
11. Complete system operating description.
12. Complete system schematic (elementary) wiring diagrams, single and three line diagrams.
13. Complete system interconnection diagrams between controller, drive motor, pump, and all related components or controls external to system, including wire numbers and terminal board point identification.
14. One-line diagram of system, including component ratings.
15. Description of diagnostic features being provided.
16. Descriptive literature for all control devices such as relays, timers, etc.
17. Itemized bill-of-materials listing all system components.
18. Description of PLC, HMI, and motor protection relay being furnished, including a description of the equipment, installation, setup, and operations manuals.
19. Annotated and cross-referenced PLC and HMI program printout.

B. Informational Submittals:

1. Listing of references.

2. Operations and Maintenance Data per Section 01 78 23, Operation and Maintenance Data.
3. Warranty: The VFD warranty shall be per the General Conditions and shall include all costs for repair, parts, labor, and travel and living expenses for service technician.
4. List of spare parts: A complete list of recommended spare parts. Include item descriptions, recommended quantities, and unit costs. The recommended list should be based on a maintenance plan where the Owner will remove and replace failed items to the lowest replaceable module/component level.
5. Test Reports: Provide copies in triplicate of the required factory testing. Reports shall be certified by the VFD test technician.

1.4 EXTRA MATERIALS

A. Spare Parts: Furnish the following spare parts for each VFD:
1. Two power modules (Cells) or 20 percent, whichever is greater, with accompanying printed circuit boards.
2. Five spare LEDs of each type used.
3. Three spare fuses of each type used.
4. Two spare control relays of each type used.
5. Two spare sets of all replacement air filters.
6. One hoisting mechanism for removal and replacement of cells, if required.

1.5 QUALITY ASSURANCE

A. All inspection and testing procedures shall be developed and controlled under the guidelines of the supplier's quality system and must be registered to ISO 9001 and regularly reviewed and audited by a third party registrar.

B. The VFD shall be factory pre-wired, assembled and tested as a complete package.

C. The VFD manufacturer shall:
1. Have experience in the manufacture of medium voltage variable frequency drives for use in similar applications at the specified voltage and power ratings. A user list, complete with contact names and telephone numbers, shall be furnished upon request.
2. Have a record of service and own and operated factory-trained and authorized service facilities located within the United States. Support personnel shall be direct employees of the manufacturer.

1.6 SERVICES OF MANUFACTURER

A. Services of the manufacturer shall be provided as follows:

1. Inspection, startup and field adjustment: An authorized service representative of the manufacturer shall visit the site for not less than one day per drive system to check the installation, supervise start-up, and supervise testing and adjustment of VFDs.
2. Instruction of Owner's personnel: The authorized service representative shall instruct the Owner's personnel in the skills required for each Trade Group indicated and the duration indicated. This includes all aspects of drive operation and maintenance, including step-by-step troubleshooting procedures with necessary test equipment. Instruction of the Owner's personnel shall be conducted separate from the start-up and testing activities. Each of the Owners Trade Groups will be instructed individually, and no more than six hours will be scheduled in one day. Duration of instruction are:

Trade Group	**Class Hours**	**Field Hours**
Electricians and Electronics Technicians	4	4
Operations and Plant Maintenance Technicians	4	4

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Products of the type or model number indicated shall be manufactured by one of the following:
   1. TMEIC Corporation.
   2. ABB Automation, Inc.
   3. General Electric
   4. Rockwell Automation/Allen-Bradley.
   5. Eaton
   6. Or equal.

2.2 VARIABLE FREQUENCY DRIVES

A. General:
   1. Number of Drive Units: 5.
   2. Driven Equipment: Vertical Pump driven by an induction motor.
   3. Input Voltage: 4,160 volts, three-phase, 60-Hz.
   4. Drive Output Voltage: 0 to 4,160 volts (4,000-volt motor).

B. Service Conditions: The VFD shall be designed, manufactured, assembled and tested to operate within the following service conditions:
   1. Elevation: 0 feet to 3,300 feet, msl.
   2. Ambient Temperature Range: 0 degrees C to 40 degrees C.
   3. Atmosphere: Noncondensing relative humidity to 95 percent.
   4. AC Line Voltage Variation: Minus 5 percent to plus 10 percent.
   5. AC Line Frequency Variation: Plus or minus 3-Hz.

C. Operating Conditions:
   1. Minimum guaranteed VFD system efficiency shall be 95 percent at 100 percent speed and 100 percent torque and 87 percent at 60 percent speed based on nominal 1200-rpm motor with load horsepower to vary as the cube of speed. The measured VFD system efficiency shall include the active front end filter, VFD power section, all auxiliary cooling systems and output filter. The overall VFD system efficiency may be calculated based on measured VFD efficiency and calculated impact of 480 volt auxiliary loads.
   2. Total harmonic distortion with filtration shall be not more than five percent for voltage and as listed in table below for current as measured on the 4,160-volt bus at the 01-MSG-01 main switchgear (point of common coupling) in accordance with IEEE 519. Harmonic distortion shall also be calculated and measured when two, three and four VFDs are operating at full load.

Table 1	
Individual Harmonic Order (Odd Harmonics)	Harmonic Current Distortion Percent of Max. Demand Load Current I_L
h < 11	4.0
11 < h < 17	2.0
17 < h < 23	1.5
23 < h < 35	0.6
35 < h	0.3
Total Demand Distortion (TDD)	5.0

      a. The short circuit current at point of common coupling under utility operation will be 20,000-amps, rms at 4.16-kV, three-phase. This value shall be used in the harmonic calculations.
      b. A preliminary harmonic analysis shall be submitted which includes all voltage and current harmonics up to the 49th calculated with four VFDs operating at full load rating.
      c. Compliance will be verified with onsite field measurements of both the voltage and current harmonic distortion at the defined point of common coupling with (to measure the harmonic

contribution of the VFDs) and without (to measure the background harmonics) the VFDs operating.

d. The VFD shall not produce harmonics within the operating speed range that will excite the motor resulting in excessive vibration.

3. The VFD shall at no time experience any overcurrent during start-up and at any time while operating. All components shall be properly sized to avoid any premature VFD break down.
4. The maximum audible noise from the VFD shall comply with OSHA Standard 3074, Hearing Conservation, which limits noise level to 85 dB(A) at a distance of one meter from the front of the equipment (with doors closed at any speed or load condition).

2.3 GENERAL

A. VFD shall consist of the following:
1. Primary power cable termination section.
2. Medium voltage surge arresters.
3. Input disconnect switch.
4. Isolation contactor.
5. Active front end rectifier (PWM converter).
6. DC bus link with reactors (if required).
7. PWM output inverter.
8. Control logic section.
9. Motor protection relays for each motor powered from the VFD.
10. Output filter (if required to limit the output dv/dt to a value less than the voltage rating of the motor insulation).
11. Motor heater control.
12. Panel shall contain motor protection relays, auxiliary power sources, human-machine interface (HMI), and a programmable logic controller (PLC). VFD shall be capable of orderly shutdown and 3 seconds power dip ride through without the use of a UPS.
13. All components listed shall be integral to the VFD lineup, factory wired and tested as a complete system.

B. The motor shall be a squirrel cage inverter duty induction design in accordance with Section 26 19 00. The VFD shall be designed such that no component shall overheat and fail during start-up and shutdown and during prolonged and continuous operation of the pump. The VFD shall be rated for continuous operation at motor nameplate FLA and at no less than 110 percent of the nameplate FLA for 60 seconds for the actual motor being supplied, and 100 percent speed.

C. Construction:
1. The input section shall contain a suitably rated, load-break disconnect switch with current-limiting, solid material power fuses, interlocked with

the door. For safety, blade position shall be visible through the door. Interlock shall be provided with a defeater. The fused switch shall have a minimum short circuit interrupting capacity of 50-kA rms symmetrical. Incoming medium voltage cable terminations shall be located in this section and shall be suitable for bottom entry. NEMA 2-hole drilled bus termination pads shall be available to terminate power cables. Termination points higher than three feet above the floor shall require extra incoming cable support to maintain spacing and short-circuit withstand capability.

2. Each VFD shall be supplied with an active front end (AFE) rectifier. The VFD system shall have an AFE rectifier to ensure dramatically lower line-side harmonics and near-unity power factor. Symmetrical Gate Commutated Thyristers (SGCTs) or Insulated Gate Bipolar Transistors (IGBTs) shall be used in the rectifier.
3. The output of the converter shall feed a dc link. dc link reactors shall be provided in positive and negative busses if required. The output of the converter/inductor combination current source shall be regulated and limited. The converter shall be sufficiently fast and effective to protect against a sudden or random application of a short circuit to the output terminals.
4. The PWM inverter section shall utilize the same SGCT or IGBT devices as the converter and invert the dc power of the current source to adjustable frequency power to the motors. The VFD shall not induce excessive power losses in the motors. The worst case rms motor line current measured at rated speed, torque, and voltage shall not exceed 1.03 times the rated rms motor current for pure sine wave operation. Voltage waveform dV/dt applied to motor shall not produce standing waves or overvoltage conditions requiring nonstandard motor insulation systems or ratings above the VFD output voltage rating. VFD output waveform shall be suitable for operating a squirrel cage induction motor without derating or requiring additional service factor for motor cable distances that may exceed 500 feet. VFD output waveforms shall be coordinated with motor design to allow motor to operate within all specified temperature limits between 10 percent and 100 percent speed regardless of loading. If an additional dv/dt or sinewave filter is required, it shall be included within the VFD.
5. The VFD output shall produce no electrically induced pulsating torques to the output shaft of the mechanical system, eliminating the possibility of exciting a resonance caused by VFD-induced torque pulsations. The VFD Sub-supplier shall supply all data required by the Supplier to perform the torsional analysis. The VFD shall not cause micro-pitting of the motor shaft.
6. The control logic section shall be fully digital and not require analog adjustment pots or fixed selector resistors.

7. Fault log data storage memory shall be powered from a rechargeable source furnished with the VFD and with at least a 6-day capability or shall be nonvolatile EEPROM memory.
8. Medium voltage cables and components shall be isolated in separate compartments from the low voltage components. Sufficient space for power cable entry and termination shall be provided, all in accordance with NEC requirements.
9. VFD control power shall be from a separate external 480-volt, three-phase, 20-amp circuit. Provide a red nameplate "Warning, VFD has two sources of power: 4160V from 010MSG-01 breaker #X and 480V from Panel PP1-X,X,X". Provide fused 120-volt control transformer for control power requirements of the VFD.
10. The VFD inverter and rectifier devices shall be capable of being replaced within thirty minutes by a single plant technician without the need for any special tools or devices.

D. Basic Features: The VFD controller shall have the following basic features:
1. Speed Profile: Individual adjustable settings for start, stop, entry, slope, and minimum and maximum speed points. The maximum and minimum speed set points for each VFD shall be preset to the values specified in Section 43 23 15. Drives shall include "Critical Frequency Avoidance" logic. Initial acceleration setting shall be from zero to minimum speed in 15 seconds, and from minimum to maximum speed at a rate of no more than a flow increase rate of cfs per minute. The deceleration rate shall be no more than a flow decrease rate of cfs per minute.
2. Provide for an external 4 mA to 20 mA dc speed reference input signal. Provide a signal current isolator to ensure signal and galvanic isolation of the grounded or ungrounded input speed reference signal.
3. Status and alarm outputs each shall be SPDT electrically isolated auxiliary contacts rated 5 amps at 120V ac, 60-Hz.
    a. Alarm outputs shall consist of two separate outputs; VFD fault, and motor fault, which shall be wired together into a common "FAIL" alarm output for each fault. VFD fault outputs shall be activated by any of the following, as a minimum and shall be displayed on the operator terminal on the door of the VFD:
        1) Output or input under-voltage or over-voltage.
        2) Power unit over-temperature.
        3) Instantaneous overcurrent.
        4) Commutation failure (if applicable).
        5) Input power loss of phase.
        6) VFD output short circuit.
        7) Control power failure.

4. Motor fault outputs shall be activated by any of the following as a minimum and shall be displayed on the operator terminal on the door of the VFD:
    a. Motor short circuit.
    b. Motor overload.
    c. Motor ground fault.
    d. Motor over voltage.
    e. Motor over frequency.
    f. Motor phase reversal.
    g. Motor current unbalance.
5. Separate pump/motor high vibration shutdown input contacts from the remote vibration monitoring panel shall cause a normal VFD vibration shutdown and output to the PCM.
6. Separate temperature alarm outputs shall be provided for each pump/motor powered by the VFD and shall be displayed on the operator terminal or motor protection relay on the door of the VFD. Temperature alarm outputs shall include:
    a. Motor winding high temperature.
    b. Motor or pump bearing high temperature.
7. VFD and motor failure alarms shall normally latch in the trip mode and shall require an operator intervention to reset the alarms. An exception to this requirement are utility overvoltage, undervoltage or voltage failure alarms. These alarms shall automatically reset at the motor control and allow the operator to manually restart the pump after an adjustable 0-minute to 60-minute delay period after the alarm occurs and resets. If the alarm condition still exists, the pump shall not restart.
8. Normal and emergency shutdown contacts, each consisting of a remote contact closure rated 5-amp at 120V ac maximum shall be inputs to the VFD.
9. Provide the opening of the normal shutdown input contact via either the local panel mounted switch or through the PCM. Opening shall cause the motor speed to ramp down to zero speed by a controlled deceleration.
10. Provide opening of the emergency shutdown input contact, via either the local panel mounted switch or remote E-stop. Opening shall cause the VFD to be immediately de-energized. The motor shall continue to spin forward dissipating its inertia until the motor comes to a complete stop. The check valve shall completely close as the flow reverses.
11. Startup of the VFD shall be accomplished by the following procedure:
    a. The operator shall manually reset any alarms or failures pertaining to the VFD control system. Each pump shall be started locally at the VFD panel. When the HAND/OFF/REMOTE (H/O/R) selector switch, located on the local VFD panel, is selected to the HAND position and the operator activates the local START pushbutton, the pump VFD start sequence shall begin. A run permissive must

then be received from the Pump Station Master PLC. This permissive shall allow that VFD to be capable of starting. The pump shall start and begin to automatically ramp up to the minimum speed. If a low system differential pressure is sensed at the Pump Station Master PLC, a second control signal requiring throttling of the pump control valve will be sent to the VFD PLC. If this second control signal is received, the VFD PLC shall reference a preset differential pressure set point (30-feet of pressure) for the differential pressure controller of the pump control valve. The pump control valve shall open normally, except it will throttle its position to maintain a minimum of 30-feet of differential pressure across the pump control valve. As the pump control valve moves to its differential pressure set point, the pump VFD shall ramp up to maintain the flow set point provided by the Pump Station Master PLC. If two pumps are brought on-line with a required throttling signal from the Master PLC, the differential pressure set point across the pump control valves shall be 20-feet. If the low system differential head permissive is not required, the pump control valve differential pressure set point shall be 0 feet of differential, which shall move the pump control valve to a fully open position. Each pump shall be started manually, one at a time, in the MANUAL mode.

b. The speed of the pump shall be adjusted manually at the VFD panel when the MANUAL/REMOTE speed control selector switch is in the MANUAL position.

c. The pump can be manually shutdown, in a normal condition, by the operator pushing the STOP pushbutton, located on the VFD panel or by selecting the OFF position on the H/O/R switch. The pump shall ramp down to minimum speed and then shutdown.

d. In the event an emergency occurs, the pumps shall be shutdown by placing the EMERGENCY STOP mushroom style pushbutton switch, located on the local VFD panel, in the depressed position. The appropriate pumps shall immediately power down. The motors shall continue to spin forward dissipating its inertia until the motors come to a complete stop. The check valve shall completely close as the flow in the pump discharge line reverses.

e. The pump can be started remotely from the workstations by selecting the REMOTE position on the H/O/R selector switch. The PCM will provide a normally-open start contact to start the VFD. Upon closure of the contact, the VFD shall ramp up to minimum speed and then adjust output speed corresponding to the 4-20mA speed command input from the PCM.

12. Provide adjustable minimum to maximum frequency limits of 6-Hz to 60-Hz. The VFD shall be provided with a frequency limit stop to insure that the motor horsepower is not exceeded.
13. Provide independent, timed linear acceleration and deceleration functions, adjustable from 360 seconds to 700 seconds.
14. Provide terminal blocks for wires entering and leaving the VFD unit. Terminals shall be identified with alpha-numeric characters identical to the terminal identifiers indicated on the schematic and connection diagrams.
15. Provide drive control circuitry to energize both motor space heaters from an internally generated 120 volt power source whenever the motors are not running.
16. Frequency regulator shall operate within the following tolerances:
    a. Frequency regulator span shall be 4 mA at minimum speed and 20 mA at maximum speed.
    b. Frequency regulator accuracy shall be within 1.0 percent of span.
    c. Frequency regulator deadband shall be within 0.5 percent of span.
    d. Frequency regulator repeatability shall be within 0.5 percent of span.
    e. Frequency reference signal input resistance shall be no more than 550 ohms.

2.4 ENCLOSURE

A. The enclosure shall be a dead-front, freestanding assembly with cabinet base and maximum dimensions as indicated. Maximum height of any door mounted switch or indicator shall be 72 inches above the bottom of the VFD enclosure. Doors shall be minimum 12-gauge sheet steel. Removable lifting angles shall be provided.

B. The enclosure shall be NEMA 1 for an indoor application with gasketed doors and door openings. The enclosure shall be front access only. No rear or side access shall be required. The rear panel cover shall not be used for mounting of internal equipment. The enclosure shall be suitable for bottom cable entry and exit.

C. All VFD components, including input switch/compartment, cooling equipment, DC link, PLC, and motor protection relay shall be mounted and wired in a grounded continuous, multi-section enclosure meeting the following requirements without exception:
    1. Power conversion and auxiliary equipment enclosure sections shall be NEMA 1 design.
    2. All power conductors (bus or cable) shall be insulated, except the bus that is not accessible from VFD cabinet doors.
    3. All wiring shall be located internally within the VFD enclosure.

4. It shall be the responsibility of the Sub-supplier to provide all cooling or heating equipment for the internal components of the VFD in order for it to operate satisfactorily without breakdown per the Service Conditions herein.
5. VFDs shall be furnished with redundant cooling fans (complete with motor starters), and shall be capable of operating at full load with one cooling fan out of service. Automatic switchover controls shall be provided for redundant cooling fans.
6. Ventilation exhaust from each of the VFD cabinet sections shall be ducted to adapt to one common connecting duct, installed by the Installing Contractor, from an outlet at the top of each VFD enclosure. Cooling fans shall be designed to produce the required airflow against internal static pressure. External static pressure shall be negated by the exhaust fan as shown on the drawings.
7. Maximum door swing clearance shall not exceed 36 inches.
8. Enclosure shall be painted manufacturer's standard color and painting system.

2.5 PROTECTIVE FEATURES AND CIRCUITS

A. The controller shall include the following protective features:
1. Static instantaneous overcurrent and overvoltage trip.
2. Phase sequence detector and undervoltage protection.
3. Power unit over-temperature protection.
4. Electronic, motor inverse time, overload protection.
5. Responsive action to shutdown the VFD on high temperature from the motor winding or bearing temperature detectors or on high vibration from any bearing vibration system indicated. All analog temperature signals shall be converted to contacts by the use of RTD relays or similar devices. Contacts shall open on fault condition or loss of relay power. RTD relays or similar devices shall be selected and provided in coordination with the motor Sub-supplier. RTD relays or similar devices shall be mounted within the VFD cabinet. Each VFD shall be supplied with a GE Multilin, SR469, motor protection relay (MPR), with MODBUS RS-485 interface to the pump station control system. All VFD and MPR alarm contacts shall be configured to be normally closed, open in alarm condition, and open on loss of power.
6. The VFD shall be capable of transient operation with a line voltage dip of 15 percent of normal operating voltage on a variable torque load. During line dip, the VFD shall automatically provide a speed droop limiting maximum capable speed for the duration of the input voltage dip.
7. Vibration Monitoring System: Refer to Section 26 09 13. The vibration monitoring panel shall output normally-closed contacts from respective pumps and motors to shut down the VFD upon contact opening.

B. The power circuit design shall be such that the following fault conditions can occur without damage to the power circuit components:
   1. Single phase fault or three phase short circuit on VFD output terminals.
   2. Loss of three-phase input power due to opening of VFD input disconnect device or utility power failure during VFD operation.
   3. Loss of one phase of input power.

2.6 CONTROL DEVICES

A. Pilot devices and instruments shall be mounted on a VFD unit door. Pilot devices shall be heavy-duty type with contacts rated at 10 amps minimum at 600V ac. Indicating lights shall be LED, push-to-test type. Door-mounted indicating lights shall be removable without removing the related wiring. The control units of the same type and size shall be made interchangeable. Relays shall have energization indication.

2.7 PROGRAMMABLE LOGIC CONTROLLER

A. A programmable logic controller shall be provided and housed within each VFD enclosure. The PLC shall be capable of communicating to the pump station PCM via a ControlNet network. The PLC shall communicate to the VFD through a DeviceNet connection providing access to the VFD parameters for monitoring via the HMI touchscreen. The Manufacturer of the PLC shall be Allen- Bradley, ControlLogix Series, no substitution. The HMI shall communicate to the PLC via a serial connection. The HMI shall be an Allen-Bradley PanelView Plus 6 Graphic Terminal, or equal. The PLC shall be furnished with the following:
   1. Modular, field expandable design allowing the system to be tailored to this process control application. The capability shall exist to allow for expansion of the system by the addition of hardware and/or user software.
   2. The processor plus input and output circuitry shall be of a modular design with interchangeability provided for all similar modules. Modules are defined herein as devices that plug into a chassis and are keyed to allow installation in only one direction. The design shall prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot.
   3. The PLC shall have downward compatibility whereby all new module designs can be interchanged with all similar modules in an effort to reduce obsolescence.
   4. All hardware shall be rated to operate at an ambient temperature of 0 degrees to 60 degrees C (32 degrees to 140 degrees F), with an ambient temperature rating for storage of minus 40 degrees to plus 85 degrees C (minus 40 degrees to plus 185 degrees F), and shall function continuously in the relative humidity range of 5 percent to 95 percent with no condensation. The PLC system shall be designed and tested to operate in the high electrical noise environment of an industrial plant.

5. The PLC shall have one dedicated serial port, which supports RS-232-C, RS-422, and RS-423A signals. It shall be accessible in control logic and provide support for Slave SCADA communication protocol systems. Alternatively, it shall be usable for programming purposes or for access to peripheral devices such as bar code scanners, CRTs, etc.

B. PLC Power Supply:

1. The PLC shall operate in compliance with an electrical service of 120V ac, single-phase and in the frequency range from 47-Hz to 63-Hz. The power supply shall be mounted in the PLC housing, be sized to power all modules mounted in that housing and an "average module load" for any empty housing slots plus 25 percent above that total. Power supply shall be by the same manufacturer as the PLC and shall be of the same product line. A single main power supply shall have the capability of supplying power to the CPU and local input/output modules. Auxiliary power supplies shall provide power to remotely located racks.
2. The power supply shall automatically shut down the PLC system whenever its output current is detected as exceeding 125 percent of its rated current. The power supply shall monitor the incoming AC line voltage for proper levels. When the power supply is wired to use 120V ac power, the system shall function properly within the range of 97V ac to 132V ac. If the voltage level is detected as being out of range for more than one-half line cycle, the power supply shall automatically shut down the system and remain disabled until the proper voltage level returns. In addition, the power supply shall provide surge protection, isolation, and outage carryover up to two cycles of the ac line.
3. Design features of the PLC power supply shall include diagnostic indicators mounted in a position to be easily viewed by the user. These indicators shall provide the operator with the status of the dc power applied. In addition, a means of disabling power to the CPU shall be possible from a power disconnect switch mounted in a position easily accessible by the operator.
4. At the time of power-up, the power supply shall inhibit operation of the processor and I/O modules until the dc voltages are within specifications.
5. The power supply shall include fuse protection.

C. Communications: The PLC shall be equipped to communicate to other PLCs via a ControlNet connection. The PLC shall also be equipped to communicate with the VFD via a DeviceNet connection. The communications from the PLC to the HMI shall be configured to be a serial connection or DeviceNet connection. A dedicated RS-232 programming port shall remain unused to allow for connection of a programming terminal.

D. PLC Input/Output (I/O) Modules:

1. I/O Modules General: All I/O housings and modules shall be suitable for hostile industrial environments as described above. All I/O modules shall be isolated and conform to surge withstand standards and noise immunity standards. The I/Os shall be 4-mA to 20-mA dc for all analog inputs and outputs and shall be 24V dc for discrete inputs and dry relay contacts for safe discrete outputs. Modules shall be removable without having to disconnect wiring from the module's terminals by means of a swing-arm or plug-in wiring connector. Each PLC I/O location shall contain the I/O modules required to provide all of the I/O points contained in the I/O Lists. As a minimum, each PLC I/O location shall contain an installed spare capacity of at least 20%. During normal operation, a malfunction in any remote input/output channel shall affect the operation of only that channel and not the operation of the CPU or any other channel. Any remote input/output channel shall be field selectable to shut down the CPU upon failure of that channel. Upon remote channel shutdown, the CPU shall see all inputs on the malfunctioning channel as they were when the shutdown occurred and all outputs shall de-energize on that channel. Circuit components for both remote input and output shall be mounted on plug-in modules and keyed to prevent module insertion into the wrong slot. Isolation shall be used between all internal logic and external power circuits. This isolation shall meet the minimum specification of 1,500-volts rms.
2. Discrete Input Modules: Defined as contact closure inputs from devices external to the programmable controller module. Individual inputs shall be optically isolated from low energy common mode transients to 1,500-volts peak from field wiring or other I/O Modules. The modules shall have LED's to indicate status of each discrete input. Input signal level shall be 120V ac. The input module shall have a maximum of 16 points each. The PLC system shall include discrete input hardware consisting of the following types:
    a. AC/DC input for devices which operate at 120V ac, 50/60-Hz or 120V dc, 220V ac, 50/60-Hz. or 220V dc.
    b. AC input for devices that operate at 24V ac, 50/60-Hz.
    c. DC input for devices that operate at 5V dc to 30V dc and 10V dc to 60V dc.
    d. Isolated ac input that provides isolation of 120V ac or 120V dc input signals.
    e. TTL (5V dc) input for transistor-transistor logic, either high or low true logic, compatible with input devices such as solid state control and measuring equipment.
3. Discrete Output Modules: Defined as contact closure outputs for ON/OFF operation of devices external to the programmable controller module. The output modules shall be optically isolated from inductively generated, normal mode and low energy, common mode transients to 1,500-volts

peak. All output modules shall have LED's to indicate status of each output point. Output contact rating shall be 2 amps minimum, 24V ac. Each output point shall be individually isolated and fused. Discrete output contacts which are used to operate motors greater than 10 horsepower or with NEMA 2 or larger starters shall be provided with interposing relays in the VFD. Both the automatic start/stop output contacts and the safety/power system permissive output contacts shall be provided with relays when the above condition is met. Both the automatic start/stop output contacts and the safety/power system permissive output contacts shall be provided with relays when the above condition is met. The PLC system shall also offer discrete input hardware consisting of the following types:

a. AC output for devices which operate at 120V ac, 50/60-Hz.
b. AC output for devices which operate at 220/240V ac, 50/60-Hz.
c. AC output for devices which operate at 24V ac, 50/60-Hz.
d. DC output for devices which operate at 10V dc to 60V dc.
e. DC power output for operating heavy-duty clutches, brakes, and solenoids. Available in 12 to 24, 48, and 125V dc versions.
f. Isolated AC output that provides six isolated outputs capable of switching 120V ac or 220V ac power.
g. TTL (5V dc) output which provides transistor-transistor logic, either high or low true logic, compatible for operating 5V dc level electronic devices.
h. Contact output that provides four normally open and four normally closed reed relay outputs.
i. Contact output that provides three normally open/normally closed reed relay outputs.

4. Analog Input Modules: Defined as 4 mA to 20 mA dc signals, where an analog to digital conversion is performed with 16-bit precision and the digital result is entered into the processor. The analog to digital conversion shall be updated with each scan of the processor. Input modules shall be source or sink to handle 2-wire or 4-wire transmitters respectively. Analog inputs shall also be available in the following ranges:
   a. Voltage Range: 0 to plus 5V dc, plus 1 to plus 5V dc, zero to plus 10V dc, minus 5 to plus 5V dc, minus 10 to plus 10V dc.
   b. Current Range: 0 mA to 20 mA, minus 20 to plus 20 mA.
5. Analog Output Modules: Defined as 4 mA to 20 mA dc output signals where each output circuit performs a digital to analog conversion minimum of 15-bit precision with each scan of the processor. Each analog output module shall have six isolated output points which shall be rated for loads of up to 550 ohms. Provide current loop isolators as required to break ground loops.

E. PLC Uninterruptible Power Supply:

1. General:
    a. Completely static uninterruptible ac power systems (UPS) shall be provided for power to the PLC. The UPS system shall be a self-contained unit consisting of a static inverter, batteries, bypass switch, rectifier charger and static transfer switch.
    b. The VFD/PLC panel shall be furnished with UPS to provide backup power at full load for 30 minutes.
2. Operation: On normal power, the PLC panel load shall be supplied from the ac power line through the static inverter and the rectifier charger which shall also maintain the battery in a fully charged "float" condition. During line power failure, the UPS shall provide same wave ac power to the load. It shall also provide the local PLC with a dry contact output for alarm and monitoring through the SCADA system. Upon return of normal power, UPS shall recharge the battery in preparation for future ac power line failure.
3. UPS shall have the following requirements:
    a. Input/Output Voltage: 120V ac, 60-Hz, single-phase.
    b. Brownout protection.
    c. Lightning and surge protection.
    d. Noise Isolation: 38-dB common mode, 47-dB normal mode.
    e. Output Capacity: Based on load calculation.
    f. Efficiency: 95 percent on line.
    g. Alarms: Low Backup time, overload, replace battery. Low battery.
4. Manufacturers: FERRUPS or Toshiba.

2.8 DIAGNOSTICS

A. A door-mounted flat panel screen operator terminal shall be furnished with the VFD and be capable of controlling the VFD and setting drive parameters. The operator terminal shall include the following features:
    1. The display shall present diagnostic messages and parameter values in English engineering units when accessed, without the use of codes. Provide the ability to switch to SI units.
    2. The keypad / touch screen shall allow the operator to enter exact numerical settings in English engineering units. A plain English user menu shall be provided in software as a guide to parameter settings, (rather than codes). Drive parameters shall be factory set in EEPROM and resettable in the field through the operator terminal.
    3. Password security shall be available to protect drive parameters from unauthorized personnel. The EEPROM stored drive variables shall be able to be transferred to a new board to reprogram spare boards. Provide the ability to reset the password.
    4. Individual "Help-Screens" shall be incorporated into the display allowing operators to be "guided" through the start-up and shutdown process, along with troubleshooting the VFD when a "Failure" occurs. These screens

shall be accessed directly from any operating page by pressing a "Help" button programmed into the display.

5. The VFD shall be capable of direct communication to a compatible computer for serial link setup of parameters, fault diagnostics, trending and diagnostic log downloading. An RS-232 port or Ethernet RJ45 jack shall be door-mounted for computer or printer interface. VFD parameters, fault log and diagnostic log shall be downloadable for hardcopy printout via the RS-232 port and a standard serial printer or from maintenance software via the RJ45 jack and printed as pdf..

B. The VFD shall be provided with the following diagnostics:

1. Indication of the following fault conditions:
   a. No fault.
   b. Blown power fuse.
   c. Control power failure.
   d. Under-voltage.
   e. Instantaneous overcurrent.
   f. Sustained overload.
   g. Over-temperature.
   h. Output over-voltage.
2. Diagnostic Features and Fault Handling:
   a. A "Fault Log" shall record, store, display and print upon demand, the following 30 most recent events:
      1) VFD mode (Auto/Manual).
      2) Date and time of day (of fault).
      3) Type of fault.
      4) Reset mode (Auto/Manual).
   b. A "Historic Log" shall record, store, display and print upon demand, the following control variables at 2.7-mSec intervals for the 50 intervals immediately preceding a fault trip:
      1) VFD mode (Manual/Auto/Inhibited/Tripped, etc.).
      2) Speed demand.
      3) VFD output frequency.
      4) Demand (output) amps.
      5) Feedback (motor amps).
      6) VFD output volts.
      7) Type of fault.
      8) Drive-in (on/off).
   c. The fault log record shall be accessible via a RS-232 serial link or Ethernet linkas well as page-by-page on the terminal display.

2.9 POWER FACTOR CORRECTION

A. The collective true power factor (displacement power factor x distortion power factor) of the VFD and the motors, when running between 50 percent and

100 percent speed, shall not be less than 0.98 measured at the Point of Common Coupling. A power factor compensation feature shall be provided to control power factor – leading or lagging.

2.10 FACTORY TESTING

A. Component Tests: All components (including furnished spares) shall be 100 percent tested. All printed circuit boards shall be burned-in continuously per the manufacturer's standard test procedure to ensure reliable operation. The printed circuit boards shall be tested after burn-in to insure they are functioning within specification. Every SGCT or IGBT shall have the following critical parameters tested at rated current: gating, turn-on, turn-off, high temperature, forward blocking, reverse blocking and waveform characteristics. All assembled phase cells shall be tested for cell balance at rated voltage, maximum current, maximum dV/dT and maximum dI/dT.

1. Control power shall be applied to microprocessors, printed circuit boards, diagnostic boards, PLC, LCD display, and similar devices including software to test for proper operation, sequencing, logic and diagnostics.
2. All wiring shall be checked for continuity and for functional compliance with the wiring diagrams.

B. System Tests: Testing shall proceed in the order given below.

1. Functional Test: Each VFD shall be completely functionally tested at the factory as a unit. The Sub-supplier shall give the Engineer a minimum of five weeks notice prior to the test. All costs for the Engineer's expenses shall be borne by the Supplier and included in the bid price. Such costs shall include travel and subsistence for 2 people, but shall exclude salaries. Base bid price on engineers located in San Diego, CA. Test results in triplicate shall be submitted to the Engineer and no equipment shall be shipped until the test data have been approved in writing by the Engineer. Test reports shall include the Sub-supplier's standard tests as well as functional tests of the motor protection relay, HMI, and PLC. The test report shall indicate the test procedure and instrumentation used to measure and record data. The test report shall be certified by the test personnel and be submitted to the Engineer.
2. Load Tests: Each VFD shall be factory load tested at 100 percent of its maximum rating for a continuous period of three hours without overheating or shutdown. The load shall be applied as a motor load, dynamometer load, or inductor at reduced voltage.

PART 3 EXECUTION

3.1 FIELD TESTING

A. Harmonic Analysis for All Drives: Onsite harmonic tests shall be performed at 100 percent and 80 percent speeds with four VFDs operating. Tests shall be conducted using a harmonic analyzer by Reliable or BMI/Dranetz. Tests shall prove that sufficient filtering has been provided to limit the harmonic distortion to a magnitude of five percent of both current and voltage at the point of common coupling. The output of each drive shall also be measured to record the harmonics present in the motor circuit.

B. Background harmonics shall be recorded for a minimum of 48 hours at the point of common coupling prior to the first pump field harmonics tests are recorded.

END OF SECTION

SECTION 26 20 00
LOW-VOLTAGE AC INDUCTION MOTORS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. This section applies only when referenced by a motor-driven equipment specification. Application, horsepower, enclosure type, mounting, shaft type, synchronous speed, and deviations from this section will be listed in the equipment specification. Where such deviations occur, they shall take precedence over this section.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers Association (ABMA):
   a. 9, Load Ratings and Fatigue Life for Ball Bearings.
   b. 11, Load Ratings and Fatigue Life for Roller Bearings.
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   b. 620, Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Machines.
   c. 841, Standard for Petroleum and Chemical Industry—Premium Efficiency Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 370 kW (500 hp).
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. C50.41, Polyphase Induction Motors for Power Generating Stations.
   c. MG 1, Motors and Generators.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. Underwriters Laboratories (UL):
   a. 83, Standard for Safety for Thermoplastic-Insulated Wire and Cables.
   b. 674, Standard for Safety for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.
   c. 2111, Standard for Safety for Overheating Protection for Motors.

1.3 DEFINITIONS

A. CISD-TEFC: Chemical industry, severe-duty enclosure.

B. DIP: Dust-ignition-proof enclosure.

C. EXP: Explosion-proof enclosure.

D. Inverter Duty Motor: Motor meeting applicable requirements of NEMA MG 1, Section IV, Parts 30 and 31.

E. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.

F. ODP: Open drip-proof enclosure.

G. TEFC: Totally enclosed, fan-cooled enclosure.

H. TENV: Totally enclosed, nonventilated enclosure.

I. WPI: Open weather protected enclosure, Type I.

J. WPII: Open weather protected enclosure, Type II.

1.4 SUBMITTALS

A. Action Submittals:

1. Descriptive information.
2. Nameplate data in accordance with NEMA MG 1.
3. Additional Rating Information:
    a. Service factor.
    b. Locked rotor current.
    c. No load current.
4. Enclosure type and mounting (such as, horizontal, vertical).
5. Dimensions and total weight.
6. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.
7. Bearing type.
8. Bearing lubrication.
9. Bearing life.
10. Space heater voltage and watts.
11. Description, ratings, and wiring diagram of motor thermal protection.
12. Motor sound power level in accordance with NEMA MG 1.

13. Maximum brake horsepower required by the equipment driven by the motor.
14. Description and rating of submersible motor moisture sensing system.

B. Informational Submittals:

1. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection and Testing.
2. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. General Electric.
2. Reliance Electric.
3. MagneTek.
4. Siemens Energy and Automation, Inc., Motors and Drives Division.
5. Baldor.
6. U.S. Electrical Motors.
7. TECO-Westinghouse Motor Co.
8. Toshiba International Corp., Industrial Division.
9. WEG Electric Motors Corp.

2.2 GENERAL

A. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.

B. In order to obtain single source responsibility, use a single supplier to provide drive motor, its driven equipment, and specified motor accessories.

C. Meet requirements of NEMA MG 1.

D. For motors used in hazardous (classified) locations, Class I, Division 1, Groups B, C, and D, and Class II, Division 1, Groups E, F, and G provide motors that conform to UL 674 and have an applied UL listing mark.

E. Motors shall be specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.

F. Lifting lugs on motors weighing 100 pounds or more.

G. Operating Conditions:

1. Maximum ambient temperature not greater than 40 degrees C.
2. Motors shall be suitable for operating conditions without reduction being required in nameplate rated horsepower or exceeding rated temperature rise.
3. Overspeed in either direction in accordance with NEMA MG 1.

2.3 HORSEPOWER RATING

A. As designated in motor-driven equipment specification.

B. Constant Speed Applications: Brake horsepower of driven equipment at any operating condition not to exceed motor nameplate horsepower rating, excluding service factor.

2.4 SERVICE FACTOR

A. 1.15 minimum at rated ambient temperature, unless otherwise noted.

2.5 VOLTAGE AND FREQUENCY RATING

A. System Frequency: 60 Hz.

B. Voltage Rating: Unless otherwise indicated in motor-driven equipment specification:

Voltage Rating		
Size	**Voltage**	**Phase**
1/2 hp and smaller	115	1
3/4 hp through 400 hp	460	3

C. Suitable for full voltage starting.

D. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.

2.6 EFFICIENCY AND POWER FACTOR

A. For all motors except single-phase, under 1 hp, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:

1. Efficiency:
   a. Tested in accordance with NEMA MG 1, Paragraph 12.59.

b. Guaranteed minimum at full load in accordance with NEMA MG 1 Table 12-12, Full-load Efficiencies for NEMA Premium Efficiency Electric Motors Rated 600 Volts or Less (Random Wound), or as indicated in motor-driven equipment specification.

2. Power Factor: Guaranteed minimum at full load shall be manufacturer's standard or as indicated in motor-driven equipment specification.

2.7 LOCKED ROTOR RATINGS

A. Locked rotor kVA Code F or lower, if motor horsepower not covered by NEMA MG 1 tables.

B. Safe Stall Time: 12 seconds or greater.

2.8 INSULATION SYSTEMS

A. Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system.

B. Three-phase and Integral Horsepower Motors: Unless otherwise indicated in motor-driven equipment specification, Class F with Class B rise at nameplate horsepower and designated operating conditions , except EXP motors which must be Class B with Class B rise.

2.9 ENCLOSURES

A. Enclosures to conform to NEMA MG 1.

B. TEFC and TENV: Furnish with drain hole with porous drain/weather plug.

C. Explosion-Proof (EXP):

1. TEFC listed to meet UL 674 and NFPA 70 requirements for Class I, Division 1, Group C and D hazardous locations.
2. Drain holes with drain and breather fittings.
3. Integral thermostat opening on excessive motor temperature in accordance with UL 2111 and NFPA 70.
4. Terminate thermostat leads in terminal box separate from main terminal box.

D. Submersible: In accordance with Article Special Motors.

E. Chemical Industry, Severe-Duty (CISD-TEFC): In accordance with Article Special Motors.

2.10 TERMINAL (CONDUIT) BOXES

A. Oversize main terminal boxes for motors.

B. Diagonally split, rotatable to each of four 90-degree positions. Threaded hubs for conduit attachment.

C. Except ODP, furnish gaskets between box halves and between box and motor frame.

D. Minimum usable volume in percentage of that specified in NEMA MG 1, Section 1, Paragraph 4.19 and NFPA 70, Article 430:

Terminal Box Usable Values		
Voltage	**Horsepower**	**Percentage**
Below 600	15 through 125	500

E. Terminal for connection of equipment grounding wire in each terminal box.

F. Coordinate motor terminal box conduit entries versus size and quantity of conduits shown on Drawings.

2.11 BEARINGS AND LUBRICATION

A. Horizontal Motors:

1. 3/4 hp and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
2. 1 hp through 400 hp: Regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
3. Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.

B. Vertical Motors:

1. Thrust Bearings:
   a. Antifriction bearing.
   b. Manufacturer's standard lubrication 100 hp and smaller.
   c. Minimum 50,000 hours L-10 bearing life.
2. Guide Bearings:
   a. Manufacturer's standard bearing type.
   b. Manufacturer's standard lubrication 200 hp and smaller.
   c. Minimum 100,000 hours L-10 bearing life.

C. Regreasable Antifriction Bearings:

1. Readily accessible, grease injection fittings.
2. Readily accessible, removable grease relief plugs.

D. Oil Lubrication Systems:

1. Oil reservoirs with sight level gauge.
2. Oil fill and drain openings with opening plugs.
3. Provisions for necessary oil circulation and cooling.

2.12 NOISE

A. Measured in accordance with NEMA MG 1.

2.13 BALANCE AND VIBRATION CONTROL

A. In accordance with NEMA MG 1, Part 7.

2.14 EQUIPMENT FINISH

A. Protect Motor for Service Conditions:

1. ODP Enclosures: Indoor industrial atmospheres.
2. Other Enclosures: Outdoor industrial atmospheres, including moisture and direct sunlight exposure.

B. External Finish: Prime and finish coat manufacturer's standard.

C. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

2.15 SPECIAL FEATURES AND ACCESSORIES

A. Screen Over Air Openings: Corrosion-resistant on motors with ODP, WPI, and WPII enclosures meeting requirements for guarded machine in NEMA MG 1, and attached with stainless steel screws.

B. Space Heaters:

1. Provide winding space heaters with leads wired out to motor terminal box.
2. Provide extra hole or hub on motor terminal box as required.
3. Unless shown otherwise, heater shall be suitable for 120V ac supply, with wattage suitable for motor frame size.

C. Nameplates:

1. Raised or stamped letters on stainless steel or aluminum.
2. Display motor data required by NEMA MG 1, Paragraph 10.39 and Paragraph 10.40 in addition to bearing numbers for both bearings.
3. Premium efficiency motor nameplates to display NEMA nominal efficiency, guaranteed minimum efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.

D. Anchor Bolts: Provide meeting manufacturer's recommendations and of sufficient size and number for specified seismic condition.

2.16 SPECIAL MOTORS

A. Requirements in this article take precedence over conflicting features specified elsewhere in this section.

B. Chemical Industry, Severe-Duty (CISD-TEFC):

1. In accordance with IEEE 841.
2. TEFC in accordance with NEMA MG 1.
3. Suitable for indoor or outdoor installation in severe-duty applications including high humidity, chemical (corrosive), dirty, or salty atmospheres.
4. Motor Frame, End Shields, Terminal Box, and Fan Cover: Cast iron.
5. Ventilating Fan: Corrosion-resistant, nonsparking, external.
6. Drain and Breather Fittings: Stainless steel.
7. Nameplate: Stainless steel.
8. Gaskets between terminal box halves and terminal box and motor frame.
9. Extra slinger on rotor shaft to prevent moisture seepage along shaft into motor.
10. Double shielded bearings.
11. 125,000 hours minimum L-10 bearing life for direct-connected loads.
12. External Finish: Double-coated epoxy enamel.
13. Coated rotor and stator air gap surfaces.
14. Insulation System, Windings, and Connections:
    a. Class F insulation, Class B rise or better at 1.0 service factor.
    b. Multiple dips and bakes of nonhygroscopic polyester varnish.
15. Service Factor:
    a. At 40 Degrees C Ambient: 1.15.
    b. At 65 Degrees C Ambient: 1.00.
16. Safe Stall Time Without Injurious Heating: 20 seconds minimum.

C. Severe-duty Explosion-proof: Meet requirements for EXP enclosures and CISD-TEFC motors.

D. Submersible Pump Motor:

1. Manufacturers:
   a. Reliance Electric.
   b. ITT Flygt Corp.
2. At 100 Percent Load:

Submersible Pump Motors		
Horsepower	**Guaranteed Minimum Efficiency**	**Guaranteed Minimum Power Factor**
5 through 10	80	82
10.1 through 50	85	82

3. Insulation System: Manufacturer's standard Class B or Class F.
4. Motor capable of running dry continuously.
5. Enclosure:
   a. Hermetically sealed, watertight, for continuous submergence up to 65-foot depth.
   b. Listed to meet UL 674 and NFPA 70 requirements for Class I, Division 1, Group D hazardous atmosphere.
   c. Seals: Tandem mechanical.
6. Bearing and Lubrication:
   a. Permanently sealed and lubricated, replaceable antifriction guide and thrust bearings.
   b. Minimum 15,000 hours L-10 bearing life.
7. Inrush kVA/horsepower no greater than NEMA MG 1 and NFPA 70, Code F.
8. Winding Thermal Protection:
   a. Thermal sensor and switch assembly, one each phase, embedded in stator windings and wired in series.
   b. Switches normally closed, open upon excessive winding temperature, and automatically reclose when temperature has cooled to safe operating level.
   c. Switch contacts rated at 5 amps, 120V ac.
9. Motor Seal Failure Moisture Detection:
   a. Probes or sensors to detect moisture beyond seals.
   b. Probe or sensor monitoring module for mounting in motor controller, suitable for operation from 120V ac supply.
   c. Monitoring module with control power transformer, probe test switch and test light, and two independent 120V ac contacts, one opening and one closing when flux of moisture is detected.
10. Winding thermal protection, moisture detection, and bearing overtemperature specified above may be monitored by single device providing two independent 120V ac contacts, one closing and one opening on malfunction.
11. Connecting Cables:

a. One cable containing power, control, and grounding conductors.
b. Each cable suitable for hard service, submersible duty with watertight seal where cable enters motor.
c. Length: 30 feet minimum.
d. UL 83 listed and sized in accordance with NFPA 70.

2.17 FACTORY TESTING

A. Tests:

1. In accordance with IEEE 112 for polyphase motors.
2. Routine (production) tests in accordance with NEMA MG 1. Test multispeed motors at all speeds.
3. For energy efficient motors, test efficiency and power factor at 50 percent, 75 percent, and 100 percent of rated horsepower:
   a. In accordance with IEEE 112, Test Method B, and NEMA MG 1, Paragraph 12.59. and Paragraph 12.60.
   b. On motors of 100 hp and smaller, furnish certified copy of motor efficiency test report on an identical motor.
4. Provide test reports for all polyphase motors.

B. Test Report Forms:

1. Routine Tests: IEEE 112, Form A-1.

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with manufacturer's instructions and recommendations.

B. Align motor carefully and properly with driven equipment.

C. Secure equipment to mounting surface with anchor bolts.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Code of Federal Regulations (CFR): 10 CFR Part 431, DOE 2016 efficiency.
2. Institute of Electrical and Electronics Engineers (IEEE): C57.96, Guide for Loading Dry Type Transformers.
3. National Electrical Contractor's Association (NECA): 409, Recommended Practice for Installing and Maintaining Dry-Type Transformers.
4. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. ST 20, Dry-Type Transformers for General Applications.
5. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
6. Underwriters Laboratories, Inc. (UL):
   a. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
   b. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   c. 1561, Standard for Dry-Type, General Purpose, and Power Transformers.

1.2 SUBMITTALS

A. Action Submittals:

1. Descriptive information.
2. Dimensions and weight.
3. Transformer nameplate data, including efficiency.
4. Schematic and connection diagrams.
5. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

2. Test Report: Sound test certification for dry type power transformers (0 volt to 600 volt, primary).
3. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.

PART 2 PRODUCTS

2.1 GENERAL

A. UL 1561, NEMA ST 20, unless otherwise indicated.

B. Dry-type, self-cooled, two-winding, with copper windings.

C. Units larger than 5 kVA suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

D. Efficiency: Meet or exceed DOE 2016 efficiency requirements and transformers 15 kVA and larger shall comply with Title 20 and Title 24.

E. Maximum Sound Level per NEMA ST 20:

1. 40 decibels for 0 kVA to 9 kVA.
2. 45 decibels for 10 kVA to 50 kVA.
3. 50 decibels for 51 kVA to 150 kVA.
4. 55 decibels for 151 kVA to 300 kVA.
5. 60 decibels for 301 kVA to 500 kVA.

F. Overload capability: Short-term overload per IEEE C57.96.

G. Wall Bracket: For single-phase units, 15 kVA to 37-1/2 kVA, and for three-phase units, 15 kVA to 30 kVA.

H. Vibration Isolators:

1. 30 kVA and Above: Isolate core and coil assembly from transformer enclosure with integral vibration isolator.

I. Manufacturers:

1. General Electric Co.
2. Square D Co.
3. Eaton/Cutler-Hammer.
4. ABB

2.2 GENERAL PURPOSE TRANSFORMER

A. Insulation Class and Temperature Rise: Manufacturer's standard.

B. Core and Coil:

1. Encapsulated for single-phase units 1/2 kVA to 25 kVA and for three-phase units 3 kVA to 15 kVA.
2. Thermosetting varnish impregnated for single-phase units 37.5 kVA and above, and for three-phase units 30 kVA and above.

C. Enclosure:

1. Single-Phase, 3 kVA to 25 kVA: NEMA 250, Type 3R, nonventilated.
2. Single-Phase, 37-1/2 kVA and Above: NEMA 250, Type 2, ventilated.
3. Three-Phase, 3 kVA to 15 kVA: NEMA 250, Type 3R, nonventilated.
4. Three-Phase, 30 kVA and Above: NEMA 250, Type 2, ventilated.

D. Voltage Taps:

1. Single-Phase, 3 kVA and Above: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
2. Three-Phase, 3 kVA and Above: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.

E. Impedance: 1.9 percent minimum on units 75 kVA and larger.

2.3 CAST COIL DRY TYPE TRANSFORMERS

A. Transformers 01-XFMR-03 and -04.

B. Vacuum cast coil dry type distribution transformer.

C. Primary voltage: 4160V, delta, 60kV BIL.

D. Secondary voltage: 480/277V, wye, 30kV BIL.

E. Impedance: 5.75%, +/- 7.5% tolerance.

F. Insulation class: 180F.

G. Temperature rise: 115F over 30F average, 40F ambient.

H. Taps: 2-2.5% FCAN, 2-2.5% FCBN.

I. Partial discharge maximum level of 10 pC per IEC 60076-11.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with NECA and manufacturer's instructions.

B. Provide moisture-proof, flexible conduit for electrical connections.

C. Connect voltage taps to achieve (approximately) rated output voltage under normal plant load conditions.

D. Provide wall brackets for units where indicated as wall mounted on Drawings.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractor's Association (NECA): 407, Recommended Practice for Installing and Maintaining Panelboards.
2. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. 289, Application Guide for Ground Fault Circuit Interrupters.
   c. KS 1, Enclosed Switches.
   d. PB 1, Panelboards.
   e. PB 1.1, General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
4. Underwriters Laboratories, Inc. (UL):
   a. 67, Standard for Panelboards.
   b. 98, Standard for Enclosed and Dead-Front Switches.
   c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
   d. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   e. 508, Standard for Industrial Control Equipment.
   f. 870, Wireways, Auxiliary Gutters and Associated Fittings.
   g. 943, Ground-Fault Circuit-Interrupters.
   h. 1699, Standard for Arc-Fault Circuit-Interrupters.

1.2 SUBMITTALS

A. Action Submittals:

1. Manufacturer's data sheets for each type of panelboard, protective device, accessory item, and component.
2. Manufacturer's shop drawings including dimensioned plan, section, and elevation for each panelboard type, enclosure, and general arrangement.
3. Tabulation of features for each panelboard to include the following:
   a. Protective devices with factory settings.
   b. Provisions for future protective devices.
   c. Space for future protective devices.
   d. Voltage, frequency, and phase ratings.

e. Enclosure type.
f. Bus and terminal bar configurations and current ratings.
g. Provisions for circuit terminations with wire range.
h. Short circuit current rating of assembled panelboard at system voltage.
i. Features, characteristics, ratings, and factory settings of auxiliary components.
j. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's recommended installation instructions.
3. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.

1.3 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this section that are listed and labeled as defined in NEC Article 100.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Eaton/Cutler-Hammer.
2. General Electric Co.
3. Square D Co.
4. Siemens.

2.2 GENERAL

A. Provide equipment in accordance with NEMA PB 1, NFPA 70, and UL 67.

B. Wire Terminations:

1. Provide panelboard assemblies, including protective devices, suitable for use with 75 degrees C or greater wire insulation systems at

NFPA 70, 75 degrees C conductor ampacity, and in accordance with UL 486E.

2. Lugs for termination of conductors shall comply with Section 26 05 05, Conductors.
3. Lugs for termination of copper feeder phase and neutral conductors shall be replaceable, bolted mechanical or crimp compression type.

C. Load Current Ratings:

1. Unless otherwise indicated, load current ratings for panelboard assemblies, including bus and circuit breakers, are noncontinuous as defined by NEC. Continuous ratings shall be 80 percent of noncontinuous rating.
2. Where indicated "continuous" or "100 percent", selected components and protective devices shall be rated for continuous load current at value shown.

D. Short Circuit Current Rating (SCCR): Integrated equipment short circuit rating for each panelboard assembly shall be no less than the indicated SCCR.

E. Series-Connected Short Circuit Current Ratings: Panelboards utilizing UL 67 listed, series-connected device ratings to achieve the required SCCR are acceptable where permitted by NFPA 70 and not otherwise indicated.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Overcurrent Device Mounting and Arrangement: Design panelboards to accommodate device installation and replacement without disturbing adjacent devices and without removing main bus.

B. Overcurrent Protective Devices: In accordance with NEMA KS 1, UL 98, and UL 489. Protective devices shall be adapted to panelboard installation.

C. Provisions for Future Overcurrent Device:

1. Provide space, mountings and bus connections such that like device may be installed without additional hardware.
2. Panel openings shall be closed with individual removable cover for each provision for future device.
3. Unless otherwise indicated, "spaces" in panelboards shall be fully equipped provision for future like devices.
4. Provisions for future devices shall be suitable devices rated no less than 60 amperes.

D. Protective Device Locking: Furnish provisions for handle padlocking for main, subfeed, and branch devices where indicated.

E. Branch Protective Devices:

1. Provide Wire Lug Load Connections: Mechanical or crimp compression type, removable/replaceable, and suitable for 75 degrees C rated conductors without derating switch nor conductor ampacity.
2. Provide a nameplate for each circuit, blanks for spares.

2.4 CIRCUIT BREAKERS

A. General: Thermal-magnetic unless otherwise indicated, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle. Circuit breakers shall comply with Section 26 05 04, Basic Electrical Materials and Methods.

B. Bus Connection: Bolt-on circuit breakers in all panelboards.

C. Trip Mechanism:

1. Individual permanent thermal and magnetic trip elements in each pole.
2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
3. Two and three pole, common trip.
4. Automatically opens all poles when overcurrent occurs on one pole.
5. Test button on cover.
6. Calibrated for 40 degrees C ambient, unless shown otherwise.

D. Unacceptable Substitution:

1. Do not substitute single-pole circuit breakers with handle ties for multi-pole breakers.
2. Do not use tandem or dual circuit breakers in normal single-pole spaces.

E. Specialty Breakers: Where indicated, provide breakers with the following features:

1. Ground Fault Circuit Interrupter (GFCI): Rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel). Ground fault sensor shall be rated same as circuit breaker. Breaker shall include push-to-test and reset buttons.
2. Heating and Air Conditioning Rated (HACR): Where indicated, provide breaker UL listed for the protection of such equipment.

2.5 ENCLOSURES

A. General:

1. Provide as specified in Section 26 05 04, Basic Electrical Materials and Methods.
2. Type 1, Type 3R, and Type 3S material code-gauge, hot-dip galvanized sheet steel with reinforced steel frame.
3. Provide surface-mount panelboard from trim with same dimensions as box front.

B. Finish: Rust inhibitor prime followed by manufacturer's standard gray baked enamel or lacquer. NEMA Type 1 enclosure box may be unfinished galvanized sheet steel.

C. NEMA 250 Type 1 Branch Panelboard Enclosure:

1. Secure front trim to box with concealed trim clamps.
2. Provide door in panelboard front trim, with concealed hinges, to access protective device operating handles.
3. Provide multi-point latching for doors over 30 inches in height.
4. Door Lock: Secure with flush catch and tumbler lock; all panelboards keyed alike, with two milled keys each lock.
5. Circuit Directory: Metal frame with transparent plastic face and enclosed card, mounted inside each panel door.

2.6 BUSSING AND TERMINAL BARS

A. Bus:

1. Material: Copper, full sized throughout length. Provide for mounting of future protective devices along full length of bus regardless of number of units and spaces shown. Machine, drill, and tap as required for current and future positions.

B. Equipment Ground Terminal Bus: Copper with suitably sized provisions for termination of ground conductors, and bonded to box.

1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
2. Provide individual termination points for all other grounding conductors such as feeder, grounding electrode, etc.
3. Termination points shall be bolted crimp compression lugs for conductors 6 AWG and larger.

C. Neutral Terminal Bus: Copper with suitably sized provisions for termination of neutral conductors, and isolated from box.

1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.

2. Provide individual termination points for all other neutral conductors.
3. Termination Points: Bolted crimp compression lugs for conductors 6 AWG and larger.

D. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances for future protective device ampere ratings indicated.

2.7 SPECIAL FEATURES

A. General: Where indicated on Drawings or schedules, provide special features as specified.

B. Surge Arresters:

1. Comply with Section 26 43 00, Surge Protection Devices.
2. Provide protective device within panelboard as disconnecting means and short circuit protection per manufacturer's recommendation.
3. Provide factory mounting within panelboard utilizing UL-recognized mounting device.

C. Fire Alarm Circuits: Identify all branch circuits feeding fire detection and alarm panels and equipment with a red, engraved to white core, plastic nameplate attached to the individual branch circuit breakers. Engrave nameplates with "FIRE ALARM CIRCUIT".

PART 3 EXECUTION

3.1 GENERAL

A. Install in accordance with NECA 407, NEMA PB 1.1, and manufacturers' written installation instructions.

B. Install securely, plumb, in-line and square with walls.

C. Install top of cabinet trim 78 inches above floor, unless otherwise shown. Install cabinet so tops of protective device operating handles are no more than 78 inches above the floor.

D. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289.

E. Install filler plates in unused spaces.

F. Wiring in Panel Gutters: Train conductors neatly in groups; bundle and wrap with nylon wire ties.

G. Provide typewritten circuit directory for each panelboard.

H. Provide engraved identification for each protective device.

END OF SECTION

SECTION 26 24 19
LOW-VOLTAGE MOTOR CONTROL

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which shall be followed for this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Electrical Contractors Association (NECA): 402, Standard for Installing and Maintaining Motor Control Centers.
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 volts maximum).
   b. ICS 1, Industrial Control and Systems: General Requirements.
   c. ICS 2, Controllers, Contactors, and Overload Relays Rated 600 Volts.
   d. ICS 2.3, Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600V.
   e. ICS 18, Motor Control Centers.
   f. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. Underwriters Laboratories, Inc. (UL):
   a. 98, Enclosed and Dead-Front Switches.
   b. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   c. 845, Motor Control Centers.

1.2 DEFINITIONS

A. CT: Current Transformer.

B. LCD: Liquid Crystal Display.

C. N.C.: Normally Closed.

D. N.O.: Normally Open.

E. THD: Total Harmonic Distortion.

F. VT: Voltage Transformer.

1.3 SUBMITTALS

A. Action Submittals:

1. Descriptive information.
2. Itemized Bill of Material.
3. Dimensional drawings.
4. Front Panel Elevations.
5. Conduit entrance locations.
6. Bus data.
7. Protective Devices: Copies of time-current characteristics.
8. Anchoring instructions and details.
9. Typed Tabulation:
    a. Motor name; tag (equipment) numbers as shown on Drawings.
    b. Motor horsepower.
    c. Nameplate full load current.
    d. Measured load current and voltage.
    e. Heater model number and relay setting.
    f. Protective device trip settings.
    g. Manufacturer's solid state starter switch or dip switch or program settings.
    h. Attach above typed, tabulated data to a copy of starter manufacturer's overload heater or setting selection tables for starters provided.
10. Control diagrams.
11. One-line diagrams.
12. Schematic (elementary) diagrams.
13. Outline diagrams.

B. Informational Submittals:

1. Manufacturer's installation instructions.
2. Factory test reports, certified.
3. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Provide products manufactured within scope of Underwriters Laboratories that conform to UL Standards and have applied UL Listing Mark.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Shipping Splits: Established by Contractor to facilitate ingress of equipment to final installation location within building.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Eaton Electrical/Cutler-Hammer.
2. GE Industrial Systems.
3. Schneider Electric/Square D Services.
4. Allen-Bradley.
5. Siemens.

2.2 GENERAL

A. Like Items of Equipment: End product of one manufacturer.

B. Make adjustments necessary to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate motors actually provided under this Contract.

C. Controllers: NEMA ICS 1, NEMA ICS 2, Class A.

D. Control Transformer:

1. Two winding, 120-volt secondary, primary voltage to suit.
2. Two current-limiting fuses for primary circuit.
3. One fuse in secondary circuit .
4. Mount within starter unit.

E. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

F. Lifting lugs on equipment and devices weighing over 100 pounds.

G. Anchor Bolts: Galvanized, sized seismically by a licensed structural engineer registered in the state where equipment is to reside, and as specified in Section 05 50 00, Metal Fabrications.

H. Seismic Zone and Importance Factor shall be as specified in Section 01 61 00, Common Product Requirements.

I. Operating Conditions:

1. Ambient Temperature: Maximum 40 degrees C .
2. Altitude: Zero feet above sea level.
3. Equipment to be fully rated.

J. Enclosures: In accordance with NEMA 250.

K. Equipment Finish:

1. Electrocoating process applied over rust-inhibiting phosphated base coating.
2. Exterior Color: Manufacturer's standard.

2.3 SEPARATELY MOUNTED MOTOR CONTROL

A. Manually Operated Starter, Fractional Horsepower:

1. Rating: 16 amperes continuous at 277 volts maximum.
2. Single-phase, nonreversing, full voltage with overload protection.
3. Toggle operated.
4. Enclosure: NEMA 250, Type 1, 3R, 4X, 7 and 9as shown.
5. Neon Light: Red
6. Handle guard/lock-off attachment.

B. Manually Operated Starter, Integral Horsepower:

1. Rating: Horsepower rated to maximum of 10 horsepower at 600 volts with overload protection.
2. Single-phase or three-phase, nonreversing, full voltage.
3. Control: Toggle.
4. Enclosure: NEMA 250, Type 1, 4X, 7 and 9 as shown on Drawings.
5. Red pilot light in series with auxiliary contact.
6. Locking in OFF position.
7. Two spare auxiliary, field-changeable contacts.

C. Combination Full-Voltage, Magnetic Starter:

1. Rating: Horsepower rated at 600 volts, UL labeled for 65,000 amperes at 480 volts short circuit capacity with overload protection.
2. Three-phase, nonreversing, full voltage.
3. Control: As shown on Drawings.
4. Disconnect Type: Motor circuit protector.
5. Enclosure: NEMA 250, Type 1, 4X, 7 and 9 as shown on Drawings.
6. Pilot Lights: Red–ON and Green–OFF.
7. Padlockable operating handle, capable of up to three locks.

D. Thermal Motor Overload Protection:

1. Inverse-time-limit characteristic.
2. Heater: Bimetallic overload, adjustable trip, or directly heated melting alloy, ratchet principle type element.

3. Relay Trip: Standard, Class 20.
4. Manual reset.
5. Provide in each ungrounded phase.
6. Mount within starter unit.

E. Solid State Motor Overload Protection:

1. Inverse-time-limit characteristic.
2. Phase loss, phase unbalanced and Class II ground fault protection.
3. Current operated electronic circuitry with adjustable trip.
4. Class 10/20/30 relay trip, switch selectable.
5. N.O. auxiliary contact for remote monitoring.
6. Manual reset.
7. Provide in each ungrounded phase.
8. Mount within starter unit.
9. Communications:

2.4 MOTOR CONTROL CENTERS

A. General:

1. In accordance with NEMA ICS 1, NEMA ICS 2, NEMA ICS 18, and UL 845.
2. Voltage Rating: 600 volts.
3. Short Circuit Rating: 65,000 amperes rms symmetrical at 480 volts for entire motor control center as a complete assembly.
4. Main and branch circuit breakers, controllers, wire connections, and other devices to be front mounted and accessible, unless otherwise noted.
5. NEMA ICS 18, Part 3.
   a. Class: II.
   b. Type: B.

B. Enclosure:

1. Type: NEMA 250 Type 1, indoor gasketed
2. Vertical Section Standard Indoor Dimensions for NEMA 1 Type:
   a. Nominal, 90 inches high, 20 inches wide, 21 inches deep.
   b. Alternative width dimensions of 24 inches and 30 inches are acceptable for oversize devices or panels.
   c. Do not exceed space shown.
3. Construction:
   a. Sheet steel reinforced with channel or angle irons.
   b. Butt sections flush, end-to-end against similar section without bolts, nuts, or cover plates causing interference.
   c. Removable top cover plates and bottom cover plates.

d. Removable plates on end panels for future bus extension.

4. Section Mounting: Removable formed-steel channel sills and lifting angles to meet specified seismic requirements.
5. Horizontal Wiring Compartments: Accessible from front, full width, top and bottom.
6. Vertical Wiring Compartment:
   a. Full height, isolated from unit starters with separate hinged door and tie supports.
   b. No terminal blocks allowed in vertical wireway compartment.
7. Terminal board compartment at unit space indicated with 20 percent spare terminals.
8. Unit Compartment: Individual compartments separated by steel barriers for each starter, feeder, or other unit capable of being wired from front without unit removal.
9. Compartment Doors: Separate hinged doors for each starter, feeder, or other unit.
10. Door Interlocking: Mechanically interlock starter and feeder doors so doors cannot be opened with unit energized. Provide defeater mechanism to allow intentional access and energizing at any time by qualified individual.
11. External disconnect handles with ON/OFF and trip positions showing, padlockable in OFF position with up to three-lock capability.
12. Cable Entrance: Main leads enter from bottom; control and feeder circuits enter from top and bottom.

C. Bus:

1. Horizontal Power Bus:
   a. Three-phase tin-plated copper, entire width of control center, rated as shown.
   b. Construct to allow future extension of additional sections.
   c. Pressure type solderless lugs for each incoming line cable.
   d. Isolated from top horizontal wireway.
   e. Provide Belleville washers on bus connection bolts.
2. Vertical Power Bus:
   a. Three-phase tin-plated copper, full height of section, rated 300 amperes, minimum.
   b. Sandwich type bus insulation providing deadfront construction with starter units removed except for bus stab openings.
   c. Insulated and isolated barrier, complete with shutters.
   d. Provide Belleville washers on bus connection bolts.
3. Neutral Bus:
   a. 50 percent neutral, entire width of control center.
   b. Copper, tin-plated.
   c. Provide Belleville washers on bus connection bolts.

4. Ground Bus:
    a. Copper, bare, rated 300 amperes, entire width of control center.
5. Bus Bracing: 65,000 amperes rms symmetrical.

D. Motor Controller Unit:

1. Provide indicated individual components and control devices including pushbuttons, selector switches, indicating lights, control relays, time delay relays, and elapsed time meters as specified in Section 26 05 04, Basic Electrical Materials and Methods.
2. Construction:
    a. Drawout combination type with stab connections for starters NEMA ICS, Size 5 and smaller.
    b. Bolt-on combination type with cable connection to riser for starters NEMA ICS, Size 6 and larger.
    c. Readily interchangeable with starters of similar size.
    d. Pull-apart unit control wiring terminal boards capable of accepting up to 2#14 AWG wires minimum on drawout units.
3. Starters:
    a. NEMA ICS 18, standard rating, except none smaller than NEMA ICS, Size 1.
    b. Rating: Horsepower rated at 600 volt, UL labeled for 65,000 amperes at 480 volts short circuit capacity with overload protection.
    c. Three-phase, nonreversing, unless specified otherwise.
    d. Disconnect Type: Motor circuit protector.
    e. Combination Full Voltage, Magnetic Starter:
        1) Control: As shown on Drawings.
        2) Pilot Lights: As shown on Drawings.
    f. Communications: None.
    g. Padlockable operating handle when de-energized with up to three-lock capability.
    h. Unit door interlocked to prevent opening when disconnect is in closed position.
    i. Mechanical interlocked to prevent placing disconnect in ON position when unit door is open.
    j. Minimum Dimensions: 12 inches high by full section width, less vertical wireway.
4. Disconnecting Device:
    a. As indicated.
    b. Padlockable in OPEN position for up to three locks.
5. Circuit Breaker:
    a. Meet requirements of UL 489.
    b. Molded case with manufacturer's recommended trip setting for maximum motor protection.

c. Thermal-magnetic trip or magnetic trip only as shown.
d. Tripping indicated by operating-handle position.
e. Interrupting capacity required for connection to system with short-circuit capacity indicated.

6. Solid State Motor Overload Protection:
   a. Inverse-time-limit characteristic.
   b. Phase loss, phase unbalance and Class II ground fault protection.
   c. Current operated electronic circuitry with adjustable trip.
   d. Class 10/20/30 relay trip, switch selectable.
   e. One N.O. auxiliary contact for remote monitoring.
   f. Manual reset.
   g. Provide in each ungrounded phase.
   h. Mount within starter unit.
   i. Communications: None.

E. Control Unit:

1. Disconnecting Device: Pull-apart terminal blocks capable of de-energizing external source control circuits in unit.
2. Control Devices: As indicated and as specified in Section 26 05 04, Basic Electrical Materials and Methods.
3. Control Wiring:
   a. Copper, 14 AWG, minimum.
   b. Permanent sleeve type markers with wire numbers applied to each end of wires.
   c. Terminate wires using insulated locking fork or ring type crimp terminals.
   d. Terminate current transformer leads on shorting type terminal blocks.

F. Incoming Line Terminal:

1. Construction: As specified in Paragraph, Motor Controller Unit.
2. Incoming Service Feeder: Cable.
3. Mechanical type CU-/AL lugs for 75 degrees C cable.

G. Main Protective Device and Feeder Unit:

1. Construction: As specified in Paragraph Motor Controller Unit.
2. Incoming Service Feeder: Cable.
3. Solid State Trip Circuit Breaker:
   a. In accordance with UL 489.
   b. Main protective device.

c. Insulated or molded case breakers with ambient insensitive solid-state trips and having current sensors and logic circuits integral in breaker frame.
d. Solid-state current control with adjustable ampere setting, adjustable long-time delay, adjustable short-time trip and delay band, fixed or adjustable instantaneous trip, and adjustable ground fault trip and delay band.
e. Setting adjustments to be covered by a sealable, tamper-proof, transparent cover (insulated case breakers only) or by compartment door for other breakers).
f. Locate trip button on front cover of breaker to permit mechanical simulation overcurrent tripping for test purposes and to trip breaker quickly in emergency situation.

4. Molded Case Circuit Breaker:
   a. In accordance with UL 489.
   b. Feeder protective device.
   c. Thermal-magnetic trip and interrupting capacity required for connection to system with short circuit capacity indicated.
   d. Indicate tripping by operating-handle position.
   e. Suitable for use with 75 degrees C wire at full NEC 75 degrees C ampacity.

5. Key Interlocking:
   a. Mechanical lock cylinders within main and generator breaker compartments.
   b. Key and Lock Cylinder Type: Kirk.
   c. Keys to be captive when breakers are closed.
   d. Two main and generator breaker arrangements.

H. Key Interlocks:

1. Two Main and One Generator Breaker Arrangement:
   a. Two keys available for each group of three locks.
   b. Both mains must be open to close generator breaker.

I. Automatic Transfer Switches: As specified in Section 26 36 23, Automatic Transfer Switch.

J. TVSS: As specified in Section 26 43 00, Transient Voltage Suppression.

K. Transformers: As specified in Section 26 22 00, Low-Voltage Transformers.

L. Pushbuttons, Indicating Lights, Selector Switches, Elapsed Time Meters, Control Relays, Time-Delay Relays, and Reset Timers: As specified in Section 26 05 04, Basic Electrical Materials and Methods.

M. Nameplates:

1. Laminated plastic; white, engraved to black core.
2. Provide for each motor control center and each unit.
3. Engrave with inscription shown on single-line diagram.
4. Provide blank nameplates on spaces for future units.
5. Attach with stainless steel panhead screws on face of control center.

2.5 SOURCE QUALITY CONTROL

A. Factory Testing:

1. Applicable Standards: NEMA ICS 18, UL 845, and NEC Article 430, Part VIII.
2. Perform standard factory inspection and tests in accordance with NEMA requirements to verify components have been designed to Specification, assembled in accordance with applicable standards, and each unit functions in accordance with electrical diagrams.
3. Actual operation shall be performed wherever possible. Otherwise, inspect and perform continuity checks.
4. Verify component devices operated correctly in circuits as shown on diagrams or as called for in Specification.
5. Control Circuits and Devices:
   a. Energize circuit at rated voltage.
   b. Operate control devices.
   c. Perform continuity check.
6. Instruments, Meters, Protective Relays, and Equipment:
   a. Verify devices functioned by energizing potential to rated values with connection to devices made at outgoing terminal blocks.
   b. Verify protective relays operated for functional checks and trips manually initiated to verify functioning of operation for indicator and associated circuits.
7. Perform dielectric tests on primary circuits and equipment, except potential transformers. Tests shall be made phase-to-phase and phase-to-around with 60-cycle test voltages applied for 1 second at 2,640 volts.
8. Verify equipment passed tests and inspection.
9. Provide standard factory inspection and test checklists, and final certified and signed test report.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Install equipment in accordance with NEMA ICS 2.3, IEEE C2, NECA 402, Submittals, and manufacturer's written instructions and recommendations.
2. Secure equipment to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions.
3. Install equipment plumb and in longitudinal alignment with pad or wall.
4. Coordinate terminal connections with installation of secondary feeders.
5. Grout mounting channels into floor or mounting pads.
6. Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.
7. Motor Data: Provide typed, self-adhesive label attached inside each motor starter enclosure door displaying the following information:
    a. Motor served by tag number and equipment name.
    b. Nameplate horsepower.
    c. Motor code letter.
    d. Full load amperes.
    e. Service factor.
    f. Installed overload relay heater catalog number.

B. Circuit Breakers:

1. Field adjust trip settings of motor starter magnetic-trip-only circuit breakers.
2. Adjust to approximately 11 times motor rated current.
3. Determine motor rated current from motor nameplate following installation.

C. Overload Relay: Select and install overload relay heaters and switch settings after actual nameplate full-load current rating of motor has been determined.

3.2 MANUFACTURER'S SERVICES

A. Furnish manufacturer's representative in accordance with Section 01 43 33, Manufacturers' Field Services, for the following services at Job Site or classroom as designated by Owner, for minimum person-days listed below, travel time excluded:

1. One person-day for installation assistance, and inspection of installation.
2. One person-day for functional and performance testing.
3. One person-day for plant startup.
4. One person-day for training of Owner's personnel.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. Federal Specifications (FS):
   a. W-C-596G, General Specification for Connector, Electrical, Power.
   b. W-S-896F, Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
3. Institute of Electrical and Electronic Engineers, Inc. (IEEE):
   a. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits.
   b. C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits.
4. National Electrical Contractors Association (NECA): 1, Standard Practice of Good Workmanship in Electrical Contracting.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. FB 11, Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
   c. WD 1, General Color Requirements for Wiring Devices.
   d. WD 6, Wiring Devices – Dimensional Specifications.
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. Underwriters Laboratories Inc. (UL):
   a. 498, Standard for Safety for Attachment Plugs and Receptacles.
   b. 508, Standard for Safety for Industrial Control Equipment.
   c. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.
   d. 1010, Standard for Safety for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
   e. 1436, Standard for Safety for Outlet Circuit Testers and Similar Indicating Devices.
   f. 1449, Standard for Safety for Surge Protective Devices (SPD).

1.2 SUBMITTALS

A. Action Submittals: Manufacturer's product data for wiring devices.

PART 2 PRODUCTS

2.1 SWITCHES

A. Switch, General Purpose:

1. NEMA WD 1 and FS W-S-896F.
2. Totally enclosed, ac type, with quiet tumbler switch and screw terminal.
3. Rivetless one-piece brass or copper alloy contact arm with silver alloy contact.
4. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
5. Rating: 20 amps, 120/277 volts.
6. Automatic grounding clip and integral grounding terminal on mounting strap.
7. Special Features: Provide the following features in comparable devices where indicated:
   a. Three-way and four-way.
8. Manufacturers and Products, Industrial Grade:
   a. Cooper Arrow Hart; AH1220 Series.
   b. Bryant; 4901 Series.
   c. Hubbell; 1221 Series.
   d. Leviton; 1221 Series.

B. Switch, Motor Rated:

1. Type: Two-pole or three-pole, manual motor starting/disconnect switch without overload protection.
2. UL 508 listed.
3. Totally enclosed snap-action switch. Quick-make, slow-break design with silver alloy contacts.
4. Minimum General Purpose Rating: 30 amperes, 600V ac.
5. Minimum Motor Ratings:
   a. 2 horsepower for 120V ac, single-phase, two-pole.
   b. 3 horsepower for 240V ac, single-phase, two-pole.
   c. 15 horsepower for 480V ac, three-phase, three-pole.
6. Screw-type terminal.
7. Manufacturers and Products:
   a. Cooper Arrow Hart.
   b. Hubbell Bryant: HBL78 Series.
   c. Leviton.

2.2 RECEPTACLES

A. Receptacle, General Purpose:

1. NEMA WD 1 and FS W-C-596G.
2. Duplex, two-pole, three-wire grounding type with screw type wire terminals.
3. Impact resistant nylon cover and body, with finder grooves in face, unless otherwise indicated.
4. One-piece mounting strap with integral ground contact (rivetless construction).
5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps, unless otherwise indicated.
7. Size: For 2-inch by 4-inch outlet box.
8. Special Features: Provide the following features in comparable devices where indicated:
    a. Listed weather-resistant per NEC 406.8.
9. Industrial Grade Manufacturers and Products:
    a. Cooper Arrow Hart; 5362 Series.
    b. Hubbell Bryant; HBL5362 Series.
    c. Leviton; 5362 Series.

B. Receptacle, Ground Fault Circuit Interrupter:

1. Meet requirements of general-purpose receptacle.
2. Listed Class A to UL 943, tripping at 5 mA.
3. Rectangular smooth face with push-to-test and reset buttons.
4. Listed weather-resistant per NEC 406.8.
5. Feed-through Capability: 20 amps.
6. Manufacturers and Products:
    a. Hubbell Bryant; GFTR20 Series.
    b. Cooper Arrow Hart WRVGF20 Series.
    c. Leviton; 7899 Series.

C. Receptacle, Corrosion-Resistant:

1. Meet requirements of general-purpose receptacle.
2. Nickel coated metal parts.
3. Manufacturers and Products:
    a. Hubbell Bryant; HBL53CM62 Series.
    b. Leviton; 53CM-62 Series.
    c. Cooper Arrow Hart; 5362CR Series.

D. Receptacle, Special-Purpose:

1. Rating and number of poles as indicated or required for anticipated purpose.

2. Provide one matching plug with cord-grip features for each special-purpose receptacle.

2.3 HAZARDOUS (CLASSIFIED) LOCATION DEVICES

A. Wiring devices for hazardous (classified) locations shall comply with NEMA FB 11 and UL 1010.

B. Switch:

1. Industrial grade, totally enclosed, ac type, with tumbler switch.
2. Capable of three-way or four-way operation where indicated on Drawings.
3. Rating: 20 amps at 120/277 volts.
4. Material: Cast aluminum backbody and cover.
5. Hazardous Area Ratings: NEMA 7D suitable for Class I, Group C and Group D; Class 2, Groups E, F and G; and Class 3 locations.
6. Manufacturers and Products:
   a. Killark: XS Series.
   b. Appleton: EDS Series.

C. Switch, Motor Rated:

1. Enclosed manual motor starter-type, three-pole, nonreversing without overloads.
2. Minimum Motor Rating: 10 horsepower, 480V ac, three-phase, three-pole.
3. Enclosure: NEMA 250, Type 7.
4. Operator: External handle with padlocking provisions.
5. Manufacturer and Product: Eaton, Type B101.

D. Receptacles, General:

1. Contain integral switch which must be closed to energize circuit.
2. Design shall permit only an approved plug to be energized.
   a. Actuation of switch shall require plug be inserted and rotated approximately 45 degrees.
   b. Plug shall lock into this position preventing unintended disengagement.
   c. To remove, plug shall be turned opposite direction as engagement and pulled straight out.

E. General Purpose Receptacle, Explosion Proof, 125 Volts, 20 Amps:

1. Dead front, interlocked, circuit breaking.
2. Receptacle Cover: Spring loaded closes when plug is removed.

3. Enclosure: Corrosion-resistant, aluminum alloy with less than 0.4 percent copper.
4. Finish: Electrostatically applied and baked powder epoxy/polyester.
5. External Hardware: Type 316 stainless steel.
6. Switch Chamber: Factory sealed to contain switch's arcing components
7. Hazardous Area Ratings: Suitable for Class I, Division 2 NEMA 7D.
8. Provide matching plug with each receptacle.
9. Manufacturers and Products:
    a. Cooper Crouse-Hinds; Ark Guard 2, Series ENR.
    b. EGS/Appleton Electric; U-Line.
    c. Killark, a division of Hubbell Inc.; UGR/UGP.

F. Ground Fault Circuit Interrupter (GFCI), Explosion-Proof:

1. Meet requirements of general-purpose receptacle, except as otherwise indicated.
2. Hazardous Area Ratings: NEMA 7D suitable for Class I, Group C and Group D, Class 2, Groups F and G, and Class 3 locations.
3. Provide matching plug with each receptacle.
4. Manufacturers and Products:
    a. Killark; Acceptor series UGFI.
    b. Appleton; EFSXXX-2023GFI.

2.4 DEVICE PLATES

A. Sectional type plate not permitted.

B. Plastic:

1. Material: Specification grade, 0.10-inch minimum thickness, noncombustible, thermosetting.
2. Color: To match associated wiring device.
3. Mounting Screw: Oval-head metal, color matched to plate.

C. Metal:

1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
2. Finish: ASTM A167, Type 302/304, satin.
3. Mounting Screw: Oval-head, finish matched to plate.

D. Cast Metal:

1. Material: Malleable ferrous metal with gaskets.
2. Screw: Oval-head stainless steel.

E. Sheet Steel:

1. Finish: Zinc electroplate.
2. Screws: Oval-head stainless steel.
3. Manufacturers:
   a. Appleton.
   b. Crouse-Hinds.

F. Engraved:

1. Character Height: 1/8-inch.
2. Filler: Black.

G. Weatherproof:

1. Receptacle:
   a. Gasketed, cast-aluminum, with individual cap over each receptacle opening.
   b. Mounting Screw and Cap Spring: Stainless steel.
   c. Manufacturers and Products:
      1) Crouse-Hinds; Type WLRD-1.
      2) Appleton; Type FSK-WRD.
2. Switch:
   a. Gasketed, cast-metal or cast-aluminum, incorporating external operator for internal switch.
   b. Mounting Screw: Stainless steel.
   c. Manufacturers and Products:
      1) Crouse-Hinds; DS-181 or DS-185.
      2) Appleton; FSK-1VTS or FSK-1VS.

H. Raised Sheet Metal: 1/2-inch high zinc- or cadmium-plated steel designed for one-piece drawn type sheet steel box.

I. Sheet Steel: Formed sheet steel or Feraloy designed for installation on cast-metal box.

2.5 OCCUPANCY SENSOR, WALL SWITCH

A. Description:

1. Passive-infrared type, 120/277-volt, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 square feet (84 square meters).
2. Provide dual switch unit where indicated.
3. Color: Manufacturer's standard white.

B. Manufacturers and Products:

1. Hubbell; WS1277.
2. Leviton; ODS 10-ID.
3. Pass & Seymour; WS3000.
4. Watt Stopper (The); WS-200.

2.6 FINISHES

A. Wiring device catalog numbers specified in this section do not designate device color. Unless otherwise indicated, or required by code, provide colors as specified below.

B. Wiring Device:

1. Office Areas: Gray.
2. Other Areas: Gray.

C. Special purpose and hazardous location devices may be manufacturer's standard color (black).

D. Corrosion-resistant receptacle may be manufacturer's standard color (yellow).

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with NECA 1.

B. Coordination with Other Trades:

1. Ensure device and its box are protected. Do not place wall finish materials over device box and do not cut holes for box with router that is guided by riding against outside of box.
2. Keep outlet box free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate raceway system, conductors, and cables.
3. Install device box in brick or block wall such that cover plate does not cross a joint, unless otherwise indicated. Where indicated or directed to cross joint, trowel joint flush with face of wall.
4. Install wiring device after wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.

2. Strip insulation evenly around conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. Length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace devices that have been in temporary use during construction or that show signs they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (150 mm) in length.
5. Use torque screwdriver when a torque is recommended or required by manufacturer.
6. When conductors larger than 12 AWG are installed on 15-amp or 20-amp circuits, splice 12 AWG pigtails for device connections.
7. Tighten unused terminal screws on device.
8. Device Plates:
   a. Do not use oversized or extra deep plate.
   b. Repair wall finishes and remount outlet box when standard device plate does not fit flush or does not cover rough wall opening.

3.2 SWITCH INSTALLATION

A. Switch, General Purpose:

1. Mounting Height: See Section 26 05 33, Raceway and Boxes.
2. Install with switch operation in vertical position.
3. Install single-pole, two-way switch such that toggle is in up position when switch is on.

B. Switch, Motor Rated:

1. Mounting Height: See Section 26 05 33, Raceway and Boxes.
2. Install with switch operation in vertical position such that toggle is in up position when ON.
3. Install within sight of motor when used as disconnect switch.

C. Occupancy Sensor, Wall Switch: Install in accordance with manufacturer's instructions.

3.3 RECEPTACLE INSTALLATION

A. Duplex Receptacle:

1. Install with grounding slot down.
2. Ground receptacle to box with grounding wire only.
3. Weatherproof Receptacle:
    a. Install in cast metal box.
    b. Install such that hinge for protective cover is above receptacle opening.
4. Special-Purpose Receptacle: Install in accordance with manufacturer's instructions.

3.4 DEVICE PLATE INSTALLATION

A. Securely fasten to wiring device; ensure tight fit to box.

B. Flush Mounted: Install with all four edges in continuous contact with finished wall surface without use of mat or similar material. Plaster fillings will not be acceptable.

C. Surface Mounted: Plate shall not extend beyond sides of box, unless plate has no sharp corners or edges.

D. Install with alignment tolerance to box of 1/16 inch.

E. Engrave with designated title.

F. Type (Unless Otherwise Shown):

1. Office Areas: Plastic.
2. Other Areas: Metal.
3. Exterior:
    a. Switch: Weatherproof.
    b. Receptacle in Damp or Wet Locations: Weatherproof Type.

G. Interior:

1. Flush Mounted Box: Metal.
2. Surface Mounted, Metal Box:
    a. General Purpose Areas: Sheet Steel.
    b. Other Areas: Cast.
3. Surface Mounted, Aluminum Box:
    a. General Purpose Areas: Stamped.
    b. Other Areas: Cast.
4. Surface Mounted, Sheet Steel Box: Raised sheet steel.

5. Surface Mounted, Nonmetallic Box: Manufacturer's standard.

3.5 IDENTIFICATION

A. Use tape labels for identification of individual wall switches and receptacles in dry indoor locations.

1. Degrease and clean device plate surface to receive tape labels.
2. Use 3/16-inch Kroy black letters on white background, unless otherwise indicated.
3. Identify panelboard and circuit number from which item is served on face of plate.

B. Identify conductors with durable wire markers or tags inside outlet boxes where more than one circuit is present.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections, and prepare test reports.

B. Test Instrument for 125-Volt 20-Amp Receptacle: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

C. Using test plug, verify device and its outlet box are securely mounted.

D. Line Voltage Range: 105 volts to 132 volts.

E. Percent Voltage Drop under 15-Amp Load: Less than 6 percent; 6 percent or higher is not acceptable.

F. Ground Impedance: 2 ohms, maximum.

G. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

H. Tests shall be diagnostic, indicating damaged conductors, high resistance at circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

SECTION 26 36 23
AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C37.90.1, Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
2. National Electrical Manufacturers Association (NEMA):
   a. ICS 1, General Standards for Industrial Control and Systems: General Requirements.
   b. ICS 2, Industrial Control and Systems Controllers, Contactors, and Overload Relays not more than 2000 volts ac or 750 volts ac.
   c. ICS 6, Industrial Control And Systems: Enclosures 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
4. Underwriters Laboratories, Inc. (UL): 1008, Transfer Switch Equipment.

1.2 SUBMITTALS

A. Action Submittals:

1. Descriptive product information.
2. Dimensional drawings.
3. Control diagrams.
4. Equipment ratings.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
2. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

1.3 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ASCO.

B. Russelectric.

2.2 GENERAL

A. Transfer switch to be product of a single manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.

B. In accordance with applicable standards of NFPA 70, NEMA ICS 1, NEMA ICS 2, NEMA ICS 6, IEEE C37.90.1, and UL 1008.

C. Transfer switch consisting of inherently double-throw power switch unit with interconnected control module.

D. Rated 100 percent, in amperes, for total system transfer of motor, electric heating, discharge lamp loads, and tungsten-filament lamp loads.

1. Switches rated 400 amperes and below suitable for 100 percent tungsten-filament lamp loads.
2. Switches rated above 400 amperes suitable for 30 percent tungsten-filament lamp loads.

E. Main and arcing contacts visible for inspection with cabinet door and barrier covers removed.

F. Terminal plate with pressure contacts for solidly connected neutral conductors.

G. Neutral transfer contacts for switched neutral conductors.

H. Suitable for 480/277 volts, three-phase, four-wire, grounded-wye electrical service having an available short circuit current at line terminals of 30,000 amperes rms symmetrical.

I. Switch Rating: As shown on the Drawings with continuous amperes in nonventilated enclosure.

J. Current carrying capacity of arcing contacts shall not be used to determine the transfer switch rating.

K. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

L. Operating Conditions:

1. Ambient Temperature: Maximum 40 degrees C.
2. Equipment to be fully rated without any derating for operating conditions listed above.

2.3 ENCLOSURE

A. Type: Open for mounting in motor control center.

2.4 TRANSFER SWITCH

A. Type: Electrically operated, mechanically held, double-throw.

B. Momentarily energized, single-electrically operated mechanism energized from source to which load is to be transferred.

C. Locking mechanism to maintain constant contact pressure.

D. Time delay in neutral position.

E. Silver alloy contacts protected by arcing contacts.

F. Main and arcing contacts visible when door is open and barrier covers removed.

G. Manual operating handle for transfer in either direction under either loaded or unloaded conditions.

H. Internal control wire connections made with ring or spade type terminals, lock washers, and sleeve type marking labels.

2.5 CONTROL MODULE

A. Completely enclosed and mounted separately from the transfer switch unit.

B. Microprocessor for sensing and logic control with inherent digital communications capability.

C. Plug-in, industrial grade interfacing relays with dust covers.

D. Connected to transfer switch by wiring harness having keyed disconnect plug.

E. Plug-in printed circuit boards for sensing and control logic.

F. Adjustable solid state undervoltage sensors for all three phases of utility and for one phase of standby source:

1. Pickup 85 to 100 percent nominal.
2. Dropout 75 to 98 percent of pickup setting.

G. Adjustable frequency sensors for standby source:

1. Pickup 90 to 100 percent nominal.
2. Dropout 87 to 89 percent of pickup setting.

H. Control module with adjustable time delays:

1. 0.5- to 6-second engine start delay.
2. 0- to 5-minute load transfer to emergency delay.
3. 0- to 30-minute retransfer to normal delay.
4. 0- to 30-minute unload running time delay.
5. Switch to bypass any of the above time delays during testing.

I. Form-C start contacts, rated 10 amperes, 32-volt dc, for two-wire engine control, wired to terminal block.

2.6 METERING INSTRUMENTS

A. Meters to be connected to load side of transfer switch.

B. Ammeter: LED digital type with current transformers, three-phase, line-to-line, OFF, four-position selector switch.

C. Voltmeter: LED digital type with three-phase, line-to-line, OFF, four-position selector switch and 600-volt scale.

2.7 INDICATORS

A. Type: Manufacturer’s standard.

B. Green lens to indicate switch position for utility power source.

C. Red lens to indicate switch position for standby power source.

D. White lens to indicate utility power source is available within parameters established by pickup and dropout settings.

E. Amber lens to indicate standby power source is available within parameters established by pickup and dropout settings.

F. Provide one normally open and one normally closed, 5 amperes, 120-volt contact for remote indication when transfer switch is in either position.

2.8 FACTORY TESTS

A. Test to Ensure Correct:

1. Operation of individual components.
2. Sequence of operation.
3. Transfer time, voltage, frequency, and time delay settings.

B. Dielectric strength test per NEMA ICS 1.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mount within the motor control center.

END OF SECTION

SECTION 26 42 00
GALVANIC ANODE CATHODIC PROTECTION SYSTEM

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

A. The Contractor shall provide all labor, materials, tools, and incidentals to install a cathodic protection system for the new 16-inch dielectrically coated Ductile Iron Pipe (DIP), 24-inch and 48-inch Cement Mortar Lined and Tape Coated/Mortar Coated (CML&TCMC). The cathodic protection system shall include all electrical connections, anodes, test stations, insulators, and all accessories required for a complete and operable system. The Contractor shall provide all labor, materials, tools, and incidentals to install a cathodic protection system for the new buried metallic piping associated with the Morena Pump Station Package A Yard Piping including all electrical connections, anodes, test stations, insulators, enclosures, and all accessories required for a complete and operable system.

B. The Contractor shall retain a qualified Corrosion Engineer to direct the construction of facilities specified herein. The Corrosion Engineer shall test and certify that the corrosion control facilities for this project are constructed properly and as specified, and are fully functional.

1.2 DEFINITIONS

A. Contractor: The licensed prime installer selected by the City.

B. Owner: The City of San Diego.

C. Corrosion Engineer: A qualified Corrosion Engineer retained by the Contractor who is either a Registered Professional Corrosion Engineer or NACE-International Certified Cathodic Protection Specialist or Corrosion Specialist.

D. Engineer: The City of San Diego's Resident Engineer or designated representative.

E. City's Corrosion Engineer: The Engineer's appointed representative from the City's Corrosion Section.

1.3 CONTRACTOR QUALIFICATIONS

A. All work must be conducted by qualified, experienced personnel working under continuous, competent supervision. Cathodic protection installation and testing shall be done under the direct supervision of a Corrosion Engineer. The Contractor doing the electrical installations shall have proper valid State of California licenses.

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards:

1. A497 – Steel Welded Wire Reinforcement

2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

3. AWWA C217 - Wax Coating Systems for Underground Piping Systems
4. Green Book - Standard Specifications for Public Works Construction, 2015 edition
5. Mil-C-18480-B - Coating Compound, Bituminous, Solvent, Coal Tar Base
6. NACE SP0169 - Standard Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
7. NACE SP0286 - Electrical Isolation of Cathodically Protected Pipelines
8. NEMA LE - Cotton Phenolic Resin – Electrical Grade
9. NEMA CE - Canvas Phenolic Resin - General Purpose Grade
10. NEMA G10 – Glass Reinforced Epoxy
11. UL 514 - Metallic Outlet Boxes
12. Standard Specifications of Public Works Construction City Supplement (White Book) latest edition
13. Standard Drawings for Public Works Construction latest edition.

1.5 CONTRACTOR SUBMITTALS

A. The Contractor shall furnish the following documents (Submittals) AS ONE SUBMITTAL PACKAGE:

1. Catalog cuts and other information for products to be used including:
   a. Conduit and Fittings
   b. Wire, Leads, and Cable
   c. Anode Shunts
   d. Ready Mix Concrete
   e. Plastic Warning Tape
   f. Exothermic Weld Kits
   g. Elastomeric Weld Caps
   h. Exothermic Weld Coating
   i. At-Grade Concrete Test Box
   j. Phenolic Test Board
   k. Flange Isolation Kits
   l. Wax Tape Coating System
   m. Standard Potential Galvanic Anode
2. As-Built Drawings: The Contractor shall maintain as-built drawings showing the exact locations of anodes, test stations, insulators, and wire trenching runs. Location changes shall be clearly indicated in red on a copy of the design drawings. These drawings shall be submitted to the Engineer before the work is considered complete. Provide sub-foot GPS coordinates for all test stations.
3. Certifications: The Contractor shall submit a notarized affidavit of compliance that all Work, materials and equipment required according to

this Section were properly constructed and manufactured in full conformance with these Contract Documents. The Contractor shall submit the manufacturers' Certificates of Compliance.

B. Test and Inspection Reports: The Contractor shall submit field test and inspection reports. Testing reports shall include at a minimum: native or baseline pipe-to-soil potentials; electrical isolation testing, insulating flange kit testing, electrical continuity for all metallic pipe sections containing non-welded joints or inline specials not intentionally electrically isolated, cathodic protection system activation, any deficiencies; and conclusions and recommendations. The final testing report issued for this project shall include all previous testing results, approved material submittals, and as-built drawings. The reports shall be submitted in an electronic PDF format. In addition all tabulated calculated data shall be submitted as a Microsoft Excel file format.

D. Qualifications: The Contractor shall submit documentation of the qualifications of the Corrosion Engineer.

1.6 PACKAGING AND SHIPPING

A. The Contractor shall coil wires, secure and package anodes as required to prevent damage during shipment.

1.7 NOTIFICATION FOR TESTING AND INSPECTION

A. The Contractor shall notify the Engineer at least seven days in advance of the installation of anodes, insulators, wiring, and test stations. The Engineer or the Owner’s Representative shall witness all corrosion control installations at their discretion.

1.8 CORROSION ENGINEER QUALIFICATIONS SUBMITTAL

A. Services of Corrosion Engineer: Obtain the services of a Corrosion Engineer to inspect, activate, adjust, and evaluate the effectiveness of the cathodic protection system. The Corrosion Engineer is herein defined as a registered Professional Engineer with certification or licensing that includes education and experience in cathodic protection of buried or submerged metal structures, or a person accredited or certified by NACE International at the level of Corrosion Specialist or Cathodic Protection Specialist (i.e. NACE International CP Level 4). The Corrosion Engineer shall directly oversee the Cathodic Protection Technician, review all cathodic protection specification sections related inspections and field measurements, and certify the accuracy and completeness of all cathodic protection submittals and reports.

B. Services of Cathodic Protection Technician: Obtain the services of a Cathodic Protection Technician to inspect, activate, adjust, and evaluate the effectiveness of the cathodic protection system. The Cathodic Protection Technician is herein

defined as a person accredited or certified by NACE International as a Cathodic Protection Level 2 Technician.

PART 2 – PRODUCTS

2.1 CONDUIT, FITTINGS, AND ACCESSORIES

A. All below-grade wire shall be run in schedule 40 PVC conduit. All above-grade conduit shall be rigid galvanized steel.

B. Fittings: Fittings for use with rigid steel conduit shall be galvanized cast ferrous metal, with gasket covers. Rigid metallic conduit fittings shall be galvanized conforming to UL 514. Fittings for use with either rigid nonmetallic conduit shall be PVC and shall have solvent weld-type conduit connections.

C. Elbows: All buried conduit elbows shall be long radius ell type.

2.2 WIRES

A. General: Conform to applicable requirements of NEMA WC 70. All wires shall be single conductor, unless otherwise specified. All wires shall be single conductor, stranded copper wire with 600-volt HMWPE insulation, unless otherwise specified.

B. Joint Bond for DIP: Two No. 6 AWG HMWPE.

C. Joint Bond for CML&TC Steel Pipe: Two No. 2 AWG HMWPE

D. Test Station Pipeline Leads: No. 8 AWG HMWPE.

E. Galvanic Anode Leads: No. 12 AWG THWN (WHITE).

2.3 SHUNTS

A. Galvanic Anode Test Stations: The shunt resistance shall be such that a 2-Amp current causes a voltage drop of 200-millivolts (i.e. 0.10-ohms). Shunts shall be flat manganin ribbon style as manufactured by Cott or approved equal.

2.4 CONCRETE

A. Reinforcing steel: ASTM A615, Grade 60 deformed bars and welded wire fabric.

B. Welded Wire Fabric: ASTM A497.

C. Formwork: Plywood, earth cuts may be used.

D. Concrete with minimum 3,000 psi compressive strength at 28 days.

2.5 ANCILLARY MATERIALS

A. Electrical Tape: Linerless rubber high-voltage splicing tape and vinyl electrical tape suitable for moist and wet environments. Use Scotch 130C and Scotch 88 as manufactured by 3M Products.

B. Wire Connectors: One-piece, tin-plated crimp-on lug connector as manufactured by Burndy Co., Thomas and Betts.

C. Insulating Resin: At Contractor's option, bitumastic coating (Koppers 50 or equal) may be used if allowed to dry completely before covering.

2.6 MARKING TAPE

A. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.

B. Thickness: Minimum 4-mils.

C. Width: 6-inches.

D. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.

E. Color: Red with black lettering as follows: "CAUTION CATHODIC PROTECTION CABLES BURIED BELOW."

2.7 EXOTHERMIC WELDS

A. General: Wire sleeves, welders, and weld cartridges according to the weld manufacturer's recommendations for each wire size and pipe or fitting size and material. Welding materials and equipment shall be the product of a single manufacturer. Interchanging materials of different manufacturers will not be accepted.

B. Weld Caps: Exothermic welds shall be sealed with a pre-fabricated plastic cap filled with formable mastic compound on a base of elastomeric tape. Use Royston Handy Cap IP with integrated primer or approved equivalent.

C. Weld Coating: All bare metal shall be coated. Exothermic welds and weld caps shall be coated with a cold-applied, fast-drying mastic consisting of bituminous resin and solvents per MIL-C-18480B. Use Royston R28, Royston R28 Zero VOC, Royston A51 Plus, Royston A51 Low VOC, Tapecoat TC Mastic or approved equal.

2.8 AT-GRADE TEST STATIONS

A. At-Grade (Flush) Mounted:

B. Test Box: Concrete box of dimensions as shown on the Drawings. Use Brooks 3RT, Christy G-05, or approved equal, with a cast iron lid. The cast iron lid shall be South Bay Foundry Part #B1160 and #B6199 or approved equal and shall be cast with the letters "City of San Diego Corrosion Test Station".

C. Each CP Test Box shall include a 5 inch x 5 inch cross-laminated phenolic terminal board with a minimum thickness of 1/4-inch. The phenolic material shall be NEMA type CE or LE or phenolic grade xx. The terminal board shall contain individual electrical lugs for each wire entering the test station or junction box.

2.9 WAX TAPE COATING FOR BURIED SURFACES AND BURIED ISOLATION FLANGES

A. All buried pipe sections of pipe, specials, and fitting surfaces that are not tape wrapped or epoxy coated shall be wrapped with a petrolatum wax tape coating per

AWWA C217 with plastic outer wrap. No bare metallic surfaces shall be buried, backfilled, or in contact with the soil.

B. Apply a wax tape coating system which conforms to AWWA C217 and consists of three parts: surface primer, wax-tape, and outer covering.

C. The primer shall be a blend of petrolatum, plasticizer, and corrosion inhibitors having a paste like consistency. It shall have a pour point of 100-degrees F to 110-degrees F and a flash point of 350-degrees. Use Trenton Wax-Tape Primer, or approved equal.

D. The wax-tape shall consist of a synthetic-fiber felt, saturated with a blend of high melt microcrystalline wax, solvents, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces and which firms up after application. The tape shall have a saturant pour point between 125-degrees F and 130-degrees F and a dielectric strength equal to a minimum of 100-volts per mil. Tape thickness shall be 70-mils to 90-mils in 6-inch wide rolls. Use Trenton No. 1 wax-tape, or equal.

E. The outer covering shall consist of two layers of a plastic wrapper. The plastic wrapper material shall consist of three 10-mil thick clear polyvinylidene chloride, high cling membranes wound together as a single sheet. Use Trenton Poly-Ply, or equal.

2.10 STANDARD POTENTIAL MAGNESIUM ANODES

A. CAPACITY. Standard potential magnesium anodes shall have a theoretical energy content of 1000 ampere-hours per pound and have a minimum useful output of 500 ampere-hours per pound.

B. CHEMICAL COMPOSITION (STANDARD POTENTIAL MAGNESIUM) ASTM B843

aluminum	5.30 to 6.70 percent
manganese	0.15 to 0.70 percent
zinc	2.50 to 3.50 percent
copper	0.02 percent max
nickel	0.002 percent max
iron	0.003 percent max
silicon	0.10 percent max
others, total	0.30 percent max
magnesium	remainder

C. OPEN CIRCUIT POTENTIAL. The open circuit potential of all anodes, buried in the soil, shall be between 1.45 and 1.55 volts dc versus a copper-copper sulfate reference electrode.

D. INGOT SIZE AND WEIGHT. Anodes shall be 17-pound pre-packaged, standard potential ingots with a trapezoidal cross section. Ingot length shall be 25.25 inches long. The total packaged weight shall be 45 lbs.

E. ANODE CONSTRUCTION. Anodes shall be cast magnesium with a galvanized steel core rod recessed on one end to provide access to the rod for connection of the lead wire. Silver braze the lead wire to the rod and make the connection mechanically secure. Insulate the connection to a 600 volt rating by filling the recess with epoxy and covering any exposed bare steel core or wire with heat shrinkable tubing. The insulating tubing shall extend over the lead wire insulation by not less than 1/2 inch. The anode lead wire shall be stranded copper and shall be connected directly to the anode steel core as described above. There shall be NO wire splices between the anode steel core and the tag end at the test station.

F. ANODE PRE-PACKAGED BACKFILL MATERIAL. The anodes shall be completely encased and centered within a permeable cloth bag in a special low resistivity backfill mix with the following composition:

Gypsum	75%
Powdered bentonite	20%
Anhydrous sodium sulfate	5%

G. Backfill grains shall be such that 100 percent is capable of passing through a screen of 100 mesh. Backfill shall be firmly packed around the anode such that the ingot is approximately in the center of the backfill. The resistivity of the backfill shall be no greater than 50 ohm-cm when tested wet in a soil box. Total prepackaged weight shall be approximately 45 pounds.

2.11 PIPE FLANGE ISOLATION KIT

A. For purposes of this specification, the terms “Pipe Flange Isolation Kit”, “Insulating Flange”, “Insulating Joint”, and “Dielectric Flange” are used synonymously.

B. The Contractor shall over drill flange holes where insulating kits are to be used per AWWA C207 to accommodate insulating sleeves.

C. The Pipe flange isolation kit materials shall be designated by the manufacturer as suitable for service at the operating temperatures and pressures specified on the Plans.

D. Flange isolation kits shall consist of a one piece, full-face, insulating gasket, an insulating sleeve for each bolt, insulating washers, and steel washers. For nominal pipe diameters up to and including 36-inches, provide one insulating washer and one steel washer on each side of the flange for each flange bolt.

E. Insulating Gasket: Insulating gasket retainers shall be full face, Type E, NEMA G-10 glass reinforced epoxy retainers with an Ethylene Propylene Diene Monomer (EPDM) rubber rectangular cross section O-ring seal. Minimum total gasket thickness shall not be less than 1/8-inch. The gasket shall have the same outside diameter as the pipe flange. For steel pipe the gasket's inside diameter shall be equal to the inside diameter of the pipe's steel cylinder. At valve to pipe connections where the inside diameters are not equal, the gasket's inside diameter shall be equal to the smaller of the two inside diameters. Dielectric strength shall be not less than 550-volts per mil, and compressive strength shall be not less than 50,000-psi. The manufacturer's name and date of manufacture shall be marked on both sides of the gasket with minimum two-inch tall block letters using a durable marking ink or paint. The gasket shall be installed within 12 months of its date of manufacture. Do not store insulated flange gaskets at jobsites under direct sunlight or at temperatures exceeding 110 degrees Fahrenheit. Use PSI Linebacker insulating gasket, or approved equal.

F. Insulating Sleeves: Provide full length, one piece, NEMA G-10 glass reinforced epoxy insulating flange bolt sleeves. Dielectric strength shall be not less than 400-volts per mil. The length of the insulating sleeves shall provide an air gap between the end of the insulating sleeve and inside surface of the stud bolt nut with a tolerance of 1/32-inch minimum and 1/8-inch maximum. Insulating sleeve length must be adjusted for the actual thickness of the washers and insulating washer thickness.

G. Insulating Washers: Insulating washers shall be NEMA G-10 glass reinforced epoxy with a minimum thickness of 1/8-inch. Dielectric strength shall not be less than 550-volts per mil, and compressive strength shall not be less than 50,000-psi. The insulating washer's inside diameter shall be sized to fit over the insulating sleeve's outside diameter.

H. Steel Washers: Provide hardened steel washers that conform to ASTM F436 for insulated flanges greater than 36 inches in nominal diameter. Double steel washers (4 steel washers per flange bolt) are required for insulated flanges greater than 36 inches in nominal diameter. The inside and outside diameter of the steel washers shall match those of the insulating washers. The steel washers must be able to freely rotate around the insulating sleeve. Attention must be paid to the fit between the steel washers and the insulating sleeve in order to avoid the washers twisting and cracking the sleeves when the flange bolts are torqued.

I. Provide four extra insulating sleeves and eight extra insulating washers for each insulating flange upon successful inspection of the insulating flange by the Engineer.

J. Fill the internal groove between the two insulating flange faces with an

elastomeric sealant compatible with the host pipe lining. The elastomeric sealant shall be a non-sag, polyurethane based, sealant that is NSF approved for potable water contact. The elastomeric sealant shall be Sikaflex IA or approved equal.

PART 3 – EXECUTION

3.1 GENERAL

A. Work not specifically described herein shall conform to NACE SP0169, NACE SP0286, the Standard Specifications for Public Works Construction 2015 (Greenbook) and City Supplement White Book and Standard Drawings.

3.2 WIRE CABLES AND CONDUCTORS

A. Buried Wires, Cables and Leads: Buried pipeline, test station, or anode leads and conduits shall be at a 36-inch deep, minimum, below finished grade. Wires shall be free of splices. The Contractor shall compact wire trenches and re-pave in accordance with the Greenbook/Whitebook Standards.

B. Warning Tape: Bury warning tape in the trench 12-inches below grade and above underground conductors and conduits. Align parallel to and within 2-inches of the centerline of the conduit run.

3.3 CONDUITS

A. Securing Conduits: Secure conduits entering above-grade test station boxes with double locknuts, one on the outside and one on the inside.

B. Insulation Fittings: Install insulated bushings and insulated throat connectors on the ends of rigid metallic conduit.

C. Watertight Fittings: Use watertight couplings and connections. Install and equip boxes and fittings to prevent water from entering the conduit or box. Seal unused openings.

3.4 WIRE-TO-PIPE CONNECTIONS

A. Exothermic Weld:

1. Use exothermic weld method for electrical connection of copper wire to steel surfaces. Observe proper safety precautions, welding procedures, weld charge selection, and surface preparation recommended by the welder manufacturer. Assure that the pipe or fitting wall thickness is of sufficient thickness that the exothermic weld process will not damage the integrity of the pipe or fitting wall or protective lining. One exothermic weld shall be used for one wire only.

2. Preparation of Metal: Remove all coating, dirt, grime, and grease from the metal surface by wire brushing and/or use of suitable safe solvents. Clean the surface to a bright, shiny surface free of all pits and flaws. The surface must be completely dry.

3. Testing: After the weld connection has cooled, remove slag, visually inspect, and physically test wire connection by striking the weld with a 2-lb hammer while pulling firmly on the wire. All unsound welds shall be completely removed, the surface prepared again, and re-welded. All weld slag shall be removed from the weld before applying coating and weld cap.

B. Protective Coating: The Contractor shall furnish all materials, clean surfaces and repair any damage to protective coatings and linings damaged as a result of the welding. A coating shall be applied to all exothermic weld locations. The coating for dielectrically coated steel shall be as described in Section 2.11 above. All surfaces must be clean and dry and free of oil, dirt, loose particles and all other foreign materials before application of the coating. The coating must cure per the manufacturer's recommendations prior to backfill. The mortar rockshield shall be repaired per the manufacturer's recommendations.

3.5 MAGNESIUM ANODES

A. INSPECTION. All lead wires shall be inspected to ensure that the lead wire is securely connected to the anode core and that no damage has occurred to the lead wire. Lead wire failures shall require replacement of the complete anode and lead wire.

B. PRE-PACKAGED ANODE INSPECTION. Each anode shall be inspected to ensure that the backfill material completely surrounds the anode and that the cloth bag containing the anode and backfill material is intact. If the prepackaged anodes are supplied in a waterproof container or covering, that container or covering shall be removed before installation. The CONTRACTOR shall notify the ENGINEER at least seven (7) days in advance of installing the anodes.

C. LOCATION. Anodes are to be installed in augured holes as shown in the drawings. Anode positions can be adjusted slightly to avoid interference with existing structures. Alternate anode positions must be approved by the ENGINEER.

D. HANDLING. Care shall be taken to ensure that the anode is never lifted, supported, transported, or handled by the lead wire. All anodes shall be lowered into the hole using a sling or a rope.

E. ANODE HOLE SIZE AND DEPTH. Anodes shall be placed vertically at the bottom of a 12 feet deep augured hole, 12 inches in diameter (minimum).

F. SOAKING REQUIREMENTS, PRE-PACKAGED ANODES. Once the prepackaged anodes are in the hole, water shall be poured into the hole so that the anodes are completely covered with water. Allow the anodes to soak for a minimum of 30 minutes before any soil backfill is added.

G. SOIL BACKFILL. After the pre-packaged anodes are soaked, the hole is backfilled with stone-free, native soil. No voids shall exist around the anode bags and the

anode lead wire shall not be damaged. The backfill shall be tamped and compacted in 18 inch lifts above the anode taking care not to damage the anode lead wire.

3.6 AT-GRADE TEST STATIONS

A. LOCATION. Test boxes shall be located over the pipe where possible. Do not install in sidewalks, driveways, traffic lanes, or gutters. All test box locations shall be approved by the ENGINEER.

B. TEST BOX BOTTOM: Test boxes shall be set in native soil.

C. TEST LEAD ATTACHMENT. Test leads shall be attached to the pipe using the exothermic weld process. An 18-inch length of slack wire shall be coiled at each weld.

D. CONCRETE PAD. A 2-foot by 2-foot by 6-inch thick (2' X 2' X 6") reinforced concrete pad is required around each test station. Concrete pad shall extend 2-inches above grade and shall have a 2% slope.

3.7 EXTERNAL COATING

A. All insulating couplings shall be covered with a 3-layer wax tape coating system per AWWA C217 with plastic outer wrap. Additionally, all in-line valves, flanges couplings, and adapters that are not coated with a bonded dielectric coating shall be wax tape coated per AWWA C217 with plastic outer wrap.

B. Primer: Surfaces must be cleaned of all dirt, grime, and dust by using a wire brush and clean cloth. The surface shall be dry. Apply the primer by hand or brush. A thin coating of primer shall be applied to all surfaces and worked into all crevices. The primer shall be applied generously around bolts, nuts, and threads, and shall fully cover all exposed areas. The primer should overlap the pipe coating by a minimum of 3-inches.

C. Petrolatum Saturated Tape: The wax tape can be applied immediately after the primer. Short lengths of tape shall be cut and carefully molded around each individual bolt, nut, and stud end. For long bolts (such as in couplings), short lengths of tape shall be cut and circumferentially wrapped around each individual bolt. After the bolts are covered, the tape shall be circumferentially wrapped around the flange with sufficient tension to provide continuous adhesion without stretching the tape. The tape shall be formed, by hand, into all voids and spaces. There shall be no voids or gaps under the tape. The tape shall be applied with a 1-inch minimum overlap. Minimum thickness of 70 mils over flat surfaces. Minimum thickness of 140 mils over edges.

D. Outer Covering: A plastic outer cover shall be applied over the petrolatum-saturated tape. The plastic shall be a minimum of 50-guage (10-mils) and shall have two layers applied.

3.8 REBAR GROUND CABLE AT CONCRETE STRUCTURES

A. Minimum size #2 AWG, bare copper stranded grounding cable. The quantity of cable required should be sufficient to run two ground cables from a flush-to-grade concrete ground box down to two separate exothermic connections made to rebar inside each concrete encasement or major reinforced concrete structure. Locate the rebar ground text boxes adjacent to cathodic protection test boxes.

3.9 INSTALLATION OF FLANGE ISOLATION MATERIALS

A. Provide a minimum of five days advance notice to the Engineer before assembling insulated pipe flanges to allow for coordination and observance of its installation. The Engineer shall inspect the condition of the gasket's O-ring immediately before the gasket is installed to ensure it is free of cracks, dry rot, cuts, or other defects.

B. Install pipe flange insulating materials at the locations shown on the Plans. Install pipe flange insulating materials in accordance with the manufacturer's recommendations and NACE recommended practice SP0286, "Electrical Isolation of Cathodically Protected Pipelines. Particular attention shall be paid to properly aligning the flanges prior to inserting the insulating sleeves around flange bolts.

C. Prevent moisture, soil, or other foreign matter from contacting any portion of the insulated flange prior to or during installation. If moisture, soil, or other foreign matter contacts any portion of the insulated flange, disassemble it, clean with a suitable solvent and dry prior to reassembling. Follow the manufacturer's recommendations regarding the torque pattern of the bolts and the amount of torque to be used when installing the flange insulating kit. Do not use conductive grease on the flange bolts or any other flange components. Note: the following products have been tested for electrical conductivity and approved for use: Huskey 2000 Lubricating Paste & Anti-Seize compound, Triflow aerosol lubricant with Teflon additive, or approved equal.

D. All insulating flange kits that will be buried must be tested and approved by the City's Corrosion Engineer before burial. Failure to have written approval by the City before burial may require the contractor to re-excavate the insulating flange assembly for proper testing at the contractor's expense.

PART 4 – TESTING AND INSPECTION

4.1 General

A. The CP system shall be activated and adjusted by the Contractor's Corrosion Engineer. The Contractor is required to contact the City's Corrosion Section at

least 5 days in advance of all corrosion control/cathodic protection facility installations. The Engineer, City's Corrosion Engineer, or the Owner's Representative shall witness all testing and installations at their discretion. All test data shall be submitted to the City's Corrosion Engineer within seven (7) days of the completion of the testing. All testing shall be conducted under the supervision of a qualified Corrosion Engineer who is retained by the Contractor. All deficiencies found to be due to faulty materials or workmanship shall be repaired or replaced by the Contractor and at his/her expense.

4.2 TEST LEADS AND BOND WIRES

A. Responsibility: The Contractor shall be responsible for testing and inspecting all test leads, bond wires, and exothermic welds.

B. Test Method: All completed wire connections shall be tested by striking the weld with a 2-lb. Hammer while pulling firmly on the wire. Failed welds shall be completely removed, the surface re-prepared, and re-welded. Welds shall be spot tested by the Engineer. After backfilling, all test leads shall be tested using a standard ohmmeter.

C. Acceptance: The resistance between each pair of test leads shall not exceed 120% of the total wire resistance as determined from published wire data.

4.3 ANODE LEAD WIRE INSPECTION

A. Responsibility: The City's Corrosion Engineer will inspect each anode lead wire at the anode site. The Contractor shall assist the City's Corrosion Engineer and is responsible for inspecting/testing the anode lead wire insulation prior to storing and shipping.

B. Test Method: Inspection shall be visual and by feel, or by using a Holiday Tester. The Engineer shall inspect and run his or her hand along the full length of each anode lead wire cable just prior to installation in the well.

C. Acceptance: All anode lead wires shall be free of cuts, nicks, and abrasions. Cables with damage shall be rejected.

4.4 TEST LEAD TRENCHING AND BACKFILL

A. Responsibility: The Engineer, at his or her discretion, shall inspect wire trenches and backfill material and methods.

B. Test Method: The depth, trench bottom padding, and backfill material shall be visually inspected before backfilling.

C. Acceptance: Conformance with specifications.

4.5 CP TEST STATION WIRE INTEGRITY TESTING

A. Testing of Completed Welds: Exothermically welded wire-to-pipeline connections shall be inspected by the Engineer prior to backfilling the pipeline. At the Engineer's direction, tests to verify the soundness of the welds shall be conducted

by the Contractor. Tests for this purpose shall consist of striking the weld nugget with a 2-pound hammer while steadily pulling on the wire. Note that the wire near the weld shall not be unnecessarily cold worked during installation or testing. Remove and re-weld any welds that break loose or show signs of separating, as determined by the Engineer.

B. Wire Identification: The Engineer shall be given two day's advance notice to verify that buried pipe lead wires and anode lead wires are properly identified prior to backfilling the wires.

C. CP Test Wire Resistance Tests: After the pipeline is backfilled and the CP test wires are trenched to the CP Test Box or CP Monitoring Station, each pair of CP test wires shall be tested for integrity. The CP Technician shall measure the electrical resistance of one CP test wire to the pipeline and back on the second CP test wire. If more than twice the theoretical resistance of the total wire length installed is measured, the Contractor shall re-excavate the pipeline and replace or re-weld the CP test wires to the pipeline. Use the following copper wire unit resistance values to calculate the theoretical resistance of each pair of CP test wires.

1. No. 2 AWG wire 0.162 Ohms / 1000 feet
2. No. 4 AWG wire 0.258 Ohms / 1000 feet
3. No. 6 AWG wire 0.411 Ohms / 1000 feet
4. No. 8 AWG wire 0.653 Ohms / 1000 feet
5. No. 10 AWG wire 1.038 Ohms / 1000 feet
6. No. 12 AWG wire 1.650 Ohms / 1000 feet
7. No. 14 AWG wire 2.624 Ohms / 1000 feet

4.6 FLANGE ISOLATION KIT TESTING

A. Each buried insulating flange shall be tested for its electrical isolation effectiveness by and acceptable to the City's Corrosion Engineer prior to burial. The insulating flange shall be tested for electrical isolation before the wax tape coating is applied. Testing shall be performed and deemed as acceptable as described in the above grade testing procedure.

B. Each above grade or insulating flange within a vault shall be tested for its electrical isolation effectiveness. This testing shall be performed by the Contractor's Cathodic Protection Technician and witnessed by the City's Corrosion Engineer. The Contractor shall provide written notice of this testing to the Engineer a

minimum of two days in advance. If the insulated pipe flange will be buried, At the Engineer's option, the City of San Diego may repeat this testing during or immediately after the installation of the insulating flange. Replace or repair any insulated pipe flange that is determined to not meet the minimum electrical isolation requirements in this specification. The effectiveness of insulating flanges shall be determined using the following test techniques in the order shown until one of the criteria is achieved or as otherwise directed by the Engineer.

C. Electrical Potential Difference Test: Electrically bond the pipe on the vault or unburied side of the insulating flange to an electrical ground with a maximum resistance to remote soil of 5-Ohms. If the pipe on both sides of the insulating flange is mechanically connected to a minimum 50-feet of buried pipe, then the pipe does not need to be bonded to an electrical ground for this test. Measure the CP Potential of the pipe on both sides of the insulating flange using a copper/copper sulfate reference electrode. If the difference in CP Potentials is greater than or equal to 500-millivolts, the insulating flange is providing adequate electrical isolation. This test must be performed with all cathodic protection systems and anodes disconnected from the pipeline. If this criterion is not met, perform the Nilsson 400 Meter Direct Resistance Test to verify the effectiveness of the insulating flange.

D. Direct Resistance Test: Measure the electrical resistance across the insulated flange using a 97-Hertz square wave null balancing ohmmeter such as the Model 400 Nilsson Soil Resistance Meter and the four-wire resistance technique. A standard handheld digital multi-test meter's ohmmeter circuit (e.g. Fluke 97 or Beckman HD110) is not suitable for properly making these resistance measurements. Perform this test by connecting the meter's P1 and C1 terminals to one side of the insulating flange, using two wires, and then connecting the meter's P2 and C2 terminals to the other side of the insulating flange, using two additional wires. Use vise grips or temporary exothermic welds to make the wire connections to the flange or pipe. The criterion for a pipe filled with water is a minimum measurement of 5-Ohms. The criterion for a dry or a partially filled pipe is a minimum measurement of 100-Ohms. If none of the applicable criteria are met, perform the Inductive Ammeter Direct Resistance Test to verify the effectiveness of the insulating flange.

E. Inductive Ammeter Direct Resistance Test: Connect two separate wires via two separate connections to the pipe on both sides of the insulating flange. Use vise grips or temporary exothermic welds to make the wire connections. Use two pairs of test wires, one for current flow, one for voltage measurement. Using the first set

of test wires, apply a minimum 12-volt DC electrical current across the insulating flange. Using the second set of test wires, measure the voltage across the insulating flange developed by the DC current flow. Use an inductive ammeter hoop (e.g. Swain hoop) clamped around the pipe immediately adjacent to the insulating flange to measure the change in DC current flow in the pipe, through the insulated flange. Calculate the electrical resistance across the insulating flange in Ohms by dividing the change in DC Volts by the change in DC Amps (i.e. Ohm's Law). The criterion for a pipe filled with water is a minimum measurement of 5-Ohms. The criterion for a dry pipe is a minimum measurement of 100-Ohms. If either of the applicable criteria is not met, perform the NACE Insulating Flange Leakage Test, per NACE SP0286, to verify the effectiveness of the insulating flange.

F. NACE Insulating Flange Leakage Test: This test procedure shall conform to the "Leakage Test" described in the NACE Standard SP0286, Section 8, "Field Testing and Maintenance", Figure 12. The test current used shall be between 3 and 5 DC Amps. The criterion for a pipe filled with water is a maximum “electrical leakage value” of 10-percent of the test current. The criterion for a dry pipe is a maximum “electrical leakage value” of 5-percent of the test current.

G. Individual Flange Bolt Testing: For all insulated flanges to be buried and for all other insulating flanges that do not meet any of the other criteria, measure the electrical resistance of each flange bolt to both sides of the insulated flange using a Nilsson Model 400 Soil Resistance Meter and four-wire resistance technique. The measured resistance value for each flange through-bolt shall be a minimum of 1,000-Ohms, as measured from each bolt to both flanges. This criterion applies to the flange through-bolts and does not apply to valve cap bolts which are threaded on one side. Remove, inspect, and replace all dielectric flange bolt sleeves and washers that do not meet the minimum resistance criterion.

H. If an insulated flange with threaded cap bolts passes the resistance tests for all the “through-bolts” yet fails the other previous tests, remove all the threaded cap bolts, inspect and replace all imperfect dielectric flange bolt sleeve and washer materials and retest.

I. In order to make an accurate resistance measurement that passes any of these criteria it may be necessary to disable the pipe inside a vault, flow control facility, or pump station on one side of the insulated flange (or temporarily remove any electrically grounded appurtenances) so that the pipe is not grounded on one side of the insulated flange. This temporary change may eliminate an electrical path which interferes with making an accurate resistance measurement.

4.7 ELECTRICAL ISOLATION TESTING BETWEEN PIPE AND STEEL REINFORCEMENT

A. Prior to placing concrete, all pipe/wall/slab penetrations must be inspected by the City's Corrosion Engineer. Testing shall be performed and deemed acceptable as described herein. A seven-day notice is required before placing concrete.

B. Conduct visual and electrical testing at all steel pipe penetrations through reinforced concrete structures before and after the concrete is placed. This testing is required to demonstrate that all buried steel pipe is not in contact with any metallic objects embedded in the concrete wall or concrete slab including all of the following:

rebar

rebar tie wire

snap ties

shebolts

tie rods

taper ties

dowels

C. Perform this testing no more than 1 day before each concrete placement and no more than 1 day after each concrete placement. Correct all direct contacts detected between sections of pipe to be buried and concrete reinforcing components by trimming or repositioning the reinforcement components. If pipe to reinforcement contacts are detected after concrete is in place, use chipping hammers and other concrete demolition tools to remove as much concrete as is necessary to eliminate all metallic points of contact with the steel pipe. A representative from the City of San Diego, Water System Operations, Corrosion Section shall be notified a minimum of 7 days before the first pipe-vault penetration concrete is placed in order to witness and ensure proper electrical isolation. The failure for a new buried steel pipeline to pass this electrical isolation test may require concrete and reinforcing steel to be incrementally demolished by the contractor at no cost to the City of San Diego until the new pipeline passes the electrical isolation test.

D. Perform all electrical resistance measurements for this test using a 97-Hertz square wave null balancing ohmmeter such as the Nilsson Model 400 Soil Resistance Meter or the MC Miller Model 400A and the four-wire resistance technique to

compensate for the test wire and connection resistances. A standard handheld digital multi-test meter's ohmmeter circuit (e.g. Fluke 87) is not suitable for properly making these resistance measurements. Perform this test by connecting the meter's P1 and C1 terminals to the pipe, using two different wires and two different connections, and then connecting the meter's P2 and C2 terminals to the rebar, using two additional wires and connections. Use vise grips or temporary exothermic welds to make the wire connections to the pipe and rebar.

E. Rebar Ground Cable Connections at Pipe Encasements and Vault Penetrations: Select two exposed pieces of rebar separated by at least 2 feet that are wire tied to a minimum of 6 other perpendicular pieces of rebar for use as electrical ground reference test points. Using temporary connections such as vice grips or other compression clamps measure the electrical resistance between the two different pieces of rebar to ensure that the rebar test points are electrically continuous with the bulk of the rebar in the concrete structure. If either piece of rebar is not securely wire tied to all the other rebar in the encasement or vault, then the electrical resistance measurement will yield erroneous or misleading data. A maximum resistance of 0.10 Ohm between the two rebar test points is required before continuing with the electrical isolation test. Connect two unspliced lengths of minimum size #6 AWG bare copper stranded grounding cable to two different pieces of rebar. Each ground cable connection to the rebar shall be made with a separate exothermic weld or a separate mechanical compression ground clamp.

F. Direct Resistance Isolation Test: Testing shall first be performed using the Direct Resistance Test. Attach one pair of the resistance test leads to the pipe and one pair of resistance test leads to the rebar then measure the pipe to rebar resistance. If the resistance is 10 Ohms or more, the pipe is sufficiently electrically isolated from the rebar. If the test reading is less than 10 Ohms, proceed with the Steel Polarization Isolation Test described below.

G. Steel Polarization Isolation Test:

Step 1: Measure the baseline CP potentials of the buried pipeline and of the rebar using a stationary location for a copper sulfate reference electrode. Place the reference electrode in soil at an offset distance from the pipeline equal to approximately the length or width (whichever is greater) of the concrete structure under construction. If the difference between the readings of the pipe and rebar is 500 millivolts DC or more, that indicates sufficient electrical isolation. This test must be done with all nearby sources of cathodic protection electrical current turned off or disconnected, and with all welding equipment turned off. If the difference is

less than 500 millivolts DC, record the baseline CP Potentials and proceed to the next step.

Step 2: Set up a temporary DC power source such as a truck battery, a minimum 300 Watt, 2 to 4 Ohm, power rheostat, a calibrated electrical shunt, and two minimum #6 AWG test cables. Set up the DC power source with the positive cable connected to the rebar and the negative cable connected to the pipe. Initially adjust the rheostat for the largest resistance/smallest current and measure the current flow. Adjust the electrical power to a minimum current of 1 DC Amp, maximum of 10 DC Amps. Allow the DC current to flow for a minimum of 5 minutes then shut off the test current.

Step 3: Re-measure CP Potentials of the pipe and rebar using the same reference electrode in the same location with the test current off. These are called polarized CP potentials.

Step 4: Compare the polarized CP Potentials with the previously measured baseline CP Potentials. If the pipe is electrically isolated from the rebar, the test current will polarize the buried pipeline's steel cathodically (i.e. a more negative CP Potential) and shift the rebar anodically (i.e. a more positive CP Potential). If the difference between the polarized potentials of the pipeline and rebar is less than 300 millivolts DC there are one or more metallic contacts between the buried pipeline and the rebar. If the difference is 300 millivolts DC or greater the steel pipeline is sufficiently electrically isolated from the rebar.

H. In no case shall an electrical resistance measurement made with a hand held volt-ohm multimeter be accepted as an accurate isolation test procedure. In the event of a question regarding the electrical isolation of the pipeline, the Engineer shall make the final determination.

I. Electrical isolation tests shall be conducted for each pipeline encasement, each pipe to vault penetration, and any other reinforced concrete structure that a pipeline passes through. The electrical isolation tests must be performed by the City's Corrosion Engineer one day before concrete is placed, and the day after concrete is placed. The Engineer will witness the electrical isolation test conducted before the concrete is placed.

J. After the pipeline passes the rebar isolation test, direct bury the two bare copper ground cables connected to the rebar to a flush-to-grade concrete ground box near the pipe-vault penetration. Provide a cover for the test box marked "GROUND". Provide a minimum of two (2) feet of extra ground cable inside the rebar ground

test box. If there is a nearby cathodic protection test box, the rebar ground wires can be run into that box. If the rebar test wires are not long enough to reach the permanent test box, splice additional wire to them using two brass split bolts for each splice. No coating is required for the connections.

4.8 PIPELINE CONTINUITY THROUGH IN-LINE APPURTENANCES AND PIPE JOINTS

A. The CONTRACTOR'S CORROSION ENGINEER shall measure the linear resistance of sections of pipe in which in-line valves, non-welded pipe joints, or other flanged mechanical joints have been installed. All testing shall be done by the CORROSION ENGINEER in the presence of the ENGINEER.

B. TEST METHOD. Resistance shall be measured by the linear resistance method. A direct current shall be impressed from one end of the test section to the other (test station to test station). A voltage drop is measured for a given current level. The measured resistance (R) is calculated using the equation R=dV/I, where dV is the voltage drop between the test span and I is the corresponding current. The resistance shall be measured at least three (3) times for accuracy.

C. ALTERNATIVE METHODS. If other electrical continuity test methods are proposed, the CONTRACTOR shall prepare a written test procedure specifying the alternate method and equipment that will be used. A standard handheld digital multi-test meter's ohmmeter circuit (e.g. Fluke 87) is not suitable for properly making these electrical resistance measurements. Submit in writing the alternate proposed test method to the ENGINEER for approval a minimum of 30 days before the pipe laying begins. The alternative method must be acceptable to the City's Corrosion Engineer with written approval before being conducted by the Contractor.

D. ACCEPTANCE. Acceptance is a comparison between the measured resistance (from the field test data) and the theoretical resistance. The theoretical resistance must consider the pipe (length and wall thickness) and the resistance of the bond wires. The measured resistance shall not exceed the theoretical resistance by more than 120% to determine electrical continuity. The CONTRACTOR'S CORROSION ENGINEER shall submit, within seven (7) days of the completion of the testing, and in a report format, to the ENGINEER, all calculations of the theoretical resistance and measured pipe resistance for each section tested.

4.9 CATHODIC PROTECTION PERFORMANCE

A. Responsibility: The cathodic protection system shall be activated and tested by the Corrosion Engineer in the presence of the City's Corrosion Engineer. Upon completion of the performance testing, the Contractor shall adjust the level of protection in accordance with NACE SP0169 to a structure-to-electrolyte potential of –850 mV or more negative as measured with respect to a saturated copper/copper sulfate (CSE) reference electrode. This potential may be either a direct measurement of the polarized potential or a current-applied potential. Interpretation of a current-applied measurement requires consideration of the significance of voltage drops in the earth and metallic paths.

B. Test Method: Achievement of cathodic protection shall be accomplished by a pipe-to-soil potential survey at each test station of the pipeline. In the event that the full length of the pipeline has not been installed, then the extent of the survey shall be determined by the Engineer. Potential survey data shall include native pipe-to-soil potentials and instant-off pipe-to-soil potentials.

C. Acceptance Criterion for Steel Pipe With Dielectric Coating: The operation of the cathodic protection system for steel pipelines with a dielectric coating shall be tested to ensure that all portions of the buried pipeline are provided a full level of corrosion protection. The standard used to evaluate the CP potential measurements shall be as follows -0.850-VOLT CP Instant Off POTENTIAL - A negative voltage of at least -0.850-volt as measured between the buried pipeline and a copper sulfate reference electrode contacting the soil immediately over or adjacent to the pipeline in accordance with NACE SP0169. Determination of this voltage is to be made with the cathodic protection current momentarily interrupted. Voltage drops must be considered for valid interpretation of this voltage measurement.

4.10 COMPLIANCE WITH SPECIFICATIONS

A. Deficiencies: Any deficiencies or omission in materials or workmanship shall be rectified by the Contractor and at his expense. Deficiencies shall include, but not limited to: anode failures, electrical discontinuities, lack of electrical isolation, broken or missing test leads or test boxes, improper or unclean trench backfill, and other deficiencies associated with the workmanship, installation, and non-functioning equipment.

** END OF SECTION **

SECTION 26 43 00
TRANSIENT VOLTAGE SUPPRESSION

PART 1 GENERAL

1.1 SUBMITTALS

A. Submit product data on each suppressor type, indicating component values, part numbers, and conductor sizes. Include dimensional drawing for each, showing mounting arrangements.

B. Submit manufacturer's UL certified test data and nameplate data for each TVSS.

C. Submit electrical single-line diagram showing location of each TVSS.

1.2 QUALITY ASSURANCE

A. UL Compliance and Labeling:

1. For power and signal circuits, TVSS devices shall comply with UL 1449 and complimentary listed to UL 1283 as an electromagnetic interference filter. Provide units that are listed and labeled by UL.
2. For telephone circuit protection, TVSS devices shall comply with UL 497A.

B. ANSI Compliance: Use TVSS devices in compliance with the recommendations of IEEE C62.41.1, IEEE C62.41.2, and IEEE C62.45.

PART 2 PRODUCTS

2.1 GENERAL

A. All TVSS devices for power circuits, provided under this section, shall be the product of a single manufacturer.

B. TVSS devices shall be capable of performance at ambient temperatures between minus 40 degrees C and 60 degrees C, at relative humidity ranging from 0 percent to 95 percent, and at altitudes ranging from sea level to 12,000 feet.

C. TVSS devices shall be fused to disconnect the suppressor from the electrical source should the suppressor fail. The fusing shall allow full surge handling capabilities and to afford safety protection from thermal overloads and short circuits.

D. Design TVSS devices for the specific type and voltage of the electrical service. Single-phase and three-phase wye-configured systems shall have L-N, L-G, and N-G protection. Grounded delta-configured systems shall have L-L and L-G protection.

E. Power Filter: The TVSS shall include a high frequency extended range power filter complimentary listed to UL 1283 as an electromagnetic interference filter.

2.2 MANUFACTURER

A. Innovative Technology, VanGuard Series.

B. Advanced Protection Technologies, Inc.

C. General Electric.

2.3 MAIN DISTRIBUTION TVSS

A. Provide TVSS meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category C.

B. Surge current capacity shall be not less than the following:

1. L-N Capacity: 200 kA.
2. L-G Capacity: 120 kA.
3. N-G Capacity: 120 kA.

C. Suppressor housing shall be in an enclosure that has the same NEMA rating as the equipment it protects and painted to match.

D. UL 1449 maximum suppression voltage shall not be more than:

System Voltage	Phase	L-L or L-N Suppression Voltage
120	1	400
208Y/120	3	400
240	3	800
480Y/277	3	800

2.4 PANELBOARD TVSS

A. Provide TVSS meeting IEEE C62.41.1 and IEEE C62.41.2 Location Category B.

B. Surge current capacity shall be not less than the following:

1. L-L Capacity: 80 kA.
2. L-N Capacity: 80 kA.
3. L-G Capacity: 80 kA.
4. N-G Capacity: 80 kA.

C. Suppressor shall be in an enclosure that has the same NEMA rating as the panel it protects or the TVSS may be integral to a panelboard.

D. UL 1449 maximum clamp voltage shall not be more than:

System Voltage	Phase	L-L or L-N Clamp Voltage
120	1	400
208Y/120	3	400
240	3	800
480Y/277	3	800

2.5 ANNUNCIATION

A. Provide unit or separately mounted LED-type indication lights to show the normal and failed status of each module. Provide one normally open and one normally closed contacts which operate when the unit fails.

2.6 SURGE COUNTER

A. Provide each TVSS rated above 100 kA with a counter displaying the number of voltage transients that have occurred on the unit input. The counter shall be battery backed and retain the count through system power outages.

2.7 PAIRED CABLE DATA LINE INTERIOR SUPPRESSORS

A. Provide units meeting IEEE C62.41, Location Category A.

B. Use bi-polar 1,500-watt silicon avalanche diodes between the protected conductor and earth ground.

C. Provide units with a maximum single impulse current rating of 80 amperes (10 by 1,000 microsecond-waveform).

D. Breakdown voltage shall not exceed 36 volts.

2.8 PAIRED CABLE DATA LINE EXTERIOR SUPPRESSORS

A. Provide units meeting IEEE C62.41, Location Category A.

B. Suppressors shall be a hybrid design with a minimum of three stages, utilizing solid-state components and operating bi-directionally.

C. Suppressors shall meet or exceed the following criteria:

1. Maximum single impulse current rating of 10,000 amperes (8 by 20 microsecond-waveform).
2. Pulse Life Rating: 3,000 amperes (8 by 20 microsecond-waveform): 2,000 occurrences.
3. Maximum clamping voltage at 10,000 amperes (8 by 20 microsecond current waveform), shall not exceed the peak of the normal applied signal voltage by 200 percent.

PART 3 EXECUTION

3.1 APPLICATION REQUIREMENTS

A. Install TVSS when indicated on the Drawings and:

1. Main Distribution TVSS in each motor control center.
2. Panelboard TVSS in each distribution panelboard where a TVSS breaker is shown in the panel schedule.

B. Electronic Equipment Paired Cable Conductors: Install data line suppressors at the low voltage input and output of each piece of equipment, including telephone cable entrance.

1. Use secondary protectors on lines that do not exit the structure.
2. Use primary protectors on lines that exit and enter the structure.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install suppressors according to manufacturer's recommendations.

B. Install suppressors directly to the cabinet which houses the circuit to be protected so that the suppressor leads are straight and short, with all conductors laced, running directly to the point of connection within the panel, without loops or bends. If bends are unavoidable, no bend may exceed 90 degrees and bending radius may not be less than 6 inches.

C. Connecting wires shall be as short as possible with gently twisted conductors, tied together, to prevent separation. Connecting wires shall not exceed 24 inches in length at any point.

D. Field installed conductors shall be the same as specified for building wire, not smaller than No. 8 AWG and not larger than No. 4 AWG. Device leads shall not be longer than the length recommended by the manufacturer, unless specifically reviewed and approved by the manufacturer.

E. Provide dedicated disconnecting means for TVSS devices installed at motor control centers. Provide dedicated 30-60-ampere circuit breakers (size dependent upon wire size used) with number of poles as required, as disconnecting means for TVSS devices installed at panelboards. The interrupting capacity of the circuit breakers shall be that specified for the other breakers at that location.

END OF SECTION

SECTION 26 50 00
LIGHTING

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   c. A572/A572A, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
   d. A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel, with 50 ksi Minimum Yield Point to 4-in. Thick.
   e. A595/A595M, Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
   f. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   g. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   h. D6576, Standard Specification for Flexible Cellular Rubber Chemically Blown.
2. Canadian Standards Association (CSA).
3. Certified Ballast Manufacturer (CBM).
4. Federal Communications Commission (FCC).
5. Illuminating Engineering Society of North America (IESNA).
   a. HB-9, Lighting Handbook.
   b. LM-79, IES Electrical and Photometric Measurements of Solid-State Lighting Products.
   c. LM-80, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.
   d. RP (Recommended Practices) Series.
   e. TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources.
6. Institute of Electrical and Electronics Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

7. National Electrical Manufacturers Association (NEMA):
8. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
9. ICS 6, Industrial Control and Systems: Enclosures.
10. National Energy Policy Act.
11. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC) – Softbound Version.
12. Restriction of Hazardous Substances (RoHS)
13. Underwriters Laboratories, Inc. (UL):
    a. 773, UL Standard for Safety Plug-In Locking Type Photocontrols for Use with Area Lighting - Fourth Edition; Reprint with Revisions Through and Including March 08, 2002.
    b. 844, Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
    c. 924, Emergency Lighting and Power Equipment.
    d. 1310, UL Standard for Class 2 Power Units
    e. 1598, UL Standard for Safety Luminaires.
    f. 2108, UL Standard for Safety Low Voltage Lighting Systems - First Edition; Reprint with Revisions through and Including February 24, 2014.
    g. 8750, UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products - First Edition; Reprint with Revisions Through and Including April 1, 2015.
    h. Class P LED Driver Program
14. U.S. Environmental Protection Agency and U.S. Department of Energy: Energy Star.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. General:
        1) Provide catalog data sheets and pictures for all products listed below.
        2) Proposed Luminaire Substitutions (Interior and Exterior): Provide an electronic photometric file in standard '.ies' file format per the Illumination Engineering Society of North America (IESNA) for any proposed luminaire substitution not identified on the project Luminaire Schedule. Obtain file from the luminaire manufacturer or approved independent photometric testing laboratory. Include the proposed substitute luminaire with all options identified on the project Luminaire Schedule.
    b. Interior Luminaires:
        1) Catalog data sheets with pictures.

2) Luminaire material, finish, dimensions, and metal gauge.
3) Lens material, pattern, and thickness.
4) Candle power distribution curves in two or more planes.
5) Candle power chart 0 degree to 90 degrees.
6) Lumen output chart.
7) Average maximum brightness data in foot lamberts.
8) Coefficients of utilization for zonal cavity calculations.
9) Mounting or suspension details.

c. Exterior Luminaires:
1) Catalog data sheets with pictures. Luminaire material, finish, dimensions, and metal gauge.
2) Lens material, pattern, and thickness. Filters.
3) IESNA lighting classification (BUG rating).
4) Isolux diagram.
5) Lighting distribution data and lighting distribution classification type as defined in IESNA HB 9.
6) Fastening details to wall, pendant, or pole.
7) For light poles, submit catalog sheet, wind loading, pole deflection with fixture attached, total weight, all accessories, complete dimensions, and finish.
8) Brackets and supports.
9) Pole foundations.

d. LED Source Systems:
1) General:
a) IESNA LM-80 test reports.
b) IESNA TM-21 ratings.
c) Operating temperature range. Data sheet (chart/graph) describing life as a function of temperature.
d) Warranty: Light engine and driver.
e) Rated life.
f) Surge protection.
g) Thermal control device, heat sink.
h) Enclosure and wiring information.
i) Operating voltage range.
2) Electronic Module/Light Engine:
a) Correlated Color Temperature (CCT).
b) Color Rendering Index (CRI).
3) Drivers:
a) Input Current Total Harmonic Distortion.
b) Power factor.
c) Sound rating.
d) Dimming system information.

e. Time Switches:
1) Wiring diagram.
2) Contact ratings.

3) Functional features.
4) Programmable capabilities.
5) Enclosure type, dimensions.

f. Lighting Contactor:
1) Type (mechanically or electrically held).
2) Enclosure.
3) Contact ratings and configuration.
4) Coil operating voltage.

g. Outdoor Motion Sensors.

h. Emergency Shunt Relay.

i. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's printed installation instructions.
3. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

1.3 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.
2. Provide materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. in conformance with those standards and with an applied UL listing mark.

B. Standard Products:

1. Provide materials and equipment of manufacturers regularly engaged in the production of products specified in this section and that are of equal material, design, and workmanship.
2. Manufacturer shall have products that have been in satisfactory commercial or industrial use in similar applications under similar circumstances and of similar size.
3. Material and Equipment Manufacturing Date: Do not use products manufactured more than 3 years prior to date of delivery to Site.
4. Provide assembled fixture, complete with lamps, in accordance with California Code of Regulations Title 24 requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Aluminum Poles:

1. Provide manufacturer's standard protection for the finish during shipment and installation. At minimum, spirally wrap each pole shaft with protective paper secured with tape, and ship small parts in boxes.
2. Do not store poles on ground.
3. Support poles so they are at least 1 foot above ground level and growing vegetation.
4. Do not remove factory-applied pole wrappings until just before installing pole.
5. Ship poles with bolt circle template, base cover, handhold cover, and shaft cap or tenon.

PART 2 PRODUCTS

2.1 LUMINAIRES

A. Specific requirements relative to execution of the Work of this section are located in Luminaire Schedule on Drawings.

B. Provide luminaires and components tested, listed, and labeled by UL, or other approved testing agency.

C. Provide luminaires with Illumination Engineering Society of North America (IESNA) formatted photometric files, ".ies" format, certified by the luminaire manufacturer for use with lighting software.

D. Luminaire Labels:

1. External label per ANSI C136.15.
2. Internal label per ANSI C136.22.

E. Provide luminaires rated by the manufacturer to start and operate to their full lumen capacity for rated life of the luminaire at the minimum low and maximum high ambient temperatures as defined in the Contract Documents at their installation location.

F. Feed-through type, or separate junction box.

G. Wire Leads: Minimum 18 AWG.

H. Component Access: Accessible and replaceable without removing luminaire from ceiling.

I. Exterior Installations:

1. UL Labeled: SUITABLE FOR WET LOCATIONS.
2. Ballast: Removable, prewired.
3. When factory-installed photocells are provided, entire assembly shall have UL label.

J. Illuminated Exit Signs:

1. Body: As scheduled.
2. Face: Stencil.
   a. Letters:
      1) 6-inch high by 3/4-inch stroke.
      2) Color: As scheduled.
3. Mounting: As scheduled.
4. Directional Arrows: As indicated on Drawings.

K. Emergency Lighting Units:

1. Power Pack: Self-contained, 120/277-volt selectable input transformer, inverter/charger, sealed nickel cadmium battery, and indicator switch in accordance with UL 924.
2. Lighted, push-to-test indicator.
3. Capable of providing full illumination for 1-1/2 hours in emergency mode.
4. Capable of full recharge in 24 hours, automatically upon resumption of normal line voltage.
5. Capable of protecting against excess charging and discharging.
6. Emergency Self-Diagnostic System:
   a. Solid state device with LED display and audible alarm.
   b. Automatic and manual test unit.
   c. Test for malfunction of lamps, battery, and charger board.

L. Hazardous Classified Areas:

1. UL Labeled: CLASS I, DIVISION 2, GROUPS C AND D.
2. Fixture Enclosure and Fittings: Copper-free, cast aluminum in accordance with UL 844.

2.2 LED SOURCE SYSTEMS

A. General:

1. Provide IESNA LM-80 test reports.
2. Provide Energy Star compliance for solid state luminaires.

3. Listed To: UL 8750 Standard for Safety for Light Emitting Diode (LED) Equipment for use in Lighting Products.
4. Provide RoHS compliant LED light source(s) and driver(s).
5. Warranty: 5 years minimum.

B. Electronic Module/Light Engine:

1. Mount all components to a single plate and factory prewired with quick-disconnect plugs.
2. Include a driver, thermal control device, thermal protector device, and surge protector device.
   a. Provide surge protector tested in accordance with IEEE/ANSI C62.41.2 to Category C Low.
3. Provide LEDs mounted to a metal-core circuit board and aluminum heat sink for optimal thermal management and long life.
4. Light Engine Rating per TM-21: 100,000 at 25 degrees C, L70.
5. Correlated Color Temperature (CCT): As indicated on the Luminaire Schedule.
6. Color Rendering Index (CRI): Minimum of 80.

C. Drivers:

1. General Requirements for LED Driver: Output of the driver shall comply with UL Recognized Class 2 Power Supply requirement for use in dry or damp location.
2. Expected life of 100,000 hours at 25 degrees C.
3. Provide drivers mounted in an all metal can.
4. Operating Voltage Range: 50/60-Hz input source of 120V to 277V with sustained variations of plus or minus 10 percent voltage with no damage to the driver.
5. Input Current Total Harmonic Distortion: Less than 20 percent up to 50 percent of full load rating.
6. Power Factor: Greater than 0.90 for primary application up to 50 percent of full load rating.
7. Sound rating: Class A.
8. Comply with NEMA 410 for inrush current limits.
9. Dimming:
   a. Continuously dimmable from 10 percent to 100 percent.
   b. Provide driver compatible with standalone dimming controls and/or dimming systems used.
10. Comply with Reduction of Hazardous Substances (RoHS) compliant.

2.3 LIGHTING CONTROL

A. Relay Panels:

1. Where indicated on the drawings, provide a factory pre-assembled relay panel. The panel shall be for surface or flush installation, with a hinged door assembly as required.
2. The panel shall be factory pre-assembled; ETL certified to UL/CSA standards, with capacities for 1 pole or 2 pole relays as required.
3. Panel shall include the following pre-assembled and pre-wired:
4. Suitable divider separating class 1 and class 2 compartments
5. Control transformer, UL/CSA approved for class 2 circuits,
6. 8 or 16 single pole relays, or 4 or 8 2-pole relays as required to switch circuits shown on plans or schedules.
7. External control devices as required.

B. Relays:

1. Lighting control relays shall be mechanically latching and shall come complete with a manual ON/OFF switch. The mechanical switch shall continuously display the true state of the relay's internal contacts. Single pole relays shall be rated and UL/CSA listed for 120, 277and 347 VAC lighting loads at 20 amps.
2. Each lighting control relay shall be capable of controlling incandescent, fluorescent, electronic ballast and H.I.D. lighting loads and have an inrush capability of 3000 amperes. Relays shall be complete with a 5 year Manufacturer's Limited Warranty.
3. Lighting control relays shall include captive screw terminals for both the line voltage and the low voltage connections. Switching the relay shall be accomplished with ONE signal wire and a common return. The signal wire shall be able to signal ON and OFF and shall carry status current that indicates if the relay is ON or OFF.

C. Control Electronic:

1. The central controller shall be field adjustable and shall have the following features:
   a. 8 outputs; each individually programmable
   b. 7 assignable programs, 64 events per program
   c. 32 annual holiday schedules
   d. Power loss protection: 7 days for time & indefinite for program memory
   e. Astronomic programming
   f. Automatic daylight savings and leap year adjustment (selectable)

g. Time-out function. Controller shall be capable of monitoring connected relays. Should a relay be switched ON the output shall switch OFF after a preset time
h. Group override switch is supplied that can be set to switch all or some of the outputs ON or OFF.
i. Photometric sensor shall be connected to the control electronic to provide up to 8 independent channels of light level control. Sensor range is 1 to 6000 footcandles.

D. Wall Switches

1. Switch hardware shall mount to standard wall boxes.
2. Individual switches shall include an integral LED to indicate both ON and OFF states (red=ON, green=OFF).Switches can be connected directly to relays or to system switch inputs.
3. Switches shall have color coded captive screw terminals. Use #18 AWG solid conductors.

E. Outdoor Photosensor:

1. Provide where required an exterior photometric sensor capable of sensing from 1-60,000 lux. The sensor shall connect to the panel-mounted control unit using two #18 AWG wires.
2. One exterior sensor shall permit different relays to switch at different light levels. Lights shall be controlled by 'sensor only' or by a combination of time & light level.

2.4 EMERGENCY SHUNT RELAY

A. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

B. Coil Rating: 120/277V.

2.5 POLES

A. General:

1. Design for wind load as specified in Section 01 61 00, Common Product Requirements, while supporting luminaires and other appurtenances. Use effective projected areas (EPA) of luminaires and appurtenances in calculations specific to the actual products proposed on each pole.
2. Poles 40 feet and Shorter: One-piece construction.
3. Pole Height: As indicated on Luminaire Schedule.
4. Handhole:

a. Provide oval-shaped handhole having a minimum clear opening of 2.5 inches by 5 inches.
b. Secure cover with stainless steel captive screws.
c. Metal Poles: Provide an internal grounding connection accessible from handhole near bottom of each pole.

5. Do not install scratched, stained, chipped, or dented poles.

B. Aluminum Poles:

1. Manufactured of corrosion-resistant aluminum alloys. Seamless extruded or spun seamless type with minimum 0.188-inch wall thickness.
2. Shape: Roundand Straight.
3. Provide pole grounding connection designed to prevent electrolysis when used with copper ground wire.
4. Shaft Top: Fitted with cap.
5. Base:
   a. Anchor bolt mounted and machined to receive lower end of shaft.
   b. Welded joint between shaft and base.
   c. Base Cover: Cast aluminum alloy.
   d. Hardware, Except Anchor Bolts: either anodized aluminum alloy or stainless steel.
   e. Handhole.
6. Provide pole cast-in-place foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end.
7. Provide base covers to match pole and galvanized nuts and washers for anchor bolts.
8. Pole and Bracket Finish: Uniform satin finish to match fixture.

2.6 BRACKETS AND SUPPORTS

A. Features:

1. Not less than 1-1/4-inch aluminum secured to pole.
2. Slip-fitter or pipe-threaded brackets may be used, but coordinate brackets to luminaires provided. Provide identical brackets for use with one type of luminaire unless otherwise approved by Engineer.
3. Select brackets for pole-mounted street lights to correctly position luminaire no lower than mounting height indicated.
4. Mount brackets not less than 24 feet above street.
5. Provide special mountings or brackets as indicated on Drawings fabricated of metal which will not promote galvanic reaction with luminaire head.

2.7 POLE FOUNDATIONS

A. Anchor Bolts: Steel rod having a minimum yield strength of 50,000 psi; at minimum, galvanize the top 12 inches of the rod.

B. Concrete: As specified in Section 03 30 00, Cast-in-Place Concrete.

2.8 EQUIPMENT IDENTIFICATION

A. Manufacturer's Nameplate: Provide each item of equipment with a nameplate bearing manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; nameplate of distributing agent will not be acceptable.

B. Provide clear markings located to be readily visible to service personnel.

2.9 FACTORY FINISH

A. Provide electrical equipment with factory-applied painting systems that, at minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 LUMINAIRES

A. General:

1. Install in accordance with manufacturer's recommendations.
2. Provide proper hangers, pendants, and canopies as necessary for complete installation and meeting specified seismic requirements.
3. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building required to safely mount.
4. Install plumb and level.
5. Install each luminaire outlet box with galvanized stud.

B. Mounting:

1. General:
   a. Coordinate mounting, fastening, and environmental conditions with Section 26 05 02, Basic Electrical Requirements.
   b. Refer to Fastener Schedule in Section 05 50 00, Metal Fabrications.
2. Wall Mounted: Measure mounting heights from center of mounting plate to finished floor or finished grade, whichever is applicable.
3. Pendant Mounted:

a. Provide swivel type hangers and canopies to match luminaires, unless otherwise noted.
b. Space single-stem hangers on continuous-row fluorescent luminaires nominally 48 inches apart.
c. Provide twin-stem hangers on single luminaires.
d. Measure mounting heights from bottom of luminaire to finished floor or finished grade, whichever is applicable.

4. Pole Mounted:
   a. Provide cast-in-place concrete base.

C. Swinging Type: Provide, at each support, safety cable capable of supporting four times vertical load from structure to luminaire.

D. Finished Areas:

1. Install symmetrically with tile pattern.
2. Locate with centerlines either on centerline of tile or on joint between adjacent tile runs.
3. Install recessed luminaires tight to finished surface such that no spill light will show between ceilings and sealing rings.
4. Combustible Low Density Cellulose Fiberboard: Provide spacers and mount luminaires 1-1/2 inches from ceiling surface, or use fixtures suitable for mounting on low density ceilings.
5. Junction Boxes:
   a. Flush and Recessed Luminaires: Locate minimum 1-foot from luminaire.
   b. In concealed locations, install junction boxes to be accessible by removing luminaire.
6. Wiring and Conduit:
   a. Provide wiring of temperature rating required by luminaire.
   b. Provide flexible steel conduit.
7. Provide plaster frames when required by ceiling construction.
8. Independent Supports:
   a. Provide each recessed luminaire with two safety chains or two No. 12 soft-annealed galvanized steel wires of length needed to secure luminaire to building structure independent of ceiling structure.
   b. Select chain or wire with tensile strength and method of fastening to structure adequate to support luminaire weight.
   c. Fasten chain or wire to each end of luminaire.

E. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.

1. Fixture Suspension: Provide 1/4-inch threaded steel hanger rods. Scissor type hangers not permitted.
2. Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.

F. Building Exterior: Flush-mounted back box and concealed conduit, unless otherwise indicated.

3.2 EMERGENCY LIGHTING UNIT

A. Install in accordance with manufacturer's recommendations.

B. Provide permanent circuit connections with conduit and wire.

C. Connect to branch circuit feeding normal lighting in area ahead of all local switches.

D. Provide separate circuit wiring to luminaire.

3.3 POLES

A. Electrical Installations: Conform to IEEE C2 and requirements specified herein.

B. Pole Setting:

1. Depth: As indicated on Drawings or footing detail.

C. Aluminum Poles: Install according to pole manufacturer's instructions.

1. Provide cast-in-place concrete base.
2. Provide branch circuit in-line fuses in pole base handhole.

D. Grounding: Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 26 05 26, Grounding. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.4 FIELD FINISHES

A. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Paint as specified in Section 09 90 00, Painting and Coating.

3.5 FIELD QUALITY CONTROL

A. Upon completion of installation, verify equipment is properly installed, connected, and adjusted. Conduct an operating test to show equipment operates in accordance with the requirements of this section.

B. Coordinate lighting and controls installation and testing with commissioning as specified in Section 01 91 14, Testing, Integration, and Startup.

3.6 MANUFACTURER'S SERVICES

A. Lighting Control Panel:

1. Perform startup service.
2. Furnish manufacturer's representative at Job Site in accordance with Section 01 43 33, Manufacturers' Field Services, to inspect installation, test unit, and put into service.
3. Provide, at Owner's facility, training necessary to familiarize Owner's personnel with operation, use, adjustment, and problem solving diagnosis of occupancy sensing devices and systems.

3.7 CLEANING

A. Remove labels and markings, except UL listing mark.

B. Wipe luminaires inside and out to remove construction dust.

C. Clean luminaire plastic lenses with antistatic cleaners only.

D. Touch up painted surfaces of luminaires and poles with matching paint ordered from manufacturer.

E. Replace defective lamps at time of Substantial Completion.

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.1 DEFINITIONS

A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 6 inches below subgrade.

D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.

E. Stripping: Removal of topsoil remaining after applicable scalping is completed.

F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.2 SUBMITTALS

A. Action Submittals: Drawings clearly showing clearing, grubbing, and stripping limits.

1.3 QUALITY ASSURANCE

A. Obtain Engineer's approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. Clear, grub, and strip areas actually needed for waste disposal, borrow, or Site improvements within limits shown or specified.

B. Do not injure or deface vegetation that is not designated for removal.

3.2 LIMITS

A. As follows, but not to extend beyond Project limits.

1. Fill:
   a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
   b. Stripping 2 feet beyond toe of permanent fill.
2. Waste Disposal:
   a. Clearing: 10 feet beyond perimeter.
   b. Scalping and Stripping: Not required.
   c. Grubbing: Around perimeter as necessary for neat finished appearance.
3. Structures: 15 feet outside of new structures.
4. Roadways: Not required.

B. Remove rubbish, trash, and junk from entire area within Project limits.

3.3 TEMPORARY REMOVAL OF INTERFERING PLANTINGS

A. Remove and store, as specified in Section 32 93 00, plants, shrubs and trees that are not designated for removal but do interfere with construction or could be damaged by construction activities.

B. Photograph and document location, orientation, and condition of each plant prior to its removal. Record sufficient information to uniquely identify each plant removed and to assure accurate replacement.

3.4 CLEARING

A. Clear areas within limits shown or specified.

B. Fell trees so that they fall away from facilities and vegetation not designated for removal.

C. Cut stumps not designated for grubbing flush with ground surface.

D. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

E. Conform to Demolition Drawings for extent and location of tree and shrub removal.

3.5 GRUBBING

A. Grub areas within limits shown or specified.

3.6 SCALPING

A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.

B. Scalp areas within limits shown or specified.

3.7 STRIPPING

A. Do not remove topsoil until after scalping is completed.

B. Strip areas within limits to minimum depths shown or specified. Do not remove subsoil with topsoil.

C. Stockpile strippings separately from other excavated material.

3.8 TREE REMOVAL OUTSIDE CLEARING LIMITS

A. Remove Within Project Limits:

1. Dead, dying, leaning, or otherwise unsound trees that may strike and damage Project facilities in falling.

B. Cut stumps off flush with ground, remove debris, and if disturbed, restore surrounding area to its original condition.

3.9 DISPOSAL

A. Clearing and Grubbing Debris:

1. Dispose of debris offsite.
2. Burning of debris onsite will not be allowed.
3. Woody debris may be chipped. Chips may be sold to Contractor's benefit or used for landscaping onsite as mulch or uniformly mixed with topsoil, provided that resulting mix will be fertile and not support combustion. Maximum dimensions of chipped material used onsite shall be 1/4 inch by 2 inches. Dispose of chips that are unsaleable or unsuitable for landscaping or other uses with unchipped debris.
4. Limit offsite disposal of clearing and grubbing debris to locations that are approved by federal, state, and local authorities, and that will not be visible from Project.

B. Scalpings: As specified for clearing and grubbing debris.

C. Strippings:

1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil offsite.
2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

END OF SECTION

SECTION 31 23 13
SUBGRADE PREPARATION

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

1.2 DEFINITIONS

A. Optimum Moisture Content: As defined in Section 31 23 23, Fill and Backfill.

B. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

C. Relative Compaction: As defined in Section 31 23 23, Fill and Backfill.

D. Relative Density: As defined in Section 31 23 23, Fill and Backfill.

E. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil prior to placement of fill, roadway structure or base for floor slab.

F. Proof-Rolling: Testing of subgrade by compactive effort to identify areas that will not support the future loading without excessive settlement.

1.3 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Sections 02 41 00, Demolition; 31 10 00, Site Clearing; and 31 23 16, Excavation, prior to subgrade preparation.

1.4 QUALITY ASSURANCE

A. Notify Engineer when subgrade is ready for compaction or proof-rolling or whenever compaction or proof-rolling is resumed after a period of extended inactivity.

PART 2 PRODUCTS (NOT

USED) PART 3EXECUTION

3.1 GENERAL

A. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.

B. Bring subgrade to proper grade and cross-section and uniformly compact surface.

C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.

D. Maintain prepared ground surface in finished condition until next course is placed.

3.2 COMPACTION

A. Under Earthfill: Three passes with three-wheeled power roller weighing approximately 10 tons.

B. Under Earthfill: Compact upper 6 inches to minimum of 90 percent relative compaction as determined in accordance with ASTM D1557.

C. Under Structures: Compact upper 6 inches below the bottom of the structure foundations or slab-on-grade to minimum of 90 percent relative compaction as determined in accordance with ASTM D1557.

D. Under Pavement: Meet City of San Diego standard for pavement of city streets.

3.3 MOISTURE CONDITIONING

A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.

B. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten drying process.

3.4 TESTING

A. Proof-roll subgrade with equipment specified in Article Compaction to detect soft or loose subgrade or unsuitable material, as determined by Engineer.

3.5 CORRECTION

A. Soft or Loose Subgrade:

1. Adjust moisture content and recompact, or
2. Over excavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

B. Unsuitable Material: Over excavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.1 DEFINITIONS

A. Common Excavation: Removal of material not classified as rock excavation.

B. Rock Excavation:

1. General: Removal of solid material which by actual demonstration cannot, in Engineer's opinion, be reasonably loosened or ripped by single-tooth, hydraulically operated ripper mounted on crawler tractor in good condition and rated at minimum 410 flywheel horsepower; and which must be systematically drilled and blasted or broken by power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means prior to removal.
2. Trench: Removal of solid material which by actual demonstration cannot, in Engineer's opinion, be reasonably excavated with minimum 135-horsepower backhoe in good condition and equipped with manufacturer's standard boom, two rippers, and rock points or similar approved equipment; and which must be systematically drilled and blasted or broken by power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means prior to removal.
3. Term "rock excavation" indicates removal of solid material, as specified above, and does not necessarily correspond to "rock" as implied by names of geologic formations.
4. Removal of boulders larger than 1/2 cubic yard will be classified as rock excavation, if drilling and blasting or breaking them apart with power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means is both necessary and actually used for their removal.

1.2 SUBMITTALS

A. Informational Submittals:

1. Excavation Plan, Detailing:
   a. Methods and sequencing of excavation.
   b. Proposed locations of stockpiled excavated material.
   c. Proposed onsite and offsite spoil disposal sites.
   d. Numbers, types, and sizes of equipment proposed to perform excavations.
   e. Reclamation of onsite spoil disposal areas.

1.3 QUALITY ASSURANCE

A. Provide adequate survey control to avoid unauthorized over excavation.

1.4 WEATHER LIMITATIONS

A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.

B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.5 SEQUENCING AND SCHEDULING

A. Demolition: Complete applicable Work specified in Section 02 41 00, Demolition, prior to excavating.

B. Clearing, Grubbing, and Stripping: Complete applicable Work specified in Section 31 10 00, Site Clearing, prior to excavating.

C. Dewatering: Conform to applicable requirements of Section 31 23 19.01, Dewatering, prior to initiating excavation.

D. Excavation Support: Install and maintain, as specified in Section 31 50 00, Excavation Support Systems, as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 0.1 foot, except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.

B. Do not over excavate without written authorization of Engineer.

C. Remove or protect obstructions as shows and as specified in Section 01 50 00, Temporary Facilities and Controls, Article Protection of Work and Property.

3.2 UNCLASSIFIED EXCAVATION

A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

3.3 TRENCH WIDTH

A. Minimum Width of Trenches, unless otherwise shown on plans:

1. Single Pipes, Conduits, Direct-Buried Cables, and Duct Banks:
   a. Less than 4-inch Outside Diameter or Width: 18 inches.
   b. Greater than 4-inch Outside Diameter or Width: 18 inches greater than outside diameter or width of pipe, conduit, direct-buried cable, or duct bank.
2. Multiple Pipes, Conduits, Cables, or Duct Banks in Single Trench: 18 inches greater than aggregate width of pipes, conduits, cables, duct banks, plus 12-inch space between.
3. Increase trench widths by thicknesses of sheeting.

B. Maximum Trench Width: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to existing facilities, adjacent property, or completed Work. Pipe of greater strength or superior pipe bedding, when approved in writing by Engineer, may be used in lieu of maintaining the pipe widths shown or specified.

3.4 PIPE BEDDING GROOVES FOR NONPERFORATED DRAIN LINES

A. Semicircular, trapezoidal, or 90-degree-V.

B. Excavated or plowed into trench bottom. Forming groove by compaction will not be acceptable.

3.5 EMBANKMENT AND CUT SLOPES

A. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.

B. Remove stones and rock that exceed 3-inch diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.

C. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite or outside easements and rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.

3.6 STOCKPILING EXCAVATED MATERIAL

A. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.

B. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.

C. Confine stockpiles to within easements, rights-of-way, and approved work areas. Do not obstruct roads or streets.

D. Do not stockpile excavated material adjacent to trenches and other excavations, unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.

E. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

3.7 DISPOSAL OF SPOIL

A. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, offsite.

B. Dispose of debris resulting from removal of underground facilities as specified in Section 02 41 00, Demolition, for demolition debris.

C. Dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in Section 31 10 00, Site Clearing, for clearing and grubbing debris.

END OF SECTION

SECTION 31 23 19.01
DEWATERING

PART 1 GENERAL

1.1 SUBMITTALS

A. Informational Submittals:

1. Water control plan.
2. Well permits.
3. Discharge permits.
4. Water Level Elevations Observed in Observation Wells: Submit same day measured.
5. Settlement Benchmark Elevations: Submit weekly record.
6. Inflow Measurements: Submit weekly record.

1.2 WATER CONTROL PLAN

A. As a minimum, include:

1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply, means of measuring inflow to excavations, pollution control facilities, discharge locations to be utilized, and provisions for immediate temporary water supply as required by this section.
2. Drawings showing locations, dimensions, and relationships of elements of each system.
3. Design calculations demonstrating adequacy of proposed dewatering systems and components.
4. Shall meet dewatering standards described in the City's "WHITEBOOK" supplement to the Standard Specifications for Public Works Construction.

B. If system is modified during installation or operation revise or amend and resubmit Water Control Plan.

C. Water Control Plan should be prepared, reviewed and stamped by qualified and certified hydrogeologist in the state of California.

D. Data provided in the geotechnical reports, including boring logs and groundwater level measurements indicate the conditions at the borings and monitoring wells at the times and places indicated in the report. This information is not intended as a representation or warranty of continuity of conditions between borings nor the groundwater level at times other than

those reported. The owner is not responsible for interpretations or conclusions drawn by the contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. Continuously control water during course of construction, including weekends and holidays and during periods of work stoppages, and provide adequate backup systems to maintain control of water.

B. Remove and control water during periods when necessary to properly accomplish Work.

3.2 SURFACE WATER CONTROL

A. See Section 01 50 00, Temporary Facilities and Controls, Article Temporary Controls.
B. Remove surface runoff controls when no longer needed.

3.3 DEWATERING SYSTEMS

A. Provide, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry and to lower and maintain groundwater level a minimum of 5 feet below the lowest point of excavation. Continuously maintain excavations free of water, regardless of source, and until backfilled to final grade.

B. Dewatering systems shall include wells or well points, and other equipment and appurtenances installed outside limits of excavations and sufficiently below lowest point of excavation, or to maintain specified groundwater elevation.

C. Design and Operate Dewatering Systems:

1. To prevent loss of ground as water is removed.
2. To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.
3. To relieve artesian pressures and resultant uplift of excavation bottom.

D. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.

E. Provide 100 percent emergency power backup with automatic startup and switchover in event of electrical power failure.

F. Provide supplemental ditches and sumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering.

3.4 MONITORING WELLS

A. Monitoring Groundwater Levels: Install and monitor observation wells at locations selected by Engineer. Measure water levels observed in each observation well at least weekly and whenever system or component failures are discovered and whenever any event, including but not limited to flood, storms, changes in water surface elevation of nearby water bodies, may have caused a change in the groundwater elevation.

B. After groundwater level observation wells are no longer needed for monitoring groundwater levels, abandon observation wells, as required by regulations.

3.5 MONITORING FLOWS

A. Monitor volume of water pumped per calendar day from excavations, as Work progresses. Also monitor volume of water introduced each day into excavations for performance of Work. Monitor flows using measuring devices acceptable to Engineer.

3.6 DISPOSAL OF WATER

A. Obtain discharge permit for water disposal from authorities having jurisdiction.

B. Treat water collected by dewatering operations, as required by regulatory agencies, prior to discharge.

C. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.

D. Remove solids from treatment facilities and perform other maintenance of treatment facilities as necessary to maintain their efficiency.

3.7 PROTECTION OF PROPERTY

A. Make assessment of potential for dewatering induced settlement. Submit a settlement monitoring plan for review and approval based on the Dewatering methods selected.

B. Provide and operate devices or systems, including but not limited to reinjection wells, infiltration trenches and cutoff walls, necessary to prevent damage to existing facilities, completed Work, and adjacent property.

C. Securely support existing facilities, completed Work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

3.8 REMEDIATION OF GROUNDWATER DEPLETION

A. If dewatering reduces quantity or quality of water produced by existing wells, temporarily supply water to affected well owners from other sources. Furnish water of a quality and quantity equal to or exceeding the quality and quantity available to well owner prior to beginning the Work or as satisfactory to each well owner.

END OF SECTION

SECTION 31 23 23
FILL AND BACKFILL

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification applies for fill and backfill within the Morena Pump Station boundaries shown on the contract document.

B. The work of the Contractor covered by these specifications consist of furnishing labor and equipment and performing all operations necessary to remove deleterious and undesirable materials from area of grading, to properly prepare areas to receive fill, and to excavate and fill to the lines and grades shown on the plans or as directed in writing by the Geotechnical Engineer.

C. The Contractor shall perform the work in strict accordance with these specifications, and the Contractor shall be responsible for the quality of the finished product notwithstanding the fact that the earthwork may be observed and tested by a Geotechnical Engineer. Deviations from these specifications will be permitted only upon written authorization from the Geotechnical Engineer.

D. The data contained in the geotechnical study and in any following addenda indicating subsurface conditions are not intended as representations of warranties of the accuracy of continuity of subsurface conditions between explorations. The interpretations of conclusions drawn from such data shall be the responsibility of the Contractor.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D75, Standard Practice for Sampling Aggregates.
   b. D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   d. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   e. D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   f. D4829. Standard Test Method for Expansion Index of Soils.

g. D4318. Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
h. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
i. D6913. Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
j. D7928, Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.

1.3 DEFINITIONS

A. Geotechnical Engineer: shall mean a licensed civil engineer providing geotechnical engineering services to the project owner.

B. Owner: shall mean the owner of the project on whose behalf the earthwork is being performed and who has contracted with the Contractor to have the earthwork performed.

C. Relative Compaction:

1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D1556 or D6938 to laboratory maximum dry density as determined in accordance with ASTM D1557.
2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by Engineer.

D. Optimum Moisture Content:

1. Moisture content in percent as determined in accordance with ASTM D1557

E. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.

F. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.

G. Completed Course: A course or layer that is ready for next layer or next phase of Work.

H. Lift: Loose (uncompacted) layer of material.

I. Geosynthetics: Geotextiles, geogrids, or geomembranes.

J. Borrow Material: Material from required excavations or from designated borrow areas on site or imported to site.

K. Select Backfill Material: Materials available that Engineer determines to be suitable for specific use.

L. Imported Material: Materials obtained from sources offsite, suitable for specified use.

M. Structural Fill: Fill materials as required under structures, pavements, and other facilities.

1.4 SUBMITTALS

A. Action Submittals:

1. Samples:
   a. Imported material taken at source.

B. Informational Submittals:

1. Manufacturer's data sheets for compaction equipment.
2. Certified test results from independent testing agency.

1.5 QUALITY ASSURANCE

A. Notify Engineer when:

1. Fill or backfill operations will be undertaken at the Morena Pump Station site.
2. Structure or tank is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
3. Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed.
4. Fill material appears to be deviating from Specifications.

1.6 SEQUENCING AND SCHEDULING

A. Backfill against concrete structures only after concrete has attained compressive strength specified in the project plans. Obtain Engineer's acceptance of concrete work and attained strength prior to placing backfill.

B. Backfill around water-holding structures only after completion of satisfactory leakage tests as specified in project plans.

C. Do not place granular base, subbase, or surfacing until after subgrade has been prepared as specified in GreenBook Section 300.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

A. Gradation Tests:

1. Conduct as many tests as necessary to locate acceptable sources of imported material.
2. During production of imported material, test for gradation and plasticity.

B. Samples: Collected in accordance with ASTM D75:

1. Clearly mark to show source of material and intended use.

2.2 GENRAL FILL

A. Materials for compacted fill shall contain no rocks or hard lumps greater than 6 inches in maximum dimension and shall contain at least 40% of material smaller than ¼ inch in size. Material of a perishable, spongy, or otherwise improper nature shall not be used in fills.

B. Select soil to be used at finish grade to the depths and at the locations specified on the grading plans and in the geotechnical report - "Geotechnical Report, Pump Station Portion, Morena Pump Station, WW Force Main, and Brine/Centrate Conveyance Predesign (NC01), San Diego, California," prepared by AECOM, dated January 5, 2018 provided in supplementary special provisions section 2-7, shall consist of material that contains no rocks or hard lumps greater than 6 inches in maximum dimension and that has an Expansion Index of 30 or less when tested in accordance with ASTM D4829.

2.3 TRENCH BACKFILL

A. Trench backfill above pipe bedding shall be in accordance with Section 31 23 23.15.

2.4 BACKFILL AROUND BURIED TANKS

A. Wall backfill materials shall be in accordance with Section 300 of the GreenBook

2.5 WATER FOR MOISTURE CONDITIONING

A. Free of hazardous or toxic contaminates, or contaminants deleterious to proper compaction.

B. Fill shall be place at or up to 3 % above the optimum moisture content.

PART 3 EXECUTION

3.1 GENERAL

A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.

B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to a relative compaction that is indicated by test to not be less than 90 percent prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

C. Each lift shall be less than 8-inch loose lift or smaller.

D. Compaction of fill by jetting shall not be permitted.

E. During filling and backfilling, keep level of fill and backfill around each structure and buried tank even.

F. Do not place fill or backfill, if fill or backfill material is frozen, or if surface upon which fill or backfill is to be placed is frozen.

G. Utility pipes and conduits shall be placed in accordance with Section 306 of the GreenBook.

H. Tolerances:

1. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

I. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

3.2 BACKFILL UNDER AND AROUND STRUCTURES

A. Under Facilities: Within influence area beneath structures, slabs, pavements, curbs, piping, conduits, duct banks, and other facilities, backfill with select fill, unless otherwise shown. Place select fill in loose lifts of 8 inches maximum thickness and compact each lift to minimum of 90 percent relative compaction as determined in accordance with ASTM D1557**.**

B. Influence are beneath structures includes an area 5 feet horizontally beyond the building structure and within an inclined plane at 1:1 horizontal to vertical leading from the horizontal limit down and away from the structure.

3.3 BACKFILL AROUND TANKS

A. Backfill to top of tank, unless otherwise shown, with select fill and thoroughly water settle by saturating backfill and vibrating saturated backfill with a concrete vibrator inserted through full depth of backfill on 1-foot maximum centers.

B. Backfill above top of tank with general fill placed in 8-inch loose lifts. Compact each lift to minimum 90 percent relative compaction as determined in accordance with ASTM D1557,

3.4 SITE TESTING

A. Gradation:

1. One sample from each 1,000 cubic yards of finished product or more often as determined by Engineer, if variation in gradation is occurring, or if material appears to depart from Specifications.
2. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.
3. Remove material placed in Work that does not meet Specification requirements.

B. In-Place Density Tests: In accordance with ASTM D1556 or D 6938. During placement of materials, test per 500 cubic yards of material placed or as directed by Geotechnical Engineer

3.5 PAYMENT

A. Payment shall be per cubic yard of soil material placed.

END OF SECTION

SECTION 31 23 23.15
TRENCH BACKFILL

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Public Works Association (APWA): Uniform Color Code.
2. ASTM International (ASTM):
   a. C33/C33M, Standard Specification for Concrete Aggregates.
   b. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   c. C150/C150M, Standard Specification for Portland Cement.
   d. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
   e. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
   f. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
   g. D1140, Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75 micrometer) Sieve.
   h. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   i. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
   j. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   k. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   l. D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   m. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
3. National Electrical Manufacturers Association (NEMA): Z535.1, Safety Colors.

1.2 DEFINITIONS

A. Base Rock: Granular material upon which manhole bases and other structures are placed.

B. Bedding Material: Granular material upon which pipes, conduits, cables, or duct banks are placed.

C. Imported Material: Material obtained by Contractor from source(s) offsite.

D. Lift: Loose (uncompacted) layer of material.

E. Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or duct bank.

F. Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.

G. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D1557. Corrections for oversize material may be applied to either as-compacted field dry density or maximum dry density, as determined by Engineer.

H. Relative Density: As defined by ASTM D4253 and ASTM D4254.

I. Selected Backfill Material: Material available that Engineer determines to be suitable for a specific use.

J. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes producing a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids. Satisfying both of the following requirements, as defined in ASTM D2487:

1. Coefficient of Curvature: Greater than or equal to 1 and less than or equal to 3.
2. Coefficient of Uniformity: Greater than or equal to 4 for materials classified as gravel, and greater than or equal to 6 for materials classified as sand.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Manufacturer's descriptive literature for marking tapes.
2. Samples:
   a. Trench stabilization material.
   b. Bedding and pipe zone material.

c. Granular drain.
d. Granular backfill.
e. Earth backfill.
f. Sand(s).

B. Informational Submittals:

1. Catalog and manufacturer's data sheets for compaction equipment.
2. Certified Gradation Analysis: Submit not less than 30 days prior to delivery for imported materials or anticipated use for excavated materials, except for trench stabilization material that will be submitted prior to material delivery to Site.
3. Controlled Low Strength Material: Certified mix design and test results. Include material types and weight per cubic yard for each component of mix.

PART 2 PRODUCTS

2.1 MARKING TAPE

A. Nondetectable:

1. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.
2. Thickness: Minimum 5 mils.
3. Width: 6 inches.
4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
5. Manufacturers and Products:
   a. Reef Industries; Terra Tape.
   b. Mutual Industries; Non-detectable Tape.
   c. Presco; Non-detectable Tape.
   d. Or Approved Equal.

B. Detectable:

1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.
2. Foil Thickness: Minimum 0.35 mils.
3. Laminate Thickness: Minimum 5 mils.
4. Width: 6 inches.
5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
6. Joining Clips: Tin or nickel-coated furnished by tape manufacturer.
7. Manufacturers and Products:
   a. Reef Industries; Terra Tape, Sentry Line Detectable.

b. Mutual Industries; Detectable Tape.
c. Presco; Detectable Tape.
d. Or Approved Equal.

C. Color: In accordance with APWA Uniform Color Code.

Color*	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines
*As specified in NEMA Z535.1, Safety Color Code.	

2.2 TRACER WIRE

A. Material: Minimum 12-gauge solid copper or copper jacket with a steel core, with high-density polyethylene (HDPE) or high-molecular weight polyethylene (HMWPE) insulation suitable for direct bury.

B. Splices: Use wire nut or lug suitable for direct burial as recommended by tracer wire manufacturer.

C. Manufacturers:

1. Copperhead Industries, LLC.
2. Performance Wire & Cable Inc.
3. Pro-line Safety Products Company.

2.3 TRENCH STABILIZATION MATERIAL

A. Base Rock:

1. Clean, hard, durable 3-inch minus crushed rock or gravel, or pit run, free from clay balls, other organic materials, or debris.

B. Granular Backfill:

1. Clean gravel or crushed rock.
2. Maximum Particle Size: 1-inch.

3. Dry sand, accepted by Engineer, may be provided for trenches above maximum groundwater level.

2.4 BEDDING MATERIAL AND PIPE ZONE MATERIAL

A. Unfrozen, friable, and no clay balls, roots, or other organic material.

B. Clean or gravelly sand with less than 5 percent passing No. 200 sieve, as determined in accordance with ASTM D1140, or gravel or crushed rock within maximum particle size and other requirements as follows unless otherwise specified.

1. Duct Banks: 3/4-inch maximum particle size.
2. PVC Irrigation System Piping and Ductile Iron Pipe with Polyethylene Wrap: 3/8-inch maximum particle size.
3. Pipe Under 18-Inch Diameter: 3/4-inch maximum particle size, except 1/4 inch for stainless steel pipe, copper pipe, tubing, and plastic pipe under 3-inch diameter.
4. Pipe 18-Inch Diameter and Greater: 1-1/2-inch maximum particle size for ductile iron pipe, concrete pipe, welded steel pipe, and pretensioned or prestressed concrete cylinder pipe.
5. Perforated Pipe: Granular drain material.
6. Conduit and Direct-Buried Cable:
   a. Sand, clean or clean to silty, less than 12 percent passing No. 200 sieve.
   b. Individual Particles: Free of sharp edges.
   c. Maximum Size Particle: Pass a No. 4 sieve.
   d. If more than 5 percent passes No. 200 sieve, the fraction that passes No. 40 sieve shall be nonplastic as determined in accordance with ASTM D4318.

2.5 GRANULAR DRAIN MATERIAL (CLASS B)

A. Gradation: As follows:

Sieve Size	Percent Passing By Weight
1 inch	100
3/4 inch	90-100
3/8 inch	20-45
No. 4	0-10
No. 8	0-5

Sieve Size	Percent Passing By Weight
No. 200	0-2

2.6 EARTH BACKFILL

A. Soil, loam, or other excavated material suitable for use as backfill.

B. Free from roots or organic matter, refuse, boulders and material larger than 1/2 cubic foot, or other deleterious materials.

2.7 PROCESSED EARTH BACKFILL

A. Class A Backfill: Earth backfill, meeting the following additional requirement.

1. Free of boulders and cobbles that would be retained on a 3-inch sieve.
2. Cohesionless, free-draining material with 100 percent passing 3-inch sieve, at least 70 percent passing 1-1/2-inch sieve, and less than 15 percent passing No. 200 sieve.

2.8 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

A. Select and proportion ingredients to obtain compressive strength between 50 psi and 150 psi at 28 days in accordance with ASTM D4832.

B. Materials:

1. Cement: ASTM C150/C150M, Type I or Type II.
2. Aggregate: ASTM C33/C33M, Size 7.
3. Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618, except as modified herein:
   a. ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
4. Water: Clean, potable, containing less than 500 ppm of chlorides.

2.9 CONCRETE BACKFILL

A. Provide as specified in Section 03 30 00, Cast-in-Place Concrete.

B. Mix: ASTM C94/C94M, Option A.

1. Cement: ASTM C150/C150M, Type I or Type II.
2. Coarse Aggregate Size: 3/4 inch(es).
3. Design for Minimum Compressive Strength at 28 Days: 3000 psi.

2.10 GRAVEL SURFACING ROCK

A. As specified in Section 32 11 23, Aggregate Base Courses.

2.11 SOURCE QUALITY CONTROL

A. Perform gradation analysis in accordance with ASTM C136 for:

1. Earth backfill, including specified class.
2. Trench stabilization material.
3. Bedding and pipe zone material.

B. Certify Laboratory Performance of Mix Designs:

1. Controlled low strength material.
2. Concrete.

PART 3 EXECUTION

3.1 TRENCH PREPARATION

A. Water Control:

1. Promptly remove and dispose of water entering trench as necessary to grade trench bottom and to compact backfill and install manholes, pipe, conduit, direct-buried cable, or duct bank. Do not place concrete, lay pipe, conduit, direct-buried cable, or duct bank in water.
2. Remove water in a manner that minimizes soil erosion from trench sides and bottom.
3. Provide continuous water control until trench backfill is complete.

B. Remove foreign material and backfill contaminated with foreign material that falls into trench.

3.2 TRENCH BOTTOM

A. Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for bedding material if shown or specified.

B. Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify Engineer. Engineer will determine depth of over excavation, if any required.

3.3 TRENCH STABILIZATION MATERIAL INSTALLATION

A. Rebuild trench bottom with trench stabilization material.

B. Place material over full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.

C. Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

3.4 BEDDING

A. Furnish imported bedding material where, in the opinion of Engineer, excavated material is unsuitable for bedding or insufficient in quantity.

B. Place over full width of prepared trench bottom in two equal lifts when required depth exceeds 8 inches.

C. Hand grade and compact each lift to provide a firm, unyielding surface.

D. Minimum Thickness: As follows:

1. Pipe 15 Inches and Smaller: 4 inches.
2. Pipe 18 Inches to 36 Inches: 6 inches.
3. Pipe 42 Inches and Larger: 8 inches.
4. Conduit: 3 inches.
5. Direct-Buried Cable: 3 inches.
6. Duct Banks: 3 inches.

E. Check grade and correct irregularities in bedding material. Loosen top 1 inch to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe, conduit, direct-buried cable, or duct bank.

F. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.

G. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

3.5 BACKFILL PIPE ZONE

A. Upper limit of pipe zone shall not be less than following:

1. Pipe: 12 inches, unless shown otherwise.
2. Conduit: 3 inches, unless shown otherwise.
3. Direct-Buried Cable: 3 inches, unless shown otherwise.
4. Duct Bank: 3 inches, unless shown otherwise.

B. Restrain pipe, conduit, cables, and duct banks as necessary to prevent their movement during backfill operations.

C. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and duct banks installed in same trench.

1. Pipe 10-Inch and Smaller Diameter: First lift less than or equal to 1/2 pipe diameter.
2. Pipe Over 10-Inch Diameter: Maximum 6-inch lifts.

D. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by "walking in" and slicing material under haunches with a shovel to ensure voids are completely filled before placing each succeeding lift.

E. Do not use power-driven impact compactors to compact pipe zone material. After full depth of pipe zone material has been placed as specified, compact material by a minimum of three passes with a vibratory plate compactor only over area between sides of pipe and trench walls. Take care to avoid damaging pipe and pipe coating.

3.6 COMPACTION REQUIREMENTS

A. Compaction shall be accomplished by mechanical means. Consolidation by water settling methods such as jetting or flooding is prohibited.

B. If the backfill fails to meet the specified relative compaction requirements, the backfill shall be reworked until the requirements are met. All necessary excavations for density tests shall be made as directed by the inspector, and as acceptable to the Engineer. The requirements of the Agency having jurisdiction shall prevail on all public roads.

C. Compaction tests shall be performed at random depths, and at random intervals not to exceed 150 feet, as directed by the inspector or City.

D. Relative compaction shall be determined by the impact or field compaction test made in accordance with ASTM D 1557 Procedure C.

E. Unless otherwise shown on the Approved Plans, Standard Drawings or otherwise described in the Specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:

1. Pipe Zone – 90% relative compaction
2. Trench Zone – 90% relative compaction
3. Structural section in paved areas – per agency requirements, 95% minimum

4. Imported Granular Material for over excavation or foundation stabilization – 90% relative density

F. All excavations are subject to compaction tests.

3.7 MARKING TAPE INSTALLATION

A. Continuously install marking tape along centerline of buried piping, at depth of 2 feet. Coordinate with piping installation drawings.

1. Detectable Marking Tape: Install with nonmetallic piping and waterlines.
2. Nondetectable Marking Tape: Install with metallic piping.

3.8 TRACER WIRE INSTALLATION AND TESTING

A. Install tracer wire continuously along centerline of nonmetallic buried piping.

B. Attach wire to top of pipe using tape at maximum of 10-foot intervals. In areas where depth of cover is excessive for allowing detection of tracer wire with electronic pipe locator, install tracer wire within pipe backfill directly above pipe centerline at a minimum depth of 3 feet.

C. Install splices in accordance with manufacturer's instructions for direct bury applications. Tie ends of wire to be joined in a knot as required to reduce tension on splice.

D. Bring tracer wire to surface at each valve box, curb box, vault, air valve, blow off valve, hydrant, and pipeline marker. Tracer wire shall be brought to surface at least every 1,000 feet. If distance between pipe appurtenances exceeds 1,000 feet, install valve box to allow access to tracer wire. Mark valve box cover with the word "TRACER". Coil enough excess tracer wire at each appurtenance to extend wire 12 inches above ground.

E. Test continuity of tracer wire using electronic pipe locator in presence of Engineer prior to paving.

3.9 BACKFILL ABOVE PIPE ZONE

A. General:

1. Process excavated material to meet specified gradation requirements.
2. Adjust moisture content as necessary to obtain specified compaction.
3. Do not allow backfill to free fall into trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over top of pipe.

4. Do not use power driven impact type compactors for compaction until at least 4 feet of backfill is placed over top of pipe.
5. Backfill to grade with proper allowances for topsoil, crushed rock surfacing, and pavement thicknesses, wherever applicable.
6. Backfill around structures with same class backfill as specified for adjacent trench, unless otherwise shown or specified.

B. Class A Backfill (Native):

1. Place in lifts not exceeding thickness of 9 inches.
2. Mechanically compact each lift to a minimum of 95 percent relative compaction.

C. Concrete Backfill:

1. Place above bedding.
2. Minimum Concrete Thickness: 6 inches on top and sides of pipe.
3. Do not allow dirt or foreign material to become mixed with concrete during placement.
4. Allow sufficient time for concrete to reach initial set before additional backfill material is placed in trench.
5. Prevent flotation of pipe.
6. Begin and end concrete backfill within 4 inches of a pipe joint on each end.
7. Do not encase pipe joints except within the limits of the concrete backfill.

D. Controlled Low Strength Material:

1. Discharge from truck mounted drum type mixer into trench.
2. Place in lifts as necessary to prevent uplift (flotation) of new and existing facilities.

3.10 MAINTENANCE OF TRENCH BACKFILL

A. After each section of trench is backfilled, maintain surface of backfilled trench even with adjacent ground surface until final surface restoration is completed.

B. Gravel Surfacing Rock: Add gravel surfacing rock where applicable and as necessary to keep surface of backfilled trench even with adjacent ground surface, and grade and compact as necessary to keep surface of backfilled trenches smooth, free from ruts and potholes, and suitable for normal traffic flow.

C. Topsoil: Add topsoil where applicable and as necessary to maintain surface of backfilled trench level with adjacent ground surface.

D. Concrete Pavement: Replace settled slabs as specified in Section 32 13 13, Concrete Paving and Asphalt.

E. Asphaltic Pavement: Replace settled areas or fill with asphalt as specified in Section 32 13 13, Concrete Paving and Asphalt.

F. Other Areas: Add excavated material where applicable and keep surface of backfilled trench level with adjacent ground surface.

3.11 SETTLEMENT OF BACKFILL

A. Settlement of trench backfill, or of fill, or facilities constructed over trench backfill will be considered a result of defective compaction of trench backfill.

END OF SECTION

SECTION 31 32 19.16
GEOTEXTILE

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ASTM International (ASTM):
   a. D737, Standard Test Method for Air Permeability of Textile Fabrics.
   b. D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
   c. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
   d. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   e. D4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
   f. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   g. D4716, Test Method for Determining the (In-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
   h. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
   i. D4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
   j. D4884, Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles.
   k. D4886, Standard Test Method for Abrasion Resistance of Geotextiles (Sand Paper/Sliding Block Method).
   l. D5199, Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
   m. D5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
   n. D6193, Standard Practice for Stitches and Seams.

1.2 DEFINITIONS

A. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.

B. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile furnished.

C. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile furnished.

D. Nondestructive Sample: Sample representative of finished Work, prepared for testing without destruction of Work.

E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.

F. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D4884.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Manufacturer material specifications and product literature.
    b. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.
    c. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.
2. Samples:
    a. Geotextile: One-piece, minimum 18 inches long, taken across full width of roll of each type and weight of geotextile furnished for Project. Label each with brand name and furnish documentation of lot and roll number from which each Sample was obtained.
    b. Field Sewn Seam: 5-foot length of seam, 12 inches wide with seam along center, for each type and weight of geotextile.
    c. Securing Pin and Washer: One each.

B. Informational Submittals:

1. Certifications from each geotextile manufacturer that furnished products have specified property values. Certified property values shall be either minimum or maximum average roll values, as appropriate, for geotextiles furnished.
2. Field seam efficiency test results.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver each roll with sufficient information attached to identify it for inventory and quality control.

B. Handle products in manner that maintains undamaged condition.

C. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

1.5 SCHEDULING AND SEQUENCING

A. Where geotextile is to be laid directly upon ground surface, prepare subgrade as specified in Section 31 23 13, Subgrade Preparation, first.

B. Notify Engineer whenever geotextiles are to be placed. Do not place geotextile without Engineer's approval of underlying materials.

PART 2 PRODUCTS

2.1 WOVEN GEOTEXTILE

A. Composed of polymeric yarn interlaced to form planar structure with uniform weave pattern.

B. Calendared or finished so yarns will retain their relative position with respect to each other.

C. Polymeric Yarn: Long-chain synthetic polymers (polyester or polypropylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.

D. Sheet Edges: Selvaged or finished to prevent outer material from separating from sheet.

E. Unseamed Sheet Width: Minimum 6 feet.

F. Nominal Weight per Square Yard: Per ASTM D5261.

2.2 NONWOVEN GEOTEXTILE

A. Pervious sheet of polyester, polypropylene, or polyethylene fabricated into stable network of fibers that retain their relative position with respect to each other. Nonwoven geotextile shall be composed of continuous or discontinuous

(staple) fibers held together through needle-punching, spun-bonding, thermal-bonding, or resin-bonding.

B. Geotextile Edges: Selvaged or otherwise finished to prevent outer material from pulling away from geotextile.

C. Unseamed Sheet Width: Minimum**:** 6 feet.

D. Nominal Weight per Square Yard: Per ASTM D5261.

E. A: Nominal Thickness (mils): Per ASTM D5199.

2.3 SEWING THREAD

A. Polypropylene, polyester, or Kevlar thread.

B. Durability: Equal to or greater than durability of geotextile sewn.

2.4 SECURING PINS

A. Steel Rods or Bars:

1. 3/16-inch diameter.
2. Pointed at one end.
3. With head on other end sufficiently large to retain washer.
4. Minimum Length: 12 inches.

B. Steel Washers for Securing Pins:

1. Outside Diameter: Not less than 1.5 inches.
2. Inside Diameter: 1/4 inch.
3. Thickness: 1/8 inch.

C. Steel Wire Staples:

1. U-shaped.
2. 10 gauge.
3. Minimum Length: 6 inches.

PART 3 EXECUTION

3.1 LAYING GEOTEXTILE

A. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

3.2 SHEET ORIENTATION ON SLOPES

A. Orient geotextile with long dimension of each sheet parallel to direction of slope.

B. Geotextile may be oriented with long dimension of sheet transverse to direction of slope only if sheet width, without unsewn seams, is sufficient to cover entire slope and anchor trench and to extend at least 18 inches beyond toe of slope.

3.3 JOINTS

A. Unseamed Joints:

1. Overlapped.
2. Overlap, unless otherwise shown:
    a. Foundation/Subgrade Stabilization: Minimum 18 inches.
    b. Riprap: Minimum 18 inches.
    c. Drain Trenches: Minimum 18 inches, except overlap shall equal trench width if trench width is less than 18 inches.
    d. Other Applications: Minimum 12 inches.

B. Sewn Seams: Made wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by Engineer, also may be used instead of overlap at joints for applications that do not require stress transfer.

1. Seam Efficiency:
    a. Minimum 70 percent.
    b. Verified by preparing and testing minimum of one set of nondestructive Samples per acre of each type and weight of geotextile installed.
    c. Tested according to ASTM D4884.
2. Types:
    a. Preferred: “J” type seams.
    b. Acceptable: Flat or butterfly seams.
3. Stitch Count: Minimum three to maximum seven stitches per inch.
4. Stitch Type: Double-thread chainstitch according to ASTM D6193.
5. Sewing Machines: Capable of penetrating four layers of geotextile.
6. Stitch Location: 2 inches from geotextile sheet edges, or more, if necessary to develop required seam strength.

3.4 SECURING GEOTEXTILE

A. Secure geotextile during installation as necessary with sandbags or other means approved by Engineer.

B. Secure Geotextile with Securing Pins or Staples:

1. Insert securing pins with washers through geotextile.
2. Securing Pin Alignment:
   a. Midway between edges of overlaps.
   b. 6 inches from free edges.
3. Spacing of Securing Pins:

Slope	Maximum Pin Spacing
Steeper than 3:1	2 feet
3:1 to 4:1	3 feet
Flatter than 4:1	5 feet

4. Install additional pins across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.
5. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.
6. Where staples are used instead of securing pins, install in accordance with alignment and spacing above. Push in to secure geotextile firmly to subgrade.

3.5 PLACING PRODUCTS OVER GEOTEXTILE

A. Before placing material over geotextile, notify Engineer. Do not cover installed geotextile until after Engineer provides authorization to proceed.

B. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as specified in Article Repairing Geotextile.

3.6 INSTALLING GEOTEXTILE IN TRENCHES

A. Place geotextile in a way to completely envelope granular drain material to be placed in trench and with specified overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.

B. After granular drain material is placed to required grade, fold geotextile over top of granular drain material, unless otherwise shown. Maintain overlap until overlying fill or backfill is placed.

3.7 RIPRAP APPLICATIONS

A. Overlap geotextile at each joint with upstream sheet of geotextile overlapping downstream sheet.

B. Sew joints where wave run-up may occur.

C. Limit height of riprap fall onto geotextile to prevent damage.

1. Drop Height: 0 foot for greater than 200-pound rock.

3.8 GEOTEXTILE-REINFORCED EARTH WALL APPLICATIONS

A. Sew exposed joints; extend sewn seams minimum 3 feet behind face of wall.

B. Protect exposed geotextile from damage, ultraviolet light exposure, and deterioration until permanent facing is applied.

3.9 SILT FENCE APPLICATIONS

A. Install geotextile in one piece, or continuously sewn to make one piece, for full length and height of fence, including portion of geotextile buried in toe trench.

B. Install bottom edge of sheet in toe trench and backfill in a way that securely anchors geotextile in trench.

C. Securely fasten geotextile to wire mesh backing and each support post in a way that will not result in tearing of geotextile when fence is subjected to service loads.

D. Promptly repair or replace silt fence that becomes damaged.

3.10 REPAIRING GEOTEXTILE

A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile.

B. Repair Procedure:

1. Place patch of undamaged geotextile over damaged area and at least 18 inches in all directions beyond damaged area.
2. Remove interfering material as necessary to expose damaged geotextile for repair.
3. Sew patches or secure them with heat fusion tacking or with pins and washers, as specified above in Article Securing Geotextile, or by other means approved by Engineer.

3.11 REPLACING CONTAMINATED GEOTEXTILE

A. Protect geotextile from contamination that would interfere, in Engineer's opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

END OF SECTION

SECTION 31 45 19
STONE COLUMNS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of testing and material standards which all relevant work shall comply with:

1. ASTM D-1241 – Aggregate Quality.
2. ASTM STP 399 – Dynamic Penetrometer Testing (if applicable).
3. ASTM D-422 – Gradation Soils
4. ASTM D344 - Static Cone Penetration Testing (CPT)

B. Installation of Stone Columns shall comply with the following:

1. Contract Documents
2. Project geotechnical report – "Geotechnical Report, Pump Station Portion, Morena Pump Station, WW Force Main, and Brine/Centrate Conveyance Predesign (NC01), San Diego, California," prepared by AECOM, dated January 5, 2018 & Geotechnical Report Addendums 1 and 2 dated August 13, 2018 and December 20, 2018.
3. Form of contract between Owner and General Contractor, Owner and Installation Contractor, and General Contractor and Installation Contractor as appropriate.

1.2 .DEFINITIONS

A. Vibro-placement method: inserting a probe by vibrating means into the ground to densify surrounding soil and filling the void created with gravel or stone as the probe is withdrawn.

1.3 DESCRIPTION OF WORK

A. Work shall consist of designing, furnishing and installing materials, and constructing a ground improvement system at the locations noted on the drawings and as specified herein. Ground improvement system shall be vibro-placed stone columns.

B. Provision of all equipment, material, labor, and supervision to design and install stone columns shall be included in the work. Design shall rely on subsurface information presented in the project geotechnical report - "Geotechnical Report, Pump Station Portion, Morena Pump Station, WW Force Main, and Brine/Centrate Conveyance Predesign (NC01), San Diego, California," prepared by AECOM, dated January 5, 2018.

C. The Installer shall locate and protect underground utilities and above ground utilities and other structures from damage during installation of the stone columns.

D. The Installer shall comply with all Cal OSHA requirements for safety for the project.

1.4 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Stone column detail drawings sealed by a California licensed professional engineer, where required by California state professional engineering regulations.

2. Product Data:
   a. Aggregate source and gradation.

B. Informational Submittals:

1. Statement of qualifications for stone column installation contractor.

2. Installation and monitoring plan describing installation means and methods used by the installation contractor, including aggregate gradation and approximate weight of aggregate to be placed per volume of installation probe advanced per foot.

3. Test data - The installation contractor shall furnish the Owner's Geotechnical Engineer a description of the installation equipment, installation record, complete test data and analysis of the test data and recommended design parameter values based on the Test Section and Cone Penetration Test (CPT) data results. The report shall be prepared under supervision of a California registered professional engineer.

4. Daily Progress Reports – The Installer shall furnish a complete and accurate record of stone column installation to the General Contractor. The record shall indicate the pier location, length, average lift

thickness and final elevations of the base and top of piers. The record shall also indicate the type and size of the densification equipment used. The Installer shall immediately report any unusual conditions encountered during installation to the General Contractor, the Designer and the Owner.

5. Verification Test Results – The Installer shall provide CPT results for the post-installation subsurface conditions to the Owner's Geotechnical Engineer to evaluate the ground improvement at the site.

6. Monitoring plan – The Installer shall provide a monitoring plan for nearby structures, including the Army Corps of Engineers levee to the south of the project, to monitor for settlement or lateral movement during installation of the stone columns. The monitoring plan shall be submitted to the Owner's geotechnical engineer for approval prior to stone column installation.

1.5 TEST SECTION

A. A test section at least 40 feet by 40 feet in plan dimension shall be installed prior to production installation of the stone columns at the site.

B. Two CPTs shall be advanced for the test section to evaluate the subsurface conditions to verify ground improvement for the stone column installation method. Results of the CPTs shall be submitted and reviewed by the Owner's Geotechnical Engineer prior to installation of the stone columns at the site.

1.6 STONE COLUMN DESIGN

A. The stone column design shall be verified by the results of the CPTs and the evaluation of liquefaction potential.

B. Stone Columns shall be designed in accordance with generally-accepted engineering practice and the methods described in Section 1 of these Specifications. The design shall meet the following criteria.

1. Minimum Stone column area coverage for test section: 40 foot by 40 foot grid pattern as shown in the drawings.
2. Minimum depth of stone columns as shown on plans.
3. Estimated post-liquefaction settlement after ground improvement: less than 2 inches.

C. The design submitted by the Installer shall consider the bearing capacity and settlement of all footings supported by stone columns, and shall be in accordance with acceptable engineering practice and these specifications. Total and differential settlement shall be considered.

D. The stone column system shall be designed to preclude plastic bulging deformations at the top-of–pier design stress and to preclude significant tip stresses. The results of the CPT tests shall be used to verify the design assumptions.

1.7 DESIGN SUBMITTAL:

A. The Installer shall submit one (1) set of detailed design calculations, construction drawings, and shop drawings, (the Design Submittal), for approval at least three (3) weeks prior to the beginning of construction. A detailed explanation of the design parameters for stone column spacing, diameter, and aggregate gradation shall be included in the Design Submittal. Additionally, the quality control test program for stone columns, meeting these design requirements, shall be submitted. All computer-generated calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in California.

1.8 QUALITY ASSURANCE

A. Qualifications:

Installer: Where required by state professional engineering regulations, ground improvement design shall be designed by an engineer licensed in the state of California.

1.9 QUALITY CONTROL REPRESENTATIVE

A. Installer shall have a full-time Quality Control (QC) representative to verify and report all QC installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the Design Engineer, the General Contractor, and to the Owner

B. Stone column installation shall be monitored by an on board computer monitoring system. Monitoring system shall log stone column number, time of installation, depth, hydraulic pressure applied during the boring process and during the compacting process. Recorded data for each stone column shall be plotted depth/pressure versus time. Installation records for each shall be made available upon request in electronic format within 24 hours of installation.

C. The QC procedures shall include the preparation of Stone Column Progress Reports completed during each day of installation and containing the following information:

1. Footing and stone column location.
2. Stone column length and drilled diameter (if pre-drilled).

3. Planned and actual stone column elevations at the top and bottom of the element.
4. Average lift thickness for each stone column.
5. Soil types encountered at the bottom of the stone column and along the length of the element.
6. Depth to groundwater, if encountered.
7. Documentation of any unusual conditions encountered.
8. Type and size of densification equipment used.

1.10 QUALITY CONTROL VERIFICATION PROGRAM

A. The installer shall be responsible for performing CPTs for the verification program to assure the quality of the construction. The program shall verify that the installed ground improvement system satisfies the performance requirements noted on the contract plans and the design requirements determined by the ground improvement system designer. At a minimum, the verification program shall include the following:

1. Quality control program to verify that the ground improvement system is installed in accordance with the designer's specifications and the requirements in this special provision. The quality control program shall include testing and observations employed by the ground improvement installer.
2. Perform CPTs at a minimum spacing of 40 feet in each direction.
3. CPT results to be submitted to the Owner's Geotechnical Engineer to evaluate the calculated post-liquefaction settlement after ground improvement.

1.11 RESPONSIBILITIES OF GEOTECHNICAL ENGINEER & INDEPENDENT ENGINEERING TESTING AGENCY

A. The Owner's Geotechnical Engineer shall review and approve the Installer's Design Submittal.

B. The Owner's Geotechnical Engineer shall monitor the installation of stone columns to verify that all work is performed in accordance with the approved Design Submittal.

C. The Owner's Geotechnical Engineer shall report any discrepancies to the Installer and General Contractor immediately.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate used for piers shall be selected by the installation contractor and be approved by the Owner's Geotechnical Engineer.

B. Potable water or other suitable source shall be used to increase aggregate moisture content where required. Access to water on site shall be provided by the Installer.

C. Installer to coordinate adequate and suitable marshalling areas on the project for the use of the Installer for the storage of aggregate and equipment.

PART 3 EXECUTION

3.1 STONE COLUMN

A. Install stone columns with a down-hole vibrator capable of densifying the aggregate by forcing it radially into the surrounding soil. The vibrator shall be of sufficient size and capacity to construct stone columns to the diameters and lengths shown on the installers approved drawings.

B. The probe and follower shall have visible markings at regular increments to enable measurement of penetrations depths.

C. The probe and follower tubes shall be of sufficient length to reach the elevations shown on the installer's approved construction drawings. The probe, used in combination with the available pressure to the tip jet shall be capable of penetration to the required tip elevation. Preboring shall be permitted if it is specified in the installer's approved construction procedure submittal.

D. Provide methods for supplying to the tip of the probe a sufficient quality of air or water to widen the probe hole to allow adequate space for stone backfill placement around the probe.

E. The probe shall penetrate into the foundation soil layer to the minimum depths required in the project drawings.

F. Lift thickness shall not exceed 4 feet. After penetration to the treatment depth, slowly retrieve the vibrator in 12-inch to 18-inch increments to allow backfill placement.

G. Compact the backfill in each lift by repenetrating it at least twice with the vibrating probe to densify and force the stone into the surrounding soil.

H. Install stone columns so that each completed column is continuous through its length.

3.2 PLAN LOCATION AND ELEVATION OF STONE COLUMN

I. The center of each stone column shall be within six inches of the plan locations indicated. The final measurement of the top of piers shall be the lowest point on the aggregate in the last compacted lift. Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

J. The probe and follower tubes shall not be inclined more than 3 degrees from vertical during installation.

3.3 REJECTED STONE COLUMN

A. Stone columns improperly located or installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the Designer approves other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner.

END OF SECTION

SECTION 31 45 20
JET GROUTING

PART 1 GENERAL

1.1 SCOPE, PROJECT OBJECTIVES AND JOB SITE CONDITIONS

A. SCOPE

1. This Section specifies requirements for furnishing all labor, equipment, materials, and supplies necessary for soil stabilization ground improvement by jet grouting as required to meet the project objectives specified herein.

2. The work shall consist of installing, monitoring and testing of Jet Grout within the limits indicated beneath Diversion Structures 1,2, 3, and Junction Structure 1.

3. In connection with the Jet Grouting program, as shown on the drawings, the Jet Grouting Contractor shall provide all labor, materials and equipment to accomplish the following items of work:
   a. Mobilization & Demobilization
   b. Drilling
   c. Jet Grouting
   d. Quality Control/Quality Assurance and verification
   e. Spoil containment, collection and disposal.

4. This section is intended for a performance type specification in so far that the Contractor shall be responsible for selecting jet grouting parameters, equipment, and construction methods of the Jet Grouted elements to meet the requirements specified on the project plans.

1.2 PROJECT OBJECTIVES

A. Construction of a soil cement zone as overlapping Jet-grouted columns in single or multiple rows, with the following characteristics:

1. Minimum zone dimensions: 2 feet beyond outside dimensions of planned diversion or junction structures.

2. Minimum percentage of treatment for a defined volume of soil: 50 percent.

3. Minimum treatment area: 100 percent.

4. Minimum UCS: 250 pounds per square foot.

5. Vertical and horizontal tolerances: +/- 1 inch?

1.3 JOB SITE CONDITIONS

A. The project site conditions are reported in the AECOM Geotechnical Report titled "Design Development Report, Geotechnical Report, Pump Station Portion, Morena Pump Station, WW Force Main, and Brine/Centrate Conveyance Predesign (NC01), San Diego, California," dated January 5, 2018. Applicable information at the proposed jet grouting area includes geotechnical Borings DS-01 through DS-03 and DS-06 provided as part of supplementary special provisions section 2-7. The area of the proposed jet grouting is underlain by artificial fill to a depth of about 4 to 5 feet over alluvium. Potentially liquefiable loose granular alluvium exists to a depth of 50 feet.

B. The jet grouting is to mitigate the potential for liquefaction settlement to a depth of 50 feet below ground surface at the sites of the proposed pipe connections at Diversion Structures 1, 2, 3, and Junction Structure 1 within Friars Road.

C. Prior to submitting a bid price for the Jet Grouting, the grouting Contractor shall conduct a site inspection and review available subsurface information (including all geotechnical engineering and data reports). Prior to bid, Contractor shall verify the suitability of the methods for the project based on the conditions indicated by the subsurface information provided.

D. Due to the proximity of existing trolley track bridge pier, a pre-construction survey to document the existing condition of the structure shall be performed by the contractor.

E. A detailed utility location plan that identifies and distinguishes between abandoned, existing to be abandoned, existing to remain, and proposed new utilities will be provided by the Owner. The Contractor will be responsible to locate below ground utilities in the field.

F. Other project conditions shall include project constraints defined in the bid documents:

1. Environmental restrictions:

2. Noise Restrictions:

3. Work boundaries:

4. Hours for construction:

5. Hauling Restrictions:

6. Waste material handling and disposal:

7. Overhead Utilities:

8. Obstructions:

G. The contractor shall provide a monitoring plan for nearby existing improvements, including:

1. MTS light rail.

2. United States Army Corps of Engineers (USACE) levee north of and bordering Friars Road.

1.4 REFERENCES

The most recent version of the following:

1. ASTM C150 or AASHTO M85 Portland Cement

2. ASTM D1633 - Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders

3. API Recommended Practice 13B-1: Standard Procedures for Field Testing Water Based Drilling Fluids

4. ACI 233R Slag Cement in Concrete and Mortar or C989-99 Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

5. ASTM D3740 Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

6. ASTM C618 or AASHTO M295 - Fly Ash

7. AASHTO T26 Water Testing of Non-Potable Water or ASTM C1602/C 1602M Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

8. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

9. ASTM C469 – Standard Test Method for Static Modulus of Elasticity and Poisson’s Ratio of Concrete in Compression

10. Contract Documents
    a. Geotechnical Report, dated January 5, 2018
    b. Addendum to Geotechnical Report, dated December 20, 2018
    c. Section 024100, Demolition
    d. Section 036200, Grouting
    e. Section 311000, Site Clearing
    f. Section 312316, Excavation

1.5 DEFINITIONS

A. Double Fluid Jet Grouting: The jet grouting technique where one fluid, typically neat cement grout, is injected at high velocity through horizontal radial nozzle(s) and is assisted by a second fluid, typically air, delivered through a coaxial nozzle(s), to directly erode and mix with the in-situ soil.

B. Fresh-on-fresh sequence (also referred to as wet-on-wet): Method that involves jet grouting elements successively without waiting for the grout to harden in the overlapping elements.

C. Jet Grouting Parameters: Pressure of the fluid(s) within the jet grouting string; flow rate of the fluid(s); grout composition; rotational speed of the jet grouting string; rate of withdrawal or insertion of the jet grouting string; and number and size of nozzles.

D. Jet Grouting String: Jointed rods with single, double or triple inner conduit that conveys the jet grouting fluid(s) to the monitor.

E. Jet Grouting Supervisor: The individual on site who is in practical and responsible charge for the jet grouting work.

F. Jet Grouting: An in-situ injection technique employed with specialized equipment that includes grout pump(s), grout mixer, drill rig, drill rods and injection monitor with horizontal radial nozzles delivering high velocity fluids to erode, mix, and stabilize in-situ soils using an engineered grout slurry.

G. Monitor (adjusted for single, double, and triple systems): A single, double, or triple fluid drill pipe attached to the end of a drilling string and designed to deliver one to three fluids of the Jet Grouting process, typically air, water, and/or grout. The monitor has one or more injection points (nozzles).

H. Pre-drilling: Method that utilizes traditional soil drilling techniques and/or equipment to pre-bore each jet grout hole prior to jet grouting.

I. Prejetting, precutting or prewashing: The method in which the jet grouting of an element is facilitated by a preliminary disaggregation phase consisting of jetting with water and/or other fluids.

J. Primary-secondary sequence: Method in which installation of an overlapping element cannot commence before a specified hardening time or achievement of predetermined strength of the adjacent previously constructed elements(s).

K. Single Fluid Jet Grouting: The jet grouting technique where a single fluid, typically neat cement grout, is injected at high velocity through horizontal radial nozzle(s) to directly erode and mix with the in-situ soil.

L. Soil-cement element: A column, partial column (sector) or panel (planar shape also known as fans), of soil-cement formed by jet grouting, used as a component of a soil-cement structure.

M. Soil-cement structure: A single zone or block of jet grout elements that are partially or fully interlocked as indicated on the Contract Drawings. Soil cement structures shall be comprised of soil cement elements of sufficient pattern and spacing as to stabilize the soil mass within the limits shown on the Contract Drawings to meet the performance requirements specified in this Section.

N. Soil-cement: Mixture of grout slurry and in-situ soils formed by the jet grouting process.

O. Specific energy: pressure times flow divided by lift rate.

P. Spoil Return: All materials including but not limited to liquids, semi-solids, and solids, which are discharged above ground surface during, or as a result of jet grouting. Spoils consist of native soil, ground water, grout, and erosional water (if any) injected as part of the jet grouting process.

Q. Structural reinforcement: members inserted into the jet grout column to provide additional strength, including deformed bars, high strength steel threadbars, steel casing, or steel beams.

R. Triple Fluid Jet Grouting: The jet grouting technique where one fluid, typically water, is injected at high velocity through horizontal radial nozzle(s) and is assisted by a second fluid, typically air delivered through a coaxial nozzle(s), to erode the in-situ soil, while a separate nozzle placed lower on the monitor delivers a third fluid, typically neat cement grout, at lower velocity to simultaneously fill the soil zone eroded by the cutting fluids (air and water).

S. UCS: Unconfined Compressive Strength at 28 days

T. Uniformity: The amount of uniformly mixed material measured by core recovery. It is calculated as the total length of recovered core minus the sum of the lengths of unmixed soil regions or lumps that extend across the entire diameter of the core divided by the total core run length expressed as a percentage.

U. Young's Modulus E50: Secant modulus of the stress strain curve at 50% of failure strength (UCS).

1.6 SUBMITTALS

The Engineer will approve or reject the Contractor's qualifications within 15 calendar days after receipt of a complete qualifications submission. Additional time required due to incomplete or unacceptable submittals will not be cause for time extension or impact or delay claims. All costs associated with incomplete or unacceptable submittals shall be borne by the Contractor.

A. Qualifications - The following shall be submitted to the Owner's representative by the specialty grouting Contractor six (6) weeks prior to the start of the work:

1. The following shall be submitted to the Owner's representative by the specialty grouting Contractor six (6) weeks prior to the start of the work:
   a. Resumes of the management, supervisory, and key personnel, for approval by the Owner's representative, in accordance with qualifications above.

B. Jet Grouting Equipment - The following shall be submitted to the Owner's representative by the grouting Contractor four (4) weeks prior to the start of the work:

1. Catalog cuts, details of grout mixers, pumps, drill rigs, and a plan view of the jet grout equipment arrangement proposed for use on this project, noting any equipment that has been modified or is of unique construction.

2. Examples of field data collection forms, including a sample copy of daily field report.

C. Grout Mix Design - The following shall be submitted to the Owner's representative by the grouting Contractor two (2) weeks prior to the start of the work:

1. Mix design for the project indicating sources and types of grout materials, including (if available) field test data from previous projects. If the specialty grouting Contractor intends to deviate from the materials defined in this specification: it shall submit evidence of satisfactory use of the proposed material from past projects with similar soil conditions or pre-construction trials.

2. Method for verifying grout mix proportions.

3. Field Demonstration Test Program

4. Details of proposed field demonstration test program for jet grouting, as specified below. This shall include location of test columns, layout of test pattern, jet grouting parameters to be used and variables to be tested during

test program, and details of proposed quality control/quality assurance testing to meet acceptance criteria specified in this specification. Test program plan shall be submitted to the Owner's representative by the specialty grouting Contractor four (4) weeks prior to the start of the work. The Engineer shall review and comment within 5 working days of receipt of complete submittal.

5. Following performance of the field demonstration test program and prior to beginning production jet grouting operations, submit a summary of the test program including details regarding as-built layout of test area, drilling procedures, grout mixture, jet grouting parameters, quality control/quality assurance records and test results, and proposed jet grouting parameters for use in production grouting based on test program. The Engineer shall review and comment within five (5) days of receipt of complete submittal.

D. Jet Grouting Procedure - The following shall be submitted to the Owner's representative by the grouting Contractor two (2) weeks prior to the start of the work:

1. General Work Procedures Plan outlining the spacing, location, depth and general sequence to achieve the specified criteria detailed in this specification. Jet Grout element locations shall be dimensionally referenced to the contract drawings and shown on layout plans of suitable scale to effectively indicate the details of the layout. If pre-drilling of jet grout holes is required, describe the methods and type of equipment to be used.

2. A general jet grout spoil return management plan outlining waste containment methods during jet grouting and treatment and removal plans for jet grout spoil return. Include estimated width of annulus for spoil return and corrective actions to be taken if spoil return is not free-flowing, interrupted or episodic.

3. Jet grout site specific safety plan or job hazard analysis.

4. Quality assurance, quality control and verification procedures to be used for the field test and production work.

5. Details of the procedures to obtain soil-cement samples; and catalog cuts or shop fabrication drawings of the soil-cement sampling device and curing boxes.

6. Proposed details and formats of all required tabular and graphical data presentations that will be submitted to the Engineer during the course of the Work. This will include submittal of a copy of the reports used for data monitoring and recording, as described below in this specification.

7. Details of column diameter and overlap verification.

E. Daily Reports - Within one business day after the end of a work shift, the daily reports as described in this specification shall be submitted to the Owner's representative by the specialty grouting Contractor.

PART 2 MATERIALS & EQUIPMENT

2.1 MATERIALS

A. The grout slurry may consist of a homogeneous mixture of any of the following materials:

1. Cement, Portland, type I or II, ASTM C-150 or AASHTO M85

2. Ground granulated blast furnace slag ASTM C989 Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

3. Flyash Class C or F, ASTM C618 or AASHTO M295.

4. Potable Water or approved other source shall be free of deleterious materials that may adversely affect the grout.

5. Bentonite, if required, powdered bentonite per API Standard 13A

6. The ratios of the material components, by weight, shall be proposed by the Contractor, confirmed during the preconstruction test program, and reviewed by the Engineer. Once accepted, grout slurry composition shall not be changed unless requested in writing by the Contractor and accepted in writing by the Engineer.

B. Equipment

1. General: All equipment used for drilling boreholes; lowering, raising and rotating jet monitors; mixing grout; supplying pressurized grout and air-water to jet monitors; and jet monitors shall have proven performance records for use in Jet Grouting work.

2. Drilling Equipment: Use drilling equipment of a type and capacity suitable for drilling required hole diameters and depths, and lowering, raising, and rotating jet grout monitors to the depths and at the rates required to perform the work as shown on the Contract Drawings and as specified herein. The drill rig shall be equipped with automated controls to regulate and maintain consistent rod lift rate and rod rotations per minute (RPM), and shall have pressure gauges and flow meters for all fluids injected.

3. Grout Mixing and Injection Equipment: Use grout mixers and holding tanks, water tanks, air compressors, and pumps of sufficient capacity to ensure adequate supply of grout, air, and water at required pressure to the

Jet Grouting monitors during a full work shift to produce grout elements of the quality and dimensions necessary.

4. Jet-Grouting pump: Shall be capable, with the nozzles proposed, of providing the required pressure and flow rate adequate for the execution of the work.

5. Compressor (for double and triple fluid Jet-Grouting): Shall be capable of producing the pressure and flow rate values proposed by the Contractor depending on the parameters chosen.

6. Filling grout pump (for triple Jet-Grouting): Shall be capable of producing the pressure and flow rate proposed by the Contractor depending on the parameter chosen.

7. Jet Grout Tools: Use Jet Grouting monitors with appropriate nozzles with the capacity suitable for producing jet grout elements in the soil types identified during Subsurface Explorations performed at the site, and of the size and depth shown on the Contract Drawings and as specified herein. The drill hole diameter shall be sufficiently large to be a clear path for continuous spoil return during all jetting operations.

8. Equipment Instrumentation: Provide instrumentation that allows continuous monitoring and automatic recording of data throughout the jet grouting operations. As a minimum, the following shall be provided:

9. Pressure gauges/devices at the drilling rig to automatically record pressures of cement grout, water, and air during the grouting process.

10. Flow meter(s) to monitor and record the rate and total volume of grouting fluids through the grouting monitor at every element.

11. Devices that automatically monitor and record the rate of monitor rotation and withdrawal.

PART 3 EXECUTION

3.1 TEST PROGRAM

A. Prior to production work, a test program shall be conducted by the Contractor in accordance with the accepted work plan. The test program shall be used to optimize/verify the various parameters including type of jet-grouting (single, double or triple), necessity of pre-jetting with water, grout mix composition, fluid(s) flows and pressures, rotational speed, lift rate, spoil return, grout, and number and size of nozzles; and confirm that resultant in situ soil-cement properties and dimensions meet required design criteria.

B. The test program will be observed, reviewed and verified for contract conformance by the Owner's Engineer. The test program shall be installed in areas near the planned production work at a location agreed upon between the Engineer and jet grouting subcontractor and in representative soils and depths anticipated to be found during production work.

C. Each test section shall consist of a plan of elements suitable to demonstrate feasibility and installed to the same elevations specified for the production jet grouting work.

D. The test elements shall be exposed by excavation (where possible) and measured for geometric properties. If full-depth excavation is not feasible, core samples or other testing method shall be used to demonstrate column size/geometry. In cases where excavation is not reasonable, coring at the centroid of a group of three (3) elements shall be carried out, as a minimum.

E. Where coring is used to verify diameter, verticality shall be measured for each test column and the coreholes to verify the location of the elements at the final depth.

F. Three acceptable/representative specimens or a number determined suitable by the Owner's Engineer from each column shall be sent to an independent Laboratory for the tests required to satisfy the criteria specified in this specification.

G. The results of the test program and the recommended jet grouting parameters for the production work shall be submitted in a report to the Owner's Engineer for review. The Contractor, at their expense, shall be required to repeat the construction of a test section if the results of the test program do not meet the project requirements. The test program shall confirm that the resultant soil-cement properties met the required design criteria prior to the Contractor proceeding with production work.

3.2 PRODUCTION WORK

A. Execute production jet grouting using the same jet grout tooling, materials, and procedures as demonstrated from the satisfactory set of test elements.

B. Install jet grout elements, such that continuous spoil return up the borehole annulus is achieved during all work. When spoils return is lost, the Contractor shall stop jetting and reestablish spoils return prior to resuming jet grouting.

C. Horizontal location and verticality/deviation shall meet the requirements of this specification.

D. The sequence of jet grout column installation and the need to perform pre-jetting is the responsibility of the jet grouting Contractor and will be based on the results of the successful test program.

E. Maintain a clean site and dispose of all spoil debris, water, and spilled material during jet grouting operations.

F. Equipment for mixing, holding, and pumping grout shall be in a secure location and shall be operated to minimize spillage of material. No material will be allowed to enter storm drains or other drainage courses.

G. Monitoring: The Contractor shall monitor nearby grade, structures and utilities during all jetting work. Contractor shall submit the monitoring plan for review and approval by the Owner's Geotechnical Engineer. Of particular concern is the western jet grouting locations near Diversion Structures 1 and 2 and Junction Structure 1, where the MTS trolley bridge support is near the grouting locations. The settlement or distress monitoring may include surface settlement points, telltales, and/or tiltmeters. Install instrumentation a minimum of one (1) week prior to installing the test sections or production grouting. A baseline reading shall be obtained one (1) day prior to grouting the test section. Monitoring of the instrumentation shall be performed daily for the entire period of grouting and shall continue one (1) week after the completion of the jet grouting program.

H. If jet-grouting is interrupted during the execution of a column, the re-start of the jetting shall be undertaken at least 6 inches below the stopping point.

I. Site access shall be provided to Owner's representatives for observation of the work.

J. If reinforcement is required, the Contractor shall install it at the design location in the fresh column, immediately after the completion of the jet-grouted column or shall install in a borehole drilled in the hardened column.

3.3 QUALITY CONTROL/QUALITY ASSURANCE

A. All Jet Grouting shall be performed in the presence of the Owner's quality control/quality assurance (QC/QA) Representative. Owner's QC/QA representative shall be notified prior to initiating jet grouting. Monitoring and logging of Jet Grouting operations for both test areas and production work shall be performed by the jet grouting Contractor.

B. The Contractor's equipment shall be configured to record and continuously show all fluid flows and pressures, rotational speed, depth and rod lift rates. The rod lift rate and rod RPM shall be set by the driller then automatically controlled by the drill rig and automatically recorded on the jet grout installation log during the entire jet grouting process. The Owner's QC/QA representative shall be provided means to monitor this information in real time on request.

C. All the data monitored and recorded, as described in this specification, shall be made available within one working day to the Owner's Engineer in a format previously agreed on prior to the work. The Contractor shall supply the Engineer

with the software used for this task. The software shall be capable of processing the recorded data and presenting the data graphically in a satisfactory manner.

D. Grout mix proportions shall be measured and documented by the Contractor per the submittal requirements above. Appropriate records shall be kept by the Contractor and submitted to the Owner's Engineer to verify that grout mixture(s) are as accepted. Include daily quantities of materials used in Daily Reports.

E. Throughout the jet grouting operations, perform continuous coring to full depth on three (3) percent of production columns to obtain drill cores of the jet grouted soil. The core will be evaluated by the Owner's Engineer for compliance with specific acceptance criteria defined herein. The Contractor shall be notified immediately if the soil-cement samples do not meet the acceptance criteria outlined herein.

3.4 DAILY REPORTS

A. Within one business day of a work shift, submit summary daily reports during production jet grouting that provide the information listed below. A sample of the report form proposed for use by the Contractor shall be submitted to the Owner's Engineer for approval prior to the start of work. Daily reports shall include the following:

1. Equipment and Personnel on site

2. Work initiated and completed

3. Production interruptions

4. Grouting Records
   a. Jet grout element number, size and location.
   b. Time and date of beginning and completion of each grout element, including interruptions to the jetting process or material supply.
   c. Grout mix data, including mix proportions and unit weight density measurements.
   d. Injection pressure of all fluids used to construct each grout element.
   e. Flow rates of all fluids used to construct each grout element.
   f. Rotation rate and lift rate of jet rods for each grout element.
   g. Total grout quantity used for each element.
   h. Top and bottom elevations of the jet grout element.
   i. Whether flow of spoils return was continuous.

5. Total quantities of materials used for that day.

6. Observations of any unusual, or unanticipated conditions including obstructions, stoppages, loss of circulation, etc., impacts on instrumentation or monitoring.

7. Applicable verification testing done.

8. Continuous recording of jet grouting parameters shall be provided for each production column to verify consistency with the test program results.

3.5 ACCEPTANCE CRITERIA

Installation records and daily reports documenting that the selected parameters from the test program were accurately repeated for the production work

A. Coring / Uniformity:

1. Full-depth core samples retrieved by the contractor shall be used to evaluate uniformity.

2. Core recovery (expressed as a percentage) is equal to the total length of recovered core divided by the total core run length. Length of recovered core includes lengths of treated and untreated soil.

3. Percent treatment is calculated as the total length of recovered core minus the sum of the lengths of unmixed soil regions or lumps that extend across the entire diameter of the core divided by the total core run length expressed as a percentage.

4. Uniformity is acceptable if percent treatment is at least 80 percent for every 5-ft core run. If the minimum percent treatment cannot be confirmed by coring in coarse sandy or gravelly soil, downhole camera/video can be used to confirm uniformity.

5. If the contractor uses core runs shorter than 5 ft (e.g., 3 ft), then the recovery and percent treatment can be calculated by adding equal amounts of core run length on either side of the short core run length to make up a total 5-ft run length for calculation purposes.

B. Unconfined Compressive Strength of Jet Grout Soil Cement Mix: At least 90 percent of all jet grout samples tested shall have a minimum 28-day unconfined compressive strength of 250 psi.

C. Minimum overlap thickness: shall be 12 inches

D. Borehole deviation and horizontal tolerances:

E. The center of the elements shall not be more than 3” from the indicated plan location. Deviations shall be less than required for adequate column overlap.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Jet Grouting shall be measured as follows:

B. Mobilization and demobilization will be measured on a lump sum basis. Mobilization pay item will be deemed complete when the Contractor's equipment is set up and ready to commence jet grouting operations. Demobilization item will be complete when all equipment is removed.

C. Test program, including verification testing, will be measured on a lump sum basis. Test program will be deemed complete when the test elements are installed, and the test grouting report is submitted and the results accepted by the Owner's Engineer.

D. Jet grouting will be measured on a lump sum basis. Jet grouting will be deemed complete when all the columns are installed and accepted by the Owner's Engineer.

E. No separate measurement will be made for the Contractor's Quality Assurance-Quality Control Program, including verification testing, all of which shall be considered part of the Work of jet grouting. However, if coring is utilized as a verification test, coring will be measured by the linear foot of core hole.

4.2 PAYMENT

A. Mobilization and demobilization shall be paid as lump sum items.

B. Test Program shall be paid as a separate lump sum item.

C. Jet Grouting shall be paid per Section 01 29 00, Payment Procedures.

D. No separate payment will be made for the Contractor's Quality Assurance-Quality Control Program, including verification testing, all of which shall be considered part of the Work of jet grouting. However, if coring is utilized as a verification test, payment will be made on a unit price basis per linear foot of core hole.

END OF SECTION

SECTION 31 50 00
EXCAVATION SUPPORT SYSTEMS

PART 1 GENERAL

1.1 WORK OF THIS SECTION

A. The Work of this Section includes support of temporary open excavations by means of sheet pilings, soldier piles and lagging, structural steel walls and struts, liner plates, and timber. The CONTRACTOR shall be responsible for the design and selection of methods in shoring conformance with the design criteria as specified herein.

B. The Work of this Section applies to temporary excavation support systems for demolition, construction of underground cast-in-place concrete structures, and installation of buried pipelines, and boring and receiving shaft or pits.

1.2 RELATED SECTIONS

A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:

1. Section 31 23 19.01 Dewatering
2. Section 31 23 16 Excavation
3. Section 31 23 23.15 Trench Backfill
4. Section 03 30 00 Cast-in-Place Concrete
5. Section 05 50 00 Metal Fabrications

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. ASTM A 36 Structural Steel.
2. ASTM A 328 Steel Sheet Piling.
3. AWS D1.1 Structural Welding Code-Steel.
4. UBC Chap. 25 Wood.
5. WCLIB Grading Rules.
6. WWPA Grading Rules.
7. AISC Manual of Steel Construction.
8. AASHTO, Section on Steel Tunnel Liner Plate

B. The Contractor shall comply with all Cal OSHA requirements for safety for the project. The Contractor shall also comply with the requirement of the MSHA.

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01 33 00:

1. The proposed excavation support system for each construction component where excavation support systems will be used.
2. Arrangement and details for each excavation support system, supporting design calculations, and construction methods to be used for the installation of each system.
3. Soldier pile installation methods, connection details, bracing preloading, and jacking procedures, as applicable.
4. Sheet pile or secant pile wall properties and installation methods, construction details, as applicable.
5. Depths below the main excavation bottom elevation to which the support system will be installed.
6. Elevations of ground surface, struts, and shores, as applicable.
7. Permissible depth to which excavation may be carried before supports must be installed and preloaded.
8. Full excavation depth load to be carried by various support system members.
9. Bracing loads for various stages of excavation, bracing removal, and concrete placement.
10. Preloads as required.
11. Proposed sequence of strut and shore removal as applicable and as related to concrete placement and backfilling operations.

B. The above Shop Drawings shall be coordinated with other shop drawing submittals for work specified elsewhere in which support of excavation is required.

C. The proposed method of installing sheet piling including sequence of installation, template, and equipment description, as applicable.

D. Contingency plan for alternative procedures to be implemented if the excavation support system is found to perform unfavorably.

E. Monitoring plan – The Contractor shall provide a monitoring plan for nearby structures, including the Army Corps of Engineers levee to the south of the project, to monitor for settlement or lateral movement during installation of excavation support. The monitoring plan shall be submitted to the Owner's geotechnical engineer for approval prior to stone column installation. The Contractor shall conduct pre and post video inspection.

1.5 QUALITY ASSURANCE

A. The design of all excavation support systems, including the design of all means of support and all member sizes and connection details, shall be designed, and Shop Drawings and calculations signed, by a Professional Civil or Structural Engineer, licensed to practice in the State of California and experienced in the design of excavation support systems. The work of this licensed Engineer shall be procured by the Contractor. All design drawings and calculations shall be checked and initialed by a checker. The design drawings, calculations, and support system drawings shall be submitted by the Contractor to the Owner's Representative for approval.

1.6 DESIGN CRITERIA

A. Shop Drawings with supporting calculations for the various excavation support systems shall be prepared in accordance with the following criteria:

1. Design the excavation support system and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, and construction loads including impact, and other surcharge loads in such manner as will allow the safe and expeditious construction of the permanent structures, to minimize ground movement or settlement, and to prevent damage to or movement of adjacent buildings, structures, roadways and utilities.
2. Design support members to resist the maximum loads expected to occur during the excavation and support removal stages.
3. Design for staged removal shall conform to construction concrete placement, and backfill sequence shown. Design shall consider provisions for future construction, and limits on bracing level elevations as shown on the plans.
4. Maximum vertical center-to-center spacing of supports shall be 16 feet between top 2 support levels and 12 feet below second support level unless otherwise approved. If decking beams are not required, install the uppermost bracing tier at a vertical distance of not more than 6 feet below the top of excavation.
5. Where water flows from the face of excavation, the maximum height of unsupported excavation shall not exceed 15 inches.
6. In running sand and silt, provide positive means for securing timber lagging to the soldier piles to avoid shifting or falling off of the lagging, and positive means for containing such material behind lagging.
7. Review of the Contractor's Shop Drawings and methods of construction by the Owner's Representative does not relieve the Contractor of responsibility for the adequacy of the excavation support systems.

8. No portion of the excavation support system's vertical face will be permitted to penetrate the design lines as indicated on the Drawings for the permanent concrete structure to be constructed within the excavation.
9. Vertical support capacity shall be provided for wall systems and internal bracing elements, for loads due to vertical force components of tieback anchors, the weight of the structural systems themselves, and live load on any portion of the system.

B. Timber Support Systems and Members:

1. The minimum thickness of timber lagging between soldier piles spaced 5 to 7 feet center-to-center shall be 3 inches for excavations up to 25 feet in depth, and 4 inches for excavations deeper than 25 feet.
2. For other conditions and types of lagging, design calculations shall be submitted.

1.7 SAFETY

A. Except as otherwise indicated, the following codes apply to the Work of this Section:

1. Title 8, California Administrative Code, Chapter 4, Subchapter 4, Construction Safety Orders, Article 6, Excavations, Trenches, Earthwork.

1.8 PROJECT CONDITIONS

A. Utility agencies shall be notified, and caution exercised while exposing utility facilities by hand or other methods approved by utility owner.

B. If existing utility facilities interfere with the proposed method of support, the method shall be modified in a manner that will protect the facility and accommodate the proposed Work. Shop Drawings shall be revised and resubmitted along with design calculations required to account for the modified support method and to show the actual location of the existing utilities.

C. Provisions shall be made for contingencies as follows:

1. Monitor performance of support system components, for both vertical and horizontal movement, at regular intervals not to exceed 3 days.
2. Provide contingency plan for alternative procedures to be implemented if unfavorable performance is evidenced.
3. Keep on hand materials and equipment necessary to implement contingency plan.

D. Elements of the support system shall not be spliced unless approved by the Owner's Representative.

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel sheet piling shall be continuous interlocking type ASTM A 328 of appropriate shape and provided with at least one 2-1/2-inch-diameter handling hole on the centerline of the web located at least 6 inches from each end of the sheet pile.

B. Fabricated connections and accessories, steel H-piles, WF shapes, and other structural steel shall conform to the requirements of ASTM A 36, unless otherwise approved.

C. Concrete shall be as specified in Section 03 30 00.

1. For encasement of steel soldier piles below the final level of excavation, minimum concrete strength of 2,500 psi shall be used.
2. For encasement of soldier piles above the final level of excavation, lean concrete shall be used, the strength of which shall be adequate to protect the excavated faces of the augured hole.

D. Wood lagging shall be dimension lumber with minimum allowable stress of 1100 psi.

1. The stress grade of the lagging shall be in conformance with the allowable stresses of the UBC, Chapter 25.
2. Lumber shall be grade marked by WWPA or WCLIB with species and grade conforming with those shown on approved Shop Drawings.

E. Jet grouted columns or Cast in Drilled Hole Secant Piles concrete shall be a minimum strength to resist lateral loading.

1. Steel reinforcement shall be designed to resiste the lateral loads applied.

PART 3 EXECUTION

3.1 GENERAL

A. The support system shall extend the main excavation bottom elevation to a depth adequate to prevent lateral movement and to adequately support applied vertical loads. In areas where additional excavation is required below the main excavation subgrade provisions shall be made to prevent movement of main excavation

supports. Damage to existing utilities during installation of excavation support system shall be avoided.

B. Water control measures shall be provided in accordance with the requirements specified in Section 31 23 19.01.

3.2 SOLDIER PILES

A. Soldier piles shall be installed by preboring or other approved pre-excavation methods to tip elevation shown on approved Shop Drawings. Prevent prebored or other pre-excavated holes from collapsing.

B. Prebored hole shall be filled with lean concrete from bottom of hole to subgrade dependent upon analysis of vertical support requirements.

C. Remaining pile length shall be filled with lean concrete, completely encasing the pile.

D. Concrete shall be placed from the bottom of the hole upwards by means of a flexible pipe connected to a hopper.

3.3 SHEETING AND LAGGING

A. Sheeting and lagging shall be installed with no gap between the boards unless specifically approved. As installation progresses, the voids between the excavation face and the lagging or sheeting shall be backfilled with sand or soil rammed into place. Materials such as hay or burlap shall be used where necessary to allow drainage of groundwater without loss of soil or packing material. If gaps in the lagging are allowed, the gap width between lagging boards shall be limited to 1/2 inch maximum.

B. If unstable material is encountered, suitable measures shall be taken to retain it in place or to otherwise prevent soil displacement.

C. Extend lagging down to final subgrade.

D. A sufficient quantity of material shall be on hand for sheeting, shoring, bracing, and other operations for protection of work and for use in case of accident or emergency.

3.4 STEEL SHEET PILING

A. Steel sheet piling may be used only where existing subsurface conditions are suitable for installation of sheet piling to the full depth of penetration required, and to proper alignment and plumbness, specified herein, without damage to the

sheet piling or rupture of its interlocks. The use of steel sheet piling will not be permitted where sheeting would be required to penetrate boulders, rock or other materials which may prevent the proper installation of sheet piling.

B. Steel sheet piling shall be installed in plumb position with each pile interlocked with adjoining piles for its entire length so as to form a continuous diaphragm throughout the length of each run of wall, bearing tightly against original ground. Install sheeting to depth required for design. Exercise care during installation so that interlocking members can be extracted, if required, without injury to adjacent ground. The installation equipment shall be suitable to the type and nature of the subsurface materials anticipated to be encountered. The equipment, and methods of installation, cutting, and splicing shall conform to the approved Shop Drawings.

C. Liner plate shall be installed to proper line and grade and dimensions.

3.5 INTERNAL BRACING SUPPORT SYSTEM

A. All bracing support members shall be installed and maintained in tight contact with each other and with the surface being supported.

B. Bracing members shall be preloaded by jacking the struts and shores in accordance with loads, methods, procedures, and sequence as described on the approved Shop Drawings. Coordinate excavation work with bracing installation and preloading. Use steel shims and steel wedges welded or bolted in place to maintain the preloading force in the bracing after release of the jacking equipment pressure. Use procedures so as to produce uniform bracing member loading without appreciable eccentricities, overstressing, or support member distortion.

C. Struts shall be provided with intermediate bracing as needed to enable them to carry their maximum design load without distortion or buckling. Provide diagonal bracing as necessary to maintain the stability of the system. Web stiffeners, plates, or angles shall be provided as needed to prevent rotation, crippling, or buckling of connectors at points of bearing between structural steel members. Allow for eccentricities resulting from field fabrication and assembly.

D. Excavations shall be to a depth no more than 2 feet below the elevation of the support member about to be placed. The support member shall be installed and preloaded immediately after installation and prior to continuing excavation.

3.6 JET GROUTED OR CIDH SECANT PILE SUPPORT SYSTEMS

A. Secant piles shall be designed in accordance with foundation improvements as well as horizontal shoring support.

B. Secant pile walls shall be water tight.

C. Struts shall be provided with intermediate bracing as needed to enable them to carry their maximum design load without distortion or buckling. Provide diagonal bracing as necessary to maintain the stability of the system. Web stiffeners, plates, or angles shall be provided as needed to prevent rotation, crippling, or buckling of connectors at points of bearing between structural steel members. Allow for eccentricities resulting from field fabrication and assembly.

D. Excavations shall be to a depth no more than 2 feet below the elevation of the support member about to be placed. The support member shall be installed and preloaded immediately after installation and prior to continuing excavation.

3.6 REMOVAL OF SUPPORT SYSTEMS

A. Where removal is required wholly or in part, such removal shall be performed in a manner that will not disturb or damage adjacent new or existing construction or utilities. Fill all voids immediately with lean concrete, or other approved means.

B. All elements of support systems shall be removed to a minimum depth of 6 feet below final ground surface. However, when a structure poured against the sheeting system extends above the 6-foot limit, removal of the sheeting system shall be to the top of the structure.

C. All damage to property resulting from removal shall be promptly repaired at no cost to the Owner. The Owner's Representative shall be the sole judge as to the extent and determination of the materials and methods for repair.

END OF SECTION

SECTION 31 71 19
MICROTUNNELING

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. The Work specified in this Section consists of installing plastic lined reinforced concrete (PLRCP) pipe along the alignment shown in the Contract Drawings and documents by Microtunneling. The soil material and hydrological conditions are described in the Geotechnical Data Report (GDR) and Geotechnical Baseline Report (GBR). "Geotechnical Report, Pump Station Portion, Morena Pump Station, WW Force Main, and Brine/Centrate Conveyance Predesign (NC01), San Diego, California," prepared by AECOM, dated January 5, 2018. Curved and straight microtunneling are specified the CONTRACTOR may adjust the shown curved alignment within the project easement boundary subject to OWNER's approval. CONTRACTOR shall furnish all labor, tools, and equipment, and perform operations necessary or incidental for the excavation and support of microtunneling operations including construction of the launching and receiving shafts and supply of suitable jacking pipes.

B. The support of excavation for shafts shall be in accordance with the Contract Documents, except as modified herein for microtunneling operations. This specification describes the additional measures that shall be provided by CONTRACTOR for each of the launching and receiving shafts used with the microtunneling method.

C. The shafts used for launching and receiving shall be made fully adequate for the microtunneling work and for any permanent structures situated within the shafts. CONTRACTOR shall be responsible for providing each launching shaft and each receiving shaft with the provisions necessary to perform the microtunneling operations. Furnish labor, equipment, material, and additional design, as necessary, to meet the minimum requirements as contained herein.

D. CONTRACTOR shall hire a California licensed Professional Engineer meeting the requirements as contained herein. CONTRACTOR is responsible for the work produced by this engineer. CONTRACTOR shall also hire a California licensed surveyor meeting the requirements as contained herein. CONTRACTOR is responsible for the work produced by this surveyor.

E. CONTRACTOR shall provide each launch shaft with thrust blocks, entrance seals, base slabs, pumping and drainage systems, ventilation systems, electrical systems, and lighting systems. CONTRACTOR's licensed engineer shall design the shaft support (SOE), thrust blocks, entrance seals, and base slabs including necessary modifications to the shoring. CONTRACTOR shall also be responsible for developing a Fluid Control Plan to be implemented by CONTRACTOR at each of the shaft sites in accordance with the requirements as contained herein.

F. CONTRACTOR shall provide each receiving shaft with exit seals, base slabs, and, as necessary, a pumping and drainage system to maintain dry working conditions. CONTRACTOR's licensed engineer shall design the exit seals including necessary modifications to the shoring.

G. CONTRACTOR shall prevent the inflow of ground and/or groundwater into the shafts during the microtunneling operations including but not limited to exit and entry of the shaft during the launching and receiving processes of the MTBM. The ground shall be improved, as necessary, to prevent any inflow of ground and/or groundwater in excess of specified tolerances as contained herein.

H. CONTRACTOR shall prevent the machine from veering off of the design alignment during the launching, jacking, and/or receiving process in excess of the specified tolerances as contained herein. CONTRACTOR shall redesign pipeline and associated structures at no additional cost to the OWNER, if and when necessary due to exceedance of the specified tolerances.

I. CONTRACTOR shall be responsible for ensuring that each of the shafts, including modifications, used with the microtunneling is fully adequate for installation of the permanent structures as shown on the Contract Documents. CONTRACTOR shall modify these shafts as necessary to accommodate the construction of these structures. Furthermore, CONTRACTOR's licensed engineer shall provide additional design necessary for completing this work.

J. The CONTRACTOR shall provide a microtunnel boring machine (MTBM) capable of excavating through the ground and any material as described in the GBR, furnishing and installing jacking pipe complete and operational as specified in the documents to the specified line and grade. Furnish and attempt to replace lubricant with grout behind the jacking pipes to completely fill any annular void between the pipe extrados and the excavated surface through grout holes in the pipes.

K. CONTRACTOR shall store, process, properly transport, and legally dispose of muck and/or excavated material in accordance with the Contract Documents.

L. Microtunneling operations will be carried out to minimize settlements to within limits established in the Contract Documents. CONTRACTOR shall be responsible for damage caused by construction activities to include damage by subcontractors, and conducting restoration of existing facilities for damages due to shaft construction and microtunneling related ground movment.

M. CONTRACTOR's engineer shall develop a Survey Plan in accordance with the requirements as contained herein. The Licensed surveyor shall perform survey readings associated with this plan.

N. The 60in PLRCP microtunnel drive between Junction Structure 1 jacking shaft and the pump station passes under a levee and buried levee RipRap as indicated in the GBR and on the drawings. Contractor is advised that pieces of RipRap may be found in the tunnel

alignment. Contractor will carry out at least 3 pilot bores of at least 150ft long from the jacking shaft to probe for obstructions in the crown of the tunnel alignment. Contractor will submit means and methods to complete the pipeline as per the drawings.

O. The 48in steel casing microtunnel drive from Custer Street to the 66in Overflow Pipe on Friars road passes under the Trolley tracks and a levee and as indicated on the drawings and GBR will pass through the bottom levee rip rap. Contractor must submit means and methods to remove or pass through the rip rap and complete the casing installation without causing movement to the trolley tracks.

1.2 REFERENCES:

A. American Association of State Highway and Transportation Officials (AASHTO).

B. American Society of Civil Engineers (ASCE).

C. California Occupational Safety and Health Administration (CAL-OSHA) – Particular attention is called to Sub-part S, Underground Construction, and Sub-part K, Electrical, of the Standards and Guidelines 29 CFR Part 1926,

D. Guidelines 2007 and ASCE 36 Standard Construction Guidelines for Microtunneling

1.3 DEFINITIONS:

A. Microtunneling: A continuously supported trenchless installation of a pipe by jacking the pipe directly behind a closed face, remotely controlled, steerable, guided, microtunnel boring machine (MTBM) which provides a continuous pressure on the face of the excavation to balance groundwater and earth pressures.

B. Microtunneling Boring Machine (MTBM) :The total system of the mechanized excavating equipment, consisting of a boring and articulated steering head, trailing shield segment(s), auxiliary and support equipment, and other items necessary for the sustained excavation operations of the microtunnel.

C. Jacking Pipe: pipe specifically designed to withstand jacking loads as defined herein, that serves as initial construction lining and tunnel support, and as the final carrier or casing pipe.

D. Hydraulic pipe joint : Specialty pipe joint system for jacking pipe through a curved drive to spread the jacking force or reduce force concentration over the pipe perimeter. It consists of a hose mounted in the pipe joint with controllable deformation and fluid pressure, which can be translated into forces acting on the pipe.

E. Ground Conditioning Agents: Used during microtunneling operations to control settlement, reduce cutting head torque, and prevent excessive wear on cutting tools and other MTBM components. These may include 1) foam (both simple surfactant/air/ water foam and polymer/surfactant/air/water foam); 2) polymers; 3) bentonite slurry.

F. Lubrication: Bentonite and/or polymer lubricant injected in the annular space between the pipe and surrounding ground during microtunneling to support the annular space and reduce friction between the pipe and soil.

G. Muck: Material excavated from shafts or tunnel including any ground treatment, lubrication, or slurry. Also referred to as spoils.

H. Spoil Transport System: A system of piping, pumps, valves, screw conveyors, or other equipment which transports the muck from the tunnel face to the surface. This includes the slurry treatment plant if a slurry based system is utilized.

I. Jacking Shaft: Excavation from which the MTBM is launched, which incorporates a thrust block to spread reaction loads to the ground. Also referred to as launching shaft.

J. Receiving Shaft: Excavation to which the MTBM is launched towards. A shaft can be used as both a jacking shaft and receiving shaft for adjacent microtunnel drives but is not required.

K. Jacking System: A system of hydraulic jacks installed inside the jacking shaft that provides thrust for the string of pipe in the ground and the MTBM. Capacity of jacks and extension rate is synchronized with excavation rate of the MTBM.

L. Intermediate Jacking Station (IJS): A fabricated steel cylinder fitted with hydraulic jacks installed at intermediate locations in the pipe string to allow selective shoving of discrete segments of the total pipe string and MTBM.

M. Laser: An optical system projecting a beam to a target to provide guidance for and location of the MTBM.

N. Guidance system : A sytem that may be based on a laser for straight drives or a Gyro or a automated or manual system based on suveyors total stations and prisms to provide position information for curved drives

O. Controls: The system which provides operational control to the MTBM including steering and synchronizes excavation, removal of the excavated material, and jacking of pipe to maintain overall balance to provide complete and adequate ground support at all times. The controls are generally containerized and located on the surface adjacent to the Jacking shaft.

P. Face Access: Provision of an opening in the MTBM pressure wall to give man access to the muck chamber behind the cutter wheel to allow cutter tool changes in stable ground

Q. AirLock: A system that allows access to the muck chamber behind the cutter head under pressure to change cutter tools if required

R. Contact Grouting: Grout used to fill the annular space between the pipe and the soil due to MTBM overcut upon completion of a microtunnel drive.

S. Dewatering: System of wells or excavations and pumps used for lowering the groundwater and/or removing groundwater from the microtunnel shafts.

T. Entrance Seal: A mechanism incorporated into the launching shaft, including any necessary ground improvement, to prevent the inflow of ground and/or groundwater into the shaft while launching the MTBM and jacking subsequent pipes.

U. Exit Seal: A mechanism incorporated into the receiving shaft, including any necessary ground improvement, to prevent the inflow of ground and/or groundwater into the shaft while in the process of recovering the MTBM at the receiving shaft.

V. Grade: Vertical alignment.

W. Launching: The machine is in the process of being launched at the beginning of a drive when passing through the entrance seal along the alignment beyond the outside edge of the launching shaft

X. Line: Horizontal alignment.

Y. Receiving: The machine is in the process of being received at the end of a drive when passing through the exit seal along the alignment beyond the outside edge of the receiving shaft.

Z. Shoring: Scheme of the shaft for supporting the excavation and controlling the groundwater.

AA. Thrust Block: A thrust block, including necessary ground improvement, is used to evenly distribute the jacking loads to the ground as part of the pipe installation process without excess movement or misalignment of the equipment.

BB. Pilot Bore: A small diameter test bore to be used to probe the ground on the tunnel alignment for obstructions.

1.4 SUBMITTALS:

A. Submit the following in accordance with the Contract Documents.

1. Coordination and Implementation Plans to demonstrate that applicable requirements from the Contract Documents as well as the requirements as contained herein, have been reviewed and coordinated by CONTRACTOR. Each of the subcontractors, if any, shall sign these plans.

2. Fluid Control Plan to ensure that the equipment operator maintains full control over fluid volumes and fluid pressures during microtunneling operations including slurries and/or lubricants. CONTRACTOR shall determine the construction activities at each launch shaft site location and describe these in detail. CONTRACTOR's engineer shall evaluate these activities and develop a plan including recommendations to ensure that fluid control is not impeded to any degree

by any construction activity occurring at the site including but not limited to backfilling operations, leakage in the shoring, dewatering activities, and induced flow of groundwater. Consideration shall be given to the ground and groundwater conditions as defined in the GBR. CONTRACTOR's engineer shall sign this plan.

3. Shaft Layout and Details: For each microtunneling shaft and drive from it, provide complete details, drawings, and schematics, as applicable. Show layout of shaft, including equipment, drawn to scale. Demonstrate that proposed layout of shafts is adequate for sequence of construction, equipment operations, and means and methods of pipe installation including required acceptance testing. Describe in detail provisions for the working slab, invert treatment, and pump and drainage systems. Include details of lighting, ventilation, hydraulic, and electrical systems.

4. Structures Shown on Contract Documents: Evaluate each microtunneling shaft and demonstrate that each shaft is adequate for installation of the permanent structures as shown on the Contract Documents including each stage of construction and backfilling. Provide detailed descriptions, procedures, shop drawings, schematics, and explanations. Furthermore for design modifications to accommodate these structures, provide fully developed design details, material requirements, standards, calculations, shop drawings, procedures, construction stages, and explanations signed and sealed by CONTRACTOR's engineer. Evaluate ground improvement schemes and contingency measures to be implemented as part of the design.

5. Contractor will submit means and methods to carry out pilot tube probing under the levee on the drive between Junction structure 1 jacking shaft and the pump station, and if obstructions are found in the tunnel alignment a method for completing the drive as per the contract drawings.

6. Contractor will submit specific means and methods to complete the 48in casing drive through the levee riprap and under the trolley tracks between custer street and the 66in Overflow pipe.

7. Survey Techniques: Provide complete details that fully describe the survey techniques to be used for transfer of line and grade.

8. Provide details of site monitoring plan including provision of measuring ground movements at shafts and along the tunnel alighnment and the monitoring of any existing structures within 100ft of the centerline of the excavation and tunnel alignment. Submit a plan for actions to be taken in the case of ground movements or movements of structures exceeding the allowable movement limits (Unless otherwise submitted 1/2in movement requires action to be taken as per the plan)

9. Qualifications of key personnel to include CONTRACTOR's California licensed engineer, project superintendent, MTBM operators, shift supervisors, and licensed surveyor.

10. Field Inspections, not less than once per week, in accordance with requirements as contained herein.

B. Shop Drawings (Minimum of 60 days before microtunneling is scheduled to begin):

1. Calculations and working drawings signed and sealed by a Professional Engineer registered in the State of California, showing jacking and reception shafts support, including shaft exit cut outs and thrust blocks designed to resist maximum jacking loads.

2. Working drawings indicating limits of jacking and reception shafts showing layout of tunneling and ancillary equipment.

3. MTBM shop drawings including:

a. Configuration of cutterhead and over cut.

b. Ventilation system details for personnel entry to the MTBM.

c. Provision for cutter tool replacement during a drive

d. If an Airlock is supplied the Airlock operational manual

e. Jacking pipe lubrication system details.

f. Grade and alignment control system details.

g. MTBM emergency groundwater control provisions.

h. Details of slurry pumping and separation control if applicable.

4. Jacking pipe calculations and details as required by the Contract Documents.

5. Calculations and working drawings signed and sealed by a Professional Engineer registered in the State of California for methods of controlling groundwater, in accordance with the Contract Documents, during microtunneling.

6. Show pertinent dimensions, spacing, and layout of Microtunneling components. Indicate sizes, shapes, material specifications, and elevations, as related to depth of excavation. Include plan, elevations, sections, and details showing the arrangement and method of installation during intermediate construction stages in addition to providing the final stages.

C. Design calculations:

1. Include design assumptions, and for computer software, provide the program input.

2. Demonstrate the integrity of the pipe design and conformance to applicable design standards. Account for loads, sequences, and conditions during the various construction stages.

3. Provide analyses to determine impacts with existing site improvements including but not limited to structures and utilities.

4. For backfilling of shafts after microtunneling operations, provide analyses for end bearing capacity, skin friction/down-drag, and settlement.

D. Show existing structures, utilities, trees, and other site improvements located within each of these shaft areas.

E. Product Data (Minimum of 60 days before microtunneling is scheduled to begin):

1. Submit details of muck or slurry conditioning additives used to reduce machine applied torque and maintain muck flow and pressure holding capability.

F. Examples of Shift reports & Data Recording printouts (Minimum of 60 days before microtunneling is scheduled to begin):

1. A sample of the Data log printout or manual log of the jacking operation to be used, which will include the following items and be provided every 24hrs:

a. Position of the MTBM in relation to the design line and grade.

b. Jacking forces exerted on the pipe and at each intermediate jacking station if applicable.

c. Date, starting time, and finish time of each pipe joint.

d. Instantaneous jacking rate and total distance jacked.

e. Position of the steering jacks.

f. Pitch and roll of the MTBM.

g. Cutterhead RPM & torque.

h. Details of problems, obstructions, or delays: including the conjectured cause.

i. Rotational speed of screw conveyor if applicable.

j. For slurry based system: The volume of slurry in both the supply and return side of the slurry loop, indication of slurry bypass valve position, and indication of pressure in face support chamber.

k. Face water jet use .

l. For slurry based system the viscosity and density of the slurry supply fluid to the MTBM

m. Shift report identifying the operating crew, weather , any downtime and reasons, description of the ground being excavated,

2. A sample of the visual inspection form to be used.

3. Settlement monitoring report showing ground movements for each monitoring point and for each monitored structure. Monitoring survey will be carried out daily for all monitoring points within 100ft of the MTBM during excavation.

G. Special Equipment and Repair (Minimum of 60 days before microtunneling is scheduled to begin):

1. Certification by the original MTBM manufacturer of the thrust, torque, condition, and operational characteristics of equipment to be used for installing the specified pipe. The microtunneling equipment shall employ a spoil removal system with a pressure balance system that is capable of equalizing pressures between the tunnel face and the microtunneling machine head to positively and continuously support the face of the excavation to balance groundwater and earth pressures.

2. Manufacturer's literature describing in detail the microtunneling system to be used. If the contract documents specify curved microtunneling , provide a detailed description of at least one similarly sized microtunnel project on which this system or similar has been successfully used in a curved drive application. Provide the names, addresses and telephone numbers of owner's representatives for these projects as well as the length, diameter, curve properties, and pipe material used. Indicate whether the machine proposed for this contract currently exists, or will be newly manufactured.

3. Details of special precautions required and the inspection procedures to be taken when stopping the machine for repair, weekends, holidays etc. to ensure that the pipe string does not become "locked" by soil pressure and face stability is not compromised during the shutdown including contingency measures to be implemented if problems arise or in groundwater control if power is lost.

H. Installation and inspection data (Minimum of 45 days before microtunneling is scheduled to begin.):

1. A detailed technical description of the microtunneling procedure, and construction techniques to provide the access required to install the specified pipe in conformance with the Contract Documents to include:

a. Intended machine parameters to achieve pressure balance at the tunnel face, including cutterhead rotation speed, torque, thrust, pump or screw conveyor speeds, and discharge rates, rate of advance, and volumetric control.

b. Details of muck handling system, rock crushing and spoil separation methods if required, including proposed additive formulations and calculations of the system capacity to handle flows at all distances and changes of elevation to and from the MTBM.

c. Details of conditioning agents to be used, including concentration, injection rate, injection point, and ratios of these conditioning agents.

d. Details of main jacking system, intermediate jacking stations, hydraulic joints (if proposed) and their proposed spacing, method of operation and thrust capacity. Include calculations of anticipated jacking forces required to advance the pipe and calculations of maximum jacking force permissible on straight and curved sections for the selected jacking pipe material. Include details and supporting compression calculations for joints used with intermediate jacking stations and hydraulic joints. Describe controls to prevent the maximum jacking force from being exceeded during the curved drive including use of hydraulic joints and/or other measures to prevent pipe overstress.

e. Description of guidance system and procedures for maintaining line and grade.

f. Method of spoil disposal conforming to the Contract Documents.

g. A startup plan for the MTBM and the method of launching through the launching shaft wall into the ground, and the plan for exiting the drive at the reception shaft.

h. A plan for contact grouting after the pipe has been installed. The details shall include injection pressure, method of controlling grout pressures, and method for verifying complete filling of the void space between the pipe and the surrounding ground.

i. Complete information on CONTRACTOR's safety plan for personnel conducting the tunneling or jacking operations and appurtenance installation in accordance with OSHA and local regulations. The plan shall include provisions for lighting, ventilation, and electrical safety.

j. Contingency Plan, detailing measures to be taken when surface settlement exceeds the maximum values as described herein and in the Contract Documents.

k. A procedure (method statement) for remedial grouting to reduce infiltration rates to specified levels, if applicable.

I. Performance reports and test data (daily when MTBM is operating):

1. Jacking operation data log containing the data detailed in this Specification taken at intervals no more than 1 minute apart and a minimum of 10 times per pipe section. If the data is collected digitally it shall be submitted in both hard copy and digital format on an appropriate storage media.

2. If the electronic data log is not submitted or available in a digital format then a CD video recording of the operator's console shall be required. Video shall show a real- time clock that matches the time scale used in the manual log, and information used by the operator in machine operation, guidance, and control. Indicators for the MTBM being viewed by the CD recorder shall indicate when the MTBM is excavating and the number of the pipe joint that is being pushed. (The video disk shall be submitted to the OWNER each week and a complete video recording at the end of each drive)

3. Separate log tracking pipe lubricant used in gallons, its measured viscosity, and pumping pressure,

4. Separate log tracking the volume of muck removed from the tunnel excavation for each pipe section and from the site each day.

J. Survey Plan:

1. This plan shall be developed by CONTRACTOR's engineer to transfer line and grade from the surface to the working floor of the shaft and to complete the as-built survey of the pipe installed by microtunneling.

2. In pipes over 48in inside diameter Include the survey techniques to be used for acquiring the as-built line and grade. The surveyed points along the installed pipe shall be spaced at a distance not to exceed 10 feet but not less than one survey reading shall be taken per pipe. Additionally, survey low or high points will be indicated.

3. Provide interpretation of this data; compare with specified tolerances for line and grade as contained herein as well as in the Contract Documents. Whichever are more restrictive.

4. Submit as-built survey data to OWNER at the end of each drive.

1.5 QUALITY ASSURANCE:

A. Experience Requirements:

1. Microtunnel construction is deemed specialty contractor work. The specialty subcontractor or CONTRACTOR, if the CONTRACTOR elects to self-perform this work, shall have experience using MTBMs of the types specified for this project.
2. CONTRACTOR's engineer shall be licensed by the State of California with experience designing microtunneling and shafts in similar ground conditions. This engineer shall meet applicable regulatory criteria for each system design. Experience and education shall be documented in a resume with a detailed description of the work actually performed on each of the reference projects.

Include contact details for each of the reference projects to include the current phone number, e-mail address, and title of a senior project representative familiar with his/her work. Descriptions of reference project shall include the number of shafts designed, dimensions, shoring methods, modifications to shoring, base slab details, ground and groundwater conditions, and thrust block details. Also indicate method of analyses, standards, computer programs, and materials used for constructing the shafts to include the entrance and exit seal. Provide sample design documents.

3. The Licensed surveyor, to be hired by the City, shall be registered in the State of California.

4. Provide a project superintendent with tunneling experience who has worked on microtunneling/pipe jacking projects in similar ground conditions and curved alignment using equipment similar to the equipment selected for this project.

5. Provide a MTBM operator and a shift supervisor for each shift with tunneling experience who has worked on microtunneling/pipe jacking projects using equipment similar to the equipment selected for this project, in similar ground conditions, and if proposed, curved alignment experience.

B. CONTRACTOR Design Responsibilities:

1. Design and details of jacking unit thrust collar to be used for symmetric and uniform transfer of jacking forces to the pipe.

2. Design and arrangement of shafts, including dimensions, capacity and location of the jacking reaction thrust block, frame alignment and interface with the pipe, support system for shaft walls, and provisions for control of groundwater. The excavation and excavation support shall be coordinated with construction of the permanent structure, tunnel access and manhole facilities.

3. Design and arrangement of microtunneling system including:

   a. An MTBM specifically designed for excavating and installing pipe from the jacking shaft through the geological materials as described in the GDR and GBR, for the soil and rock types, density, strength, abrasivity and maximum hydrostatic, and earth pressures. The MTBM shall also be designed to cut through boulders or obstructions as described in the GBR. The excavated diameters shall be suitable for the installed pipe diameters along the alignment specified in the Contract Documents.

b. A spoil transport system specifically designed for matching the excavation advance rate to the spoil removal rate while conveying the tunnel muck from the face for geologic materials as described herein and in the GBR. Including a surface separation plant if a recycled slurry based microtunneling system is selected, and additives, such as foams, or other muck conditioners.

c. A jacking system specifically designed for maintaining microtunnel advance as prescribed in the Contract Documents through the geologic materials as described in the GBR.

d. Design and arrangement of intermediate jacking stations, including jacking and reaction plates and their interface with the pipe, external shield, and jack capacity and location.

e. A laser, theodolite or gyro guidance control system specifically designed for maintaining tunnel tolerances as it is advanced along the required alignment as prescribed in the Contract Documents through the subsurface environment as described in the GDR and GBR.

4. Methods of excavation at the face, and details of cutting head tooling.

5. For MTBM over 60in outside diameter, provision of entry to the cutter / muck chamber for changes of cutter tools or removal of obstructions.

6. Locations where pipe lubricant is to be used and lubrication procedure.

7. Requirements for ports in pipe wall, for introduction of lubricant and contact grouting.

8. Procedure for operation of the MTBM to maintain tunnel face stability and minimize surface settlements at all times and under all conditions indicated during both excavation operations and periods of MTBM shutdown.

9. For personnel entry provide provisions for adequate ventilation in tunnels and shafts.

10. Provision for gas monitoring in the MTBM and shafts

11. Provisions for adequate lighting to facilitate as required the work in tunnels and shafts. Power and lighting circuits shall be separate as per regulations.

C. Design Criteria:

1. The geotechnical conditions including groundwater elevations to be encountered during microtunneling as detailed in the GBR.

2. Minimum shaft design loadings as provided in the GBR, plus additional construction loads such as erection, handling, storage and jacking forces necessary for installation of the pipe and other structures. Truck loading shall be minimum HS-20 vehicle loading distributions in accordance with AASHTO.

3. At Friars Rd jacking shaft take into account the multiple drives to be undertaken from a single shaft and the shaft wall MTBM launch cut outs required to ensure shaft structural stability is not compromised.

4. Internal pipe diameter, alignment, and invert location and elevations shall conform to those shown in the Contract Documents.

5. All electrical equipment should be suitable for CAL OSHA Potentially Gassy Conditions in the MTBM with an automatic power shut down to the MTBM if elevated LEL is detected. Ventilation fans will require continuous power and, if located within the tunnel, be designed for M1 operation for Class 1 Zone 1. Ventilation systems will be operated as required by CAL OSHA at no additional cost to the Owner.

6. The MTBM shall meet the following minimum requirements:

    a. Providing continuous positive face support in excess of the in-situ pressure during all phases of tunnel excavation and shutdown.

    b. Articulated to enable controlled steering in both the vertical and horizontal directions to the tolerances indicated in the Contract Documents.

    c. All functions shall be controlled remotely from the surface under normal operation.

    d. Capable of controlling shield rotation of the MTBM in the ground.

    e. Capable of injecting lubricant from the back of the MTBM and around the exterior of the pipes being jacked. Lubricant shall be refined, processed natural high swelling montmorillonite clay or other product as approved by the OWNER as necessary to produce satisfactory lubrication and earth support.

    f. Capable of controlling heave and settlement to the acceptable tolerances as specified in the Contract Documents.

    g. Provide access to the rear of the cutter wheel via an access door on MTBM that are over 60in outside diameter and on MTBM with an outside diameter over 72in with the provision of compressed air and an air lock if required.

    h. Capable of boring through the anticipated geotechnical conditions and any obstruction as described in the GBR.

7. The main and intermediate jacking system shall each consist of an even number of thrust cylinders arranged symmetrically. Each cylinder of the mainjacking system shall have individual activation, synchronized activation and individual thrust control. Cylinders shall not exert force when idle but shall resist displacement. The installed thrust capacity shall be at least 20 percent greater than the maximum theoretical combined reactions from the hydrostatic pressure, pipe friction, earth pressure, and cutter forces of the proposed drive.

1.6 COORDINATION DOCUMENTATION:

A. CONTRACTOR's engineer shall inspect, to the extent necessary, and certify that construction operations were performed in accordance with the approved design submittals. Deficiencies shall be immediately corrected by CONTRACTOR and reported to OWNER.

1.7 CONDITIONS:

A. The entire length of tunnel is classified as "Potentially Gassy." Perform work as specified herein, in accordance with the Contract Documents, and with current applicable CAL OSHA regulations for potentially gassy conditions and codes of Federal, State, and local agencies. Comply with applicable provisions of 29 CFR Part 1926, Subpart S, "Underground Construction" Standard Number 1926.800 by OSHA and Subpart P, "Excavations", latest revision. Should there be conflict between these specifications and OSHA requirements, the more restrictive will apply.

B. CONTRACTOR shall comply with applicable codes, standards, and regulations.

C. CONTRACTOR shall assess existing conditions, including property rights of adjacent properties whether private or public. Be responsible for the proposed temporary works and construction methods.

D. CONTRACTOR shall provide access to OWNER at all times during construction operations to perform inspections.

1.8 TOLERANCES:

A. Inflow of Ground and Groundwater: Not more than a total of one (1) cubic foot of ground shall enter into the shaft. Not more than one (1) gallon per minute of groundwater shall enter into the shaft during the course of the drive. If the groundwater is mixed with slurry and/or lubricant, it shall be prevented from entering the shaft in accordance with Fluid Control Plan.

B. Line and Grade during the Launching and Receiving Operations: During launching and receiving operations, line shall be maintained within ± 3 inches and grade shall be maintained within ± 1.5in

C. Maximum variation from lines and grades shown on the Contract Documents: +/-3inches in lateral alignment and +/-1.5infor vertical grade, providing that the final grade of flow

line shall be in the direction shown. In the case of variation outside the required tolerance correction of the line and grade will not exceed 1inch in 25ft.

D. Maximum ground settlements and/or differential settlements shall not exceed the limits provided in the ground movement monitoring plan.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Sewer jacking pipe shall consist of plastic lined reinforced concrete pipe (PLRCP), as required to provide a safe, stable tunnel excavation and acceptable in-place pipe. Pipe materials shall be in accordance with the Contract Documents and specifications.

B. CONTRACTOR shall be responsible for selecting and designing appropriate pipes and pipe joints to safely carry the loads imposed during construction, including jacking forces. Pipe joints shall be flush with the inside and outside of the pipe surface when pipes are assembled. Special consideration shall be given for a " jack control" system using hydraulic joints and/or other means on the curved segment of the alignment.

2.2 EQUIPMENT:

A. Microtunnel Boring Machine (MTBM)

1. The Microtunneling Boring Machine (MTBM) shall have a closed face capable of providing positive supporting pressure to the full excavated area (face) at all times and must have the capability of controlling and measuring the pressure at the face. The balancing of earth and groundwater pressures shall be achieved by the use of slurry pressure, auger earth pressure balance system, or a combination of the two. The system shall be capable of any adjustment required to maintain face stability for anticipated ground conditions. For equipment that uses a slurry spoil transportation system the earth and groundwater pressure at the face shall be controlled by the use of a variable flow slurry pumping system, pressure control valves and a minimum of two flow meters, one on the supply side and one on the return side. For equipment that uses an auger spoil transportation system the earth and groundwater pressures at the face shall be managed by controlling the volume of spoil removal relative to the advance rate (Earth Pressure Balance) and shall be augmented by the application of compressed air or soil conditioning agents if conditions require.

2. The MTBM shall be capable of controlling rotation or roll by means of bi-directional drive on the cutter head and/or by use of fins or grippers.

3. The MTBM cutter head shall be electro or hydro mechanically powered and shall provide sufficient torque to cut the face, crush material as required and feed the excavated material to the spoil transportation system.

4. The MTBM shall be articulated and fully steerable, both vertically and horizontally.

5. Automated Spoil Transportation

   a. The MTBM system shall include an automated spoil transportation system that has the capability of matching the excavation rate to the rate of spoil removal such that settlement tolerances can be maintained.

   b. A separation process shall be provided when using a slurry spoil transportation system. The separation process shall be designed to provide adequate and efficient separation of solids from the slurry so that clean slurry can be returned to the cutting face for reuse and the solids can be disposed of in an efficient manner.

B. Control Systems

1. A remote control system shall be provided that allows for the operation of the system without the need for personnel to enter the tunnel for routine operation of the system. The control equipment shall integrate the system of excavation, removal of spoil and its simultaneous replacement by a pipe. As each pipe section is jacked forward, the control system shall synchronize all of the operational functions of the system. The system shall provide complete and adequate ground support at all times.

2. Line and grade shall be controlled by a guidance system that relates the actual position of the MTBM to a design reference established by a surveying system. Typically in straight drives by a laser beam transmitted from the jacking shaft to a target mounted in the MTBM. The laser shall be mounted in the jacking shaft independent of the jacking frame and thrust block..For long or curved drives Laser guided tachimetry or theodolite or gyroscope is also acceptable and in any case shall be used for guidance through the curved portions of the alignment. The guidance system shall be checked and calibrated at least every 50ft of pipe jacking or once every day whichever is the sooner. The active steering information shall be monitored and transmitted to the operation console. The minimum information available to the operator at the control console shall include the position of the MTBM relative to the reference, roll, inclination, attitude, rate of advance, installed length, thrust force, and cutter head torque.

C. Jacking Equipment

1. Each pipe section shall be jacked forward as the excavation progresses in such a way as to provide complete and adequate ground support at all times. A jacking frame shall be provided for developing a uniform distribution of jacking forces around the perimeter of the pipe.

2. The thrust reaction block shall be properly designed and constructed and shall be perpendicular to the jacked pipe alignment. The thrust reaction block shall be designed to support the maximum estimated jacking force with a factor of safety of at least two.

3. Intermediate jacking stations shall be provided to maintain total jacking forces within the capacity of the main jacking system and the thrust reaction block. Intermediate jacking stations shall be provided of sufficient numbers and spacing to ensure completion of the drive and be of individual capacity compatible with the maximum safe jacking capacity of the pipe including through the curve.

PART 3 - EXECUTION

3.1 CONSTRUCTION:

A. General Requirements:

1. Do not begin work on the microtunneling and shafts until relevant submittals have been approved.

2. All permits have been issued by the relevant authorities

3. Construction techniques required to provide access for microtunneling shall be such as to ensure the safety of the work, at all times and during all stages of the work.

4. Support excavations and control movement of the ground, pavement, utilities or structures outside of the excavation. Ensure support of excavation conforms to applicable Local Safety Standards, OSHA Standards, trenching, and shoring standards.

5. If, at any time, the method being used by the CONTRACTOR for supporting any material or structure adjacent to excavation is not safe in the opinion of the OWNER or applicable Federal, State, or local inspection authorities, provide additional bracing and support necessary to furnish the added degree of safety required by the OWNER. Provide such added bracing and support by such method approved by the OWNER as the CONTRACTOR may elect to use but the taking of such added precautions shall in no way relieve the CONTRACTOR of their sole final responsibility for the safety of lives, work, and structures. The use of such additional bracing and support shall be at no additional cost to the OWNER. The absence of an order for additional bracing shall in no way relieve the CONTRACTOR of the sole and final responsibility.

6. Ventilation and air quality monitoring shall conform to the requirements of OSHA 3115-06R 2003 Underground Construction regulations for Gassy or Potentially Gassy Operations. The ventilation design shall be determined by the CONTRACTOR.

7. Furnish necessary labor, material, equipment, power, water, and utilities to complete the work. Additionally:

   a. Select the means and methods for performing the work.

b. Select, design, and install the thrust blocks. The thrust blocks shall be sufficiently reinforced, isolated, and otherwise anchored, to include necessary ground improvement measures, to prevent movement from occurring within the launching shaft and/or misalignment of the jacking frame.

c. Select, design, and install the entrance seals, including necessary modifications to the shoring, for the launching shafts.

d. Select, design, and install the base slabs, including necessary modifications to the shoring, for the launching shafts.

e. Select, design, and install the exit / entry seals, including necessary modifications to the shoring, for the receiving shafts.

8. Construct the shafts to accommodate the installation of the pipe, MTBM, and jacking device. Execute microtunneling such that settlement is maintained below maximum levels detailed in this Section of the specification, such that the in-place pipe shall have full bearing against earth, and such that voids shall be fully filled with grout.

9. Damaged and/or deficient materials shall be repaired and/or replaced as directed by OWNER.

10. Provide surface drainage during the period of construction to protect the work.

11. Control of Line and Grade:

a. The OWNER will establish the baselines and benchmarks indicated on the plans. The CONTRACTOR shall check these baselines and benchmarks at the beginning of the contract period and report errors or discrepancies to the OWNER. Use these baselines and benchmarks to furnish and maintain reference lines and grades for microtunnel construction. Use these lines and grades to establish the starting location of the microtunnel.

b. Mount guidance system in a manner than isolates it from effects of movement by the jacking forces.

c. When the excavation is off line or grade, return to the plan line and/or grade at a rate of no more than 1 inch per 25 feet.

12. Grouting:

a. A uniform mixture of 1:6 maximum (cement:sand) cement grout shall be placed to fill voids, which exist between the pipe and the ground in accordance with the requirements of this Section and the Contract Documents. Grout shall have a minimum 28-day compressive strength of 500 psi.

13. Protect the existing improvements at the site from damage including but not limited to structures, utilities, and culverts.

3.2 INSTALLATION:

A. Perform work in accordance with the approved submittals.

B. The licensed surveyor shall be responsible for verifying control points identified in the Contract Documents. CONTRACTOR's surveyor shall check baseline and/or benchmarks shown prior to starting and report errors or discrepancies to OWNER.

C. Notify OWNER immediately upon detecting larger than predicted deformation, distress, or damage to the excavation support system.

D. Notify OWNER immediately of any structural element that is not in accordance with the approved design submittals.

E. Do not resume construction activities until corrective measures have been fully implemented.

F. Microtunnel each pipe section as the excavation progresses in such a way to provide complete and adequate ground support at all times. Utilize a jacking frame that develops a uniform distribution of jacking forces around the periphery of the pipe. Design and construct the thrust block to sustain jacking reactions and construction forces. The thrust block shall be normal (square) with the proposed pipe alignment and designed to support the maximum obtainable jacking pressure with a factor of safety of at least 2.0. The jacking system, including intermediate jacks used, shall be capable of continuously monitoring the jacking pressure and rate of advancement.

G. On drives over 500ft utilize an automated (ABIS) lubrication system that injects a lubricant from the rear of the MTBM and at intervals along the pipeline to the external surface of the pipe, which lowers the friction developed on the outside of the pipe during jacking. Spacing of lubricant points along the pipe train shall be at the CONTRACTOR's option. Modify this system as required to prevent pipe binding or stoppage at no additional cost to the OWNER.

H. Utilize a spoil transportation method capable of handling and removing the expected excavated materials as indicated herein and in the GBR.

I. Limit the overcut on the tunnel shield to no more than ½ inch on radius for pipe 48in or less in diameter and ¾ inch on radius for pipes over 48in in diameter unless approved by the OWNER. The annular space created by the overcut shall be filled with a lubricant that has been proven suitable for the particular ground conditions to be tunneled.

J. After completion of microtunneling, attempt to replace lubricant between the pipe exterior and surrounding ground with a cement grout. Control the pressure and the amount of grout to prevent damage and displacement of the pipe.

K. Use additive as required in muck conditioning system to reduce machine applied torque and maintain muck flow and pressure holding capability.

L. If a slurry system is used then a slurry separation plant shall be used. The plant shall clean the excavated spoil from the slurry for disposal and return the slurry back to the MTBM face for reuse. The type of separation plant used shall be designed by the CONTRACTOR.

M. Dispose of excavated material off-site in accordance with applicable permit and regulatory requirements and in accordance with the Contract Documents.

3.3 FIELD INSPECTION:

A. CONTRACTOR's engineer shall conduct visual inspections to verify:

1. Shafts and modifications to the shoring were constructed in accordance with the approved design submittals.

2. Entrance/exit seals were constructed in accordance with the approved design submittals.

3. Thrust Blocks were constructed in accordance with the approved design submittals.

4. Base slabs were constructed in accordance with the approved design submittals.

5. Layout of shaft is generally in accordance with approved submittals.

B. Details of these visual inspections shall be written into a field inspection report and submitted to OWNER.

C. Submit to the OWNER copies of field notes used to establish lines and grades; however, the CONTRACTOR remains fully responsible for the accuracy of the work and the correction of it, as required.

D. Record locations where the jacking pipe has deflected more than 3in off line or 1in off grade

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. T11, Standard Method of Test for Materials Finer Than 75□m (No. 200) Sieve in Mineral Aggregates by Washing.
   b. T27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates.
   c. T89, Standard Specification for Determining the Liquid Limit of Soils.
   d. T90, Standard Specification for Determining the Plastic Limit and Plasticity Index of Soils.
   e. T96, Standard Specification for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   f. T99, Standard Specification for the Moisture-Density Relations of Soils Using a 2.5 kg (5.5 pound) Rammer and a 305 mm (12 in) Drop.
   g. T180, Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18-in) Drop.
   h. T190, Standard Specification for Resistance R-Value and Expansion Pressure of Compacted Soils.
   i. T265, Standard Method of Test for Laboratory Determination of Moisture Content of Soils.
   j. T310, Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
2. ASTM International (ASTM):
   a. C88, Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
   b. D1883, Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
   c. D2419, Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
   d. D4791, Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

1.2 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross-section.

B. Completed Lift: Compacted with uniform cross-section thickness.

C. Standard Specifications: When referenced in this section, shall mean the Standard Specifications for Public Work Construction (Green Book), as supplemented by the White Book**.**

1.3 SUBMITTALS

A. Action Submittals:

1. Samples: Submit for specified materials 20 days prior to delivery to Site.

B. Informational Submittals:

1. Certified Test Results on Source Materials: Submit copies from commercial testing laboratory **20** days prior to delivery of materials to Project showing materials meeting the physical qualities specified.
2. Certified results of in-place density tests from independent testing agency.

PART 2 PRODUCTS

2.1 BASE COURSE

A. Clean, hard durable, pit run gravel or crushed stone graded from coarse to fine containing enough fines to bind material when compacted.

B. Physical Qualities:

1. Abrasion, AASHTO T96: 35 percent maximum wear.
2. Fractured Face: C**:** 75 percent minimum particles.
3. Liquid Limit, AASHTO T89: Maximum 30 percent.
4. Plasticity Index, AASHTO T90: Maximum 6 percent.
5. Sand Equivalency, ASTM D2419: 35 percent, minimum.
6. Resistance (R) Value, AASHTO T190: 75 minimum.
7. CBR Value, ASTM D1883: 100 percent, minimum.
8. Soundness, ASTM C88: 12 percent, maximum.
9. Flat and Elongated Particles, ASTM D4791: 8 percent, maximum.

C. Gradation, AASHTO T27, Based on U.S. Standard Sieves:

Table 1 Gradation Percent Passing by Weight		
Sieve Designation	**Material**	
(Square Opening)	**Aggregate Base Course**	**Leveling Course**
50 mm (2")		
38 mm (1-1/2")	100	
25 mm (1")		100
19 mm (3/4")	90-100	70-100
(3/8")		
4.75 mm (1/4")	35-55	
(No. 8)		20-50
2.00 mm (No. 10)		
1.20 mm (No. 16)		
(No. 30)	10-30	
425 □m (No. 40)		
(No. 50)		8-28
177 □m (No. 80)		
150 □m (No. 100)		
75 □m (No. 200)	2-9	2-6

2.2 LEVELING COURSE AND GRAVEL SURFACING

A. As specified in the Standard Specifications.

B. Clean, tough, uniform quality, durable fragments of crushed rock, free from flat, elongated, soft or disintegrated pieces, or other objectionable matter occurring either free or as coating on stone. Gradation as specified in Table 1.

C. Physical Qualities: Same as for base course.

2.3 SOURCE QUALITY CONTROL

A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.

B. Final approval of aggregate material will be based on test results of installed materials.

C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

A. As specified in the Standard Specifications.

B. As specified in Section 31 23 13, Subgrade Preparation.

C. Obtain Engineer's acceptance of subgrade before placing base course or surfacing material.

3.2 EQUIPMENT

A. In accordance with the Standard Specifications.

B. Compaction Equipment: Adequate in design and number to provide compaction and to obtain specified density for each layer.

3.3 HAULING AND SPREADING

A. In accordance with the Standard Specifications.

B. Hauling Materials:

1. Do not haul over surfacing in process of construction.
2. Loads: Of uniform capacity.
3. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

C. Spreading Materials:

1. Distribute material to provide required density, depth, grade, and dimensions with allowance for subsequent lifts.
2. Produce even distribution of material upon roadway or prepared surface without segregation.
3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.

3.4 CONSTRUCTION OF COURSES

A. Construction of Courses: In accordance with the Standard Specifications.

B. Untreated Aggregate Base Course:

1. Maximum Completed Lift Thickness: 6 inches.
2. Completed Course Total Thickness: As shown.
3. Spread lift on preceding course to required cross-section.
4. Lightly blade and roll surface until thoroughly compacted.
5. Add keystone to achieve compaction and as required when aggregate does not compact readily due to lack of fines or natural cementing properties, as follows:
   a. Use leveling course or surfacing material as keystone.
   b. Spread evenly on top of base course, using spreader boxes or chip spreaders.
   c. Roll surface until keystone is worked into interstices of base course without excessive displacement.
   d. Continue operation until course has become thoroughly keyed, compacted, and will not creep or move under roller.
6. Blade or broom surface to maintain true line, grade, and cross-section.

C. Leveling Course**:**

1. Maximum Completed Lift Thickness: 4 inches.
2. Completed Course Total Thickness: As shown.
3. Spread on roadway or preceding course to depth, grade, and cross-section shown.
4. Lightly blade surface and roll until thoroughly compacted to line and grade shown.
5. Maintain moisture levels to prevent loss of fines during processing.

D. Gravel Surfacing**:**

1. Maximum Completed Lift Thickness: 9 inches.
2. Completed Course Total Thickness: As shown.
3. Spread on preceding course in accordance with cross-section shown.
4. Blade lightly and roll surface until material is thoroughly compacted.

3.5 ROLLING AND COMPACTION

A. In accordance with the Standard Specifications.

B. Commence compaction of each layer of base after spreading operations and continue until density of 95 percent of maximum density has been achieved as determined by AASHTO D: T99 and T180.

C. Roll each layer of material until material does not creep under roller before succeeding layer is applied.

D. Commence rolling at outer edges and continue toward center; do not roll center of road first.

E. Apply water as needed to obtain specified densities.

F. Place and compact each lift to required density before succeeding lift is placed.

G. Remove floating or loose stone from surface of preceding course before placing leveling course.

H. Surface Defects: Remedy by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.

I. Finished surface shall be true to grade and crown before proceeding with surfacing.

3.6 SURFACE TOLERANCES

A. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.

B. Finished Surface of Untreated Aggregate Base and Leveling Course: Within plus or minus 0.04 foot of grade shown at any individual point.

C. Gravel Surfacing: Within 0.04 foot from lower edge of 10-foot straightedge placed on finished surface, parallel to centerline.

D. Overall Average: Within plus or minus 0.01 foot from crown and grade specified

3.7 DRIVEWAY RESURFACING

A. Replace gravel surfacing on driveways that were gravel surfaced prior to construction.

B. Provide compacted gravel surfacing to depth equal to original, but not less than 4 inches.

C. Leave each driveway in as good or better condition as it was before start of construction.

3.8 FIELD QUALITY CONTROL

A. In-Place Density Tests:

1. Provide Owner two (2) hours advance notification prior to testing.
2. Show proof that areas meet specified requirements before requesting that Owner identify density test locations.
3. Refer to Table 2 for minimum sampling and testing requirements for aggregate base course and surfacing.

Table 2
Minimum Sampling and Testing Requirements

Property	Test Method	Frequency	Sampling Point
Gradation	AASHTO T11 and AASHTO T27	One sample every 500 tons but at least every 4 hours of production	Roadbed after processing
Moisture Density (Maximum Density)	AASHTO T180 , Method D	One test for every aggregate grading produced	Production output or stockpile
In-Place Density and Moisture Content	AASHTO AASHTO T265 for moisture content	One for each 500 ton but at least every 10,000 sq ft of area	In-place completed, compacted area

3.9 CLEANING

A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING AND ASPHALT

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO).
   a. M6, Standard Specification for Fine Aggregate for Portland Cement Concrete.
   b. M80, Standard Specification for Coarse Aggregate for Portland Cement Concrete.
   c. M153, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
   d. M157, Standard Specification for Ready-Mixed Concrete.
   e. M213, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   f. M227/M227M, Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
2. American Concrete Institute (ACI):
   a. 305R, Hot Weather Concreting.
   b. 306R, Cold Weather Concreting.
   c. 308, Standard Practice for Curing Concrete.
   d. 318/318R, Building Code Requirements for Structural Concrete and Commentary.
   e. 325.9R, Guide for Construction of Concrete Pavements and Concrete Bases.
3. ASTM International (ASTM):
   a. A615/A615M, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   b. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   c. C33, Specification for Concrete Aggregates.
   d. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   e. C42/C42M, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   f. C78, Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).

g. C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
h. C94/C94M, Standard Specification for Ready-Mixed Concrete.
i. C143/C143M, Standard Test Method for Slump of Hydraulic Cement Concrete.
j. C150, Specification for Portland Cement.
k. C172, Standard Practice for Sampling Freshly Mixed Concrete.
l. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
m. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
n. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
o. C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
p. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
q. C803/C803M, Test Method for Penetration Resistance of Hardened Concrete.
r. C1330, Specification for Cylindrical Seal Backing for Use With Cold Liquid Applied Sealants.
s. C805, Test Method for Rebound Number of Hardened Concrete.
t. D920, Standard Specification for Elastomeric Joint Seals.
u. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
v. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
w. D1752, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
x. D2628, Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete.
y. D2828, Specification for Non-Bituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type.
z. D3406, Specification for Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements.
aa. D3569, Specification for Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant Type for Portland Cement Concrete Pavements.
bb. D3581, Specification for Joint Sealant, Hot-Applied, Jet-Fuel-Resistant-Type, for Portland Cement and Tar-Concrete Pavements.

cc. D5249, Specification for Backer Material for Use With Cold- and Hot-Applied Joint Sealants in Portland Cement Concrete and Asphalt Joints.
dd. D5893, Specification for Cold-Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
ee. E329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

4. National Ready Mixed Concrete Association (NRMCA).

1.2 SUBMITTALS

A. Provide as required in Section 03 30 00, Cast-in-Place Concrete.

B. Action Submittals:

1. Product Data: Admixtures.
2. Design Data:
   a. Concrete mix design signed by concrete mix designer.
   b. Minimum Information:
      1) Name of ready-mix plant.
      2) Project.
      3) Engineer.
      4) Contractor.
      5) Mix design number.
      6) Specified concrete strength.
      7) Water-cement-fly ash ratio.
      8) Maximum aggregate size.
      9) Cement content.
      10) Fly ash content.
      11) Water content.
      12) Type, name, and amount of admixtures.
      13) Unit weight.
      14) Slump.
      15) Ingredient proportions corrected for average moisture content for particular times of year.
3. Jointing Drawings: Identify location and spacing of each type of joint.
4. Gradation for coarse and fine aggregates, and combined gradation. List percent passing each sieve size.
5. Detailed plan for cold weather placements, including curing and protection.
6. Detailed plans for hot weather placements, including curing and protection.

C. Informational Submittals:

1. Manufacturers' Certificate of Compliance:
   a. Portland cement.
   b. Admixtures.
   c. Fly ash.
   d. Aggregates.
2. Statements of Qualifications:
   a. Mix designer.
   b. Batch plant.
   c. Testing laboratory.
3. Test Reports:
   a. Admixtures: Chemical ingredients and percentage of chloride in each admixture and fly ash.
   b. Fly Ash: Source test analysis and amount used in accordance with ASTM C94/C94M, Section 16.
   c. Mix Design: For each trial, signed by qualified mix designer.
   d. Laboratory Mixes: Cylinder test results.
4. Concrete Delivery Tickets:
   a. For each batch of concrete before unloading at Site.
   b. Minimum Delivery Ticket Information:
      1) Name of ready-mix plant.
      2) Serial number of ticket.
      3) Date and truck number.
      4) Name of Contractor.
      5) Job name and location.
      6) Mix design number.
      7) Amount of concrete (cubic yards).
      8) Type and amount of admixtures.
      9) Amount of water added at batch plant.
      10) Time of loading, arriving at Site, and unloading.
      11) Volume of water added by receiver of concrete and their initials.
   c. Record of drum revolution counter, type, and brand.

1.3 QUALITY ASSURANCE

A. Provide as required in Section 03 30 00, Cast-in-Place Concrete.

B. Qualifications:

1. Mix Designer: Licensed professional engineer registered in the state of Project or a certified concrete mix designer approved by local Department of Transportation.
2. Testing or Inspection Agency: In conformance with ASTM E329.

3. Batch Plant: Currently certified by the National Ready Mixed Concrete Association.

C. Prepaving Conference:

1. Held between Contractor, Subcontractor involved in concrete paving, and Engineer.
2. To be conducted a minimum of 14 days prior to commencing paving.
3. Conference cannot be held until mix design and admixture Submittals have been received by Engineer.
4. Items to discuss shall include, but not be limited to:
   a. Mix design.
   b. Method of placement.
   c. Curing.
   d. Finishing schedule.
   e. Traffic control.
   f. Protection of work.

D. Hot Weather Concreting: Conform to ACI 305R.

E. Cold Weather Concreting: Conform to ACI 306R.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Transporting of ready-mix concrete shall be in accordance with ASTM C94/C94M.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement:

1. Furnish cement for Project from one source.
2. Provide as required in Section 03 30 00, Cast-in-Place Concrete.
3. Portland cement shall be Type III meeting the requirements of the Standard Specification**.**
4. In accordance with ASTM C150.
5. Pozzolan: As specified in Section 03 30 00, Cast-in-Place Concrete.

B. Aggregates:

1. General:
   a. As specified in Section 03 30 00, Cast-in-Place Concrete.

b. Aggregate for portland cement concrete mixture shall be 1-inch maximum size stone meeting requirements of the Standard Specification.
c. Material: Natural aggregates, free from deleterious coatings.
d. Aggregates shall not be potentially reactive as defined in ASTM C33.
e. Aggregates not in compliance with soundness and durability requirements of ASTM C33 may be used with prior approval of Engineer; provided it can be shown by special testing or record of past performance that these aggregates produce concrete of adequate strength and durability. Aggregate soundness testing for fine and coarse aggregates shall be in accordance with ASTM C33 and ASTM C88.

2. Fine Aggregates:
   a. Grading Class meeting requirements of the Standard Specifications.
   b. Must be graded coarse to fine within the following limits.

General Requirements	
Sieve Size Passing	**Percentages by Weight**
3/8"	100
No. 4	90-100
No. 8	55-85
No. 16	45-75
No. 30	25-55
No. 50	5-30
No. 100	0-8

   c. Sand: Equivalent of not less than 68.
   d. Materials finer than 200 sieve shall not exceed 4 percent.

3. Coarse Aggregate:
   a. Grading Class meeting requirements of the Standard Specifications.
   b. Materials finer than 200 sieve shall not exceed 0.5 percent.
   c. Size: 1-1/2 inch to No. 4.

Grading Requirements		
Sieve Size Passing	**Separated Sizes 1-1/2 Inch to 3/4 Inch**	**Percentages (by Weight) 3/4 Inch to No. 4**
2"	100	
1-1/2"	90-100	
1"	30-65	100
3/4"	0-15	90-100
3/8"		20-50
No. 4		0-10

C. Physical Properties:

1. Meet requirements of AASHTO M80 for Class B.
2. In accordance with the Standard Specifications.

D. Water: ASTM C94/C94M.

E. Admixtures:

1. Add admixtures to mix at batch plant.
2. Air Entraining: ASTM C260.
3. Water Reducing:
   a. ASTM C494/C494M, Type A, normal, containing no chlorides and compatible with air-entraining admixtures.
   b. Type E, accelerating water reducing type, may be used with prior approval by Engineer.
   c. Do not use calcium chloride, salt, or antifreeze agents.

2.2 ANCILLARY MATERIALS

A. Tie Bars: Grade 40 deformed steel bars conforming to Section 03 21 00, Reinforcing Steel**.**

B. Dowels: Conform to requirements of AASHTO M227/M227M, Grade 70.

C. Joint Filler:

1. Preformed expansion joint filler conforming to as specified in Section 03 15 00, Concrete Joints and Accessories
2. Fillers furnished under AASHTO M213 shall be tested in accordance with ASTM D1751.

D. Joint Sealant:

1. Preformed elastomeric joint seal conforming to AASHTO M220.
2. Hot-poured elastomeric joint seal conforming to AASHTO M282.
3. Hot-applied, jet-fuel-resistant joint sealant conforming to ASTM D3569**.**
4. Cold-applied single component joint sealant conforming to ASTM D5893.
5. Elastomeric joint sealant conforming to ASTM C920.

E. Backer Rod:

1. Backer material conforming to ASTM D5249.
2. Cylindrical sealant backing conforming to ASTM C1330.

F. Curing Compound: ASTM C309, suitable for spray application.

G. Curing Membranes:

1. White polyethylene sheeting.
2. Waterproof paper.
3. Cotton or jute mats.

H. Evaporation Retardant: Confilm as manufactured by Master Builders Company.

2.3 EQUIPMENT

A. Ready-Mix Concrete Batch Plants: Certified by NRMCA.

B. Batch Plants:

1. Conform to requirements of Section of the Standard Specifications.
2. Bins shall have adequate separate compartments for fine aggregate, each separate size of coarse aggregate and cement. Bins and compartments shall be tight and ample to prevent spilling from one bin to another. Separate compartments, including weighting hoppers, shall discharge freely and efficiently.
3. Scales for weighing aggregates and cement may be either beam type or springless dial type. They shall be accurate within 0.5 percent under operating conditions throughout the range of use and, tested and adjusted as often as Engineer may deem necessary to assure their continued accuracy.
4. Equipment for dispensing water and admixtures shall provide a separate feed, accurate quantity measurement, and shall inject water and

admixture at a time in mixing process to ensure thorough and complete mixing throughout batch of portland cement concrete.

5. Automatically controlled batchers shall have automatically interlocked mechanisms providing the following:
    a. Positive weighing and discharge of cement and of each separate size of aggregate.
    b. Interlocking between weighing hoppers to prevent part of batch from being discharged until each separate hopper has been filled with correct proportion.
    c. Simultaneous discharge of hoppers.
    d. Lockable compartment containing time setting controls.
6. Equip mixers with a timing device that will not permit batch to be discharged until specified mixing time has elapsed. The means of storing, measuring and introducing water into mixer shall provide positive control and accurate measurement.

C. Ready-Mix Concrete Trucks:

1. Agitator mixer type.
2. Equipped with operable electrically actuated drum revolution counters.
3. Use of nonagitator equipment will not be permitted.
4. Each mixer shall carry a clearly visible manufacturer's plate showing capacity of mixer and other pertinent operating rates and limits.
5. Provision shall be made at mixer for controlled addition of air-entraining admixtures or other special components of mix.
6. Mixing Speed: 70 to 100 revolutions at a mixing speed recommended by truck mixer manufacturer.

D. Hauling Equipment:

1. Hauling equipment shall conform to AASHTO M157, Paragraph 11.6 and Paragraph 12.
2. Upon delivery of each batch of concrete to Site, a trip ticket shall be submitted to Engineer.

E. Paving Equipment:

1. Slipform Paver:
    a. Place portland cement concrete with two separate machines, one a spreader and one a slipform paver. Machines, when operating in tandem shall spread, consolidate, screed, and float finish freshly placed portland cement concrete in one pass with a minimum of hand finishing. Each machine shall be fully self-propelled and equipped with electronic controls to control line and grade from both sides.

b. Spreader shall be able to deliver mix without segregation or displacing reinforcing steel.
c. Able to vibrate portland cement concrete for full width and depth and be equipped with vibrating tubes or arms to work in portland cement concrete. Sliding forms shall be held together rigidly to prevent them from spreading. Form shall be long enough so slumping of portland cement concrete will not exceed 1/4 inch.
d. Supports of paver and other equipment which ride on previously placed pavement shall be equipped to prevent marring, edge breaking, or chipping of previously placed pavement.

2. Bridge Deck Finisher/Paver: A bridge or similar finishing/paving machine utilizing previously constructed and cured curb and gutter as side forms and support for machine rails may be used with prior approval of Engineer.

F. Concrete Saws:

1. Provide power driven concrete saws for sawing joints or finishing concrete, adequate in number of units and power to complete sawing at required rate.
2. Saws and related equipment shall be of proven adequacy and design to perform efficiently and shall be subject to immediate replacement, if specified results are not obtained.
3. Standby saw shall be available at Site.

G. Smoothness Testing Equipment: Supply two 12-foot straightedges for determining smoothness.

2.4 CONCRETE MIX DESIGN

A. As specified in Section 03 30 00, Cast-in-Place Concrete, with a minimum flexural strength of 650 psi.

B. Compressive strength of 4,000 psi minimum and flexural strength of 650 psi minimum, both at 28 days.

1. If the 650 psi flexural strength specification requires a compressive strength in excess of 4,000 psi, the higher compressive value shall be used as a standard minimum for compressive strength cylinder tests taken during construction.
2. The relationship between compressive strength f_c and modulus of rupture f_r shall be:

$$f_r = k\sqrt{f_c}$$

with k derived from the tests results.

C. Concrete target strengths shall be in accordance with ACI 318/318R.

D. Maximum water-cement ratio or water-cement plus pozzolan ratio, if applicable, shall not exceed 0.48.

E. Replacement of cement with pozzolan shall not exceed 20 percent.

F. Maximum Aggregate Size: 3/4 inch(es) minus.

G. Allowable Slump: 3 inches, plus or minus 1 inch.

H. Allowable Air Entrainment: 5 percent, plus or minus 1 percent by volume.

I. Concrete shall contain water reducer. Amount of admixture added to concrete shall be in accordance with manufacturer's written instructions.

J. Use of set-retarding admixtures shall be subject to prior approval by Engineer.

K. Do not use frozen materials or materials containing ice or snow.

L. Concrete temperature as delivered to site ready for placement shall be above 50 degrees F and below 90 degrees F.

M. If Contractor proposes to use a current mix design that meets these Specifications, has been used on a previous similar project, and less than 1 year has elapsed since it was last used; Contractor shall submit documentation of production of concrete produced from that mix design to Engineer for review. If review verifies concrete produced meets these Specifications and strength requirements, and establishes a correlation between compressive strength and flexural strength, no trial batches for proposed mix design will be required.

2.5 ASPHALT

A. New asphalt shall meet the following requirements: 6 inches of asphalt above 12 inches of aggregate base. Asphalt mix design shall be ¾-inch Type III, Class B3. Top 6 inches of aggregate base shall be asphalt treated permeable base, which shall conform to the applicable requirements of Section 68-3.02B(1) "Asphalt Treated Permeable Material" of the State of California, Department of Transportation, Standard Specifications, and Section 301-4 "Bituminous Stabilized Base" of the Standard Specifications for Public Works Construction. Bottom 6 inches of aggregate base shall be Class II aggregate base material.

PART 3 EXECUTION

3.1 WEATHER LIMITATIONS

A. Concrete shall not be placed:

1. Until the air temperature in the shade is 35 degrees F and rising and is forecast to remain above 35 degrees F.
2. On frozen ground.
3. During periods of rain or snow.

B. Concrete placement shall not continue when air temperature drops below 40 degrees F.

C. Protect concrete pavement from inclement weather for 7 days after it has been placed, when rain is imminent, and when air temperature drops or is forecast to drop below 35 degrees F.

3.2 PREPARATION

A. Prepare base as specified in Section 32 11 23, Aggregate Base Courses. Dampen base thoroughly prior to concrete placement; standing water will not be permitted.

B. Formwork shall be complete prior to placement of concrete. Area in which concrete is to be placed, shall be smooth and free of ruts, projections, debris, spilled concrete, mud, sloughed soil, standing water, organic and other objectionable materials.

C. Construction Joints: Inspect prior to placement of concrete.

D. Prior to placing paving equipment in position, full width and length of the area on which the tracks of the paving equipment is to operate shall be brought to density and surface tolerances required.

E. Protect existing exposed surfaces such as grates, catch basins, air valves, manholes, and cleanout lids from splattered and spilled concrete during concrete placement by use of durable waterproof paper.

F. Furnish operable backup vibrator on Site prior to concrete placement.

3.3 SLIP FORM PAVING

A. Deliver from hauling vehicles to paving machine hopper.

B. Contractor's equipment hauling portland cement concrete or reinforcement will not be permitted on subgrade, but will be allowed on base, with turns or

other maneuvering kept to a minimum. Damage to subgrade or base shall be corrected to satisfaction of Engineer.

C. Place in final position uniformly in one layer, so a minimum of finishing will be necessary to provide a dense, homogenous pavement conforming to true grade and cross section.

1. Spreader shall receive portland cement concrete mixture in its hopper and uniformly spread and strike it off at proper thickness for full width of area being paved.
2. Paver shall vibrate, consolidate, and finish slab to proper grade and cross section.

D. Paver:

1. Operated with as continuous forward movement as possible.
2. Coordinate mixing, delivering, and spreading portland cement concrete to provide uniform progress.
3. Stopping and starting paver shall be held to a minimum. If, for any reason, it is necessary to stop forward motion of paver, vibratory and tamping elements shall also be stopped immediately.
4. No external force shall be applied to paver, except with approval of Engineer.

E. While placing portland cement concrete, provision shall be made for constructing joints, placing dowels, tie bars, and other devices as called for by Drawings and as provided in Article Joints.

F. Portland cement concrete shall be rejected if it:

1. Is not in place within 1 hour after being mixed.
2. Has begun to take an initial set prior to placement.
3. Has been retempered with water.

G. If necessary, supplemental hand spreading and distributing shall be with shovels. Rakes will not be permitted.

H. Portland cement concrete shall not be fouled with foreign matter.

I. Use vibrators to consolidate portland cement concrete pavement at least 6 feet each side of construction joints and expansion joints.

3.4 STATIONARY SIDE FORM CONSTRUCTION

A. Where width of pavement is narrow, tapering, or of irregular pattern not lending itself to being constructed by prescribed machine methods, Contractor

shall be permitted to place concrete as specified in Section 03 30 00, Cast-in-Place Concrete. Perform strike off, consolidation, final floating, and surface finishing with equipment, tools, means, labor, and methods other than those specified, provided the Work meets approval of Engineer and the following requirements:

1. As concrete is being placed, striking off and consolidating portland cement concrete shall be done without causing segregation of material and shall include thorough uniform vibration throughout the mass until it is uniformly compacted.
2. Portland cement concrete shall be struck off by means of templates or screeds designed and manipulated to shape portland cement concrete to specified cross section between forms, carrying a slight excess of portland cement concrete in front of leading edge of templates or screeds at all times. Tamp portland cement concrete to reduce voids to a minimum.
3. Floating shall follow vibrating, striking off, and tamping operations and shall include transverse floating or other smoothing and finishing action. This shall provide a surface and evenness within a 12-foot straightedge tolerance of 0.01 foot. Test hardened surface in presence of Engineer. Surface shall be free from laitance, soupy mortar, marks, or irregularities.

B. Defects:

1. Fill areas of minor honeycomb or other minor defect in composition of portland cement concrete along exposed edges of portland cement concrete with a stiff mortar of cement and fine aggregate. Apply to moistened portland cement concrete to satisfaction of Engineer.
2. Area showing serious defects in composition of concrete shall be removed and replaced with pavement of specified quality for full width of strip between longitudinal joints or edges and for a length not less than between the nearest transverse joints.

3.5 JOINTS

A. General:

1. Referred to as contraction or construction, either of which may be transverse or longitudinal, as called for by Drawings or as approved by Engineer.
2. Joints, backer material, joint filler and joint sealants shall extend to pavement edges or to each other, as the case may be, and shall be constructed perpendicular to surface of pavement.

3. Joints shall not vary from specified or indicated line by more than 1/4 inch.
4. Contractor shall submit jointing plan and details to Engineer for approval. Take into consideration placement of joints in curb and gutter, at catch basins, and position of manholes and other large structures, as well as other limitations herein mentioned.
5. Place manhole or similar large structure in line of joint, or if impractical, isolate structure from pavement with premolded joint filler, 1/2-inch wide, conforming to AASHTO M213 and ASTM D1751.

B. Contraction Joints:

1. Sawed Type with Poured Filler:
   a. Sawing shall be to a depth as shown on Drawings with a maximum width of 1/4 inch and a minimum width of 1/8 inch, in straight lines as shown or as approved by Engineer.
   b. Perform saw cuts as soon as portland cement concrete has set enough to permit sawing without tearing or raveling, before uncontrolled cracking results, and within 24 hours of placing portland cement concrete.
   c. Saws may be single or tandem, as Contractor may elect, and shall be controlled by guides to true line.
   d. Clean joints thoroughly of foreign matter before pouring approved rubber asphalt filler.
   e. Tops of joint filler shall be true to pavement cross section within 1/8 inch and shall be protected from damage by portland cement concrete operations.
   f. Areas containing uncontrolled cracks shall be removed and replaced.
   g. Restore curing agents broken or damaged by sawing operations.
2. Space longitudinal joints as shown on Drawings at the interface between lanes, normally at intervals between 12 feet to 16 feet.
3. Transverse joints shall be as shown on Drawings or as approved by Engineer, with intervals of 12 feet to 16 feet.

C. Construction Joints:

1. Construct when there is an interruption of longer 45 minutes in portland cement concrete placing operations or where specified.
2. Place parallel with intended contraction joint.
3. Tool both free edges of joints with 1/8 inch radius rounder to remove laitance and mortar resulting from finishing operations and to provide clean rounded edge. Tooling shall not form ridges on surface of concrete.

4. New portland cement concrete placed contiguous to joint shall conform to proportions and consistency of previously placed concrete.
5. Transverse Construction Joint:
    a. Doweled type using No. 8 by 36-inch long dowels at 12-inch centers coated with plastic, grease, heavy oil or other approved material that will neither bond with nor be harmful to operation at a depth of 1/2 the pavement thickness parallel to centerline.
    b. If sufficient portland cement concrete has not been mixed at the time of interruption to place a construction joint at least 3 feet from a planned contraction joint, remove excess portland cement concrete back to a position to satisfactorily meet these criteria and to satisfaction of Engineer.
    c. Fill joint which has opened to a width of 1/8 inch or greater during construction or maintenance periods with poured filler.
    d. Do not construct within 3 feet of a transverse contraction joint.
6. Longitudinal Construction Joint:
    a. Tied type using No. 5 x 36-inch deformed tie bars at 12-inch centers.
    b. Tie Bars:
        1) Not required at construction joint between portland cement concrete pavement and gutter, except where shown on Drawings and mentioned above.
        2) Placement:
            a) Plastic Portland Cement Concrete: Insert before vibrating and finishing portland cement concrete; or
            b) Hardened Concrete:
                (1) Drill hole, insert, and grout tie bars into place.
                (2) Drill holes large and deep enough to allow tie bars to be inserted with grout.
                (3) Perform any time after portland cement concrete has attained enough strength to resist any damage caused by drilling.
                (4) Tie bars shall be grouted a maximum of 3 hours prior to placement of adjacent portland cement concrete.
        3) Replace loose tie bars by drilling and grouting as described.

D. Scored Joints:

1. Configuration: 1/4-inch wide by 1/4-inch deep at locations indicated on Drawings formed by tooling of concrete while it is still fresh.
2. Do not fill or seal.
3. Layout of joints shall be straight and true and shall not vary from indicated line by more than 1/4 inch.

3.6 SURFACE FINISHING

A. Use temporary screeds. Wet screeding and jitterbugging shall not be permitted.

B. Pavement shall have surface tolerance of 1/4 inch in 10 feet in accordance with ACI 325.9R.

C. Salting, spreading of cement or cement and sand mixture to speed up hardening shall not be permitted.

D. Exposed pavement edges shall be edged to a 1/2-inch radius after finishing. Edging shall not form ridges on pavement surface.

E. Pavement shall be treated and protected by use of evaporation retardant applied in accordance with manufacturer's written instructions. Flat surfaces shall be treated immediately after screeding and floating or if time period greater than 15 minutes occurs between finishing operations.

F. Pavement shall be screeded, floated, and given skid-resistant surface.

3.7 CURING OF PORTLAND CEMENT CONCRETE

A. Immediately after the final floating, surface finishing, and edging has been completed, and while portland cement concrete surface is still moist, cover and cure entire exposed surface for at least 72 hours in accordance with one of the following provisions:

1. Liquid Membrane-Forming Compounds: Apply compound uniformly to portland cement concrete by pressure spray methods at a rate which will form an impervious membrane, but at least at a rate of 1 gallon per 150 square feet.
2. Other Membranes:
    a. Apply to damp portland cement concrete as soon as it can be placed without marring surface.
    b. Place in contact with surface, extend beyond sides or edges of slabs or forms, and fasten down to hold it in position as a waterproof and moistureproof covering.
    c. Laps shall be sufficient to maintain tightness equivalent to sheeting.
    d. Transverse laps for waterproof paper shall be at least 18 inches, and longitudinal seams shall be cemented.
    e. Cotton or jute mats shall be saturated with water prior to placing and kept fully wetted during curing period.

B. Concrete shall be cured by use of curing compound, for minimum of 7 days after concrete placement, in accordance with ACI 308. Curing compounds shall be applied in accordance with manufacturer's written instructions.

C. Exposed surfaces shall be sprayed with curing compound immediately after free surface water has disappeared from finished surface.

D. Concrete temperature shall be maintained in accordance with ACI 306R.

E. Curing compounds shall not come in contact with hardened concrete that is to be concreted against.

3.8 FIELD QUALITY CONTROL

A. Retain independent testing or inspection agency to perform inspection, sampling, and testing.

B. Concrete Sampling: In accordance with ASTM C172. Take sample not less than every 5,000 square feet or fraction thereof of concrete placed each day.

C. Perform following tests on each sampling:

1. Slump: ASTM C143/C143M.
2. Air Content: ASTM C231.
3. Compressive Strength: ASTM C39/C39M.
4. Flexural Strength: ASTM C78.

D. Strength Tests:

1. Make and cure cylinders and beams in accordance with ASTM C31/C31M.
2. Cylinders: Make four, standard 6-inch diameter by 12 inches high. Cure one in field and three in laboratory.
3. Beams: Make three, standard 6 inches by 6 inches by 21 inches. Cure in field.
4. Compressive: Test one field-cured cylinder at 7 days and two laboratory-cured cylinders at 28 days. Test last cylinder at 56 days if 28-day cylinder is below specified strength.
5. Flexural: Test one beam at 7 days and two beams at 28 days.

E. Acceptance of concrete shall be in accordance with ACI 318/318R.

F. Concrete with compressive strength less than specified, as evidenced by cylinder tested at 56 days, shall be additionally tested as follows:

1. Less Than 500 psi Low in Compression or Less Than 75 psi Low in Flexure:
   a. Penetration Resistance Test: ASTM C803.
   b. Rebound Hammer Test: ASTM C805.
   c. Perform tests within 24 hours of noncomplying strength tests.
2. More Than 500 psi Low in Compression or More Than 75 psi Low in Flexure:
   a. Concrete Coring: Take three standard cores from concrete representing original specimens.
   b. Take and prepare cores in accordance with ASTM C42/C42M.
   c. Test cores in accordance with ASTM C39/C39M.
   d. Take cores within 24 hours of noncomplying strength test.

G. Pay Factor:

1. Portland cement concrete shall be accepted according to average compressive strengths of four or more cylinders taken for 28-day tests for each 500 cubic yards placed and the following acceptance schedule.

Acceptance Schedule Compressive Strength	
Pay Factor	**Percent of Specified Strength**
1.00	95 percent or higher
0.90	90 to 95 percent
0.70	80 to 90 percent
Remove and replace	Less than 80

2. Whenever percentage of specified compressive strength falls below the level of 80 percent, Engineer may require the portland cement concrete be removed and replaced to meet required Specifications.
3. If the compressive strength, f_c, to comply with the flexural strength requirement is greater than 4,000 psi, then the specified strength shall be multiplied by:

$$\frac{F_c}{4000}$$

3.9 CLEANING

A. Clean concrete splatter from exposed surfaces.

B. Thoroughly broom and wash concrete surfaces before opening to traffic.

3.10 PROTECTION OF CONCRETE

A. Do not operate construction equipment or allow traffic on newly placed portland cement concrete until the following requirements are met:

1. Joints have been filled as per Article Joints.
2. Concrete has attained a compressive strength of at least 4,000 pounds per square inch.

B. Protect new concrete from construction operations, mechanical disturbances, water flow, and soiling until open for traffic.

C. Erect and maintain suitable barriers to protect concrete from traffic or other detrimental trespass until pavement is opened to traffic.

D. Maintain watchmen after normal working hours for at least a 24-hour period to ensure barriers are not removed or destroyed, and that trespass and vandalism upon pavement does not occur.

E. Wherever it is necessary that traffic, including Contractor's vehicles and equipment, be carried from one side of pavement to the other, construct suitable bridges over pavement, and maintain them in good condition as long as they may be required. Leaving gaps in pavement to facilitate movement of traffic will not be allowed, unless prior written permission is obtained from Engineer.

F. Protect new concrete from dirt, asphalt, and other deleterious substances that may be tracked onto new pavement from construction activities.

G. Pavement damaged by traffic or damaged from any other cause, prior to its official acceptance, shall be repaired or replaced to the satisfaction of Engineer.

END OF SECTION

SECTION 32 14 00
UNIT PAVERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section. Adhere to City of San Diego Whitebook for all related requirements.

1.2 SUMMARY

A. This Section includes the following:

1. Permeable Concrete pavers set in aggregate setting beds to comply with recommendations published by the Interlocking Concrete Pavement Institute, Brick Industry Association or National Concrete Masonry Association..
2. Permeable Bedding Course and Subgrade.
3. Aluminum edge restraints.

B. Related Sections include the following:

1. Division 31 "Earthwork" for excavation and compacted subgrade.
2. Section 32 13 13 – Concrete Paving and Asphalt.

1.3 SUBMITTALS

A. Product Data: For pavers, aggregates, and edging materials.

B. Product Data: For the following:

1. Permeable Concrete Pavers, manufactured to meet ASTM C936, 'Hydrologic' Pavers by RCP Block or Approved Equal.
   Pavers shall be 3.15" thick, 8000 psi with5/16s gaps to provide 5%-15% drainage with 'Permeable Paver Fill'
2. Pavers shall have a Stone-top Texture, Char-Brown color, Random Pattern of Jumbo (11" width), Rectangle (8.25" width), Square (5.5" width).Bedding Course shall be #8 Aggregate (2" depth).
3. Subgrade shall be #2 open graded aggregate as storage reservoir (min. 12" depth).
4. Aggregate joint filler to be #8.
5. Edge restraints.

C. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.

D. Samples for Initial Selection: For the following:

1. Each type of unit paver indicated.
2. Joint materials.
3. Edge restraints.

1.4 QUALITY ASSURANCE

A. Contractor shall provide documentation demonstrating training in construction of the permeable pavement systems or acceptable experience and references in the construction of permeable pavement systems.

B. Source Limitations: Obtain each type of unit paver, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

PART 2 PRODUCTS

2.1 CONCRETE PAVERS

A. Permeable Pavers: paving units complying with ASTM C 936, made from normal-weight aggregates.

1. Pavers shall be shall be, 8000 psi with5/16s gaps to provide 5%-15% drainage, ‘Hydrologic’ Pavers as manufactured by RCP Block or approved equal.

2. Thickness: 3.15” thick
3. Face, Size, and Shape: Pavers shall have a Stone-top Texture, Random Pattern of Jumbo (11” width), Rectangle (8.25” width), Square (5.5” width).
4. Color: Char-Brown color

2.2 ACCESSORIES

A. Metal edge restraints: Provide ‘GEOEDGE’ Aluminum Green Build Edging System, as manufactured by Permaloc Corporation or approved equal. Edging to be ‘Mill Finish’ aluminum in 7.5" X 8.5" size with minimum .25” thick exposed top lip.

B. Geotextile Fabric if required by City.

2.3 AGGREGATE SETTING-BED MATERIALS

A. Aggregate for Sub-base: Min. 12” depth of #2 open graded crushed stone aggregate as storage reservoir.

B. Aggregate for Bedding Course: Min. 2” depth of #8 gravel complying with ASTM D 2940 base material (Class II road base).

C. Joints: Fill joints with RCP Permeable Paver Joint Fill rock 1/8"-1/4" (#4 Stone) or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Exercise care in handling and cutting of pavers to prevent chipping or breakage.

D. Joint Pattern: Random pattern as indicated by manufacturer.

E. Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.

F. Tolerances: Do not exceed 1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.

G. Provide edge restraints as indicated. Install edge restraints per manufacturer's guidelines before placing unit pavers.

1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
2. For metal edge restraints with top edge exposed, drive stakes at least 1 inch (25 mm) below top edge.

3.3 AGGREGATE SETTING-BED APPLICATIONS

A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698, ASTM D 1557 laboratory density.

B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. If required, place separation geotextile over prepared subgrade, overlapping ends and edges at least 12 inches (300 mm).

D. Place aggregate sub-base, compact by tamping with plate vibrator, and screed to depth indicated.

E. Place aggregate base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.

F. If required, place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches (300 mm).

G. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and constant until pavers are set and compacted.

H. Set pavers with a minimum joint width of 5/16 inch being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines.

I. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:

1. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
2. Before ending each day's work, fully compact installed concrete pavers to within 36 inches (900 mm) of the laying face. Cover pavers that have not been compacted, and leveling course on which pavers have not been placed, with non-staining plastic sheets to protect them from rain.

J. Fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add filler until joints are completely filled.

K. Do not allow traffic on installed pavers until joints have been wetted and set.

L. Repeat joint-filling process 30 days later.

3.4 REPAIRING AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION

SECTION 32 16 00
CURBS AND GUTTERS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): T 99, Standard Specification for the Moisture-Density Relations of Soils Using a 2.5 kg (5.5 pound) Rammer and a 305 mm (12 in.) Drop.
2. American Concrete Institute (ACI): 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
3. ASTM International (ASTM):
   a. C94, Standard Specification for Ready-Mixed Concrete.
   b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   c. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

1.2 SUBMITTALS

A. Action Submittals:

1. Form Material: Information on metal forms, if used, including type, condition, surface finish, and intended function.
2. Complete data on concrete mix, including aggregate gradations and admixtures in accordance with requirements of ASTM C94.

B. Informational Submittals:

1. Curing Compound: Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements**,** and application instructions.
2. Ready-mix delivery ticket for each truck in accordance with ASTM C94.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Conform to the State of California Standard Specifications for Highway Construction.

PART 2 PRODUCTS

2.1 MATERIALS

A. Conform to the requirements of the Standard Specification.

2.2 EXPANSION JOINT FILLER

A. Preformed asphalt-impregnated, expansion joint material meeting ASTM D994, 1/2- inch thick.

2.3 CONCRETE

A. Ready-mixed meeting ASTM C94, Option A, with compressive strength as specified in Section 03 30 00, Cast-in-Place Concrete.

B. Maximum Aggregate Size: 1-1/2 inch.

C. Slump: 2 inches to 4 inches.

2.4 CURING COMPOUND

A. Liquid membrane forming, clear or translucent, suitable for spray application and meeting ASTM C309, Type 1.

PART 3 EXECUTION

3.1 INSTALLATION

A. Perform Work in accordance with the Standard Specification.

3.2 FORMWORK

A. Lumber Materials:

1. 2-inch dressed dimension lumber, or metal of equal strength, straight, free from defects that would impair appearance or structural quality of completed curb and sidewalk**.**
2. 1-inch dressed lumber or plywood may be used where short-radius forms are required.

B. Metals: Steel in new undamaged condition.

C. Setting Forms:

1. Construct forms to shape, lines, grades, and dimensions.
2. Stake securely in place.

D. Bracing:

1. Brace forms to prevent change of shape or movement resulting from placement.
2. Construct short-radius curved forms to exact radius.

E. Tolerances:

1. Do not vary tops of forms from gradeline more than 1/8 inch when checked with 10-foot straightedge.
2. Do not vary alignment of straight sections more than 1/8 inch in 10 feet.

3.3 PLACING CONCRETE

A. Prior to placing concrete, remove water from excavation and debris and foreign material from forms.

B. Place concrete as soon as possible, and within 1-1/2 hours after adding cement to mix without segregation or loss of ingredients, and without splashing.

C. Place, process, finish, and cure concrete in accordance with applicable requirements of ACI 304, and this section. Wherever requirements differ, the more stringent shall govern.

D. To compact, vibrate until concrete becomes uniformly plastic.

3.4 CURB CONSTRUCTION

A. Construct ramps at pedestrian crossings.

B. Expansion Joints: Place at maximum 45-foot intervals and at the beginning and end of curved portions of curb. Install expansion joint filler at each joint.

C. Curb Facing: Do not allow horizontal joints within 7 inches from top of curb.

D. Contraction Joints:

1. Maximum 15-foot intervals in curb.
2. Provide open joint type by inserting thin, oiled steel sheet vertically in fresh concrete to force coarse aggregate away from joint.
3. Insert steel sheet to full depth of curb.
4. Remove steel sheet with sawing motion after initial set has occurred in concrete and prior to removing front curb form.
5. Finish top of curb with steel trowel and finish edges with steel edging tool.

E. Front Face:

1. Remove front form and finish exposed surfaces when concrete has set sufficiently to support its own weight.
2. Finish formed face by rubbing with burlap sack or similar device to produce uniformly textured surface, free of form marks, honeycomb, and other defects.
3. Remove and replace defective concrete.
4. Apply curing compound to exposed surfaces of curb upon completion of finishing.
5. Continue curing for minimum of 5 days.

F. Backfill curb with earth upon completion of curing period, but not before 7 days has elapsed since placing concrete.

1. Backfill shall be free from rocks 2 inches and larger and other foreign material.
2. Compact backfill firmly.

3.5 SIDEWALK CONSTRUCTION

A. Thickness:

1. 4 inches in walk areas.
2. 6 inches in driveway areas.

B. Connection to Existing Sidewalk:

1. Remove old concrete back to an existing contraction joint.
2. Clean the surface.
3. Apply a neat cement paste immediately prior to placing new sidewalk.

C. Expansion Joints: Place in adjacent curb, where sidewalk ends at curb, and around posts, poles, or other objects penetrating sidewalk. Install expansion joint filler at each joint.

D. Contraction Joints:

1. Provide transversely to walks at locations opposite contraction joints in curb.
2. Dimensions: 3/16-inch by 1-inch weakened plane joints.
3. Construct straight and at right angles to surface of walk.

E. Finish:

1. Broom surface with fine-hair broom at right angles to length of walk and tool at edges, joints, and markings.

2. Mark walks transversely at 5-foot intervals with jointing tool; finish edges with rounded steel edging tool.
3. Apply curing compound to exposed surfaces upon completion of finishing.
4. Protect sidewalk from damage and allow to cure for at least 7 days.

END OF SECTION

SECTION 32 31 00
FENCES AND GATES

PART 1 GENERAL

1.1 WORK INCLUDED

This specification covers fabricated steel fencing, rolling gates, and swing gates for the Morena Pump Station site perimeter.

1.2 RELATED WORK

Division 03 – Concrete
Division 31 – Earthwork

1.3 SYSTEM DESCRIPTION

The Contractor shall supply powder-coated steel fence, rolling gates and swing gates as shown and specified. The system shall include all components (i.e., pickets, rails, gate uprights, wheels and hardware) required. The gate schedule for the project is as follows:

Item	Quantity	Total Width	Height	Location	Notes
Double-leaf swing gate	1	25 ft	8 ft	Main Entrance	Automated
Rolling gate	1	10 ft	8 ft	SDGE Access from Custer Street	Automated with recessed V-track
Rolling gate	1	25 ft	8 ft	Exit to Custer Street	Automated with recessed V-track
Double-leaf swing gate	1	35 ft	8 ft	Entrance from Sherman Street	Automated with recessed V-track
Wrought Iron Fence	--	--	Height as shown on Drawings	Site perimeter	Fence sections shorter than 8 feet required above masonry wall where shown on Drawings

1.4 QUALITY ASSURANCE

The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.5 REFERENCES

A. ASTM B117 - Practice for Operating Salt-Spray(Fog) Apparatus.
B. ASTM D523 - Test Method for Specular Gloss.
C. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.

D. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
E. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
F. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
G. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
H. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.

1.6 SUBMITTALS

The manufacturer's submittal package shall be provided prior to installation. Submit the following:

A. Motor cutsheets, with statement that motor horsepowers selected are sufficient for continuous duty for the opening and closing torques required. Provide estimated maximum required torques for all gates.
B. Detailed dimensional cut sheets for all gates and entire length of fence including fence specials.
C. Complete list of materials of construction.
D. Separate submittal for gate automation, remote access, keypad entry, and photo eye systems.

1.7 PRODUCT HANDLING AND STORAGE

Upon receipt at the job site, all materials shall be checked to ensure that no damages occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage and to protect against damage, weather, vandalism and theft.

PART 2 MATERIALS

2.1 MATERIAL

A. Steel material for roll gate components (i.e. pickets, rails, diagonals and uprights), shall be commercial steel with a minimum yield strength of 45,000 psi (344 MPa).

B. Provide 3-rail fence and gate design. Ornamental fence picket material shall be 1" square x 14 Ga. Tubing. Picket spacing shall be 4-5/8". Material for gate toprails, uprights and diagonals rails shall be 1-1/2"

square x 12 Ga. Material for the bottom rail shall be 2" x 4" x 11 Ga. Posts shall be a minimum of 4" square x 11 Ga. Gate and fence post embedment shall be 4 feet below ground surface. Provide ornamental curved top pickets on all fences and gates as shown on Drawings. Horizontal projection of curved top pickets shall be 10 inches.

2.2 FABRICATION

A. Pickets, rails, uprights and posts shall be precut to specified lengths. Diagonals shall be precut to specified lengths and angles. Frame materials shall be joined by welding. Pickets shall be face welded to roll gate frame, except for Invincible gates over 18' long. Invincible style gates over 18' long shall have pickets face-welded to 2" x 2" angle iron to form panels equal in length to the gate frame bay width.

B. All fences and gates shall be subjected to the PermaCoat® or equal thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including, as a minimum, a six-stage pre-treatment/wash (with zinc phosphate), an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils (0.0508mm). The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The finished color shall be black.

C. Completed gates shall be capable of supporting a 200 lb. load applied at midspan without permanent deformation.

2.3 LOOP DETECTORS

A. All gates shall have traffic loop detectors, which shall consist of continuous 6 ft x 12 ft, 14 gauge standard wire with cross-linked polyethylene insulation manufactured by LiftMaster or approved equal. Installation of loops shall be per manufacturer requirements.

B. Wiring:
   1. Plug the loop detector into the desired slot (exit, inside and outside safety) on the expansion board of the operator.
   2. Insert the twisted wires from the loop into the corresponding terminal (exit, inside and outside) on the expansion board of the operator.

2.4 MOTORS

A. Provide 24VDC continuous duty motors suitable for gate travel at 12 inches per minute.

B. Operator Duty Rating: high-cycle, high-temperature continuous duty.

C. Chassis: Constructed with ¼" gold zinc-plated steel for rust prevention.

D. Worm Gear Reduction: commercial oil bath gearbox providing 10:1 worm gear reduction.

E. Cover: high-density, UV-resistant polycarbonate.

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2.5 TRACKS

A. Provide V-notch recessed tracks provided by the gate automation supplier.

2.6 AUTOMATION AND PHOTO EYE

A. Gate automation shall be packaged and provided by the gate manufacturer through an automation supplier, Doorking or equal.

B. Provide photo-eye assembly for each gate. Photo eye assembly with 6 foot cable, photo eye bracket, photo eye hood, square reflector, reflector hood, reflector bracket, mounting hardware.

C. Provide 10 wireless remote control units to the Owner, for each gate.

D. Contractor shall furnish and install a keypad entry system for each gate, suitable for exterior vehicle access.

E. Contractor shall furnish and install an intercom system for the Main Entrance swing gate.

2.7 MANUFACTURER

A. Furnish gates and fencing as follows:

1. Ameristar PassPort Commercial Ornamental design series, Invincible style and 3-rail frame configuration manufactured by Ameristar Fence Products, Inc. in Tulsa, Oklahoma.
2. Or approved equal.

PART 3 EXECUTION

3.1 PREPARATION

All new installation shall be laid out by the contractor in accordance with the Drawings.

3.2 INSTALLATION

Gateposts shall be set in accordance with the spacing's shown in the construction plans. The "Earthwork" and "Concrete" sections of this specification shall govern post base material requirements. 6" wheels shall be bolted to the gate (between the wheel plates welded near the ends of the gate bottom rail). The gate shall be set upright with the V-grooved wheels positioned over the pre-installed steel V-track that traverses the gate opening. Roller guides shall be affixed to the gateposts at a height even with the gate toprail to hold the gate in a vertical position. Gate stops shall be welded to the end of the gate or track so gate cannot pass rollers in either direction.

3.3 CLEANING

The Contractor shall clean the jobsite of excess materials; post hole excavations shall be scattered uniformly away from posts.

3.4 COATING PERFORMANCE REQUIREMENTS

Table 1 – Coating Performance Requirements

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,000 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

END OF SECTION

SECTION 32 71 00
COMPACT BIOFILTRATION BASIN

PART 1 GENERAL

1.1 PURPOSE

A. The purpose of this specification is to establish criteria for Modular Subsurface Flow Wetland Units MW-01 and MW-02 used for biofiltration of stormwater runoff including dry weather flows and other contaminated water sources. Units MW-01 and MW-02 are shown on the Civil Drawings. These units shall comply with all requirements identified in the City of San Diego Storm Water Standards Manual.

1.2 DESCRIPTION

A. Modular Subsurface Flow Wetland Systems (MSFWS) are used for filtration of stormwater runoff including dry weather flows. The MSFWS is a pre-engineered biofiltration system composed of a pretreatment chamber containing filtration cartridges, a horizontal flow biofiltration chamber with a peripheral void area and a centralized and vertically extending underdrain, the biofiltration chamber containing a sorptive media mix which does not contain any organic material and a layer of plant establishment media, and a discharge chamber containing an orifice control structure. Treated water flows horizontally in series through the pretreatment chamber cartridges, biofiltration chamber and orifice control structure.

1.3 MANUFACTURER

A. The manufacturer of the MSFWS shall be one that is regularly engaged in the engineering design and production of systems developed for the treatment of stormwater runoff, and which have a history of successful production, acceptable to the engineer of work. In accordance with the drawings, the MSFWS(s) shall be a filter device Manufactured by BioClean A Forterra Company, or approved equal.

1.4 SUBMITTALS

A. Shop drawings are to detail the MSFWS and all components required and the sequence for installation, including:
    1. System configuration with primary dimensions
    2. Interior components
    3. Any accessory equipment called out on shop drawings
    4. Statement from each manufacturer that both units comply with stated design criteria on Civil Drawings for MW-01 and MW-02.

5. Material specification for concrete, media bed, pre-filter cartridge, grating, hatch, f low control riser, and underdrain manifold.

B. Inspection and maintenance documentation submitted upon request.

PART 2 PRODUCTS

2.1 SHIPPING, STORAGE AND HANDLING

A. Shipping – MSFWS shall be shipped to the contractor's address or job site, and is the responsibility of the contractor to offload the unit(s) and place in the exact site of installation.

B. Storage and Handling– The contractor shall exercise care in the storage and handling of the MSFWS and all components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be born by the contractor. The MSFWS(s) and all components shall always be stored indoors and transported inside the original shipping container until the unit(s) are ready to be installed. The MSFWS shall always be handled with care and lifted according to OSHA and NIOSA lifting recommendations and/or contractor's workplace safety professional recommendations.

PART 3 EXECUTION

3.1 GENERAL

A. The installation of the MSFWS shall conform to all applicable national, state, state highway, municipal and local specifications.

3.2 INSTALLATION

A. The Contractor shall furnish all labor, equipment, materials and incidentals required to install the (MSFWS) device(s) and appurtenances in accordance with the drawings and these specifications.

B. Grading and Excavation site shall be properly surveyed by a registered professional surveyor, and clearly marked with excavation limits and elevations. After site is marked it is the responsibility of the contractor to contact local utility companies and/or DigAlert to check for underground utilities. All grading permits shall be approved by governing agencies before commencement of grading and excavation. Soil conditions shall be tested in accordance with the governing agencies requirements. All earth removed shall be transported, disposed, stored, and handled per governing agencies standards. It is the responsibility of the contractor to install and maintain proper erosion control measures during grading and excavation operations.

C. Compaction – All soil shall be compacted per registered professional soils

engineer's recommendations prior to installation of MSFWS components.

D. Backfill shall be placed according to the geotechnical engineer's recommendations, and with a minimum of 6" of gravel under all concrete structures.

E. Concrete Structures – After backfill has been inspected by the governing agency and approved the concrete structures shall be lifted and placed in proper position per plans.

F. Subsurface Flow Wetland Media shall be carefully loaded into area so not to damage the Wetland Liner or Water Transfer Systems. The entire wetland area shall be filled to a level 9 inches below finished surface.

G. Planting layer shall be installed per manufacturer's drawings and consist of a minimum 3" grow enhancement media that ensures greater than 95% plant survival rate, and 6" of wetland media. Planting shall consist of native plants recommended by manufacturer and/or landscape architect. Planting shall be drip irrigated for at least the first 3 months to insure long term plant growth. No chemical herbicides, pesticides, or fertilizers shall be used in the planting or care and maintenance of the planted area.

3.3 MAINTENANCE AND INSPECTION

A. Inspection – After installation, the contractor shall demonstrate that the MSFWS has been properly installed at the correct location(s), elevations, and with appropriate components. All components associated with the MSFWS and its installation shall be subject to inspection by the engineer at the place of installation. In addition, the contractor shall demonstrate that the MSFWS has been installed per the manufacturer's specifications and recommendations. All components shall be inspected by a qualified person once a year and results of inspection shall be kept in an inspection log.

B. Material Disposal - All debris, trash, organics, and sediments captured by the MSFWS shall be transported and disposed of at an approved facility for disposal in accordance with local and state requirements. Please refer to state and local regulations for the proper disposal of toxic and non-toxic material.

3.4 QUALITY ASSURANCE

A. WARRANTY

1. The Manufacturer shall guarantee the MSFWS against all manufacturing defects in materials and workmanship for a period starting from the date of delivery to the job site. The manufacturer shall be notified of repair or replacement issues in writing within the warranty period. The MSFWS is limited to the recommended application for which it was designed.

END OF SECTION

SECTION 32 84 23
LANDSCAPE IRRIGATION SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

A. The General and Special Conditions of the contract apply to the work of this section the same as though written herein.

B. The General and Special Conditions of the contract apply to the work of this section the same as though written herein.

C. Contractor shall comply with State Codes, Regional Standard Drawings, as well as City of San Diego Whitebook and Greenbook Specifications.

D. The following is a list of standards which may be referenced in this section:

1. American Society of Mechanical Engineers (ASME): B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24.
2. ASTM International (ASTM):
   a. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   b. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   c. B32, Standard Specification for Solder Metal.
   d. B88, Standard Specification for Seamless Copper Water Tube.
   e. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
   f. D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   g. D1785, Standard Specifications for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   h. D2241, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
   i. D2466, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   j. D2467, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
3. National Fire Protection Association (NFPA): NFPA No. 70, National Electrical Code (NEC).

1.2 SUBMITTALS

A. Action Submittals:

1. Contractor shall furnish the articles, equipment, materials or processes specified by name in the drawings and specifications. No substitution will be allowed without prior written approval by Landscape Architect.
   a. Product Data:
      1) Valves
      2) Valve access boxes.
      3) Controllers, timers, wiring, operation manual.
      4) Backflow prevention devices, assemblies and enclosures.
      5) Pipe and fittings.
      6) Tree Bubbler Assemblies
2. Qualifications:
   a. CLT Certificates for project foreman in charge of irrigation system installation.
3. Operation and Maintenance Data and Manuals.
4. Record Drawings: Redline mark-up with accurate dimensions of completed irrigation system.

1.3 QUALIFICATIONS

A. Contractor shall employ only Certified Landscape Technicians (CLT's) certified in Irrigation by the California Landscape Contractors Association (CLCA), as foremen for all irrigation installation work.

B. System Installer: Experience installing systems of similar complexity and size, thoroughly familiar with materials specified for installation and methods of installation to be present onsite and with authority to direct Work under this section throughout its installation.

1.4 EXTRA MATERIALS

A. Furnish the following:

Quantity	Item
2 sets	Special wrenches for removal and installation of each type of sprinkler head provided
1 set	Valve keys for manual operation of valves

PART 2 PRODUCTS

2.1 PIPE BASE MATERIAL

A. 1/4-inch minus clean sand.

2.2 GRAVEL

A. 3/4-inch minus, 1/2-inch plus, clean, washed, round gravel.

2.3 PIPE AND FITTINGS

A. Plastic pipe shall be extruded from 100% virgin polyvinyl chloride (PVC) Type 1, Grade 1 as manufactured by Lasco Industries, Pacific Plastics, John-Manville, or approved equal. All pipe shall be new and unused.

B. All plastic pipe shall be continuously and permanently marked with the following information: manufacturer's name, nominal pipe size, PVC 1120, SDR (Standard Dimension Ratio) and/or the pressure rating in PSI, NSF (National Sanitation Foundation)

C. All plastic pipe to be installed on the non-pressure side of the valves shall be PVC 1220, Schedule 40, Type I, Grade I, conforming to ASTM D-1745, unless otherwise shown on the drawings, details, or legend. All plastic pipe to be installed on grade on the non-pressure side of the valves shall be PVC 1220, Schedule 40, Type I, Grade I, conforming to ASTM D-1745, and shall be UV Resistant.

D. All pipe to be installed on the pressure side of valves shall also be PVC 1220, Schedule 40 (meeting these same specifications) for sizes up to and including 1-1/2 inch, Class 315 for sizes larger than 1-1/2 inch.

E. Plastic fittings for pressure side of valves shall be PVC 1220, IPS Schedule 80. Plastic fittings for non-pressure pipe shall be PVC 1220, IPS Schedule 40, NSF slip fittings and Schedule 40 threaded fittings. Fittings shall be as shown in the details and as manufactured by Lasco, Pacific, Western, or approved equal.

F. Solvent-weld glue shall be Lasco #711 Grey Heavy Body, or approved equal. All pressure-side pipe shall be primed with Lasco “Purple Primer” solvent before gluing. Fit and glue pipe per manufacturer’s specifications.

G. All threaded nipples shall be standard weight Schedule 80 molded threads. All threaded nipples exposed above grade shall be gray in color.

H. Pipe for sleeving shall be PVC 1120, Schedule 40, sized as indicated on the drawings. Provide pull rope 10 feet longer than sleeve.

2.4 VALVES

A. Ball Valves:

1. Zone Shutoff Valves 2 Inches and Smaller: Bronze, double disc wedge type with integral taper seats.
2. 2-1/2 Inches and Larger: Iron body, brass trimmed, double disc wedge type with integral taper seats.
3. Service rated (nonshock cold water) at not less than 200 psi. Cast or stamp manufacturer's identification on valve body.

B. Electric Remote Control Zone Valves:

1. Normally closed type with automatic shutoff in event of power failure.
2. Close or not open in less than 4 seconds.
3. Capable of manual control during power failure.
4. Flow control device: To eliminate effects of flow on opening or closing of valve.
5. Corrosion-resistant plastic.
6. Waterproofed for burial.
7. Union for supply line connection.
8. Operation not dependent on pressure loss through valves.
9. Include flow control mechanism.
10. UL listed.

C. Quick-Coupling Valves:

1. Allow for attachment of hose swivels and for air blowout of system.
2. Body:
   a. One- or two-piece type with locking cap.
   b. Heavy-duty brass in accordance with ASTM B584, 81-3-7-9 type, or heavy-duty bronze.
   c. Cap: Brass, bronze, or other noncorrosive metal.
3. Watertight before and after coupler is inserted.
4. Mechanism designed so valve seat is closed before coupler is removed.
5. Manufacturer's casting or stamp on valve body.
6. Valve design compatible with valve couplers, keys, and hose swivels.
7. Provide keys for locking caps.

2.5 VALVE ACCESS BOXES AND COVERS

A. Box: Thermoplastic to house remote control, manual control, zone shutoff, gate, automatic drain valves and globe valves that will not be installed with valve markers.

B. Each ball valve shall be housed in a round box, HDPE plastic type, model #910, green color, as manufactured by Carson-Brooks, or approved equal.

C. Lids shall be model #910-3B, green color, bolt down, with stainless steel locking bolt. Lids shall be marked "IRRIGATION SHUT-OFF."

2.6 AUTOMATIC CONTROL SYSTEM

A. General: UL listed, and manufactured expressly for control of automatic circuit valves of underground irrigation systems. The number and kind of circuit controls is as shown on drawings.

B. Control Enclosure: As shown on drawings.

C. Allow for manual or semiautomatic operation without disturbing preset automatic operation.

2.7 ELECTRICAL CONDUCTORS AND CONDUIT

A. Conductors:

1. Power Source to Controller or Timer: Conduit encased copper, minimum size No. 10, Type TW, consisting of two conductors and bare copper ground wire.
2. Wire Sizes: All wire shall be insulated, solid copper conductor of type approved for direct burial. Use color-coded wire for pilot wires, a different color for all valves of each controller, and install per valve manufacturer's specifications and wire chart. Common wire for each controller shall be white with stripe of same color as pilot wires. Spare wires shall be black. Colors different from all pilot and extra wires shall be used for master valve and flow sensor wires.
3. Sizing of wire shall be in accordance to manufacturer’s recommendations, in no case less than #14 in size.
4. Connections on 24 volt wire shall be made by Dri-Splice DS-100 as manufactured by the Spears, or approved equal.
5. Higher voltage line connections or 110 volt shall be made by clamp and waterproofed with 3M Company Scotchcast splicing kits or approved equal.

B. Conduit:

1. Aboveground: Galvanized, rigid steel, electrical type.
2. Underground: Schedule 40 PVC electrical type.
3. Meet requirements of Section 26 05 04, Basic Electrical Materials and Methods.

2.8 ELECTRICAL CONNECTORS

A. Manufacturers and Products:

1. Rain Bird; Pen-Tite wire connectors, or equal.

2.9 TREE BUBBLER ASSEMBLY

A. Manufactured Assembly as shown on drawings.

2.10 BACKFLOW PREVENTION ASSEMBLIES

A. Reduced Pressure Backflow Preventer Assembly shall be per City of San Diego requirements.

PART 3 EXECUTION

3.1 TRENCH EXCAVATION, PREPARATION AND BACKFILL

A. Commence irrigation system construction only after soil has been fine graded.

B. Backfill: Trench Backfill shall be clean washed sand, no rocks or cobbles.:

1. Pipe Base Material: Place and firmly tamp sand to 2-inch depth to provide continuous solid foundation for pipe.
2. To a point 4 inches above pipe, place and compact pipe base material.
3. Place backfill in layers not exceeding 6 inches, thoroughly compact each layer, up to finished grade, except in planting areas.
4. Smooth up and make clean and free of excess materials and debris those areas disturbed by operations performed under this Specification.

3.2 INSTALLATION OF PIPE AND FITTINGS

A. Plastic Pipe:

1. Use only strap wrenches on threaded joints.
2. Follow manufacturer's recommendations in use of solvent cement.
3. Do not subject unthreaded pipe joints to hydrostatic pressure for 48 hours after making joints.
4. Lay pipe on the prepared pipe base, snaking pipe from one side of trench to the other to provide for subsequent contraction.

5. Start backfill activities only after successful completion of hydrostatic pressure testing.

B. Pipe under Improved Areas (Curbs, Walks, Pavements): Install inside sleeves.

C. All PVC distribution lateral lines shall have a minimum clearance of 6" from each other. Parallel lines shall not be installed directly over one another.

D. Provide 6 inch vertical clearance between crossing lines.

E. Provide minimum cover of 18 inches for all pressure supply lines.

F. Provide minimum cover of 18 inches for all control wire runs.

G. Provide minimum cover of 12 inches for all non-pressure lines.

H. All lines under driveway and roadway pavement shall have a 24 inch minimum cover.

3.3 SLEEVES

A. Provide a minimum cover of 18 inches where installed under improved areas.

3.4 INSTALLATION OF VALVES AND VALVE ACCESS BOXES

A. Valves: Install with a union.

1. With Handles: Set at a depth to provide clearance between top of handle and box cover, or sleeve in which placed, when the valve is in open position and the cover is closed.
2. Quick-Coupling: 4 inches above finished grade for flower beds and 12 inches from the edge of lawns, curbs, pavement, or graveled surfaces.

B. Valve Access Boxes and Sleeves: Install with brick blocking on a gravel base to provide foundation, ease of leveling, and proper drainage.

3.5 BACKFLOW PREVENTION DEVICES

A. Install with a union on the discharge side of the assembly, except those with flange type fittings.

B. Connecting Pipe: Galvanized steel of at least same size as component parts used with the assembly, from supply line to 10 feet beyond the assembly.

C. Reduced Pressure Backflow Preventer Assembly:

1. Install in the supply line ahead of the section control valves they serve and immediately after the meter or pump.
2. Assemblies may be installed at a lower elevation than the sprinkler heads, but install assembly centerline 2 feet above grade with adequate drainage.
3. Do not place where assembly could be submerged in water.

3.6 IRRIGATION LINE CLEARANCES

A. Same Trench: Minimum 6-inch horizontal clearance.

B. Crossing Lines: Minimum 2-inch vertical clearance.

C. Other Utilities: Minimum 12-inch clearance in any direction.

3.7 SYSTEM DRAINAGE

A. Drain Valves: Locate at low points of pipelines so entire system is drained.

B. Slope line(s) to ensure entire system effectively drained to drain valves.

3.8 AUTOMATIC CONTROLLER AND WIRING

A. Install in accordance with manufacturer's recommendations.

3.9 TREE BUBBLER ASSEMBLIES

A. Set perpendicular to finished grade at manufacturer's recommended height.

3.10 FLUSHING

A. Flush supply lines and laterals to clear lines of all dirt and debris.as follows:

1. Before installation of valves and fittings.
2. Reflush after installation of valves and fittings.
3. Install sprinkler heads, filter screens, and nozzles immediately after flushing operation is completed.

3.11 PRESSURE TESTING

A. All pressure lines shall be tested under hydrostatic pressure of 150 PSI, and all non-pressure lines shall be tested under the existing static pressure and both be proven watertight.

B. Pressure shall be sustained in lines for not less than two (2) hours. If leaks develop, the joints shall be replaced and the test repeated until the entire system is proven watertight.

C. Tests shall be observed and approved by City Representative prior to backfill.

3.12 RECORD DRAWINGS

A. Contractor shall provide measurements and field notes for preparation of accurate "project record" drawings. Show dimensions from two permanent points of reference such as building corners for locations of all valves, equipment, wire runs and pipe runs.

3.13 CONTROLLER CHART

A. Contractor shall provide reduced plan mounted to inside of Controller cabinet.

1. Color coded showing areas of coverage for each valve zone.

3.14 CLEAN UP AND REPAIR

A. Contractor will be responsible for all maintenance and repair of entire irrigation system, including vandalism and theft, until final acceptance.

3.15 GUARANTEE

A. The entire irrigation system shall be guaranteed FOR material and workmanship, including settling of backfilled areas and trenches for a period of one year following the date of final acceptance of the work.

B. Should any operational difficulties in connection with the sprinkler system develop within the specified guarantee period, which in the opinion of the Owner may be due to inferior material and/or workmanship, said difficulties shall be immediately corrected to the satisfaction of the City's Representative, at no additional cost.

END OF SECTION

SECTION 32 93 00
PLANTS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. City of San Diego Whitebook and Greenbook
2. American Association of Nurserymen (AAN): Z60.1, Nursery Stock.
3. Federal Housing Administration (FHA), Section 1103-103.
4. Hortus Third, Liberty Hyde Bailey, Hortorium, 1976.

1.2 DEFINITIONS

A. Measurement:

1. Take trunk caliper 6 inches above the ground level (up to and including 4-inch caliper size) and 12 inches above the ground level for larger trees.
2. Measure size of container-grown stock by height and width of plant.
3. Measure herbaceous perennials pot size, not top growth.

1.3 SUBMITTALS

A. Submittals:

1. Plant materials photographs of current nursery stock, with nursery source listed for each plant type.
2. Product data on all manufactured products specified, including root barriers, tree stakes and ties, tree drainage standpipes, aluminum edging.
3. Inorganic Rock Mulch Samples
4. Organic Bark Mulch Sample
5. Pre-emergent Herbicides
6. Product data on soil amendments, fertilizers, import soil, compost, specialty soils, etc.
7. Agronomic Soil Analysis of 3 samples taken from existing soil at the site shall be submitted to an approved Agronomic Soil Lab (Wallace Labs or Soil & Plant Laboratories, Inc.). Test shall include pH, N-P-K, SAR, minerals, micro-nutrients, EcE, boron levels, soil particle size, percolation rates, and a full textural evaluation.
8. Operation and Maintenance Data with Schedule and description for care, and maintenance of each type of plant for 120 day period in climate and location of the Project.

9. Guarantee in writing for all new trees.

B. Informational Submittals:

1. State Landscape License and CLT Certificate for Foreman.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Cover plants during shipment with a tarpaulin or other suitable covering to minimize drying.

B. Plant Protection: Plants shall be handled carefully to protect foliage, branches, and roots. Plants shall be adequately protected at all times from drying out and from other injury. Protect root balls and pots of plants which cannot be planted within twelve (12) hours of delivery with soil or other suitable materials. Where possible, store plants in the shade. Keep all plant roots moist before, during, and after planting. Plants shall be watered as soon as they arrive on the site and shall be kept moist until they are planted.

C. Store fertilizers and soil amendments in dry conditions away from any contaminants.

D. Store root control barriers in secure location with dry conditions. Do not store directly on the ground.

1.5 GUARANTEE

A. Guarantee shall provide for removal and replacement with new plants for plants found to be defective, diseased, severely damaged, not in a vigorous, thriving condition or dead during a period of 120 days for shrubs and groundcovers, and for a period of 365 days for all trees. Guarantee shall begin upon date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in the General Conditions.

B. Replace defective plants with new plants free of dead or dying branches and branch tips, and bearing foliage of a normal density, size, and color. Closely match new plants to adjacent specimens of the same species and meet requirements of this Specification.

C. Plants damaged due to Project occupancy, vandalism, or proven acts of neglect by others may not be subject to this special guarantee.

1.6 MAINTENANCE

A. Commence to maintain plant life immediately after planting and maintain for 120 days after notice of Substantial Completion.

B. In accordance with accepted Submittal on care and maintenance of plants and as follows:

1. Maintain by watering, pruning, cultivating, and weeding as required for healthy growth.
2. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required.
3. Spray as required to keep trees and shrubs free of insects and disease.
4. Maintenance includes temporary protection fences, barriers, and signs as required for protection.
5. Coordinate watering to provide deep root watering to newly installed trees.

1.7 SCHEDULING AND SEQUENCING

A. Plant Deliveries: Notify Engineer at least 2 days in advance of each delivery.

B. Planting Season: Conduct planting during times of year that are normal for such work as determined by accepted local practice.

C. Plant trees and shrubs after final grades are established

PART 2 PRODUCTS

2.1 PLANT MATERIALS

A. Provide quantity, size, genus, species, and variety of trees and shrubs indicated; comply with applicable requirements of AAN Z60.1.

B. Nomenclature (Names of Plants): In accordance with “Hortus Third”.

C. Plant Size:

1. Nursery-grown, habit of growth normal for species.
2. Sound, healthy, vigorous, and free from insects, diseases, and injuries.
3. Equal to or exceeding measurements specified in plant list. Measure plants before pruning with branches in normal position.
4. Root System: Well developed and well distributed throughout the container, such that the roots visibly extend to the inside face of the growing container. (not rootbound).

5. Sizes: Dimensional relationship requirements of AAN Z60.1 for kind and type of plants required.

D. Plant Quality and Condition:

1. Trees and/or shrubs will be rejected if any one of the following characteristics are present:
    a. Enlarged cankers or galls at base of trunk, just above the soil level.
    b. Topped leaders or crooked trunks.
    c. Scars or trunk damage, broken branches, or trees that have been recently pruned back.
    d. Non-structural branching or rootbound condition.
2. Root System of Container-Grown Plants: Well developed and well distributed throughout the container, such that the roots visibly extend to the inside face of the growing container. (No rootbound plants will be accepted)
3. Container-Grown Plants: Grown in delivery containers for at least 6 months but not over 2 years with well-established root systems, sufficient to hold earth together after removal from container, without being root bound.
4. Label at least one tree and shrub of each variety with securely attached waterproof tag bearing legible designation of botanical and common name

E. Plant List**:** On Drawings.

F. Replacement Shrubs and Trees: Same species, size, and quality as specified for plant being replaced.

2.2 TREE STAKING MATERIALS

A. Wood Stake: Lodgepole Pine 2 inches by 2 inches by 10 feet.

B. Tree Ties: Vinyl tree ties as manufactured by Cinch Tie or equal.

2.3 TREE ROOT BARRIERS

A. Contractor shall furnish and install tree root barriers as specified. The tree root barriers shall be product #UB 24-2 as manufactured by Deep Root or approved equal. The barriers shall be black, injection molded panels, of 0.085-inch wall thickness in modules 24-inches long by 24-inches deep; manufactured with a minimum 50% post-consumer recycled polypropylene plastic with added ultraviolet inhibitors; recyclable

B. Each panel shall have not less than four (4) molded integral vertical root deflecting ribs of a minimum 0.085-inch thickness protruding ½-inch at 90° from interior of the barrier panel, spaced 6-inch apart.

C. Each panel shall have a double top edge consisting of two parallel, integral, horizontal ridges of a minimum 0.085-inch thickness, 3/8-inch wide and 1/4-inch apart with the lower rib attached to the vertical root deflecting ribs.

D. Each panel shall have a minimum of 9 anti-lift ground lock tabs consisting of integral horizontal ridges of a minimum 0.085-inch thickness in the shape of a segment of a circle, the 2-inch chord of the segment joining the panel wall and the segment, protruding 3/8-inch from the panel. The nine ground locks on each panel shall be about equally spaced between each of the vertical root deflecting ribs (3 between each set of ribs).

E. Each panel shall have preassembled self-locking flexible (0°-180°) joiner strips to connect one panel to the next.

2.4 LANDSCAPE EDGING

A. Edging shall be 3/16" x 5.5" high strength aluminum (6063 extruded aluminum alloy) with pre-fabricated locking strips, and 12" long stakes, as manufactured by Sure-loc Edging Corporation.

B. Finish to be Silver Mill Finish fabricated in sections with loops pressed from or welded to face of sections to receive stakes.

C. Stakes: Minimum 12 inches long.

2.5 MULCH

A. Free from noxious weed seed and foreign material harmful to plant growth.

B. Organic Bark: Medium grind, fir, pine; maximum 3/4-inch particle size.

C. Stone Mulch:

1. Round river rock shall be 3"-8" size, washed, with no fines for use in tree wells along street and along all curb lines and building foundations.

2. Pea gravel for use in larger landscape beds to be min. 1 inch washed, with no fines.

2.6 HERBICIDE

A. Selective, pre-emergent, surface-applied herbicide shall be wetable powder or granular type, appropriate to site area, soil type, indigenous weeds to be

controlled, and type of ground cover to be planted. Follow all manufacturer's precautions and label instructions. Comply with all local jurisdictional restrictions and ordinances.

2.7 PLANTING BACKFILL MIX

A. Amend backfill soil with organic amendments, compost, and additives to meet requirements/recommendations of agronomic soil analysis.

B. Compost product shall be fully composted 100 percent recycled organic product, consisting of 35 percent digested, centrifuged, composted bio-solids and 65 percent aged wood fibers. Contractor shall submit a specification sheet along with a fresh sample of proposed material for agronomic testing, not more than 30 days old, including description of particle size, total N (nitrogen), NH4-N (ammonia), NO3-N (nitrate), EcE, pH, micro nutrients, and metals.

2.8 FERTILIZER

A. Commercial Fertilizer shall be organic, granular controlled release fertilizer containing amount recommended per soil test, or the following minimum percentages, by weight, of plant food nutrients:

1. 14 percent available nitrogen
2. 7 percent available phosphorus
3. 3 percent available potassium
4. 5 percent sulfur
5. 3 percent iron

B. Fertilizer Tablets shall be 21 gram and 5 gram tablets, with 20-20-5 formulation, "Agriform" as manufactured by Sierra Industries or approved equal installed per details.

PART 3 EXECUTION

3.1 SCHEDULING

A. Inspection: Prior to starting work, carefully inspect previously installed work by other trades and verify that such work is complete to the point where work of this section may properly and safely commence.

B. Irrigation system shall be fully operational including automatic controller, before commencing planting operations.

C. Code Compliance: Verify that work of this Section may be installed in strict accordance with the original design, all pertinent codes and regulations, and all pertinent portions of the referenced standards.

3.2 LOCATION OF PLANTS

A. Locate new trees, shrubs and groundcovers as shown on Drawings, unless obstructions are encountered. Locations of all plant materials shall be reviewed and approved by City Representative prior to digging holes. Locate no planting, except ground cover, closer than 18 inches to pavements, pedestrian pathways, and structures.

3.3 PREPARATION

A. Planting Soil: For pit and trench type backfill, mix planting soil prior to backfilling and stockpile at Site.

B. Trees:

1. Pits, Beds, and Trenches: Excavate with vertical and scarified sides.
2. Trees: Make excavations at least twice as wide as root ball.
3. Fill excavations with water and allow to percolate out prior to planting.
4. Dig holes for tree standpipes to a depth of 36” below bottom of tree pit and install 4” diameter PVC tube covered with filter fabric sock. Backfill hole around outside of the PVC tube with crushed gravel and place removable drain grate lid on top of pipe at soil surface.

3.4 BACKFILLING

A. Backfill with planting soil, except where existing soil is suitable according to top soil analysis.

3.5 TREE STAKING

A. Support trees immediately after planting to maintain plumb position.

B. Install 2 lodgepole pine stakes for each tree, per City Standard detail. Position stakes spaced equally about each tree, not piercing the rootball.

3.6 TREE ROOT BARRIERS

A. Install the tree root barriers in a linear fashion adjacent to paving, sidewalk, or curb in all conditions where trees are to be planted closer than 6-feet to these improvements. Root barriers shall extend 10-feet in each direction from

center of tree as measured along length of improvement. Only full panels shall be used.

B. Vertical root deflecting ribs shall be facing inwards to the root ball and the double top edge shall be ½-inch above grade.

C. Panels shall be connected with the flexible joiner strips to the required length for the linear application.

3.7 EDGING

A. Anchor edging with stakes in locking devices to 12" depth, with top of stake at 1 inch below top elevation of edging.

3.8 FERTILIZER

A. Add 21 gram plant tablets in plant pits, adhering to the following schedule: 1 tablet for each I gallon; 2 tablets for each 5 gallon; 3 tablets for each 15 gallon; and 4 tablets for each 24-inch box tree.

B. Commercial Fertilizer:

1. Follow Soil Test recommendations for all plant materials.
2. On 80th day of the establishment period, all ground cover areas shall receive top dressing of 5-pounds of 16-8-8 commercial fertilizer per 1,000 square feet.

3.9 MULCHING

A. Cover planting area around each tree with 3-inch thick layer of mulch immediately after planting. Moisten planting area with water.

3.10 PRUNING AND REPAIR

A. Prune only after planting and in accordance with standard horticultural practice to preserve natural character of the plant. Perform in presence of Engineer. Remove all dead wood, suckers, and broken or badly bruised branches. Use only clean, sharp tools. Do not cut lead shoot.

3.11 WEED CONTROL

A. Maintain a weed-free condition within planting areas. Apply pre-emergent selective herbicide to mulched beds at manufacturer's recommended rate of application.

3.12 ESTABLISHMENT AND MAINTENANCE

A. Throughout the entire 120 day maintenance period, Contractor shall apply water to plants by monitoring climate and plant conditions and adjusting water levels on a regular basis to maintain plants in a healthy and vibrant condition until final acceptance of work.

B. Comply with all local and regional watering limitations, water quality requirements pertaining to runoff, and overspray restrictions.

C. Plants that cannot be watered efficiently with an automated water system shall be watered with a hose by the Contractor.

D. Immediately after planting, apply water to each tree and shrub by means of a hose. Apply water in a moderate stream in the planting hole until the material about the roots is completely saturated from the bottom of the hole to the top of the ground.

E. Ground cover planting shall be immediately sprinkled to avoid drying out until the entire planted area is thoroughly watered and the soil soaked to the full depth of each plant hole.

F. Fertilize all areas every 30 days after start of maintenance period at the rate of 5 lbs. per 1000 square feet with ammonium sulfate 21-0-0, or as recommended in soil analysis. There shall be a minimum of 3 applications.

G. On the 80th day of the establishment period, all ground cover areas shall receive top dressing of 5-pounds of 16-8-8 commercial fertilizer per 1,000 square feet.

3.13 CLEAN UP AND REPAIR

A. All areas shall be kept in a neat and orderly condition on a daily basis.

B. Contractor shall remove all trash, excess soil, empty plant containers, or other accumulated debris from the site at no extra cost.

C. Contractor shall repair any damage to project area caused by work operations.

3.14 WEED AND PEST CONTROL

A. Weeds, Nut grass, Dallas grass, Johnson grass, Bermuda grass, and any other noxious grass species shall be removed and disposed of as they appear.

B. Contactor shall provide constant diligence to detect the presence of disease, insects, and/or rodent infestations and proper preventative or control measures taken at his own expense.

3.15 PLANT REPLACEMENT

A. During the 120 day maintenance period, any plant indicating weakness or probability of dying, shall be replaced by the Contactor

3.16 MAINTENANCE PERIOD

A. Upon completion of the 120 day maintenance period, all areas included in the contract shall be substantially clean and free of debris and weeds. All plant materials shall be live, healthy, and free of infestations.

B. Any erosion or slippage of soil caused by watering shall be repaired by the Contactor at his expense.

C. All walks, curbs, and gutters shall be kept clear of debris, mud, dust, and standing water by sweeping, mopping or hosing down as required to maintain cleanliness throughout.

3.17 PROTECTION OF INSTALLED WORK

A. Protect planting areas and plants against damage for duration of maintenance period.

END OF SECTION

SECTION 33 05 01
CONVEYANCE PIPING—GENERAL

PART 1 GENERAL

1.1 GENERAL

A. This section applies to the potable/domestic water pipelines serving the site.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 301, Specifications for Structural Concrete.
2. American Water Works Association (AWWA):
   a. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
   b. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   c. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm).
   d. C209, Cold-Applied Tape Coatings for Steel Water Pipe
   e. C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
   f. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   g. C214, Tape Coatings for Steel Water Pipelines
   h. C217, Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
   i. C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
   j. C221, Fabricated Steel Mechanical Slip-Type Expansion Joints.
   k. C606, Grooved and Shouldered Joints.
3. ASTM International (ASTM):
   a. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
   b. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   c. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   d. C150/C150M, Standard Specification for Portland Cement.
   e. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
4. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.

b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.3 DESIGN REQUIREMENTS

A. Where pipe class or wall thickness is not indicated, design piping system for maximum stress based on the test pressure and earth loads**.**

1.4 SUBMITTALS

A. Action Submittals:

1. Detailed pipe fabrication drawings showing pipe details, special fittings and bends, dimensions, coatings, and other pertinent information.
2. Layout drawing showing location of each pipe section and each special length.
3. Pipe pressure class.
4. Wall thickness, reinforcing, and strength calculations.
5. Product Data: Manufacturer's data for couplings, saddles, gaskets, and other pipe accessories. Indicate maximum rated working pressure and test pressure for each item.

B. Informational Submittals: Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. In accordance with manufacturer's recommendations and as specified in individual Specification(s) following this section**.**

B. Marking at Plant: Mark each pipe and fitting at plant. Include date of manufacture, manufacturer's identification, specification standard, diameter of pipe, dimension ratio, pipe class, pipe number for laying purposes, and other information required for type of pipe.

C. Pipe, specials, and fittings received at Project Site in damaged condition will not be accepted.

D. Gasket Storage: Store rubber gaskets in cool, well ventilated place, and do not expose to direct rays of sun. Do not allow contact with oils, fuels, petroleum, or solvents.

E. Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.

F. Handling:

1. Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.
2. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.
3. Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted using one sling near center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workers. Slings shall bear uniformly against pipe.
4. Pipe and fittings shall not be stored on rocks or gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.

PART 2 PRODUCTS

2.1 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372. For this project, those requirements apply only to domestic water piping for bathrooms and lavatories.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.2 PIPE

A. As specified in the individual specification(s) following this section.

2.3 JOINTS

A. As specified in the individual specification sections following this section.

2.4 COUPLINGS

A. General:

1. Coupling linings for use in potable water systems shall be in conformance with NSF/ANSI 61.
2. Couplings shall be rated for appropriate operating pressure and hydrostatic test pressure.
3. Exposed, bolted, sleeve-type couplings shall be lined and coated with fusion bonded epoxy in accordance with AWWA C213.
4. Buried, bolted, sleeve-type couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213 and wrapped with petroleum wax tape in accordance with AWWA C217**.**

B. For Pipe with Plain-Ends:

1. Bolted, sleeve-type coupling, in accordance with AWWA C219.
2. Fabricated steel, mechanical slip-type expansion joints, in accordance with AWWA C221.

C. For Pipe with Grooved Ends:

1. Grooved couplings, in accordance with AWWA C606. System shall provide for flexible or rigid joints as shown on Drawings**.**
2. Exposed couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213.
3. Buried couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213 and wrapped with petroleum wax tape in accordance with AWWA C217.

D. For Pipe with Flanged Ends:

1. Flanged coupling adapters, in accordance with AWWA C219.
2. Dismantling joints for connecting flanged pipe shall be AWWA C219 compliant. Provide studs and nuts to seal gasket separate and independent from tie-bar restraint system.
3. Rubber expansion joints shall allow compression, extension, and lateral deflection of the pipes being joined.

E. Bolting Materials for Couplings: Type 316 Stainless steel in accordance with AWWA C219.

2.5 SERVICE SADDLES

A. Double strap design rated for 250 psi minimum working pressure.

2.6 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Modular Mechanical Seal:

1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
2. Assemble interconnected rubber links with Type 316 stainless steel bolts, nuts, and pressure plates.
3. Size modular mechanical seals according to manufacturer's instructions for the size of pipes shown to provide a watertight seal between pipe and wall sleeve opening.
4. Manufacturers and Products:
   a. Thunderline/LinkSeal, Div. of PSI, Houston, TX; Link Seal.
   b. Calpico, Inc., South San Francisco, California; Sealing Linx.
   c. Advance Products and Systems, Lafayette, Louisiana; Innerlynx.
   d. Or equal.

B. Wall Sleeves:

1. Diameter, ends, and length shall be as shown on Drawings.
2. Shall include integral seep ring to minimize seepage between metal sleeve and concrete.

C. Wall Couplings:

1. Diameter, ends, and length shall be as shown on Drawings.
2. Wall couplings shall provide flexible mechanical joint.
3. Body and end rings shall be coated with fusion bonded epoxy.
4. Body shall include integral seep ring.
5. Shall comply with AWWA C219.

2.7 FLANGES, FLANGE GASKETS, AND BOLTING MATERIALS

A. As specified in individual specifications following this section.

B. Flanges, bolting materials, and flange gaskets for steel flanges shall conform to AWWA C207.

C. Flanges, bolting materials, and flange gaskets for ductile iron flanges shall conform to AWWA C110 and AWWA C115.

D. Type 316 Stainless steel bolting material shall conform to ASTM F593.

E. If the flanges are coated, provide two washers for each bolt on each side of the flange to minimize damage to the coating as the nuts are tightened. Provide bolts of the proper length to accommodate the washers.

2.8 FLANGE INSULATION KITS AND INSULATING COUPLINGS

A. Reference the Cathodic Protection Details on the Drawings.

2.9 CONCRETE FOR THRUST BLOCKS

A. Thrust Block Concrete: As specified in Section 03 30 00, Cast-in-Place Concrete.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 deformed bars.

C. Welded Wire Fabric: ASTM A497/A497M.

D. Formwork: Plywood earth cuts may be used as approved by Engineer**.**

E. Mix: ASTM C94/C94M, Option A.

1. Cement: ASTM C150/C150M, Type III.
2. Coarse Aggregate Size: 3/4 inches.
3. Design for Minimum Compressive Strength at 28 Days: 3,000 psi.

2.10 PIPE LOCATING TAPE

A. As specified in Section 31 23 23.15, Trench Backfill.

2.11 PIPE BEDDING AND PIPE ZONE MATERIAL

A. Granular material as specified in Section 31 23 23.15, Trench Backfill.

2.12 TRENCH STABILIZATION MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

PART 3 EXECUTION

3.1 GENERAL

A. Notify Engineer at least 2 weeks prior to field fabrication of pipe or fittings.

B. Furnish feeler gauges of proper size, type, and shape for use during installation for each type of pipe furnished.

C. Distributing Materials: Place materials along trench only as will be used each day, unless otherwise approved by Engineer. Placement of materials shall not be hazardous to traffic or to general public, obstruct access to adjacent property, or obstruct others working in area.

3.2 EXAMINATION

A. Verify size, material, joint types, elevation, and horizontal location of existing pipeline to be connected to new pipeline or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Damaged Coatings and Linings: Repair using coating and lining materials in accordance with manufacturer's instructions.

3.3 PREPARATION OF TRENCH

A. Prepare trench as specified in Section 31 23 16, Excavation.

B. Unless otherwise permitted by Engineer, maximum length of open trench shall not exceed what is indicated in the City's encroachment permit.

3.4 INSTALLATION

A. General:

1. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
2. Install individual pipe lengths in accordance with approved lay diagram. Misplaced pipe shall be removed and replaced.
3. Inspect pipe and fittings before installation, clean ends thoroughly, remove foreign matter and dirt from inside.
4. Flanged Joints:
    a. Install perpendicular to pipe centerline.
    b. Bolt Holes: Straddle vertical centerline, aligned with connecting equipment flanges or as shown on Drawings.
    c. Use torque-limiting wrenches to provide uniform bearing and proper bolt tightness.
    d. Flange Type: Use flat-faced flange when joining with flat-faced ductile or cast iron flange.
5. Couplings:
    a. Install in accordance with manufacturer's written instructions.
    b. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
    c. Clean gaskets before installation.
    d. If necessary, lubricate with gasket lubricant for installation on pipe ends.
    e. Tighten coupling bolts progressively, drawing up bolts on opposite sides gradually until bolts have uniform tightness.

B. Buried Pressure Pipe:

1. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown on Drawings.
2. Placement:
    a. Keep trench dry until pipe laying and joining is completed.
    b. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
    c. Measure for grade at pipe invert, not at top of pipe.
    d. Excavate trench bottom and sides of ample dimensions to permit proper joining, welding, visual inspection, and testing of entire joint.
    e. Prevent foreign material from entering pipe during placement.
    f. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
    g. In general, lay pipe upgrade with bell ends pointing in direction of laying.
    h. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
        1) Shorter pipe lengths.
        2) Special mitered joints.
        3) Standard or special fabricated bends.
    i. Check gasket position with feeler gauge to assure proper seating.
    j. After joint has been made, check pipe alignment and grade.
    k. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
    l. Prevent uplift and floating of pipe prior to backfilling.
3. Disposal of Excess Excavated Material: As specified in Section 31 23 16, Excavation.

3.5 THRUST RESTRAINT

A. Location: At pipeline tees, plugs, caps, bends, and locations where unbalanced forces exist.

B. Thrust Blocking:

1. Place only where shown on Drawings.
2. Quantity of Concrete: Sufficient to cover bearing area of pipe and provide required soil bearing area as shown on Drawings.
3. Place blocking so pipe and fitting joints are accessible for repairs.
4. Place concrete in accordance with Section 03 30 00, Cast-in-Place Concrete.

3.6 CORROSION PROTECTION

A. Buried Pipe: As specified in the individual specifications following this section.

B. Notify Engineer at least 3 days prior to start of surface preparation, coating application, and corrosion protection work.

3.7 PLACEMENT OF PIPE LOCATING TAPE

A. Place pipe locating tape in accordance with Section 31 23 23.15, Trench Backfill.

3.8 PIPE BEDDING AND ZONE MATERIAL

A. Place pipe bedding and pipe zone material in accordance with Section 31 23 23.15, Trench Backfill.

3.9 FIELD QUALITY CONTROL

A. Pressure Leakage Testing: As specified in the individual specification(s) following this section.

3.10 CLEANING AND DISINFECTION

A. Following assembly and testing, and prior to disinfection and final acceptance, flush pipelines with water at 2.5 fps minimum flushing velocity until foreign matter is removed. Dispose of water and flushed foreign matter.

B. If impractical to flush large diameter pipe at 2.5 fps, clean pipe in-place from inside by brushing and sweeping, then flush or blow line at lower velocity

C. Remove accumulated debris through blow-offs 2 inches and larger or by removing spools and valves from piping.

D. Disinfection: As specified in Section 33 13 00, Disinfection of Water Utility Distribution Facilities.

END OF SECTION

SECTION 33 05 01.09
POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   a. C605, Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
2. ASTM International (ASTM):
   a. D2241, Standard Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).
   b. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
   c. D2466, Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
   d. D2467, Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
   e. D2672, Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.
   f. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings.
   g. D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
3. NSF International (NSF).

1.2 SUBMITTALS

A. Action Submittals: Drawings showing pipe diameter, pipe class, dimension ratio (DR) and fitting details. Include detailed information on two-part solvent and proposed detailed method for solvent welding. Include proposed rubber gasket material.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
2. Hydrostatic Testing Plan: Submit at least 15 days prior to testing and at minimum, include the following:

a. Testing dates.
b. Piping systems and section(s) to be tested.
c. Method of isolation.
d. Method of conveying water from source to system being tested.
e. Method of disposing of test water.
f. Calculation of maximum allowable leakage for piping section(s) to be tested.

3. Certification of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
4. Test report documentation.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Solvent Cement: Store in accordance with ASTM D2855.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pipe:

1. PVC, conforming to requirements as shown on drawings**.**
2. Pipe to be used for potable water conveyance shall meet the requirements of NSF 61.
3. Buried pipe for this project shall be PVC Schedule 80, unless otherwise indicated on Drawings**.**

B. Joints:

1. Rubber gasketed, push-on for 12-inch PVC Schedule 80 drain pipe. Provide EPDM, peroxide cured rubber gaskets.
2. Solvent welded for schedule 80 PVC, 6 inches diameter and smaller.
3. Conform to ASTM D2774 and ASTM D2672.

C. Fittings: PVC schedule 80, unless otherwise indicated on Drawings.

D. Service Saddles:

1. Double strap type with minimum strap width of 2 inches.
2. Straps: Type 316 stainless steel.
3. Saddles: Ductile iron, epoxy-coated, 10 mils minimum thickness. Minimum Pressure Rating: 150 psi**.**

E. Restrained Joints:

1. Pipe restraint shall be provided through solvent welding for all pressure pipe applications.
2. 12-inch PVC gravity drain pipe shall be unrestrained.

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with AWWA C605 and ASTM D2321.

B. Solvent cement used for joints shall be as recommended by pipe manufacturer.

C. Joints:

1. Solvent Cemented: In accordance with ASTM D2855.
2. Rubber Gasketed: In accordance with ASTM D3139.

D. Pipe Bending for Horizontal or Vertical Curves:

1. Bending of pipe barrels larger than 12 inches in diameter is not allowed.
2. Radius of curves shall not exceed 75 percent of manufacturer's recommended values.
3. Use blocks or braces at pipe joints to ensure axial deflection in gasketed or mechanical joints does not exceed allowable deflection.

E. No deflection is allowed at solvent weld joints.

F. For potable, domestic, and utility water piping, disinfect pipe in accordance with AWWA C651.

G. Contractor shall coordinate with City Operations prior to and during connections to existing City utilities. Contractor shall meet City requirements for disinfection, swabbing, time of shutdown, and means/methods of tying into City – owned utilities.

3.2 INSPECTION AND HYDROSTATIC TESTING

A. General:

1. Notify Engineer in writing at least 15 working days in advance of testing. Perform testing in presence of Engineer.
2. Using water as test medium, all newly installed pipelines must successfully pass hydrostatic leakage test prior to acceptance.

3. Conduct field hydrostatic test on buried piping after trench has been completely backfilled and compacted. Testing may, as approved by Engineer, be done prior to placement of asphaltic concrete or roadway structural section.
4. Contractor may, if field conditions permit and as approved by Engineer, partially backfill trench and leave joints open for inspection and conduct an initial informal service leak test. Final field hydrostatic test shall not, however, be conducted until backfilling has been completed as specified above.
5. Supply of Temporary Water: In accordance with Section 01 50 00, Temporary Facilities and Controls.
6. Dispose of water used in testing in accordance with federal, state, and local requirements.
7. Install temporary thrust blocking or other restraint as necessary to prevent movement of pipe and protect adjacent piping or equipment. Make necessary taps in piping prior to testing.
8. Wait a minimum of 7 days after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 4 days.
9. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
10. New Piping Connected to Existing Piping:
    a. Isolate new piping with grooved-end pipe caps, blind flanges, or other means as acceptable to Engineer.
    b. Provide appropriate thrust blocking.

B. Hydrostatic Testing Procedure:

1. Furnish testing equipment, as approved by Engineer, which provides observable and accurate measurements of leakage under specified conditions.
2. Maximum Filling Velocity: one foot per second.
3. Expel air from piping system during filling.
4. Test Pressure: 50 psi above system operating pressure. Contractor shall obtain system operating pressure from Engineer during pipe submittal phase.
5. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
6. Maintain hydrostatic test pressure continuously for 2 hours minimum, adding make-up water only as necessary to restore test pressure to within 5 psi of specified hydrostatic test pressure.
7. Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.

C. Maximum Allowable Leakage:

$$L = \frac{ND(P)^{1/2}}{7400}$$

where:

L = Allowable leakage, in gallons per hour.
N = Number of joints in tested line.
D = Nominal diameter of pipe, in inches.
P = Average test pressure during leakage test, in pounds per square inch.

END OF SECTION

SECTION 33 05 10
REINFORCED CONCRETE PIPE (RCP), RUBBER GASKET JOINT WITH PVC LINING

PART 1 GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing double rubber gasketed reinforced concrete pipe (RCP) with PVC lining intended to be used for the construction of open trench gravity sanitary sewers. RCP for use in trenchless construction shall be provided as identified in the section for Microtunneling.

1.2 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 31 23 19.01 – Dewatering
2. Section 31 23 16 – Excavation
3. Section 31 23 23.15 – Trench Backfill
4. Section 31 71 19 – Microtunneling

1.3 STANDARD SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC), latest edition.

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1.	ASTM C 76	Specification for Reinforced Concrete Culvert, Storm Drain, Sewer Pipe
2.	ASTM C 150	Specification for Portland Cement
3.	ASTM C 361	Specification for Reinforced Concrete Low-Head Pressure Pipe

4.	ASTM D 412	Test Methods for Rubber Properties in Tension
5.	ASTM D 2240	Test Method for Rubber Property - Durometer Hardness

1.5 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01 33 00:

1. Manufacturer's design drawings indicating, at relative scale, concrete covers, reinforcement placements and joint assembly design. Submittals shall also include the design pipe size, D-load, cement type, concrete strength and steel areas, and types and placement of reinforcement.
2. A certified affidavit of compliance for all pipe and other products or materials furnished under this Section, as specified in the reference standards and the following supplemental requirements:
   a. Hydrostatic test reports of rubber gasket joints.
   b. Three-edge-bearing strength (D-load) test reports.
   c. PVC-Liner test reports.

1.6 FACTORY INSPECTION AND TESTING

A. The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental for one OWNER-designated inspector for up to 4 days required to complete such inspections or observations exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than fifty (50) miles outside the geographical limit of the City. The CONTRACTOR shall not be responsible for salary or salary-related costs of the inspectors.

B. **Inspection:** All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the applicable referenced standards as supplemented by the requirements herein. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of pipe manufacture.

C. **Tests:** Unless otherwise indicated, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the applicable referenced standards. The CONTRACTOR shall perform said material tests at no additional cost to the OWNER. The CONSTRUCTION MANAGER will witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR's schedule is not delayed for the convenience of the

CONSTRUCTION MANAGER. In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.

D. **Product Testing:** In addition, pipe shall be tested at the factory for D-load bearing strength in compliance with SSPWC Subsection 207-2.9.2.

E. **Hydrostatic Tests:** Pipe shall be subjected to hydrostatic test of the rubber gasket joints in accordance with ASTM C 361 except that test pressure shall be a minimum of 5 psi.

F. **PVC Liner Tests:** PVC liner shall be tested in accordance with Subsection 210-2.3 of SSPWC.

PART 2 PRODUCTS

2.1 GENERAL

A. Reinforced concrete pipe shall conform to the requirements of ASTM C 76 as modified below:

1. In no case shall pipe be less than that specified under ASTM C 76 provisions for Class III, Walls "B", or "C." Wall "A" shall not be accepted.
2. Minimum protective cover of concrete over the inner reinforcement cage shall be 1¼ inches.
3. Pipe shall be fabricated by the vertically cast process which shall be wet cast, vibrated, and steam- or water-cured. Pipe manufactured by the dry cast method is unacceptable. For steam curing, the forms shall not be removed for a minimum of 6 hours. For water curing, the minimum period for removal of forms is 24 hours. Fabrication of vertically-cast pipe shall be in accordance with ASTM C 361 and further, form oils or release agents shall not contain any material or substances as would penetrate or otherwise retard concrete set at the formed surface.

2.2 MATERIALS

A. **General:** Materials shall comply with Section 6 of ASTM C 76 modified below.

B. **Cement:** Cement used in the manufacture of reinforced concrete pipe shall

be Type II in conformance with ASTM C 150.

C. **Admixtures:** No admixture shall be used unless otherwise specified or accepted by the CONSTRUCTION MANAGER.

D. **Rubber Gaskets:** Rubber gaskets shall be neoprene and shall comply with the requirements of ASTM C 361.

E. **PVC-Liner:** PVC-liner shall conform to SSPWC Subsection 207.3 and shall be Amerplate T-Lock as manufactured by Northwest Pipe Company, Brea, California, or equal. The liner shall cover 330 degrees of the pipe interior surface, leaving an open arc of 30 degrees at the bottom of the pipe for observation of cracks that may occur during D- Load tests.

2.3 JOINTS

A. Joint assembly design shall be Carnegie bell and spigot steel joint or reinforced concrete raised or flush bell concrete joint incorporating a fully retained single rubber gasket in accordance with ASTM C 361 and as shown. For locations where pipelines will be installed below the water table, the CONTRACTOR shall provide double rubber gaskets.

PART 3 EXECUTION

3.1 GENERAL

A. Reinforced concrete pipe shall be installed in accordance with the requirements of SSPWC Subsection 306-1.2 and Section 33 05 01.

3.2 PVC-LINER INSTALLATION

A. PVC-liner installation shall conform to SSPWC Subsection 311-1.

END OF SECTION

SECTION 33 05 13
MANHOLES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): M198, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
2. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48/A48M, Standard Specification for Gray Iron Castings.
   c. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   d. A536, Standard Specification for Ductile Iron Castings.
   e. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   f. B139/B139M, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
   g. C14, Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
   h. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   i. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   j. C150/C150M, Standard Specification for Portland Cement.
   k. C192/C192M, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
   l. C387/C387M, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
   m. C443, Standard Specification for Joints for Concrete Pipe and Manholes Using Rubber Gaskets.
   n. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
   o. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
   p. C990, Standard Specification for Joints in Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants.
   q. C1311, Standard Specification for Solvent Release Sealants.

r. C1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
s. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
t. D4101, Standard Specification for Propylene Injection and Extrusion Materials.
u. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
v. F594, Standard Specification for Stainless Steel Nuts.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings including details of construction, reinforcing and joints, anchors, lifting, erection inserts, and other items cast into members.
2. Product Data:
   a. Concrete mix design.
   b. Manhole frame to structure seals.
   c. Manhole frame to structure anchor bolt.
   d. Rubber gaskets and sealants.
   e. External joint wrap.

B. Informational Submittals:

1. Experience Record:
   a. Precast concrete production capabilities.
   b. Evidence of current PCI plant certification.
2. Calculations: Proposed details and design calculations for stresses in precast concrete members for loading conditions including earth pressures and transportation, handling, and erection. Calculations shall be stamped by engineer registered in the state of California.
3. Certificate of Compliance: Certify admixtures and concrete do not contain calcium chloride.
4. Test Reports:
   a. Precast manufacturer's concrete test cylinders.
   b. Core compression test.
   c. Absorption test.
5. Manufacturer's recommended installation instructions.
6. Field quality control report.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Precast Concrete and Precast Prestressed Concrete: Product of manufacturer with experience producing precast concrete products of quality specified.
2. Precast Plant: PCI certified plant with current certification.

PART 2 PRODUCTS

2.1 GENERAL

A. Materials of Construction and Service Conditions:

1. Screws, Bolts, or Nuts: Type 304 stainless steel conforming to ASTM F593 and ASTM F594.
2. Gaskets: Internal and external seals shall be made of materials that have been proven to be resistant to the following exposures and conditions:
   a. Sanitary sewage.
   b. Corrosion or rotting under wet or dry conditions.
   c. Gaseous environment in sanitary sewers and at road surfaces including common levels of ozone, carbon monoxide, and other trace gases at installation site.
   d. Biological environment in soils and sanitary sewers.
   e. Chemical attack by road salts, road oil, and common street spillages or solvents used in street construction or maintenance.
   f. Temperature ranges, variations, and gradients in construction area.
   g. Variations in moisture conditions and humidity.
   h. Fatigue failure caused by a minimum of 30 freeze-thaw cycles per year.
   i. Vibrations because of traffic loading.
   j. Fatigue failure because of repeated variations of tensile, compressive and shear stresses, and repeated elongation and compression. Material shall remain flexible allowing repeated movement.
3. Materials shall be compatible with each other and manhole materials.
4. Designed to provide a 20-year service life.

B. Structures shall meet requirements of ASTM C478, this specification and the following:

1. Concrete:
   a. Cement: Meet requirements of ASTM C150/C150M.
   b. Compressive Strength:
      1) Minimum 4,000 psi.
      2) Minimum strength shall be confirmed at 7 days by making two standard cylinders per manhole for testing.

c. Concrete mix design shall include Xypex C-500 or C-1000 based upon mix design at dosage recommended by manufacturer for installation.

2. Reinforcement: Grade 60, unless otherwise specified.
3. Ring: Custom made with openings to meet indicated pipe alignment conditions and invert elevations.
4. Joint:
   a. Form joint contact services with machined castings.
   b. Surfaces shall be parallel with nominal 1/16-inch clearing and tongue equipped with recess for installation of O-ring rubber gasket.
5. Gasket: Meet requirements of ASTM C443.

2.2 PRECAST MANHOLES

A. Riser Sections:

1. Fabricate in accordance with ASTM C478.
2. Diameter: Minimum 60 inches.
3. Wall Thickness: Minimum 4 inches or 1/12 times inside diameter, whichever is greater.
4. Top and bottom surfaces shall be parallel.
5. Joints: confined O-ring with rubber gaskets meeting ASTM C443**.**

B. Cone Sections:

1. Eccentric.
2. Same wall thickness and reinforcement as riser section.
3. Top and bottom surfaces shall be parallel.

C. Base Sections and Base Slab:

1. Base slab integral with sidewalls.
2. Fabricate in accordance with ASTM C478.

D. Manhole Extensions:

1. Concrete grade rings; maximum 6 inches high.
2. Fabricate in accordance with ASTM C478.

E. Joint Seal Manufacturers and Products:

1. Butyl Gaskets:
   a. Hamilton Kent, Sparks, NV; Kent-Seal No. 2.
   b. Henry Company, Houston, TX; Ram-Nek.
   c. Trelleborg Engineered Solutions, Park Hills, MO; NPC Bidco C-56.

d. Or equal.

2. Confined Plastic or Rubber O-Ring:
   a. As recommended by precasting manufacturer.
   b. Meet requirements of ASTM C443.
3. External Wrap:
   a. Sealing Systems, Inc., Loretto, MN; Gator Wrap.
   b. Henry Company, Houston, TX; RU116 Rubr-Nek External Joint Wrap.
   c. Trelleborg Engineered Solutions, Park Hills, MO; NPC External Joint Wrap.
   d. Cretex Specialty Products, Waukesha, WI; Cretex Wrap.
   e. Or equal.

F. CAST-IN-PLACE MANHOLES

G. Concrete: As specified in Section 03 30 00, Cast-in-Place Concrete.

H. Reinforcing Steel: As specified in Section 03 21 00, Reinforcing Steel.

2.3 MANHOLE FRAMES AND COVER

A. Castings:

1. Tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.
2. Cast Iron: ASTM A48/A48M Class 35B.
3. Ductile Iron: ASTM A536, Grade 60-40-12.
4. Plane or grind bearing surfaces to ensure flat, true surfaces.

B. Cover: Owner's Standard.

2.4 MANHOLE FRAME CONNECTION TO STRUCTURE

A. Butyl Sealant:

1. Conform to ASTM C1311, or AASHTO M198 and ASTM C990.
2. Trowelable or cartridge applied.
3. Manufacturers and Products:
   a. Tremco Commercial Sealants and Waterproofing, Beachwood, OH; Tremco Butyl Sealant.
   b. Bostik, Middleton, MA; Chem-Calk 300.
   c. Press-Seal Gasket Company, Fort Wayne, IN; EZ-Stik #3.
   d. Or equal.

B. External Wrap:

1. Meet requirements of ASTM C923.
2. Construct of high quality rubber that will provide flexible watertight seal around joint.
3. Thickness: Minimum 60 mils.
4. Consist of a top and bottom section and be sealed to structure, frame top, and bottom with mastic as applicable.
5. Length: Extend from manhole frame and extension ring to cone section.
6. Bands: If required, constructed of minimum 16-gauge sheet if channeled, or 5/16-inch diameter if round.
7. Manufacturers and Products:
    a. Sealing Systems, Inc., Loretto, MN; Infi-Shield.
    b. Trelleborg Engineered Systems, Milford, NH; NPC Flexrib Frame-Chimney Seals.
    c. Cretex Specialty Products, Waukesha, WI; X-85 Seal.
    d. Or equal.

C. Internal Wrap or Sealing Membrane:

1. Meet requirements of ASTM C923.
2. Minimum internal thickness of 3/16 inch or as recommended by manufacturer for installation climate.
3. Designed for application and have a demonstrated history of accommodating differential expansion between frame and concrete.
4. Width: Minimum 8 inches.
5. Expansive type wraps shall be fabricated of high quality rubber or urethane.
6. Bands: If required, constructed of minimum 16-gauge sheet if channeled, or 5/16-inch diameter if round.
7. Wrap shall not restrict access to manhole.
8. Manufacturers and Products:
    a. Sealing Systems, Inc., Loretto, MN; Flex-Seal Utility Sealant.
    b. Trelleborg Engineered Systems, Milford, NH; NPC Flexrib Frame-Chimney Seals.
    c. Cretex Specialty Products, Waukesha, WI; Internal Manhole Chimney Seal.
    d. Or equal.

D. Frame to Structure Anchor Bolts:

1. 3/4-inch-diameter HAS stainless steel bolts; minimum 6-5/8-inch embedment.

2. Manufacturer and Product: Hilti; HVA Capsules Adhesive Anchoring System.

2.5 MORTAR

A. Standard premixed in accordance with ASTM C387/C387M, or proportion one part Portland cement to two parts clean, well-graded sand that will pass a 1/8-inch screen.

B. Admixtures: May be included; do not exceed the following percentages of weight of cement:

1. Hydrated Lime: 10 percent.
2. Diatomaceous Earth or Other Inert Material: 5 percent.

C. Mix Consistency:

1. Tongue-and-Groove Type Joint: Such that mortar will readily adhere to pipe.
2. Confined Groove (Keylock) Joint: Such that excess mortar will be forced out of groove and support is not provided for section being placed.

2.6 BACKFILL AROUND AND UNDER MANHOLE

A. Structural fill as specified in Section 31 23 23, Fill and Backfill.

B. One-inch-minus rock or sand free from dirt, clay balls, and organic material.

2.7 FLEXIBLE JOINTS FOR SEALING PIPES IN MANHOLE

A. Manufacturers and Products:

1. NPC, Inc., Milford, New Hampshire; Kor-N-Seal flexible rubber boot with stainless steel accessories.
2. A-LOK Products, Inc., Tullytown, PA; Z-LOK XP or A-LOK flexible connectors.
3. Or equal.

2.8 SOURCE QUALITY CONTROL

A. Prior to delivery of precast manhole sections to Site, yard permeability tests may be required at point of manufacture. Engineer or Owner will select precast sections not to exceed 5 percent of the total project quantity to test from material which is to be supplied to Project. Test specimens shall be mat tested and meet permeability test requirements of ASTM C14.

B. Concrete Testing: Test two concrete test cylinders for each manhole. Compressive strength shall be tested in accordance with ASTM C31/C31M, ASTM C39/C39M, and ASTM C192/C192M.

C. Inspection:

1. Material Quality:
   a. Manufacturing process and finished sections shall be subject to inspection and approval by Owner and Engineer.
      1) Inspections may take place at manufacturer's plant, at Site after delivery, or at both.
      2) Sections not meeting requirements of this Specification or that are determined to have defects which may affect durability of structure are subject to rejection.
      3) Sections rejected after delivery shall be removed and replaced.
      4) Sections damaged after delivery will be rejected and if already installed shall be repaired to satisfaction of Owner and Engineer.
      5) If structure cannot be repaired it shall be removed and replaced entirely at Contractor's expense.
2. At the time of inspection the sections will be carefully examined for compliance with ASTM C478 and with manufacturer's drawings. Sections will be inspected for general appearance, dimensions, scratch strength, blisters, cracks, roughness, and soundness. Surface shall be dense and close textured.
3. Imperfections may be repaired, subject to approval of Engineer, after demonstration by manufacturer that strong and permanent repairs result.

PART 3 EXECUTION

3.1 GENERAL

A. Prior to installation inspect materials:

1. Sections not meeting requirements of this specification or that are determined to have defects which may affect durability of structure are subject to rejection.
2. Sections damaged after delivery will be rejected and if already installed shall be repaired to satisfaction of Owner and Engineer.
3. Remove and replace structure that cannot be repaired.

B. If needed, dewater excavation during construction and testing operations.

3.2 EXCAVATION AND BACKFILL

A. Excavation: As specified in Section 31 23 16, Excavation.

B. Backfill:

1. As specified in Section 31 23 23, Fill and Backfill.
2. Place structural fill under manhole in 6-inch maximum lifts; minimum of 12 inches unless otherwise specified on Drawings. Compact each lift to 98 percent relative compaction as determined in accordance with ASTM D698.
3. Backfill around structure with earth fill to lines and grades shown; allow for topsoil thickness where shown. Place in 8-inch thick maximum lifts. Compact each lift to 92 percent relative compaction as determined in accordance with ASTM D698.

3.3 INSTALLATION OF PRECAST MANHOLES

A. Concrete Base:

1. Precast:
   a. Place on compacted structural fill.
   b. Properly locate, ensure firm bearing throughout, and plumb first section.
2. Cast-in-Place:
   a. Invert: Minimum 8 inches below lowest connecting pipe.
   b. First section of manhole shall be cast in concrete base.

B. Sections:

1. Inspect precast manhole sections to be joined.
2. Clean ends of sections to be joined.
3. Do not use sections with chips or cracks in tongue.

C. Preformed Plastic Gaskets or Rubber O-Ring:

1. Use only pipe primer furnished by gasket manufacturer.
2. Install gasket material in accordance with manufacturer's instructions.
3. Completed Manhole: Rigid and watertight.

D. Mortar Joints:

1. Thoroughly wet joint with water prior to placing mortar.
2. Place mortar on groove of lower section prior to section installation.
3. Fill joint completely with mortar of proper consistency.
4. Trowel interior and exterior surfaces smooth on standard tongue-and-groove joint.
5. Prevent mortar from drying out and cure by applying approved curing compound or comparable approved method.
6. Do not use mortar mixed for longer than 30 minutes.

7. Chip out and replace cracked or defective mortar.
8. Completed Manhole: Rigid and watertight.

E. External Joint Wraps: Install in accordance with manufacturer's instructions.

F. Extensions:

1. Provide on manholes in streets or other locations where change in existing grade may be likely.
2. Install to height not exceeding 12 inches.
3. Lay grade rings in mortar with sides plumb and tops level.
4. Seal joints with mortar as specified for sections and make watertight.

3.4 MANHOLE INVERT

A. Construct with smooth transitions to ensure unobstructed flow through manhole. Remove sharp edges or rough sections that tend to obstruct flow.

B. Where full section of pipe is laid through manhole, break out top section and cover exposed edge of pipe completely with mortar. Trowel mortar surfaces smooth.

3.5 MANHOLE FRAMES AND COVERS

A. Install concrete grade rings as required to set covers flush with surface of adjoining pavement or ground surface, unless otherwise shown or directed.

B. Set frames in three equally spaced beads of butyl sealant that run full circumference of frame.

C. Anchor frame to manhole with specified bolts.

D. Install exterior manhole frame to structure seals in accordance with manufacturer's instructions. Seal shall cover grade rings.

3.6 WATERTIGHT MANHOLES

A. Unless otherwise noted, manholes covers shall be bolted down with sealing gasket.

3.7 CAST-IN-PLACE MANHOLE

A. Concrete: As specified in Section 03 30 00, Cast-in-Place Concrete.

B. Reinforcing Steel: As specified in Section 03 21 00, Reinforcing Steel.

3.8 MANHOLE PIPING

A. Drop Assembly: See Drawings for detail of installation requirements.

B. Flexible Joints:

1. Provide in pipe not more than 1-1/2 feet from manhole walls.
2. Where last joint of pipe is between 1-1/2 feet and 6 feet from manhole wall, provide flexible joint in manhole wall.

C. Stubouts for Future Connections:

1. Provide same type and class of pipe as specified for use in service connection, lateral, main, or trunk sewer construction. Where there are two different classes of pipe at manhole use higher strength pipe.
2. Grout pipe in precast walls or manhole base to provide watertight seal or use flexible joints as specified herein.
3. Maximum Length: 1-1/2 feet outside manhole wall.
4. Construct invert channels as shown.
5. Test Plugs:
   a. Install rubber-gasketed plugs in end of stubouts with gasket joints similar to sewer pipe being used.
   b. Plugs shall withstand internal or external pressures without leakage.
   c. Adequately brace plugs against hydrostatic or air test pressures.

D. Permanent Plugs: Clean interior contact surfaces of pipes to be cut off or abandoned as shown, and construct plug as follows:

1. Pipe 18 Inches or Less in Diameter: Concrete plug in end, minimum 2 feet long.
2. Pipe 20 Inches and Larger: Concrete plug in end, minimum 4 feet long.
3. Plugs shall be watertight and capable of withstanding internal and external pressures without leakage.

3.9 MANHOLES OVER EXISTING PIPING

A. Maintain flow through existing pipelines at all times.

B. Concrete Pipe: Apply bonding agent on surfaces in contact with concrete.

C. Construct base under existing piping.

D. Construct manhole as detailed in Drawings.

E. Apply minimum of two complete wraps of hydrophilic waterstop centered on pipe in wall.

F. Place a minimum of 24 inches of concrete around each pipe penetration outside manhole against undisturbed soil or compacted aggregate unless otherwise detailed.

G. Grout channel through manhole.

H. Saw cut out or demolish existing pipe within new manhole using method approved by Engineer.

I. Protect new concrete or grout for 7 days after placing concrete.

3.10 CONNECTIONS TO EXISTING MANHOLES

A. Core manhole bases and grouting as necessary.

B. Seal pipe in manhole using flexible connector.

C. Regrout to provide smooth flow into and through manholes.

D. Provide diversion facilities and perform work necessary to maintain flow during connection.

3.11 FIELD QUALITY CONTROL

A. Conduct negative air pressure (vacuum) test on all manholes in accordance with ASTM C1244.

B. Hydrostatic Testing:

1. When, in Engineer's opinion, groundwater table is too low to permit visual detection of infiltration leaks, hydrostatically test all manholes.
2. Procedure: Plug inlets and outlets and fill manhole with water to height determined by Engineer.
3. Manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into pipe walls to take place.
4. Leakage in each manhole shall not exceed 0.1 gallon per hour per foot of head above invert.
5. Repair manholes that do not meet leakage test, or do not meet specified requirements from visual inspection.
6. If more than 25 percent of manholes tested fail the hydrostatic test, test all or as many manholes as Engineer deems necessary.

END OF SECTION

SECTION 33 05 17
COPPER PIPE AND TUBING

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish copper pipe and fittings.
2. The extent of the piping is shown on the Contract Drawings.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with the applicable provisions of the following regulatory agencies:

1. Underwriters' Laboratories, Incorporated.
2. National Fire Protection Association.
3. ASME, Boiler and Pressure Vessel Code.
4. State and Local Building Codes and Ordinances.
5. Uniform Plumbing Code.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM B 32, Specification for Solder Metal.
2. ASTM B 42, Specification for Standard Size Seamless Copper Pipe.
3. ASTM B 68, Specification for Bright Annealed Seamless Copper Tube.
4. ASTM B 75, Specification for Seamless Copper Tube.
5. ASTM B 88, Specification for Seamless Copper Water Tube.
6. ASTM B 280, Specification for Seamless Copper Tube for Air-conditioning and Refrigeration Field Service.
7. ASTM B 302, Specification for Threadless Copper Pipe.
8. ASTM B 306, Specification for Copper Drainage Tube (BWV).
9. Product Handbook of Copper Development Association, Inc.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Detailed drawings and data on pipe fittings and appurtenances.

B. Certificates: Submit certificates of compliance with referenced standards.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Cap ends of pipe to keep interiors free from contaminates.

B. Store fittings in containers so they are not in contact with the ground.

PART 2 PRODUCTS

2.1 SERVICE CONDITIONS

A. Copper pipeline systems shall be specially designed and installed for the service intended and shall be as shown and specified.

B. Copper pipe with soldered joints shall be used for all piping less than 3 inches in diameter for process, potable and non-potable water lines, vacuum signal and pneumatic signal lines, air supply lines, process sampling lines, equipment drains and instrument drains unless specified or shown otherwise.

2.2 MATERIALS

A. Copper Piping and Fittings:

1. Copper piping to be installed in exposed locations shall be Type K (wall thickness) hard temper pipe with wrought solder joint pressure fittings. Type K copper pipe shall conform to ASTM B 88. Fittings shall conform to ANSI B16.22.
2. Copper piping to be installed in buried locations shall be Type K (wall thickness) soft temper pipe with wrought copper pressure fittings. Type K copper pipe shall conform to ASTM B 88. Fittings shall be in conformance with ANSI B16.22 or ANSI B16.29, as applicable.
3. All pipe shall be made of copper free from cupreous oxide, as determined by microscopic examination at a magnification of 75 diameters.
4. Copper pipe, when furnished in coils, shall be annealed after coiling.
5. Copper piping and fitting shall be tape wrapped in areas where hydrogen sulfide is present.

2.3 JOINTING

A. The copper piping systems shall be assembled with soldered joints. The fittings shall conform to ASTM B 61 and ANSI Standards listed in paragraph 1.2.B. The solder used for pipe joints shall be 50-50 standard solder, conforming to ASTM B 32.

B. All joints shall conform to manufacturer's recommendations and shall be made by skilled workmen.

C. Joints shall develop full strength. Strength shall be greater than the pipe joined.

2.4 MARKING

A. All items shall be marked or labeled with the following information:

1. Metal or alloy designation.
2. Temper.
3. Size and wall thickness.
4. ASTM specification number.
5. Name and location of supplier.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install to lines and grades shown.

B. See Section 33 05 01.

3.2 TESTING OF PIPING

A. Refer to Section 33 05 01.

B. Pipeline testing not described in Section 33 05 01 shall be performed in accordance with Section 306-1.4 of the SSPWC (Green Book).

END OF SECTION

SECTION 33 05 19
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): T99, Standard Method of Test for the Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.
2. American Society of Mechanical Engineers (ASME):
   a. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
   b. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
3. American Water Works Association (AWWA):
   a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
   b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
   c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
   d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   e. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Fittings.
   f. C116/A21.16, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
   g. C150/A21.50, Thickness Design of Ductile-Iron Pipe.
   h. C151/A21.51, Ductile-Iron Pipe. Centrifugally Cast, for Water.
   i. C153/A21.53, Ductile-Iron Compact Fittings for Water Service.
   j. C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
   k. C606, Grooved and Shouldered Joints.
4. ASTM International (ASTM):
   a. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
   b. A563, Standard Specification for Carbons and Alloy Steel Nuts.
   c. D882, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
   d. D1330, Standard Specification for Rubber Sheet Gaskets.
   e. D1922, Standard Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method.

f. D2000, Standard Classification System for Rubber Products in Automotive Applications.
g. D4976, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

5. International Organization for Standardization (ISO): 9001, Quality Management Systems – Requirements.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Marking plan and details of standard pipe section showing dimensions, pipe joints, fitting and special fitting pressure rating and thickness, size, coating and lining data.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, stating that inspections and specified tests have been made and that results thereby comply with requirements of Article Source Quality Control.]
2. Field Hydrostatic Testing Plan: Submit at least 15 days prior to testing and at minimum, include the following:
   a. Testing dates.
   b. Piping systems and section(s) to be tested.
   c. Method of isolation.
   d. Method of conveying water from source to system being tested.
   e. Calculation of maximum allowable leakage for piping section(s) to be tested.
3. Certifications of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
4. Test documentation form and results.

1.3 QUALITY ASSURANCE

A. Pipe manufacturer shall be ISO 9001 registered or provide the services of an independent inspection agency.

B. Prior to start of manufacturing, manufacturer not meeting or having ISO registration requirements shall submit name of at least two independent inspection agencies for approval.

1. Independent inspection agency shall be responsible, on a daily basis, for sample monitoring of chemical and mechanical tests, sample visual inspection of quality assurance tests performed on in-process pipe and

fittings, and sample visual and dimensional inspection on finished products.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:

1. Ductile iron pipe shall be manufactured, lined, coated, and tested domestically in the United States of America.
2. Pipe manufacturer shall certify source manufacturing facility has been producing ductile iron pipe of the specified diameters, pressure, dimensions and standards.
3. Ductile iron pipe and fitting shall be supplied by a single manufacturer.
   a. Mixing of components and sources is not permitted.
   b. Fitting from outside the United States of America shall be produced in a facility with documented experience manufacturing, coating, testing, and delivery of size and type specified to projects in the United States of America.

B. Pipe:

1. General:
   a. Pipe shall be new and recently manufactured. Refurbished pipe shall not be provided.
   b. Lined and coated as specified.
2. Meet requirements of AWWA C150/A21.50, AWWA C151/A21.51, and AWWA C111/A21.11.
3. Centrifugally cast, grade 60-42-10 iron.
4. Pressure rating of pipe from 4 inches to 16 inches in diameter shall be 300 psi.
5. Grooved end pipe shall be minimum Special Class 53.

C. Joints:

1. Push-On Joint: Rated at minimum working pressure equal to pipe material design.
2. Restrained Joint:
   a. Manufactured proprietary joint that mechanically restrains pipe to adjoining pipe.
   b. Manufacturers and Products:
      1) American Cast Iron Pipe; Flex-Ring, Field Flex-Ring, and Lok-Ring.
      2) Pacific States Pipe; Thrust-Lock.
      3) U.S. Pipe; TR Flex and HP Lok
      4) Or equal.

3. Mechanical Wedge Action Type Joint:
    a. Use only in areas where adjoining to fixed points where laying length is determined in field.
    b. Prior to purchase and installation, type and application of this joint shall be approved by Engineer.
4. Use of set screws for restraint or field-lock gaskets shall not be allowed.
5. Grooved Joint:
    a. Rigid type radius cut grooved, conforming to AWWA C606.
    b. Manufacturer: Victaulic Company of America.
6. Ball Joint:
    a. Meet requirements of AWWA C151/A21.51.
    b. Minimum Working Pressure:
        1) 4-inch through 12-inch Diameter: 350 psi.
        2) Larger than 12-inch Diameter: 250 psi.
    c. Manufacturers and Products:
        1) American Cast Iron Pipe; Flex-Lock.
        2) U.S. Pipe; USIFLEX.

D. Fittings:

1. Fittings shall be new and recently manufactured. Refurbished fittings will not be accepted.
2. Mechanical, Push-On, Flanged, or Restrained Joint: In accordance with the following table:

Minimum Pressure Ratings for AWWA C110/A21.10 and C115/A21.15 Ductile Iron Fittings		
Diameter (inches)	Rubber Gasket Joints (Push-on, Mechanical, Restrained) (psi)	Flanged Joints (psi)
3 to 24	300	300
30 to 48	250	250
Minimum Pressure Ratings for AWWA C153/A21.53 Ductile Iron Fittings		
Diameter (inches)	Rubber Gasket Joints (Push-on, Mechanical, Restrained) (psi)	Flanged Joints
3 to 24	300	Not included in C153/A21.53 (refer to the C110/A21.10 Standard)
30 to 48	250	Not included in C153/A21.53 (refer to the C110/A21.10 Standard)
54 to 64	150	150 psi

3. Rubber Gasket Joints Including Mechanical Joints, Push-On Joints, and Flanged Joints: In accordance with AWWA C111/A21.11.
4. Mechanical Joint Fittings: In accordance with AWWA C110/A21.10 and AWWA C153/A21.53.
5. Grooved End Fittings:
   a. Radius cut grooved, rigid type conforming to AWWA C110/A21.10 and AWWA C153/A21.53.
   b. Manufacturers:
      1) Victaulic Company of America.
      2) Gustin-Bacon.

E. Welded Outlet: Only weld to pipe in manufacturer's shop.

F. Lining:

1. Pipe and fittings for clean water applications shall be cement mortar-lined and asphaltic seal coated in accordance with AWWA C104/A21.
2. Pipe and fittings shall be lined with 40-mil ceramic epoxy, as manufactured by Induron or equal.

G. Bolting:

1. Flanged Connection Bolts: Carbon steel, ASTM A307, Grade A hex bolts and ASTM A563, Grade A hex head nuts.
2. Grooved End Connections Bolts: Manufacturer's standard.

H. Gaskets:

1. Flat Faced Flange Gaskets:
   a. Pipe Smaller Than 54 Inches: Rated for working pressure 150 psi to 250 psi, 1/8 inch thick, red rubber (SBR), hardness 80 (Shore A), rated to 200 degrees F, conforming to ASME B16.21, AWWA C207, and ASTM D1330, Grade 1 and Grade 2.
   b. Pipe 54 Inches and Larger: Rated for working pressure greater than 250 psi; shall be Toruseal gaskets as manufactured by American Ductile Iron Pipe or Flange-Tyte gaskets as manufactured by U.S. Pipe.
2. Grooved End Joint Gaskets: Halogenated butyl, conforming to ASTM D2000 and AWWA C606.

2.2 SOURCE QUALITY CONTROL

A. Factory Tests:

1. General:
   a. Tests shall be performed on pipe with metal thickness equal to that specified.
   b. Only pipe that passes leak test shall be shipped.
2. Hydrostatic Proof Test:
   a. All Pipe: Perform at 500 psi for a minimum duration of 10 seconds.
   b. Pipe 30 Inches and Larger: Additionally test to 75 percent of minimum yield strength during test duration which shall not be less than 15 seconds.
   c. Record each test cycle on a strip chart.
   d. Each test cycle for 30-inch and larger pipe shall be marked by pipe number.
   e. Inspect each pipe during testing for leaks.
   f. Pipe which shows evidence of leaks shall be scrapped.
   g. Repair welding of leaks is not permitted.
3. Perform a 15-psi air test on welded-on outlet pipe.
4. Pipe ends (spigot end, bell and socket) shall be gauged with suitable gauges at sufficiently frequent intervals to ensure compliance to standard dimensions of AWWA C151/A21.51.

a. In addition, each socket and spigot shall be inspected in a well-lighted area for injurious defects which could affect the joint performance.
b. Remove defects by cutting of pipe ends.
c. Pipe with injurious defects in the bell shall be scrapped.
d. Manufacturer shall have a recommended ovality tolerance for pipes 18 inches inch and larger.
e. Each end of each 18-inch and larger pipe shall be measured and approved by manufacturer's quality assurance inspector to meet tolerances.

5. Submit a certified inspection report from the independent agency of witnessed tests within 10 days of the inspection.
   a. Test results shall show restrained joints in the sizes specified have been successfully tested to at least twice the specified pressure rating of the joint without leakage or failure.
6. In accordance with AWWA C104, C110, C153, and C606.

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect pipe and fittings to ensure no cracked, broken, or otherwise defective materials are being used.

3.2 PREPARATION

A. Trench Grade:

1. When specified, grade bottom of trench by hand to specified line and grade with proper allowance for pipe thickness and pipe base. Trench bottom shall form a continuous and uniform bearing and support for pipe between bell holes.
2. Before laying each section of pipe, check grade and correct irregularities found. Grade may be disturbed for removal of lifting tackle.

B. Pipe Bedding: Place and compact pipe bedding material as follows:

1. Install to full width of trench, 4 inches to 6 inches bedding below bottom to springline of pipe:
   a. Pipe 12-Inch Diameter: 4 inches to 6 inches.
   b. Pipe Larger than 12-Inch Diameter: 6 inches to 8 inches.
2. Compact to at least 95 percent of its maximum density as determined by D: AASHTO T99.
3. Ensure that no unfilled or uncompacted areas occur beneath pipe.

C. Bell (Joint) Holes: At each joint, dig bell holes of ample dimensions in bottom of trench, and at sides where necessary, to permit joint to be made properly and to permit easy visual inspection of entire joint.

3.3 INSTALLATION

A. General:

1. Provide and use proper implements, tools, and facilities for safe and proper prosecution of the Work.
2. Lower pipe, fittings, and appurtenances into trench, piece by piece, by means of a crane, slings, or other suitable tools and equipment, in such a manner as to prevent damage to pipe materials, protective coatings and linings.
3. Do not drop or dump pipe materials into trench.

B. Cleaning Pipe and Fittings:

1. Remove lumps, blisters, and excess coal tar coating from bell and spigot ends of each pipe. Wire brush outside of spigot and inside of bell and wipe clean, dry, and free from oil and grease before pipe is laid.
2. Wipe ends of mechanical joint pipe and fittings and of rubber gasket joint pipe and fittings clean of dirt, grease, and foreign matter.

C. Laying Pipe:

1. Direction of Laying: Lay pipe with bell end facing in direction of laying. For lines on an appreciable slope, face bells upgrade at discretion of Engineer.
2. Mechanical Joint, Push-On Joint, and Restrained Joint Pipe: After first length of pipe is installed in trench, secure pipe in place with approved backfill material tamped under and along sides to prevent movement. Keep ends clear of backfill. After each section is jointed, place backfill as specified to prevent movement.
3. Take precautions necessary to prevent floating of pipe prior to completion of backfill operation.
4. When using movable trench shield, take necessary precautions to prevent pipe joints from pulling apart when moving shield ahead.
5. Do not allow foreign material to enter pipe while it is being placed in trench.
6. Close and block open end of last laid section of pipe to prevent entry of foreign material or creep of gasketed joints when laying operations are not in progress, at close of day's work, or whenever workers are absent from job.

D. Joining Push-On Joint Pipe and Mechanical Joint Fittings:

1. Join pipe with push-on joints and mechanical joint fittings in accordance with manufacturer's recommendations.
2. Provide special tools and devices, such as, special jacks, chokers, and similar items required for installation.
3. Lubricate pipe gaskets using lubricant furnished by pipe manufacturer. No substitutes will be permitted.
4. Clean ends of fittings of dirt, mud, and foreign matter by washing with water and scrubbing with a wire brush, after which, slip gland and gasket on plain end of pipe. If necessary, lubricate end of pipe to facilitate sliding gasket in place, then guide fitting onto spigot of pipe previously laid.

E. Ball Joint Pipe:

1. Assemble and install in accordance with manufacturer's recommendations.
2. Hydrostatic Test:
   a. Conduct on ball joint pipe independent of other pipe systems/type being installed.
   b. Conduct test in accordance with requirements of these Specifications and manufacturer's recommendations.

F. Cutting Pipe:

1. General: Cut pipe for inserting valves, fittings, or closure pieces in a neat and workmanlike manner without damaging pipe or lining and so as to leave a smooth end, at right angles to axis of pipe.
2. Pipe: Cut pipe with milling type cutter or saw. Do not flame cut.
3. Dressing Cut Ends: Dress cut end of mechanical joint pipe to remove sharp edges or projections, which may damage rubber gasket. Dress cut ends of push-on joint pipe by beveling, as recommended by manufacturer.

G. Field Welding:

1. Use of field welded outlets will not be allowed. Welding for outlets shall be performed only in pipe manufacturer's shop.
2. Field installed outlets may be installed with saddle approved by Engineer. Opening in pipe shall be machined cut and not with cutting torch.
3. Field welding of bars for restrained joint systems will not be allowed unless approved by Engineer. Welding shall be performed in pipe manufacturer's shop.

H. Line and Grade:

1. Minimum Pipe Cover: 3 feet, unless otherwise indicated.

2. No high points will be allowed between air valves.
3. Maintain pipe grade between invert elevations to provide minimum clearance at air valve locations of 4 feet from existing ground surface to top of pipe.
4. Install air valves as shown and field verify intervening low points. When field conditions warrant, exceptions may be made upon approval of Engineer.
5. Deviations exceeding 6 inches from specified line or 1 inch from specified grade will not be allowed without express approval of Engineer.
6. Pipeline sections that are not installed to elevations shown or installed as approved by Engineer shall be reinstalled to proper elevation.

I. Thrust Restraint:

1. Primary method of restraint shall be through use of restrained joint pipe. Thrust blocking shall be used where detailed on Drawings and as approved by Engineer.

3.4 HYDROSTATIC TESTING

A. Pipeline Hydrostatic Test:

1. General:
   a. Notify Engineer in writing 5 days in advance of testing. Perform testing in presence of Engineer.
   b. Test newly installed pipelines. Using water as test medium, pipes shall successfully pass a leakage test prior to acceptance.
   c. Furnish testing equipment and perform tests in manner satisfactory to Engineer. Testing equipment shall provide observable and accurate measurements of leakage under specified conditions.
   d. Isolate new pipelines that are connected to existing pipelines.
   e. Conduct tests on entire pipeline after trench has been backfilled. Testing may be done prior to placement of asphaltic concrete or roadway structural section.
   f. Contractor may, if field conditions permit and as determined by Engineer, partially backfill trench and leave joints open for inspection and conduct an initial service leak test. Hydrostatic test shall not, however, be conducted until backfilling has been completed.
   g. Dispose of water used in testing.
2. Procedure:
   a. Maximum filling velocity shall not exceed 0.25 foot per second calculated based on the full area of pipe.

b. Expel air from pipe system during filling. Expel air through air release valve or through corporation stop installed at high points and other strategic points.
c. Test pressure shall be 125 percent of system operating pressure based on pressure as measured at pipeline lowpoint.
d. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
e. Maintain hydrostatic test pressure continuously for 2 hours minimum, adding additional make-up water only as necessary to restore test pressure.
f. Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.
g. If measured leakage exceeds allowable leakage or if leaks are visible, repair defective pipe section and repeat hydrostatic test.

3. Allowable Leakage: Allowable leakage is zero.

END OF SECTION

SECTION 33 05 24
STEEL PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes materials and fabrication of welded steel pipe, with fittings and pipe specials, in accordance with AWWA C200, as modified herein.

B. Uncollapsed welded steel liners are considered to be welded steel pipe.

C. A special is defined as any piece of pipe other than a normal full length of straight section pipe. This includes elbows, manhole sections, short pieces, reducers, adapter sections with special ends, sections with outlets, etc.

D. Except where otherwise specified or shown, steel pipelines shall be cement mortar lined.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 09 97 52 Cold-Applied Wax Tape Coating

B. Section 26 42 00 Galvanic Anode Cathodic Protection System

1.3 WORK SHALL COMPLY WITH THE FOLLOWING SPECIFICATIONS, CODES, AND STANDARDS;

A. American National Standards Institute

B16.1 Cast Iron Pipe Flanges and Flanged Fittings.

B16.5 Pipe Flanges and Flanges Hinges.

B36.10 Welded and Seamless Wrought Steel Pipe.

B. American Society for Testing and Materials

A36 Specification for Structural Steel.

A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

A105 Specification for Forgings, Carbon Steel, for Piping Components.

A106 Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

A181 Specification for Forgings, Carbon Steel, for General-Purpose Piping.

A216 Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service.

A234 Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

A283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

A370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products.

A516 Specification for Pressure Vessel Plates, Heat-Treated Carbon-Manganese- Silicon Steel.

A572 Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

A1011 Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

A1018 Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

E165 Standard Practice for Liquid Penetrant Examination for General Industry.

E709 Standard Guide for Magnetic Particle Testing.

C. American Society of Mechanical Engineers

Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels.

B16.47 Large Diameter Steel Flanges.

D. American Water Works Association

C200 Steel Water Pipe Six Inch and Larger.

C207 Steel Pipe Flanges for Waterworks Service-Sizes Four Inch through 144 inches.

C208 Dimensions for Fabricated Steel Water Pipe Fittings.

M11 Steel Water Pipe: A Guide for Design and Installation.

E. American Welding Society

AWS D1.1 Structural Welding Code.

1.4 QUALIFICATIONS OF MANUFACTURERS

A. Qualification Requirements:

1. Continuous experience in the manufacture of completed lined and coated welded steel pipe, sized 48 inches in diameter or larger, for domestic water service.

2. Experience in design and fabrication of 48-inch diameter and larger welded steel pipe fittings and pipe specials, in accordance with the specification requirements.

3. Experience of the pipe manufacturer, or specialty lining subcontractor under the direct supervision of the same pipe manufacturer, in the application of cement mortar lining.

B. Experience information to be submitted shall be organized and labeled as attachments to the welded steel pipe manufacturer qualifications as specified below:

1. A list of steel liner or single plate circumference welded steel pipe projects completed or in current fabrication within the past six years, sized 30 inches or larger, minimum 0.375 inch plate thickness. Label this item as Attachment A. List shall include the following minimum information for each project:

    a. Project Name

    b. Project Owner

    c. Year completed

    d. Owner's current contact information: Include contact name, address, telephone number, fax number, and email address.

    e. Project Size: Include pipe diameter, plate thickness, pipe length or tons of steel

    f. Type of service

    g. Type of lining

    h. Lining manufacturer name and contact information if subcontracted

2. Copies of owner approved shop drawing submittals for each of the projects listed. Label this item as Attachment B. Shop drawing submittals shall include the following minimum information:

    a. Fabrication details for steel liner or one plate circumference welded steel pipe and steel pipe fittings and specials

    b. Pipe lining system application details

3. Written statement from the pipe manufacturer showing that the pipe manufacturer or proposed plant-applied specialty lining subcontractor under the direct supervision of the pipe manufacturer, has experience in the application of the specified lining system on steel pipes sized 30 inches in diameter or larger. Label this item as Attachment C.

4. For cement mortar lining, a list of projects completed or in fabrication within the past six years, sized 30 inches in diameter or larger with a cement mortar lining. Label this item as Attachment D. List shall include the following minimum information for each project:

    a. Project Name

    b. Project Owner

    c. Year completed

    d. Owner's current contact information: Include contact name, address, telephone number, fax number, and email address.

1.5 SUBMITTALS

A. Prepare Shop Drawings consistent with the pipeline alignment and grade shown on the Plans, and with the size, location, elevation and slope information of existing utilities, pipelines and encasements obtained by the Contractor. The pipeline Shop Drawings shall include:

1. The location, length, plate thickness, and designation by number of each steel pipe section and fabrication.

2. The invert station and elevation to which the spigot end of each pipe, within the limits of horizontal or vertical curve, will be laid.

3. The elements of curves and bends, both in horizontal and vertical alignment, including elements of the resultant true angular deflections in cases of combined curvature.

4. The limits of each reach of each type of field-welded joint and of concrete encasement.

5. Locations of longitudinal and circumferential joints in the pipe, fabricated fittings, and outlets.

6. Details, locations and calculations for bulkheads, pipe restraint and all methods required to prevent excessive pipe wall stresses for hydrostatic testing of pipeline.

7. Details and locations of closures for length adjustment and for construction convenience.

8. Details of specials and fittings.

9. Details of all valves, meters, pumps and other equipment determining pipe dimensions.

10. Details of butt straps which are to be shipped separately.

B. Certified copies of mill test reports on each heat from which steel is rolled. Tests shall include physical and chemical properties. Submit certified copies of mill test reports for flanges including details of stress relief used.

C. Weld procedure specifications, procedure qualification records including all destructive and non-destructive test results and welding bead profiles as required along with individual welder qualification certificates. The Engineer shall be present during qualification of weld procedure.

D. Certificates of welding rods used for shop and field welding. Submit welding procedure specifications including drawings of bevel surfaces to be automatically welded and procedure qualification records.

E. Test reports on physical properties of rubber used in the gaskets.

F. Points of access and schedule for placement of mortar lining and removal of test bulkheads.

G. Affidavits of compliance with referenced standards (for example AWWA C200, C207) with each required submittal.

H. Within 30 days following the Notice to Proceed and before submittal of any shop drawing for pipe, pipe coating or pipe lining, the pipe manufacturer shall submit a detailed Pipe Fabrication Plan and Quality Control Program Manual for each pipe fabrication plant, as described below. Failure to submit, implement, and adhere to the submitted Pipe Fabrication Plan and the Quality Control Program Manual will be reason to reject delivery of steel pipe. Do not manufacture any pipe until the Pipe Fabrication Plan and Quality Control Program Manual have been reviewed and accepted by the Engineer.

    1. Pipe Fabrication Plan providing a description of the actual steel pipe fabrication process covering all phases of fabrication to finish pipe. The Pipe Fabrication Plan shall include, as a minimum, the following:

        a. Qualifications of plant staff directly involved in this Contract, including qualifications of welders.

        b. Current and anticipated workload of the plant. State how other work will affect the fabrication schedule for this Contract.

c. Plant quality control recordkeeping and means for transmittal to the Engineer's in-plant inspectors.

d. Shop drawing submittal process.

e. Sources of materials, and plant quality control procedures regarding these materials.

f. Schedule of material delivery to the plant.

g. Fabrication schedule.

h. Material, pipe handling and storage at the plant.

i. Steel fabrication process.

j. Welding procedures.

k. Physical testing methods and procedures for the steel pipe and welds.

l. Coating and lining materials and procedures.

m. Curing methods.

n. Repair methods and limits of repairs.

o. Bracing Plan.

p. Shipping and transportation methods from the plant to the job site.

q. Storage and handling of pipe at the job site.

2. Quality Control Program Manual providing hold points, documentation, staffing, and appropriate sign-off regarding adherence to the Contract Documents. Include a system for documenting the pertinent information for each pipe section. Complete documentation as each pipe section is fabricated, and a copy shall accompany the pipe section to the job site. Include certification of Compliance with the Contract requirements as part of the Quality Control Program Manual.

I. Provide 30 day written notice to start of pipe fabrication.

J. Within 30 days following completion of pipe fabrication, submit mill test reports on each heat, dimensional check report, shop hydrostatic test report, and results of production weld test for each pipe section by mark number. Certify each report. Include a summary list cross referencing heat numbers and pipe shop numbers with pipe mark numbers.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. Obtain the following information from the Plans:

1. Elevation of the pipe invert and of the final ground surface.

2. Alignment of the pipeline.

3. Nominal internal diameter, after lining.

4. Pipe wall thickness and welded steel pipe cylinder internal diameter.

5. Locations of double-welded and butt-welded joints.

6. Design Hydraulic Grade Line.

B. The proportioning and detailing of fabricated fittings, manholes, outlets, and pass holes, and the fabrication thereof, shall be performed in accordance with the requirements of the latest edition of the ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels; provided, that if the details shown on the Plans are better suited for the work, in the opinion of the Engineer, such details shall be controlling. Where not detailed on the Plans, the design of wyes, tees and fitting reinforcement shall be in accordance with the applicable procedures of AWWA Manual M11.

2.2 SHEET STEEL OR PLATE AND MINIMUM YIELD POINT

A. Fabricate steel pipe, appurtenances and fittings from steel sheet, plate, or coil that conforms to ASTM A36, Grade 40. Steel plates or coils shall be fine grained, fully kilned, and manufactured using a continuous casting process. The maximum carbon content shall not exceed 0.25 percent. The maximum sulfur content shall not exceed 0.015 percent. The steel shall also meet a maximum carbon equivalent of 0.45, calculated as follows:

$$CE = C + \frac{(Mn + Si)}{6} + \frac{(Cr + Mo + V)}{5} + \frac{(Ni + Cu)}{15}$$

B. Arrange the fabricated pipe sections such that adjoining pipe sections have a yield strength variation of no greater than five ksi.

C. Order the steel plate and sheet by thickness such that the maximum allowable thickness variation for steel sheet, plate, or coil shall have a zero negative thickness tolerance from

nominal calculated, specified, or shown. Do not substitute thicker plate without the Engineer's approval. Tests performed on two-inch tension specimens shall show elongations not less than 22 percent.

D. Test steel 3/8 inch and greater in thickness for notch toughness using the Charpy V-Notch test. The steel shall withstand a minimum impact of 25 ft lb at a temperature of 30 degrees F. Test each heat of steel by taking one specimen from any two coils per heat number and test in accordance with ASTM A370.

E. The cold working of steel plate to obtain the specified tensile requirements will not be permitted. Any laminations or other defects will be cause for rejection.

2.3 STRUCTURAL STEEL FOR OUTLET REINFORCEMENT

A. Conform to the requirements of ASTM A36.

2.4 MILL-MANUFACTURED STEEL PIPE

A. Size range for mill manufactured pipe is two inch through 36 inch.

B. Fabrication of mill manufactured steel pipe shall conform to the requirements of AWWA C200. Pipe shall be fabricated from steel sheet, plate, or coil that conforms to ASTM A36 Grade 36 modified to have minimum yield strength of 40,000 psi, or equivalent.

C. Alternatively, pipe shall conform to the requirements of ASTM A53, Type E or S, Grade B, or ASTM A106, Grade B. Pipe shall be standard weight in accordance with ANSI B36.10, unless otherwise shown on the Plans, and shall meet dimensional requirements of ASTM A53 for diameters up to 26 inches and ANSI B36.10 for diameters larger than 26 inches.

2.5 FLANGES

A. For design pressures up to and including 275 psi, use AWWA Class E steel flanges, or use ANSI B16.5, Class 150 steel flanges.

B. For design pressures exceeding 275 psi, use ANSI B16.5, Class 300 steel flanges for pipe diameters up to and including 24 inches. Use ASME B16.47, Class 300 steel flanges for pipe diameters 26 through 36 inches.

C. Cast iron flanges shall conform to ANSI B16.1, Class 125 or Class 300.

D. Flanges fabricated from steel plate shall meet the requirements of ASTM A516, Grade 70. Forgings shall meet the requirements of ASTM A105. Castings shall meet the requirements of ASTM A216 WCB.

E. Flange bolts, nuts, gaskets, flange insulation kits and unions, shall be in accordance with standard provisions.

F. For flanges where an insulating kit will be installed, the pipe flange and valve flange bolt holes shall be oversized an additional 1/8 inch per AWWA C207, Section 4.2.3 to accommodate the insulating sleeves according to the following schedule:

1. Pipe diameters less than 36 inches: Oversized flange boltholes are not required. Holes shall be drilled the normal 1/8-inch larger than the nominal bolt diameters.
2. Pipe diameters between 36 inches and 84 inches: The flange boltholes diameters shall be 1/4 inch larger than the nominal bolt diameters.
3. Pipe diameters larger than 84 inches: The flange boltholes diameters shall be 5/16-inch larger than the nominal bolt diameters.

2.6 JOINTS

A. Provide bell and spigot pipe ends for field welded joints, except where butt-strap joints, butt-welded joints, or flanged joints are used.

B. Where piping connects to wall pipes, meters, valves, or other equipment, match the pipe ends to the ends of the wall pipes, meters, valves, or equipment.

C. Joints for buried blow-off outlet piping fabricated as epoxy lined and coated steel pipe shall be field welded, bell and spigot joint. Provide a threaded opening at each welded joint for repairing of the epoxy lining.

2.7 FITTINGS

A. Except where detailed on the Plans, fabricated steel fittings shall be in accordance with AWWA C208. Reinforcement of fittings shall be in accordance with AWWA M11.

2.8 WELDING FITTINGS

A. Provide butt-welded wrought carbon steel fittings conforming to ASTM A234, Grade WPB. Minimum thickness shall equal the thickest matching pipe.

2.9 PIPE JOINT COMPOUND

A. Use American National Taper pipe threads on all threaded joints. Apply joint compound to the male threads only. Pipe Joint compound shall be Teflon thread sealant Bakerseal by Radiator Specialty Company, La-Co SlicTite by Lake Chemical Company, or equal.

2.10 THREADED OPENINGS

A. Provide threaded openings not less than two inches, nor more than four inches in nominal size. Threaded openings shall be a standard weight, flat-bottom, threaded welding outlet. Where the mounting surface is curved to a diameter of 36 inches or less, the mounting diameter shall be the same as that of the surface upon which it is to be mounted.

B. Provide threaded outlet and its plug forged from steel conforming to ASTM A105 or ASTM A181, Class 70. Provide weldolet outlets.

2.11 WELDING OUTLETS

A. Provide welding-type outlets with a mounting diameter the same as that of the surface upon which they are to be mounted. Where the mounting surface is curved to a diameter of 36 inches or more, the outlet bottom may be flat. Provide welding-type outlets forged from steel conforming to the requirements specified for threaded outlets. Provide weldolet outlets.

2.12 STULLING (STRUTTING)

A. Materials:

1. Shop-Lined Pipe: Wood stulls and wedges.
2. Unlined Pipe: Steel or wood.

B. Install stulling for pipe and fittings in accordance with approved submittal and as soon as practical after pipe is fabricated or, for shop-lined pipe, after lining has been applied.

C. Install stulling in a manner that will not harm lining.

2.13 TAPECOAT ROCKSHEILD SYSTEM

A. General:

1. Provide 25 mil. polyethylene backing and 375 mil foam
2. Provide perforations 1 ¼" on center
3. Manufacturer: Chase Tapecoat or equal

2.14 CEMENT-MORTAR COATING

A. General:

1. Notify Engineer at least 10 days prior to application of coating products.
2. Holdback of and coating from field-welded joints shall be as follows:
   a. For lap welded joints and flex couplings, 8 inches.
   b. For butt weld and butt strap joints, 6 inches.

3. Unless otherwise indicated, coat exterior surfaces of pipe and fittings passing through structure walls from center of wall or from wall flange to end of underground portion.

B. Shop-Applied:

1. Cement-mortar coating shall conform to AWWA C205. Thickness shall conform to AWWA C205 and shall be 3/4 inch, minimum.
2. Steel wire or ribbon mesh reinforcement shall be in accordance with AWWA C205.
3. For cement-mortar coatings applied over dielectric coated pipe, ensure reinforcing metals in coating do not electrically contact pipe.
4. Coating system for field joints shall be cement mortar in accordance with AWWA C205. Mortar shall be retained with suitable water-impermeable bands or heavy-duty diapers of sufficient strength to hold fresh mortar and resist rodding.

2.15 CEMENT-MORTAR LINING

A. General:

1. Notify Engineer at least 10 days prior to application of lining products.
2. Holdback of lining from field-welded joints shall be as follows:
   a. For lap-welded joints and flex couplings, 8 inches
   b. For butt-weld and butt-strap joints, 6 inches.

B. Shop-Applied:

1. Applied centrifugally in conformance with AWWA C205. Thickness shall be in accordance with AWWA C205, unless otherwise noted on the drawings.
2. Lining machine type that has been used successfully for similar work and approved by Engineer.
3. Maintain pipe in round condition during lining operation and thereafter by suitable bracing or strutting.
4. Provide polyethylene or other suitable bulkhead on ends of pipe and on special openings to prevent drying out of lining. Bulkheads shall be substantial enough to remain intact during shipping and storage until pipe is installed.
5. Pipe shall be left bare where field joints occur.
6. Ends of lining shall be left square and uniform. Feathered or uneven edges will not be permitted.

C. Field-Applied:

1. Materials conforming to AWWA C602.

2. Do not use pozzolanic material in mortar mix.
3. Admixtures shall contain no calcium chloride.
4. Wire mesh conforming to AWWA C205.

PART 3 - EXECUTION

3.1 DIAMETER AND LENGTH OF PIPE SECTIONS

A. The nominal diameter or inside diameter of the pipe and other fabricated steel sections as shown on the Plans is the clear diameter of the lined pipe after the application of interior mortar lining. For epoxy lined pipe, the diameter shown on the Plans shall be considered the minimum inside diameter of the pipe.

B. The length of standard sections of pipe shall be from 30 to 40 feet, except within tunnels where standard sections may be up to 50 feet in length.

C. The minimum length of closure and correction pieces shall be four feet.

D. Do not locate closure lap joints, field joints, or field closure assemblies within four feet of the end of a concrete encased section of pipe. Do not locate closure lap joints or field closure assemblies within a concrete encased section of pipe. Concrete encased pipe sections are located around manholes, outlets, and at other locations as shown on the Plans.

3.2 PIPE CYLINDER FABRICATION

A. Longitudinal and Girth Seams: Fabricate the pipe cylinder by butt welding, spiral seam, or straight seam. When using straight seams, fabricate pipe with either a single longitudinal seam and multiple courses of, from seven feet six inches to ten feet, or else with a single course having not more than the number of longitudinal seams shown in the table listed below. Where more than one longitudinal seam is used, the plates shall be of equal widths. Equally stagger the longitudinal joints of adjacent courses. When using spiral seams, coil splices shall be a minimum of two feet away from the ends of the pipe cylinder.

Pipe Nominal Diameter (in.)	No. of Seams
36 to 60	2
61 to 90	3
91 to 120	4

B. Preparation of Edges

1. Machine or face the ends and edges of plates for butt welds. Inspect sheared edges of plates or sheets over 1/4 inch in thickness for cracks. Do not use plates or sheets with edges containing cracks. If the ends are faced with a cutting torch, remove irregularities and scale due to burning by grinding or chipping. The dimensions and shape of the edges of the plates to be joined by welding and the gap between the plates shall be such as to allow thorough fusion and complete penetration, and the edges of plates shall be properly formed to accommodate the various welding conditions. Limit the maximum gap between the edges of plates prior to welding to not more than 1/16 inch.

2. Remove projecting burrs. Do not use hammering to shape the edges preparatory to welding. Cut plates true to line so that the edges, when in position for welding, are straight, parallel, and in contact on longitudinal seams.

C. Forming Steel Plate or Sheet

1. Before rolling or forming longitudinal edges, lap break the plate edges by a continuous rolling operation or forming in a press having dies that are machined to the proper radius. Exert pressure during the lap breaking operation to obtain a true and uniform curve at the edges of the plate. Roll or press form plates to the specified diameter. Continually remove scale and other foreign matter accumulating on the plate during the rolling and forming operation by an air blast so that it will not be rolled or pressed into the surface of the plate.

2. Keep the surfaces of breaker dies and rolls clear of bits of metal or other accumulated materials during forming operations. Form each section of pipe to a true circle of the specified diameter throughout its entire length so as to produce a finished pipe truly round and free from dents, kinks, and abrupt changes in curvature.

3. The outside circumference of the finished pipe shall not be less than its design value and shall not exceed its design value by more than 0.4 percent. Complete rolling and forming prior to making butt welds. Do not heat or hammer for the necessary forming of angles.

4. Do not use any forming process in which the plates are bent or otherwise formed during any stage of the process to a curvature of appreciably smaller radius than the radius of curvature corresponding to the specified diameter of the pipe.

D. Forming Bells

1. Shape the bells to accommodate the spigot penetration shown on the Plans or specified herein. Form the bell on an expanding press or by being thrust axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to a round bell of required diameter and shape, avoiding injurious reduction in plate thickness at any point, and

avoiding impairment of the physical properties of any part of the plate. Do not use any process in which the bell is formed by rolling.

2. Bells for mitered pipe shall be normal to the axis of the adjacent course of the adjoining pipe, and the axis of any such bell shall be parallel to the axis of such adjacent course. The interior circumferential length of the bell shall be greater than the exterior circumferential length of the spigot, and the difference between circumferential lengths shall not exceed 1/4 inch.

E. Preparation for Welding

1. Take special care in the layout of joints in which fillet welds are to be used in order to ensure the fusion of the weld material at the bottom of the fillet. Prior to welding, fit the plates closely; and during welding, hold them firmly together. Tack weld or clamp in place the edges of butt joints in proper alignment and so hold throughout the welding process. Do not use dogs, clips, lugs, or equivalent devices welded to the steel plate for the purpose of forcing it into position.

2. Prior to welding, clean the surfaces of plates and members to be welded by an automatic process of all scale and rust for a distance of not less than one inch and of all oil or grease for a distance of not less than three inches from the welding edge and on both sides of the plates in the case of butt joints. Remove grease or oil with lye or other solvent. Do not use kerosene or any heavier petroleum solvent.

3. Blasting and other cleaning shall preferably be done prior to any tack welding of the plates. Should inspection indicate a greater amount of porosity at the tack welds than in the remainder of the welds, sandblast the tack welds prior to automatic welding.

4. When it is necessary to deposit metal over a previously welded surface, remove any scale, slag, or welding flux thereon by a roughing tool, chisel, air chipping hammer, or other means to prevent inclusion of impurities in the weld metal.

5. Where butt-welded joints are used, take particular care in aligning the edges to be joined so that complete penetration and fusion at the bottom of the joint is accomplished. The offset in abutting edges shall not exceed 1/16 inch at circumferential and spiral seams and shall not exceed 1/32 inch at longitudinal seams.

6. For plates over 1/2 inch thickness, if thickness of the two adjacent plates are different by more than 1/8 inch, the thicker plate shall be trimmed to a smooth taper extending for a distance of at least four times the offset between abutting surfaces so that the adjoining edges will be approximately the same thickness. The length of the required taper may include the width of the weld.

F. Welding

1. Perform all welding in accordance with AWS Standards, and as provided herein.

2. Perform welding by an unvarying arc-welding process, which excludes the atmosphere during the process of deposition and while the metal is in a molten state. The size and type of electrode used, the current and voltage required, and the type of wire and flux to be used for automatic processes shall be subject to review by the Engineer. Do not use rusted or damaged electrodes. Sift used flux from automatic welders free of fines and coarse pieces and remove mill scale before reusing.

3. Welds shall be of uniform composition, neat, smooth, full strength, and ductile. Make welds with a technique which will ensure uniform distribution of load throughout the welded section with a minimum tendency to produce eccentric stress or distortion in the weld or in the adjacent metal.

4. Make all welds in such manner and on such time schedule as to avoid residual internal stresses in the welded joints and stresses due to temperature changes in the completed pipelines. Weld longitudinal seams before girth seams.

G. Longitudinal Joints

1. Double butt weld by a fully automatic welding process longitudinal joints using welding heads which permit visual investigation of the deepest point of penetration of the first pass and which permit backfilling of extensive repair cuts by the automatic process. Use starter and runoff plates for longitudinal welds. The first pass on longitudinal welds shall be on the inside of the pipe and accomplish at least 75 percent of the land. Land is defined as the non-beveled portion of the pipe face along the edge of pipe. Do not use runoff plates for weld test coupons.

2. Joint welds shall be continuous for the full length of the seam, and shall be built up uniformly at the center of the weld to form reinforcement on both sides of the plate. The weld on the outside of the pipe shall have a reinforcement of a minimum of 1/16 inch and a maximum of 1/8 inch and a minimum width of at least the thickness of the plate; provided that in any case the weld and penetration shall be of width so that both edges to be joined shall be entirely consumed in the weld, regardless of a possible inaccuracy in the line of travel of the automatic electrode. Where the welding method permits a considerable deviation in the line of travel of the welding head, place a scribed line parallel to and at a fixed distance from the edges of the plates before welding so that the location of the welding bead with regard to the plate joints may be readily checked.

3. Where welding is done from one side only, remove the bead on the inside of the pipe by chipping so that the finished weld on the inside of the pipe will be practically flush with the plates. The inside bead will in no case be required to be larger than the outside bead but shall be of size so that upon its removal, the inside fusion lines and any defects near the under surface of the weld metal will be exposed.

4. If complete penetration and reinforcement on both sides of butt-welded joints are not satisfactorily accomplished, when the welding is done from one side, then chip out the reverse side to the extent necessary to secure a clean surface of the originally deposited weld metal and make an automatic welding pass on the reverse side. The bead on the inside of the pipe shall be not more than 3/32 inch in height and the width of the bead shall be not less than 3/8 inch with smoothly tapered edges. Before making the second weld, chip out the under-side of the first weld with a round-nosed tool until entirely solid and clean metal is reached.

5. Welding shall be subject to the requirement that there shall be no valley, groove, or undercut along the edge of or in the center of the weld, and that the deposited metal shall be fused smoothly and uniformly into the plate surface at the edges of the joint.

6. If the normal welding process is interrupted for any reason, take special care when welding is resumed, to get full penetration and thorough fusion between the weld metal and the plates and the weld metal previously deposited. Where welding is interrupted by faulty machine operation, chip back the weld to where the presence of solid, clean metal indicates correct machine operation before resuming welding operations.

H. Shop Circumferential Joints and Spiral Seam Joints

1. Double butt weld shop circumferential and spiral seam joints. The details of shop circumferential and spiral seam joints shall conform to the requirements for longitudinal joints as given above. Circumferential joints in bends and welded fabricated fittings need not be made by automatic welding methods.

I. Quality of Welds

1. There shall be no greater evidence of oxidation in the metal of the weld than in the metal of the unwelded plate. Welded joints shall be of a type that will produce complete fusion of the plates and shall be free from unsound metal, pinholes, and cracks.

2. The finish of welded joints shall be reasonably smooth and free from grooves, depressions, burrs, and other irregularities. There shall be no valley or undercut in the center or edges of any weld.

3. Any pipe section which shows irregularities in shape after welding may be rerolled to make it cylindrical, but in no case shall it be reformed by hammering, and in no event shall reforming be permitted of pipe sections which after welding are found to have abrupt changes in curvature at longitudinal seams, unless such welds are subsequently removed and rewelded following the reforming operation.

4. Back chipping on both automatic and hand welding, whether for repairs or preparation of the groove for the original weld, are subject to inspection by the Engineer before

being filled with weld metal. Do not make butt welds prior to the completion of the rolling and forming. Grind butt welds for both hand and automatic welding to sound metal before welding the reverse side.

J. Defects

1. Completely remove porosity and cracks, trapped welding flux, or other defects in the welds in a manner which shall permit proper and complete repair by welding. After removing the defect, the area shall be inspected by the Engineer using liquid penetrant or magnetic particle test method. Repair defective welds by hand welding. Where the defect is so extensive as to make a hand repair undesirable, use automatic welds. If the percent of the weld defect repair area exceeds 10 percent for longitudinal or circumferential seams in pipe and fittings or five percent of spiral seams the pipe section shall be rejected and removed from the job rather than repaired.

2. Map all weld defect locations and dimensions to verify acceptable weld defect repair percentages and record on as-built drawings. A weld defect is defined as any interruption in the weld continuity that exceeds the acceptable tolerances of the governing code or as stated in the Contract Documents.

3. Gouging or pits greater than 1/16 inch in depth that occur during fabrication shall be repaired by welding and ground flush. Inspect the repaired area using the liquid penetrant method in the presence of the Engineer.

4. Repair of off-sets exceeding specification tolerances shall be repaired as follows:

   a. Repair of out of tolerance pipe may be made on localized areas for a length of eight inches by adding weld metal to provide a 4:1 transition; and

   b. All other areas out of tolerance may be repaired by removing weld metal, realigning the material and rewelding in accordance with approved weld procedures. The manufacturer shall take all reasonable precautions to minimize reoccurring imperfections, damage and discontinuities.

K. Equipment

1. In welding by an automatic process, both the rate of deposition of weld metal and the rate of travel of the electrode shall be automatically controlled. Use the submerged melt process for automatic welding.

3.3 JOINTS

A. When plate flanges are made from butt-welded segments, do not place the joints between segments adjacent to longitudinal joints in adjoining steel plate sections. Stress-relieve flanges made from butt-welded segments.

B. Furnish forged steel slip-on flanges or welding neck flanges for companion flanges and connections. Blind flanges, reducing flanges, special flanges, and flanges which are greater in diameter than 24-inch nominal pipe size may be made of plate.

C. For drilling of bolt holes of insulating flanges not dimensioned on the Plans, prepare flange bolting as recommended by the insulating sleeve manufacturer.

3.4 SHOP TESTING

A. After completion of fabrication and welding in the shop, and before the application of any lining or coating, test each component according to the following requirements.

1. Test each section of steel pipe in the shop where it is manufactured by the hydrostatic test method. Additionally, perform partial testing of each pipe section in the shop where it is manufactured by the radiographic test method or radiation imagining system in accordance with AWS D1.1 Section 6.15.2 requirements. A minimum of three areas shall be selected by the Engineer and tested utilizing 4.5 inch x 17.5 inch film.

2. Except as otherwise shown or specified, test each completed section of fabricated bend or reducer using the hydrostatic test method. If the bend or reducer is fabricated from steel pipe previously tested, retest the completed bend or reducer by hydrostatic test method or use the radiographic or ultrasonic test methods on all non-hydrostatically tested welds. Sections requiring mitering on the ends may be tested by hydrostatic test method before mitering. Pipe special sections not subject to the above requirements shall be tested by non-destructive testing methods in accordance with the AWWA C200 Section 5.2.2.1. In the event the bell is formed subsequent to hydrostatic test, perform a magnetic particle examination two inches beyond either side of that portion of welded longitudinal joint which is within the longitudinal limits of the area of plate subjected to deformation in forming the bell; provided, that a minimum of 10 percent of the longitudinal welds described above shall be examined by the radiographic method.

3. After completion of the shop hydrostatic test, test each section of pipe with manholes and outlets attached as follows:

    a. Except as specifically shown on the plans, or except as specifically noted below, for d/D greater than 0.35, where d is the nominal diameter of the outlet and D is the nominal diameter of the main pipeline, test each section by the hydrostatic test method plus soap and compressed air method at the collar. Pipe special sections not subject to the above requirements shall be tested by non-destructive testing methods in accordance with AWWA C200 Section 5.2.2.1.

    b. For d/D less than 0.35, test the collar by the soap and compressed air method.

4. Perform tests of production welds in accordance with AWWA C200 for each heat of steel used. Guided-bend tests shall be performed utilizing 1-1/2 inch width specimens. Perform impact tests on weldments in accordance with AWS D1.1 on each heat of steel used. Do not use runoff plates for weld test coupons. A guided-bend test specimen shall be considered as having passed only if no crack or other open defect exceeding 1/8 inch measured in any direction is present in the weld metal or heat affected zone of the base material after the bending. A tension test specimen shall be considered as having passed only if failure occurs in the base metal at a stress in excess of the minimum specified tensile strength. Report both yield and ultimate strength of each test specimen. Impact test values shall equal those required for the base materials. There shall be at least one impact test and one set of welding tests as described in AWWA C200, for each 1,000 lineal feet of spiral seam weld in addition to tests specified in Section 3.3.6 of the same standard.

5. Test each slip-on type flange by the soap and compressed air method.

6. Test backgouge and completed weld of all manual process groove welds by the liquid penetrant method. Test completed fillet welds by the liquid penetrant method.

B. Test Methods

1. Shop Hydrostatic Test: Vent air from the pipe before the test pressure is applied. Hold the test pressure on each section for a length of time to permit inspection of all joints. Use the following hydrostatic test pressures for testing pipes without outlets:

$$P = \frac{1.6 \times f_y \times T}{D}$$

Where: P = test pressure in psi.
f_y = yield stress of the steel used, in psi.
T = minimum thickness of the steel pipe section tested in inches.
D = internal diameter of the steel pipe or cylinder, in inches.

2. The hydrostatic test pressure for fabricated bends and pipes with outlets shall be in accordance with AWWA M-11.

3. When subjected to the above hydrostatic test pressure, the pipe shall show no leaks, distortion, or other defects. Repair any leaks or other defects which develop during the hydrostatic test by chipping out and rewelding, after which the repaired section shall again be tested until it shows no leaks or other defects.

4. Test Bulkheads: Furnish and attach suitable dished heads and blind flanges for making the hydrostatic tests, and after completion of the tests, remove the heads and properly restore the ends of the sections.

5. Radiographic Test: Make the radiographs in accordance with the requirements of the AWS D1.1. Repair defects in the welds disclosed by the radiographs. Submit all radiographs and the notation of areas for repair to the Engineer for review. Welds in which indications are characterized as cracks, incomplete fusion, or incomplete penetration are unacceptable regardless of length.

6. Ultrasonic Test: Make the ultrasonic tests in accordance with the requirements of the AWS D1.1. Repair defects in the welds disclosed by ultrasonic testing. Prepare a report of the ultrasonic testing and submit to the Engineer for review. Welds in which indications are characterized as cracks, incomplete fusion, or incomplete penetration are unacceptable regardless of length.

7. Soap and Compressed Air Test: Use compressed air at maximum 40 psi pressure into the joint, and while the joint is under pressure, swab every portion of every welded seam forming a part of the joint with a heavy soap solution or a commercial bubble-producing leak test fluid. Examine for leakage. Repair any defects disclosed by the test by chipping out, rewelding the chipped section, and retesting. Drill and tap the necessary test holes, and plug weld the holes after testing.

8. Liquid Penetrant Test: Conform to the requirements in ASTM E165. Provide materials either water washable or nonflammable. Products: "Spotcheck" by the Magnaflux Corporation or "Met-L-Check Flaw-Findr" by the Met-L-Check Company. Chip out all defects, reweld, and retest the section affected until it shows no leaks or other defects.

9. Magnetic Particle Test: Conform to the requirements in ASTM E709, using the dry powder technique. Chip out defects, reweld, and retest the section affected until it shows no leaks or other defects.

3.5 CURVES, ANGLES, CLOSURES, AND SHORT SECTIONS

A. Furnish closing courses and short sections of pipe to ensure the correct location of outlets, angles, and other pipeline features and to accommodate the pipeline installation, lining, and field testing programs. Closing courses and short sections of steel pipe shall be not less than four feet in length. Accurately form the inside diameter of butt-straps to match the largest outside diameter of the adjacent steel cylinders to which they are to join.

B. The angular deflection at any field joint in square-ended pipe shall not exceed a pull of 3/4-inch, and the penetration of the spigot into the bell at all points of the circumference shall be at least equal to the required penetration shown on the Plans. Do not use angular deflections at butt-strap joints.

C. Use pipe sections having beveled bell ends for curves and angles in the alignment which cannot be accomplished using the maximum allowable deflection at square-ended pipe joints. Beveled pipe sections used in curved alignment shall be of standard length except when shorter sections are required to limit the radius of curvature in which case all sections

shall be of equal length. Do not bevel spigot ends. The beveled end of a pipe shall not have a deflection from a plane perpendicular to the pipe axis exceeding 3.0 degrees.

D. Fabricated Bends

1. Do not use fabricated bends to accomplish angles in the alignment unless shown on the Plans or permitted by the Engineer. Deflection between the centerline of adjacent courses shall not exceed 15 degrees. Double-butt weld girth seams in the shop.

2. The radius of curvature (R) for the axis of fabricated bends shall be 2.5 times the inside pipe diameter (D). The design shown on the Plans is based on such radius. However, a radius of curvature smaller than 2.5 times the inside pipe diameter can be used provided the following hoop stress intensification factor (SI) is used to determine wall thickness. Allowable hoop stress shall be 0.6 times the yield stress of the steel.

$$SI = \frac{R-0.167D}{R-0.5D}$$

3.6 MANHOLES, OUTLETS, AND PASS HOLES

A. Install manholes and outlets vertically unless otherwise shown on the Plans. Install at the stations shown for street-type installations and install closures where required to conform to the designated locations. The manhole stations for right of way installations may be shifted a maximum of six feet with written approval of the Engineer, provided that the outlet is no closer than eight feet to the end of the pipe section.

B. The Contractor may provide, at his own expense, additional flanged outlets in the steel pipe for use in passing hose, lead wires, equipment, or materials into the pipe.

C. The Contractor may also provide, at his own expense, forged steel threaded outlets for use in passing hose or lead wires into the pipe. Tap the outlets for standard pipe thread, weld to the pipe, and close after use with solid forged steel plugs. The plugs shall not project beyond the inner surface of the pipe shell. Retap the pipe thread in the outlet to correct any distortion caused by welding. Apply a seal weld made by at least two passes around the inside or outside of the plug after it has been inserted in final position in the field.

D. Coat outlets, plugs, and closures inside and outside to match the adjacent coated surfaces in the same manner as specified for outlets and as required at field joints in the pipe.

3.7 PIPELINE LININGS AND COATINGS

A. Apply cement mortar lining to welded steel pipe, pipe fittings and specials except where the limits of epoxy or polyurethane lined pipe is shown on the Plans. Apply pipeline coatings to welded steel pipe, pipe fittings and specials according to the limits for the type of coating system as shown on the Plans, or as specified herein. Apply pipeline

linings and coatings in accordance with the specifications for the type of lining and coating indicated.

B. Coat the interior metal surfaces of the blind and reducing flanges of manholes and outlets with System No. 7 per Section 09900, Painting and Coating.

C. Coat the exposed pipe ends at insulating joints and other couplings with solid epoxy. Do not coat over insulating gasket.

D. Coat exposed pipe in vaults and structures in accordance with Section 09900, Painting and Coating, System Nos. 4, 5, or 6 depending on the location of piping.

E. Apply external tape coatings for buried steel pipe and fittings per AWWA C-209 and AWWA C-214

3.8 BLIND FLANGES

A. At outlets not indicated to be connected to valves or to other pipes, provide blind flanges with bolts, nuts, and gaskets. Provide blind flange thickness at least equal to thickness of mating flange or in accordance with AWWA C207, whichever is greater.

3.9 PRODUCT MARKING

A. Prior to shipment, plainly and permanently mark the inside of each length of straight pipe at the bell end and each pipe special and fitting to identify the design pressure or head, the steel wall thickness, the date of manufacture, the mark number, the field top designating position of the pipe by reference to the layout schedule and the designation "Bell End". For beveled pipe, show the degree of bevel and field top. Show the mark number in four inch tall letters at springline ofpipe.

B. Mark on the inside of the pipe a continuous, circumferential line, 1/16 inch wide, and 12 inches from the end of each bell section. For plant cement mortar lined pipe, place the mark on the lining. The circumferential line will be used to evaluate fit up during installation.

C. Mark a continuous line, two inches wide, along the outside of each pipe section at the point on the circumference to laid uppermost (field top). Along this line, three feet from each end of the pipe section, permanently mark the pipe number in four-inch tall letters.

D. Punch mark the spigot end of pipe sections at the field top.

E. Mark the following chart on the inside of the liner, at the spring line of the spigot side. Chart size shall be 24 inches by 24 inches, and use 1/2 inch tall lettering.

	LONGIT	CIRC	GP
FIT UP OK			

WELDER			
VT			
PT			
UT			
QA			

3.10 PIPE BRACING

A. Adequate pipe bracing shall be provided on all specials, fittings, and straight pipe to avoid damage to the pipe and fittings during handling, storage, and hauling. Pipe cylinders shall not be stacked and shall be stored in a manner to prevent damage. The following requirements shall apply:

1. The pipe bracing shall be placed as soon as practical and shall remain in place while the pipe is loaded, transported, and unloaded at the jobsite. If shop application of the cement mortar lining is selected, bracing shall be installed as soon as practical after the application of the cement mortar lining.

2. Piping shall be transported with vertical and horizontal bracing per manufacturer's plan. Any pipe damaged during handling, hauling, or storage due to improper bracing shall be repaired or replaced.

3. Pipe bracing may be reused, provided all damaged ends are redressed to provide square and uniform bearing and all previously used fasteners are removed.

3.11 REPAIR OF TAPE COATING

A. For field repair of tape coating, power tool clean the bare pipe surface to be coated to a bright, shiny metal surface (to remove rust, mill scale, weld splatter or sharp edges). Cut and apply a patch with at least 2 inches of overlap over all adjacent unaffected tape coating. Cut a second piece of tape to cover the patch completely and wrap around the pipe at least 1.25 times the pipe circumference.

3.12 COATING AND LINING OF FIELD-WELDED JOINTS

A. Using Cement Mortar: Applied to joints in accordance with AWWA C205.

B. For Field-Applied Tape Coating: Prior to applying tape coating to field welded joints, power tool clean the bare surface pipe to remove rust, mill scale, weld splatter, and sharp edges. The wrapping process shall start at a minimum of 4 inches beyond the cutback edge of the existing coating and start on the downside of the pipe. A minimum of two (2) layers of joint wrap tape coating shall be applied over the field joint. The joint coating system shall be applied under taught hand or machine tension that will result in a smooth, wrinkle free coating. Apply joint coating system in a spiral configuration. Perform holiday testing of all field joints.

C. Cement-Mortar Lining at Joints: For pipe with shop-applied cement-mortar lining, place lining at joints in accordance with AWWA C205.

END OF SECTION

SECTION 33 05 81
WALL PIPES, FLOOR PIPES AND PIPE SLEEVES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, services and incidentals as shown, specified and required to furnish and install all wall and floor pipe fittings, pipe sleeves, other wall pieces, and escutcheons.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the Work that must be installed with or attached to the wall pipe, floor pipe and pipe sleeves Work.
2. Manufacturers and suppliers of the equipment and materials specified herein shall be required to review and satisfy all relevant requirements of other sections of the Contract Documents and the requirements of the Contract Drawings. The CONTRACTOR, manufacturer, supplier, fabricator and/or subcontractors furnishing and/or installing equipment, materials, services and specialties associated with this Section shall fully coordinate their efforts to avoid potential claims that are based on failure to review relevant Contract Documents, including the Contract Drawings.
3. The CONTRACTOR shall furnish and install all equipment, labor, materials, appurtenances, specialty items and services not provided by the CONTRACTOR'S manufacturers, suppliers, fabricators and/or subcontractors but required for complete and operable systems.

C. Related work specified elsewhere that shall apply to all equipment, materials, labor and services furnished under this Section shall include, but not be limited to, the following:

1. Division 1, General Requirements:
   a. Section 01 33 00, Submittal Procedures
2. Division 3, Concrete
3. Division 5, Metals - all anchoring hardware shall be Type 316 stainless steel
4. Division 33, Utilities
   a. Section 33 05 01, Conveyance Piping
   b. Section 33 05 19, Ductile-Iron Pipe

5. Division 40, Process Integration
    a. Section 40 27 00, Process Piping – General

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.

1. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings
2. ANSI B16.4, Cast-Iron Threaded Fittings
3. AWWA C205, Cement-Mortar Protective Lining and Coating for Steel Pipe – 4in. and Larger – Shop Applied
4. AWWA C110 (ANSI A21.10), Ductile-Iron and Gray-Iron Fittings, 3-in. Through 48-in., for Water and Other Liquids
5. AWWA C111 (ANSI A21.11), Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
6. AWWA C115 (ANSI A21.15), Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
7. AWWA C151 (ANSI A21.51), Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
8. AWWA C200, Steel Water Pipe 6 Inches and Larger

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Detailed drawings and data on all wall and floor pipes and pipe sleeves

PART 2 PRODUCTS

2.01 MATERIALS

A. Wall and Floor Pipe:

1. Material: Carbon Steel.
2. End Connections: As shown on Contract Drawings.
3. Pressure Ratings:
    a. Sizes 4 - 24 inches: 350 psi.
    b. Sizes 30 - 54 inches: 150 psi.
4. Fittings may be cast or fabricated.
5. Water Stop: Water Stops shall be provided on all wall and floor pipe.
6. Fittings ends shall be flush with wall face unless otherwise shown.
7. Flanges and mechanical joint bells shall be drilled and tapped for studs.
8. Coatings: Wall and floor pipe shall be exterior coated with epoxy coating.

9. Linings: Fittings shall be interior lined same as specified for the piping connected to the fitting. Refer to AWWA C205.
10. Manufacturer: Provide wall and floor pipe as manufactured by one of the following:
    a. Thompson Pipe Group.
    b. Northwest Pipe Company.
    c. Or equal.

B. Pipe Sleeves Through Walls or Floor Slabs (New Concrete Below Grade): Sleeves shall be cast into the wall as shown on the Contract Drawings.

1. Material: Steel with welded-on waterstop.
2. Dimensions: As recommended by manufacturer and link-seal manufacturer. Length as required.
3. Pipe Sizes: Greater than 22-inch diameters.
4. Product and Manufacturer: Provide one of the following:
    a. Steel Wall Sleeve, Model WS, Thunderline Corporation.
    b. Or equal.

C. Link Seals: Provide link type mechanical seals suitable for 20 psi working pressure, accessible from one side.

1. Sizes: As recommended by manufacturer and pipe sleeve manufacturer.
2. Seal Element: EPDM black.
3. Pressure Plates: Composites.
4. Bolts and Nuts:
    a. 316 stainless steel for all applications.
5. Product and Manufacturer: Provide one of the following:
    a. Link-Seal, Model C, Thunderline Corporation, for above grade applications.
    b. Link-Seal, Model S. Thunderline Corporation for below grade applications.
    c. Or equal.

D. Escutcheon Plates:

1. Bare pipes passing through walls and ceilings in finished rooms: Provide escutcheon plates of cast brass or cast iron nickel plated, clevis or split ring and hinged with set screws.
2. Insulated pipes passing through walls and ceilings in finished rooms: Provide plated escutcheon plates of 18 gage steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Wall and Floor Pipe: Install as shown and in accordance with approved shop drawings.

B. Pipe Sleeves: Install as shown and in accordance with approved shop drawings.

1. All sleeves through floor slabs shall extend a minimum of 2 inches above finished floor.
2. Sleeves through walls shall be flush with wall face.
3. All annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.
4. Size sleeves to provide annular space required to suit link type mechanical seals that are used.
5. Do not install sleeves and pipes through structural members unless specifically shown and approved by ENGINEER.

C. Install escutcheon plates in accordance with the manufacturer's recommendations and the approved shop drawings.

END OF SECTION

SECTION 33 12 16.29
AIR AND VACUUM RELEASE VALVE ASSEMBLIES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
   a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
   b. B36.10M, Welded and Seamless Wrought Steel Pipe.
   c. B36.19M, Stainless Steel Pipe.
   d. Boiler and Pressure Vessel Code.
2. American Water Works Association (AWWA):
   a. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   b. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
   c. C220, Stainless Steel Pipe, 4 In. (100 mm) and Larger.
   d. C500, Metal-Seated Gate Valves for Water Supply Service.
   e. C504, Rubber-Seated Butterfly Valves.
   f. C507, Ball Valves, 6 In. Through 48 In. (150 mm Through 1200 mm).
   g. C509, Resilient-Seated Gate Valves for Water Supply Service.
   h. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
   i. C550, Protective Interior Coatings for Valves and Hydrants.
   j. C800, Underground Service Line Valves and Fittings.
3. ASTM International (ASTM):
   a. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   b. B43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
   c. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
   d. D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
4. Environmental Protection Agency (EPA): Safe Drinking Water Act.
5. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.

b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.2 SUBMITTALS

A. Action Submittals:

1. Product data sheets for make and model.
2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
3. Maximum recommended test pressure; maximum and minimum recommended working pressures of air valves, isolation valves, flanges, connecting piping, and fittings.
4. Recommended seating materials for specified operating pressures.

B. Informational Submittals:

1. Manufacturers' Instructions:
   a. Installation and testing of products specified.
   b. Pipeline tapping and service saddle installation.
2. Operation and maintenance data.
3. Affidavit of Compliance in accordance with AWWA C512 stating valve and all materials used conform to applicable requirements of AWWA C512 and these Specifications, and tests specified have been performed and all requirements have been met.

PART 2 PRODUCTS

2.1 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.2 AIR VALVES

A. General:

1. Air release, air/vacuum, and combination air valves shall conform to AWWA C512.
2. Exterior of air valves shall be coated in accordance with Section 09 90 00, Painting and Coating.
3. Interior of air valves shall be coated in accordance with AWWA C550.
4. Air valves shall be factory tested in accordance with AWWA C512. Suitable for operating pressures between 300 and 350 psi.

B. Air and Vacuum Valve, Water Service, 1/2 Inch to 16 Inches:

1. Suitable for water service; automatically exhausts air during system filling and allows air to re-enter during draining or when vacuum occurs.
2. 1/2-inch through 3-inch NPT inlets and outlets, 4-inch and larger ASME B16.1 Class 125 flanged inlet with plain outlet and protective hood.
3. Rated 150 psi working pressure, cast-iron or ductile iron body and cover, stainless steel float and trim, built and tested to AWWA C512.
4. Equip 4 inch and larger with antislam device to throttle flow of water into air valve and prevent damage caused by rapid closure.
5. Manufacturers and Products:
   a. Val-Matic Valve; Series 100.

C. Air Release Valve, Water Service, 1/2 Inch to 6 Inches:

1. Suitable for water service, automatically exhaust small amounts of entrained air that accumulates in a system. In CLOSED position, seat against resilient seat to prevent water leakage.
2. Rated 150 psi working pressure, cast-iron or ductile iron body and cover, stainless steel float and trim, NPT threaded inlet and outlet, built and tested to AWWA C512.
3. Equip 4 inch and larger with antislam device to throttle flow of water into air valve and prevent damage caused by rapid closure.
4. Manufacturers and Products:
   a. Val-Matic Valve; Series 15A to 45.6.

D. Combination Air Valve, Water Service, 1 Inch to 16 Inches:

1. Suitable for water service, combines operating features of air and vacuum valve and air release valve. Air and vacuum portion to automatically exhaust air during filling of system and allow air to re-

enter during draining or when vacuum occurs. Air release portion to automatically exhaust entrained air that accumulates in system.

2. Valve single body or dual body, air release valve mounted on air and vacuum valve, isolation valve mounted between the dual valves. 1-inch through 3-inch valves with NPT threaded inlet and outlet, 4-inch and larger valves with ASME B16.1 Class 250 flanged inlet and cover outlet.
3. Rated 150 psi working pressure, cast-iron or ductile iron body and cover, stainless steel float and trim, built and tested to AWWA C512.
4. Equip 4 inch and larger with antislam device to throttle flow of water into air valve and prevent damage caused by rapid closure.
5. Manufacturers and Products:
    a. Val-Matic Valve; Series 201C to 203C or 104/22 to 116/38.

E. Sewage Air and Vacuum Valve 2 Inches to 14 Inches:

1. Suitable for sewage service; automatically exhausts air during system filling and allows air to re-enter during draining or when vacuum occurs.
2. Rated working pressure of 300 psi, 1-inch through 3-inch valves with NPT threaded inlet and outlet, 4-inch and larger valves with ASME B16.1 Class 125 flanged inlet and threaded cover outlet, built and tested to AWWA C512.
3. Materials: Cast-iron or ductile iron body and cover, concave or skirted stainless steel float and trim, Buna-N seat.
4. Sewage air and vacuum valve fitted with blowoff valve, flushing valve with quick disconnect couplings, and a minimum 5 feet of hose with quick disconnect couplings to permit backflushing after installation without dismantling valve.
5. Manufacturers and Products:
    a. Val-Matic Valve; Series 301 to 306.

F. Sewage Air Release Valve 2 Inches to 4 Inches:

1. Suitable for sewage service; automatically exhausts entrained air that accumulates in a system.
2. Rated working pressure of 300 psi, operating pressure, built and tested to AWWA C512.
3. Materials: Cast-iron or ductile iron body and cover with NPT threaded inlet and 1-inch NPT threaded outlet, concave or skirted stainless steel float and trim; Buna-N resilient seat.
4. Sewage air release valve fitted with blowoff valve, flushing valve with quick disconnect couplings, and a minimum 5 feet of hose with quick

disconnect couplings to permit backflushing after installation without dismantling valve.

5. Manufacturers and Products:
   a. APCO Valve and Primer Corp.; Series 400 SARV or 450 SARV.
   b. Val-Matic Valve; Series 48 or 49.

G. Sewage Combination Air Valve 2 Inches to 6 Inches:

1. Suitable for sewage service; combines operating functions of air and vacuum valve and an air release valve. Air and vacuum portion shall automatically exhaust air during filling of a system and allow air to re-enter during draining or when a vacuum occurs. Air release portion to automatically exhaust entrained air that accumulates in system. Single body unit with air and vacuum valve and an air release valve in a single housing.
2. Rated working pressure of 300 psi, built and tested to AWWA C512.
3. Materials: Cast-iron or ductile iron body and covers, NTP threaded inlet and outlet, with concave or skirted stainless steel float and trim.
4. Sewage air release valve fitted with blowoff valve, flushing valve with quick disconnect couplings, and a minimum 5 feet of hose with quick disconnect couplings to permit backflushing after installation without dismantling valve.
5. Provide air-vac orifice and auto orifice.
6. Twin-chamber unit with adjustable surge protection orifice.
7. Manufacturer and Product: Val-Matic Valve.

H. Sewage Combination Air Valve 6 Inches to 14 Inches:

1. Suitable for sewage service; combines operating functions of air and vacuum valve and an air release valve using separate valves connected together. Air and vacuum valve shall automatically exhaust large quantities of air during system filling and allow air to re-enter during draining or when a vacuum occurs. Air release valve to automatically exhaust small quantities of entrained air that accumulates in system.
2. Rated working pressure of 300 psi.
3. Materials: Cast-Iron or Ductile Iron Body:
   a. Air and Vacuum Valve:
      1) Upper and lower concave or skirted stainless steel float and trim.
      2) Inlet Flanges: ASME B16.1 Class 250 pound.
      3) Outlet**:** Flanged.
      4) Seat: Buna-N.
   b. Air Release Valve: 2-inch NPT threaded inlet and 1/2-inch NPT threaded outlet; Buna-N seat.

4. Provide with all-bronze blow-off and flushing gate valves for each valve, all-bronze isolation gate valve between air and vacuum valve and air release valve; 5-foot rubber hose with quick disconnect couplings.
5. Manufacturer and Product: Val-Matic Valve

2.3 CONNECTION TO MAINLINE

A. Flanged Outlet or Fitting: Flange shall be Class 300 to match drilling pattern of adjoining valve and suitable for test pressure and working pressure**.**

B. Service Saddle:

1. Stainless steel double straps.
2. Body: Ductile iron, nylon, or epoxy coated.
3. Bolts and Nuts: Type 304 stainless steel.
4. Comply with applicable portions of AWWA C800.
5. Manufacturers and Products:
   a. Mueller; Series DR2S.
   b. Romac; Style 202S or 202N.

C. For steel pipe, connection to mainline will be flanged.

2.4 ISOLATION VALVES

A. Gate Valve 3 Inches and Larger:

1. Iron body, flanged joint ends, nonrising stem, O-ring sealed stuffing box, rated for minimum pressure of 300 psi.
2. Provide handwheel operator**.**

B. Globe Valve 2 Inches and Smaller:

1. All-bronze, screwed ends, union bonnet, inside screw, rising stem.
2. Rated for minimum pressure of 300 psi.

C. Corporation Stop:

1. AWWA C800 type, with ends suitable for adjoining pipe.
2. Rated for minimum pressure of 300 psi.

D. Butterfly Valve for Water Only:

1. AWWA C504, flanged ends.
2. Rated for minimum pressure of 150 psi.
3. Provide handwheel operator**.**

E. Ball Valve for Water Only:

1. AWWA C507, flanged ends.
2. Rated for minimum pressure of 150 psi.
3. Provide handwheel operator**.**

F. Ball Valve:

1. Threaded ends.
2. Rated for minimum pressure of 150 psi.
3. Provide handwheel operator**.**

2.5 ACCESSORIES

A. Insulation:

1. Cellular polystyrene**,** 2 inch(es) thick.
2. Manufacturer and Product: Dow Chemical Co.; Styrofoam, or equal.

B. Carbon Filter:

1. Granulated activated impregnated carbon, PVC housing.
2. Manufacturer and Product: Orenco Systems Inc.; Model CF, or equal.

C. Abovegrade Enclosures**:** As shown on Drawings.

D. Inflow Prevention Device on Vent Pipe:

1. Used to provide backflow prevention and prevent nonpotable water from entering the air vent piping.
2. Inflow preventer shall be designed, manufactured and tested in accordance with ASSE 1063 and rated lead-free in accordance with NSF/ANSI 61, Annex G.
3. Shall be rated for submergence to 25 psi.
4. Float checks and trim shall be Type 316 stainless steel. Resilient seats shall be EPDM with fiberglass reinforcement. The upper and lower chambers shall be constructed of ASTM A536, Grade 65-45-12 ductile iron.
5. Provide Type 304 stainless steel basket screen on device to minimize entrance of debris.
6. Manufacturer and Product: Val-Matic; FloodSafe, or equal.
7. Provide field test kit to confirm drip-tight closure of backflow prevention device.
8. Provide all necessary brackets and mounting hardware required and recommended by the manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Valves:

1. In accordance with manufacturer's printed instructions.
2. Orient valve in vault with easy access to operator.
3. Replace valves that drip or do not function properly.

B. Service Saddle:

1. Tap and install in accordance with manufacturer's printed instructions.
2. Use adapters for size of line being tapped.

C. Insulation:

1. Install within vault, above and around designated valve assemblies as required to protect valve from freezing.
2. Provide space for air passage to allow proper functioning of air valves.
3. Support insulation with clips anchored to manhole or vault wall.

D. Carbon Filter: Install in accordance with manufacturer's recommendations.

E. Pipe Support: Install in accordance with Section 40 05 15, Piping Support Systems**.**

3.2 TESTING AND INSPECTION

A. Air Valve:

1. Shall be tested with pipeline.
2. Isolation valves shall be in open position during pipeline test.

B. Isolation Valves: Test that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other.

C. Air and Vacuum Valves: Inspect valves as pipe is being filled to verify venting and seating is fully functional.

D. Verify leak-free performance during testing.

E. Using the test kit provided by the manufacturer of the inflow prevention device, perform inflow prevention test as recommended by the manufacturer.

END OF SECTION

SECTION 33 13 00
DISINFECTION OF WATER UTILITY DISTRIBUTION FACILITIES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   a. B300, Hypochlorites.
   b. B301, Liquid Chlorine.
   c. B302, Ammonium Sulfate.
   d. B303, Sodium Chlorite.
   e. C651, Disinfecting Water Mains.
   f. C652, Disinfection of Water Storage Facilities.
   g. C653, Disinfection of Water Treatment Plants.
2. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
3. Standard Methods for the Examination of Water and Wastewater, as published by American Public Health Association, American Water Works Association, and the Water Environment Federation.

1.2 SUBMITTALS

A. Informational Submittals:

1. Plan describing and illustrating conformance to appropriate AWWA standards and this Specification.
2. Procedure and plan for cleaning system.
3. Procedures and plans for disinfection and testing.
4. Proposed locations within system where Samples will be taken.
5. Type of disinfecting solution and method of preparation.
6. Certification that employees working with concentrated chlorine solutions or gas have received appropriate safety training.
7. Method of disposal for highly chlorinated disinfecting water.
8. Independent Testing Agency: Certification that testing agency is qualified to perform bacteriological testing in accordance with AWWA standards, agency requirements, and this Specification.
9. Certified Bacteriological Test Results:
   a. Facility tested is free from coliform bacteria contamination.

b. Forward results directly to the Owner's representative

1.3 QUALITY ASSURANCE

A. Independent Testing Agency Certified in the State of California with experience in field of water sampling and testing. Agency shall use calibrated testing instruments and equipment, and documented standard procedures for performing specified testing.

1.4 SEQUENCING

A. Commence initial disinfection after completion of following:

1. Completion and acceptance of internal painting of system(s).
2. Hydrostatic and pneumatic testing, pressure testing, functional and performance testing and acceptance of pipelines, pumping systems, structures, and equipment.
3. Disinfection of:
   a. Pumps and associated system piping.
   b. Treatment plant basins and processes used to supply water to system.

PART 2 PRODUCTS

2.1 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.2 WATER FOR DISINFECTION AND TESTING

A. Clean, uncontaminated, and potable.

B. Make arrangements for water supply and convey water in disinfected pipelines or containers.

PART 3 EXECUTION

3.1 GENERAL

A. Conform to AWWA C651 for pipes and pipelines**,** except as modified in these Specifications.

B. Contractor's Equipment:

1. Furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.
2. Water used to fill pipeline may be supplied using a temporary connection to existing distribution system. Provide protection against cross-connections as required by AWWA C651.

C. Disinfect the following items installed or modified under this Project, intended to hold, transport, or otherwise contact potable water:

1. Pipelines: Disinfect new pipelines that connect to existing pipelines up to point of connection.
2. Disinfect surfaces of materials that will contact finished water, both during and following construction, using one of the methods described in AWWA C652 and AWWA C653. Disinfect prior to contact with finished water. Take care to avoid recontamination following disinfection.

D. Prior to application of disinfectants, clean pipelines of loose and suspended material.

E. Allow freshwater and disinfectant solution to flow into pipe or vessel at a measured rate so chlorine-water solution is at specified strength. Do not place concentrated liquid commercial disinfectant in pipeline or other facilities to be disinfected before it is filled with water.

3.2 TURBIDITY

A. Cleaning of equipment and facilities shall include removal of materials that result in a turbidity exceeding limits stated in Article Testing.

3.3 PIPING AND PIPELINES

A. Cleaning:

1. Before disinfecting, clean foreign matter from pipe in accordance with AWWA C651.

2. If continuous feed method or slug method of disinfection, as described in AWWA C651, are used flush pipelines with potable water until clear of suspended solids and color. Provide hoses, temporary pipes, ditches, and other conduits as needed to dispose of flushing water without damage to adjacent properties.

B. Disinfecting Procedure: In accordance with AWWA C651, unless herein modified.

3.4 DISPOSAL OF CHLORINATED WATER

A. Do not allow flow into a waterway without neutralizing disinfectant residual.

B. See appendix of AWWA C651 for acceptable neutralization methods.

3.5 TESTING

A. Collection of Samples:

1. Coordinate activities to allow Samples to be taken in accordance with this Specification.
2. Provide valves at sampling points.
3. Provide access to sampling points.

B. Test Equipment:

1. Clean containers and equipment used in sampling and make sure they are free of contamination.
2. Obtain sampling bottles with instructions for handling from [Owner's] [an independent testing] laboratory.

C. Chlorine Concentration Sampling and Analysis:

1. Analysis to be performed by an independent test laboratory. Samples will be analyzed using amperometric titration method for free chlorine as described in latest edition of Standard Methods for Examination of Water and Wastewater.

D. After pipelines have been cleaned, disinfected, and refilled with potable water, an independent laboratory will take water Samples and have them analyzed for conformance to bacterial limitations for public drinking water supplies.

1. Collect Samples in accordance with applicable AWWA Standard.

2. Analyze Samples for coliform concentrations in accordance with latest edition of Standard Methods for the Examination of Water and Wastewater.
3. Obtain and analyze a minimum of two Samples on each of 2 consecutive days from each separable structure every 1,000 feet of pipeline by standard procedures outlined by state and local regulatory agencies.
4. Sampling points shall be representative and accepted by Engineer.

E. Turbidity Sampling and Analysis:

1. After pipeline**s** have been cleaned, disinfected, and refilled with potable water, an independent laboratory will take water Samples and have them analyzed for conformance to turbidity limitations for public drinking water supplies. Turbidity shall not exceed 0.3 NTU.
2. If turbidity is in excess of the limit, dispose of the water in accordance with this Specification and applicable regulations, take action to remove source of turbidity, refill system, and retest.

F. If minimum Samples required above are bacterially positive, disinfecting procedures and bacteriological testing shall be repeated until bacterial limits are met.

END OF SECTION

SECTION 33 44 13.13
CATCH BASINS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Welding Society (AWS): Code for Welding in Building Construction.
2. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48, Standard Specification for Gray Iron Castings.
   c. A615/A615M, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   e. C387, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
   f. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.

PART 2 PRODUCTS

2.1 CONCRETE

A. Concrete shall be ready-mixed, conforming to ASTM C94/C94M, Alternate 2. Compressive field strength shall be not less than 2,500 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inch. Slump shall be between 2 and 4 inches. Field strength shall be assumed as equal to 85 percent of strength of laboratory-cured cylinders.

2.2 FORMS

A. Exposed surfaces shall be plywood. Others shall be steel, matched boards, plywood, or other acceptable material. Form vertical surfaces. Provide fillets on re-entrant angles. Trench walls, large rock, or earth will not be acceptable form material.

2.3 REINFORCING STEEL

A. Reinforcing steel shall conform to ASTM A615/A615M, Grade 60, deformed bars.

2.4 PRECAST UNITS

A. Use precast units where indicated on the Drawings. Precast units shall conform to ASTM C478 except dimensions shall be as shown and specified. Submit details of proposed units to Engineer for review. Concrete risers for extensions shall be a maximum of 6 inches high and of same quality as sections. Risers shall be reviewed by Engineer before installation.

2.5 MORTAR

A. Standard premixed mortar conforming to ASTM C387, Type S, or proportion 1 part portland cement to 2 parts clean, well-graded sand which will pass a 1/8-inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: Hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to concrete.

2.6 FRAMES AND GRATES

A. Frames and grates for catch basins and storm drain inlets shall be fabricated of steel conforming to ASTM A36/A36M in accordance with details shown. Connections shall be welded. Welding shall conform to requirements of current Code for Welding in Building Construction of the American Welding Society. Frames and grates shall be properly cleaned and hot-dip galvanized after fabrication.

2.7 FRAMES AND GRATINGS

A. Cast iron frames and gratings for catch basins and storm drain inlets shall be as indicated. Bearing surfaces shall be clean and shall provide uniform contact. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects, and shall conform to ASTM A48, Class 30.

2.8 CONFORMANCE TO CODES AND STANDARDS

A. Conform to all applicable requirements of the San Diego Regional Standard Drawings, where those standards are referenced on the Drawings.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

A. Excavate as required to accomplish construction. Backfill shall be as specified for adjoining pipe trench.

3.2 CONSTRUCTION OF CATCH BASINS AND INLETS

A. Construct inlets and catch basins at locations shown and in accordance with Drawings. Construct forms to dimensions and elevations required. Forms shall be tight and well braced. Chamfer corners of forms.

B. Prior to placing concrete, remove water and debris from forms. Moisten forms just prior to placing concrete. Handle concrete from transporting vehicle to forms in a continuous manner as rapidly as practical without segregation or loss of ingredients. Immediately after placing, compact concrete with mechanical vibrator. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

C. Screed top surface of exposed slabs and walls. When initial water has been absorbed, float surfaces with wood float and lightly trowel with steel trowel to smooth finish free from marks or irregularities. Finish exposed edges with steel edging tool. Remove forms and patch defects in concrete with mortar mixed in same proportions as original concrete mix.

D. Cure concrete by preventing loss of moisture for a period of 7 days. Accomplish with a membrane-forming curing compound. Apply curing compound immediately after removal of forms or finishing of slabs. Protect concrete from damage during 7-day curing period.

3.3 PLACING PRECAST UNITS

A. If material in bottom of trench is unsuitable for supporting unit, excavate and backfill to required grade with 3-inch minus, clean, pit-run material. Set units to grade at locations shown.

3.4 EXTENSIONS

A. Install extensions as shown and specified, or if not shown and specified, to a height determined by Engineer. Lay risers in mortar with sides plumb and tops to grade. Joints shall be sealed with mortar, with interior and exterior troweled smooth. Prevent mortar from drying out and cure by applying a curing compound. Extensions shall be watertight.

3.5 INSTALLATION OF FRAMES AND GRATES

A. Set frames and grates at elevations indicated or as determined in field and in conformance with Drawings.

B. Frames may be cast in, or shall be set in mortar.

3.6 CLEANING

A. Upon completion, clean each structure of all silt, debris, and foreign matter.

END OF SECTION

SECTION 35 20 16.25
FABRICATED SLIDE AND CONTROL GATES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA): C513, Open-Channel, Fabricated-Metal Slide Gates.
2. ASTM International (ASTM):
   a. A193/A193M, Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
   b. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications.
   c. A276, Standard Specification for Stainless Steel Bars and Shapes.
   d. B209, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
   e. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
3. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
4. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.2 DEFINITIONS

A. Submersible: The ability to exclude water when submerged under a 20-foot head of fresh water for 24 hours and still maintain electrical integrity.

B. Slenderness Ratio: The ratio of the maximum unsupported stem and cylinder rod length to the stem cross-section radius of gyration.

C. Self-Contained: The arrangement of gate operator, supported by gate frame, such that operating thrust loads are not applied external to the assembly.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Make, model, weight, and horsepower of each equipment assembly.
   b. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.

c. Detailed structural, mechanical, and electrical drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment associated therewith.
d. Gate operator and stem calculations for each gate and service condition.
e. Gate opening and closing thrust forces that will be transmitted to the support structure with operator at extreme positions and load.
f. External utility requirements such as air, water, power, drain, etc., for each component.
g. Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.
h. Power and control wiring diagrams, including terminals and numbers.
i. Performance Test Procedures.
j. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's Certificate of Compliance.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's written/printed installation instructions.
5. Routine maintenance requirements prior to plant startup.
6. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
7. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.4 SYSTEM DESCRIPTION

A. Coordinate such that electric motor operators are fully assembled and tested, including motor, at the factory.

1.5 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Stem collars for all gate stems	One of each different size
lift nuts	One of each different size
Indicator lights	One dozen
Special tools required to maintain or dismantle	One complete set

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.2 SUPPLEMENTS

A. See supplements to this section for additional product information.

2.3 MATERIALS

A. Stainless Steel:

1. Plate, Sheet, and Strip: ASTM A240/A240M, Type 316L.
2. Bars and Shapes: ASTM A276, Type 316L.

2.4 PERFORMANCE REQUIREMENTS

A. Leakage shall not exceed 0.1 gallon per minute per foot of gate periphery under either seating or unseating head conditions.

2.5 SLIDE GATES

A. Rising or non-rising stem type as indicated on Gate Schedule, with assembly styles designated as follows:

1. Style A: Upward acting type for wall surface mounting on the concrete structures.
2. Style B: Upward acting type for mounting in channels with concrete embedded frame and invert.
3. Style C: Downward acting weir gate type with P-type invert seal for wall surface mounting on the concrete structures.
4. Style D: Downward acting weir gate type with invert “P” seal for embedded side frame mounting in concrete structures.

Gate Schedule

Description	Location	Qty.	Nom Pipe Dia.	Width	Height	Material	Max Seating Head Above Invert	Max Unseating Head Above Invert	Notes
Slide Gate – Rising Stem	Diversion Structures 1, 2, 3	3	48”	4 ft	4 ft	316 Stainless Steel	10’	20’	Modulating electric actuator (Type 4)
Slide Gate – Rising Stem	60-inch Influent Pipe to Screening Facility	1	60”	5’	5’	316 Stainless Steel	10’	20’	Electric actuator Type 4 open-close)
Stop Plates	Screening Facility Screens Channels	4	-	8 ft	10 ft	Fiberglass Reinforced Plastic	10’	10’	Manual/ Slotted fir Removal
Stop Plates	Screening Facility Bypass Channel	2	-	3.5 ft	10 ft	Fiberglass Reinforced Plastic	10’	10’	Manual / Slotted for Removal
Slide Gate – Rising Stem	Screening Facility Screens Channels	4	-	8 ft	6 ft	316 Stainless Steel	10’	10’	Electric actuator (Type 4 open-close)
Slide Gate – Rising Stem	Screening Facility Bypass Channel	2	-	3.5 ft	6 ft	316 Stainless Steel	10’	10’	Electric actuator (Type 4open-close)
Weir Gate – Non-Rising Stem	Diversion Structure 3	1	78”	6.5 ft	Solid Slide height 54 in; total slide height 91 in	316 Stainless Steel	15’	25’	Modulating electric actuator – cut out 72 in width x 24 in height
Weir Gate – Non-Rising Stem	Diversion Structure 2	1	72”	6 ft	Solid Slide height 36 in; total slide height 81 in	316 Stainless steel	15’	25’	Modulating electric actuator – cut out 66 in width x 36 in height
Weir Gate – Non-rising Stem	Diversion Structure 1	1	60”	5 ft	Solid Slide height 30 in; total slide height 72 in	316 stainless steel	15’	25’	Modulating electric actuator – cut out 54 in width x 30 in height

B. Guide Frames:

1. Stainless steel.
2. Vertical Guides: Design for maximum rigidity, and extend in one continuous piece from the gate invert to form posts for support of gate operators of self-contained gates. When guides extended above the operating floor, they shall be sufficiently strong so that no further reinforcements are required.
    a. Weight: Not less than 9 pounds per linear foot for stainless steel.
    b. Incorporate a replaceable UHMW polyethylene bearing strip in a retainer slot on the downstream side (unseating head side) of the gate.
3. Frame Invert: For flush bottom gate, furnish a neoprene insert to function as a seating surface for the gate disc.
    a. Weight: Not less than 9 pounds per linear foot for stainless steel.
4. Join vertical guide frames and invert with factory welded corners.
5. Size guided slot to provide a minimum disc engagement of 1 inch on each side.
6. Provide face-mounted or channel-mounted frames as shown on the Drawings.

C. Disc:

1. Disc Plate (Sliding Member): One-piece stainless steel plate. Reinforce as required so that the disc will not deflect more than 1/360 of the gate span, when the upstream liquid depth (seating head side) is as shown on the schedule and the downstream liquid depth is less than 1/2 inch.
2. Reinforce gate disc with one-piece stainless steel angles or channels welded to the disc plate. Bolted reinforcements will not be permitted.
3. For downward-opening weir gates, provide cut-out and slide height dimensions shown on Gate Schedule.

D. Operator Support Yoke:

1. For self-contained gate operators, attached to the vertical extensions of the guide frames.
2. Constructed from at least two stainless steel angles, or two other suitable shapes, and bolt in place to provide a rigid assembly.
3. Maximum Deflection: Not to exceed 1/4 inch under full operator applied loading.

E. Stems:

1. 1-1/2-inch minimum diameter, ASTM A276, Type 316 stainless steel.
2. Threads: Acme type with RMS surface roughness of 63 microinches or less on the flanks for manually operated gates and 32 microinches or less on the flanks for electrically operated gates. Extend threaded portion of stem 2 inches above operator when gate is in CLOSED position. Provide 4 threads per inch.
3. Ratio of the unsupported stem length to the radius of gyration, both in inches, shall not exceed 200.
4. Stems to withstand in compression, without damage, the thrust equal to at least 2-1/2 times the rated output of the hoisting mechanism, with a 40-pound effort applied to the handwheel or crank.
5. Design electric motor-driven floor stands to withstand at least 1.25 times the output thrust of the motor in the stalled condition.
6. Equip operating stems with cast iron, bushed stem guides, mounted on cast iron brackets; adjustable in two directions and spaced so that the L/r ratio does not exceed 200.
7. Adjustable stop collar for the CLOSED position.
8. Connect the stems to the disc plate with a yoke, bolted to the stem and welded to the disc.
9. Slide gates having a width greater than twice the height or width greater than 84 inches shall have dual stems. For downward opening weir type gates, locate stems near outside edges of gate.

F. Stem Covers:

1. Transparent plastic, vented pipe stem cover and cap.
2. Provide with OPEN/CLOSED designators with 1-inch graduations on clear mylar pressure sensitive, adhesive tape, suitable for outdoor application.

G. Manufacturers:

1. Stainless Steel:
   a. Whipps, Inc.
   b. Hydro Gate Corp.
   c. Rodney Hunt Co.
   d. H. Fontaine, Ltd.
   e. Waterman
   f. Or equal

2.6 GATE OPERATORS

A. General:

1. Components: Withstand a minimum of 250 percent of design torque or thrust at extreme operator positions without damage.
2. Mount at walkway level, 36 inches above floor, unless otherwise indicated. Electric motor actuators for diversion structures shall be mounted below grating as shown on the Drawings.

3. Gear train and gate stem sections shall produce a self-locking drive train.
4. Lift Nuts: Internally threaded with cut or cold-rolled Acme threads corresponding to stem threading.
5. Roller Bearings: Ball-thrust or tapered above and below lift nut to support both opening and closing thrusts.
    a. Grease lubrication fittings for bearings.
    b. Input pinions with needle or ball bearings.
6. Lubrication: Furnish rising stem gates with an insert lubricator flange in lift, with grease fitting for greasing stem threads below stem nut.
7. Manual Operator Limit Switches:
    a. Mounted on an angle adjacent to stem and actuated through limit switch wands by stop collar.
    b. Single-pole, double-throw type, with contacts rated 5 amps at 120V ac.
    c. Provide two switches, one for gate full OPEN, and one for gate full CLOSED, where indicated.

B. Dual-Stem Gate Operators:

1. Enclosed, geared floor stands.
2. Interconnect so operators will work as a unit from single point with interconnecting electric operator.
3. Interconnecting Shafts:
    a. Stainless steel with flexible couplings at ends.
    b. Diameter sufficient to prevent sagging.
    c. Include flanged coupling to allow precision weir leveling.

C. Type 1, Handwheel-Operated Bench Stands:

1. Direct drive.
2. Sealed, ball thrust, roller or needle bearing type and equipped with bronze lift nut, internally threaded with Acme threads.
3. Furnish mechanical seals at housing penetrations.
4. Handwheel and Baseplate: Cast Aluminum.
5. Manual Effort: Not to exceed 40 pounds.

D. Type 2, Crank-Operated Bench Stands:

1. Weatherproof housings, mounted on cast aluminum to the top horizontal member of the slide gate frame as described under paragraph Operator Support Yoke.
2. Solid Bronze Lift Nut: Integrally threaded with Acme threads.
3. Ball Thrust or Tapered Roller Bearings:
    a. Locate above and below operating nut flange to support opening and closing thrusts.
    b. Include grease lubrication fittings and input pinions.
4. Manual Crank Effort: Not to exceed 40 pounds.
5. Suitable for portable electric drill operation after removal of handcrank.

E. Type 3, Geared Floor Stands:

1. Crank-operated, with weatherproof housings with solid bronze lift nut.
2. Mount on high-strength cast-iron pedestal or base.
3. Maximum manual crank effort to operate gate shall not exceed 40 pounds.
4. Lift Nut: Internally threaded with Acme threads.
5. Furnish ball thrust or tapered roller bearings above and below the lift nut to support both opening and closing thrusts.
    a. Grease lubrication fittings for bearings.
    b. Input pinions with needle or ball bearings.
    c. Mechanical seals at housing penetrations.

F. Type 4, Electric Motor Operators:

1. 28-inch-high steel pedestal or direct yoke-mounted, totally enclosed weatherproof electric drive unit, and a totally enclosed gear box that operates a two-piece, bronze stem nut, which lifts the gate stem.
2. Gears: Heat treated alloy steel, supported throughout by antifriction ball or roller bearings and grease lubricated.
3. Automatic double-acting geared limit switches and double-acting torque switches.
    a. Gear directly to the operating gear train and shall be “in step” at all times, whether in motor or manual operation.
    b. Wire geared limit switches internally to stop the motor at the fully OPEN and fully CLOSED positions.
    c. Wire torque switches internally so that, in the event of a mechanical overload in either direction, the motor will be stopped.
4. Equip with side mounted handwheel for manual operation.
    a. Include an automatic clutch to positively disengage the handwheel at any time the drive motor control is energized.
    b. Design handwheel operator so that failure of the motorized gearing will not prevent hand operation of the gate.
5. Drive Unit:
    a. TENV, 480-volt, three-phase electric motor as specified in Section 26 20 00, Low-Voltage AC Induction Motors, with integral OPEN/STOP/CLOSE weatherproof pushbuttons, reversing controller, 480/120 volt control power transformer, space heaters in the limit switches and in the control compartments, mechanical dial type position indicator, and transparent plastic pipe stem cover and cap unless otherwise specifically noted on the Drawings.
    b. Furnish motor enclosure with drainage and breathing holes.
    c. Self-locking, with approximately 12 inches per minute gate travel speed, and a rated running torque equal to 20 percent of the motor starting torque at a rated running time of 5 minutes, without exceeding the allowable NEMA temperature rise for the insulation class used.
6. Operation: Drive the gate to its fully OPEN or CLOSED position when the OPEN or CLOSED pushbutton is depressed momentarily. Motor shall stop in mid-travel when the STOP button is depressed.

7. Controls: Furnish the following in accordance with operator control styles listed below and specified in Slide Gate Schedule:

2.7 GATE CONTROLS

A. Control Features

Feature	Description
A	Local OPEN/STOP/CLOSE pushbutton station
B	End position limit switches; OPEN and CLOSED position switches shall be normally open contacts that close at the end position; contacts shall be dry and rated for 5 amps, 120V ac
C	Continuous position output; provide transmitter to generate a 4 to 20 mA dc signal to an external loop in direct proportion to gate position; the transmitter shall be factory mounted in a NEMA 250, Type 4 enclosure. Transmitter shall be capable of driving an external load impedance of 350 ohms minimum.
D	LOCAL/REMOTE weatherproof selector switch and provisions for remote OPEN/STOP/CLOSE operation; remote commands will be by way of a four-wire circuit, as shown; motor operator shall impress the voltage required to read these contacts and shall go to the commanded position or stop when in the REMOTE mode. Provide auxiliary contact which closes when LOCAL/REMOTE switch is in REMOTE position.

a. Operator Control Styles:
   1) Provide Control Features A, B, C, and D for modulating gates and Control Features A, B, and D for all other electrically actuated gates.

2. Provide remote-mounted control units for all electric actuators shown on the Drawings installed below top grating of diversion structures.
3. All electric actuators and connecting electrical/control devices shall be rated for the NFPA hazard classifications shown on the Electrical Drawings.
4. Contractor coordinate actuator rotation with the Owner Representative to ensure that handwheel is facing upward.

5. Manufacturers and Products:
   a. Rotork Controls
   b. Flowserve Limitorque
   c. EIM
   d. AUMA
   e. Or equal.

B. Identification Tagging Requirements:

1. For each gate operator, 1-1/2-inch minimum diameter heavy brass tag, bearing the gate tag number shown in the schedule.
2. Attach the tags to the operator by soldered split key rings to that ring and tag cannot be removed. Use block type numbers and letters with 1/4-inch minimum high numbers and letters stamped on and filled with black enamel.

2.8 FRP STOP PLATES

A. Composition of the stop gate laminate shall be in accordance with the recommendations shown in the Quality Assurance Report for Reinforced Thermoset Plastic (RTP) Corrosion Resistant Equipment prepared under the sponsorship of the Society of the Plastics Industry, Inc. (SPI), and the Material Technology Institute (MTI) of the Chemical Process Industry for "Hand Lay-up Laminates," and shall meet the specifications for Type I, Grade 10 laminates shown in Appendix M-1 of said report.

B. Manufacturers shall be experienced in the design and manufacture of specific gates and accessories.

C. Composition of the gate laminate shall be in accordance with the recommendations shown in the Quality Assurance Report for Reinforced Thermostat Plastic (RTP) Corrosion Resistant Equipment prepared under the sponsorship the Society of the Plastics Industry, Inc. (SPI) and the Material Technology Institute of the Chemical Process Industries, Inc. (MTI) for "Hand Lay-up Laminates" and shall meet the specifications for Type 1, Grade 10 laminates shown in Appendix M-1 of said report.

1. Visual inspection for defects shall be made without the aid of magnification and defects shall be classified as to type and level as shown in Table 1 of ANSI/ASTM D2563-0, approved 1977, (or any subsequent revision). Allowable surface tolerances are as follows:

DEFECTS	ALLOWABLE TOLERANCE
Cracks Crazing Blisters Chips Pits Dry Spots Fish Eyes Burned Areas Entrapped Air	None
Wrinkles and solid blisters, not to exceed 1/8"	Maximum Deviation: 10% of thickness

Surface porosity (pinholes or pores in the laminate surface)	None
Exposed Glass Exposure of cut edges	None
Scratches	None more than .002" (0.05mm) deep
Foreign Matter	None

D. Maximum Fiber Stress

1. Ultimate or yield, whichever applies, does not exceed 2.5 times the working stress.

E. Deflection

1. Deflection across the plate width shall be limited to: L/360 or ¼" (6mm), whichever is less, at the maximum operating head.

F. Head Pressure

1. Plate shall be designed for a maximum head pressure as shown on plans or gate schedule.

G. Plate Size as shown on the contact drawings and/or gate schedule.

H. Surface Conditions

1. All plates shall be flat and level.
2. Warpage throughout the entire plate shall not produce a crown of more than 1/16" (1.6mm) in any direction.

I. Plate Disc

1. Plate disc shall be manufactured of fiberglass reinforced polyester totally encapsulating an internal reinforcing structure.
2. Each plate shall be molded individually to the exact dimensions specified. Seams and joints in and on the disc are not acceptable.
3. Plates shall be manufactured of reinforced thermoset plastic.
4. Plate shall have UV Stabilizing pigment in the Resin to provide long-term protection from UV.
5. The surface shall be resin rich to a depth of 0.01 inches (0.3mm) to 0.02 inches (0.5mm) and reinforced with C-glass or polymeric fiber surfacing material.
6. The surface shall be free of exposed reinforcing fibers.
7. The composition of these layers shall be approximately 95% (by weight) resin. The remaining laminate shall be made up of copolymer composite and reinforcing fibers in a form, orientation and position to meet the mechanical requirements.

8. Structural reinforcing shall be utilized to attain the necessary stiffness to meet deflection requirements, and shall be well encapsulated with a laminate not less than 1/8" (3mm) thick on each side to ensure against any permeation by water to the core areas.
9. Core material must be 100% resistant to decay and attack by fungus and bacteria and be resistant to hydrocarbons.

J. Frames and Guides

1. Guides shall be styled for embedment as shown on the contract drawings and/or gate schedule.
2. Guides shall be fabricated from FRP and shall have a slot suitable for mating with the plate body.

K. Structural characteristics for a 1/8" (3mm) glass mat laminate shall meet the following minimum physical properties.

Tensile strength	15,000 psi (1034 ksc)
Flexural Modulus	1,000,000 psi (70307 ksc)
Flexural Strength	20,000 psi (1406 ksc)
Compressive Strength	22,000 psi (1547 ksc)
Impact Strength	9.0 ft-lbs/in. (1.24 kgf.m/25mm)
Water absorption	0.13% (in 24 hours)

L. All bolts and concrete anchors shall be manufactured of AISI 316 stainless steel.

M. In-channel frames shall be fabricated of FRP.

N. Manufacturer

1. PlastiFab, Inc.
2. Or equal

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with the manufacturer's written instructions.

B. Disassemble factory assembled gate components before installation.

C. Field mount operators after installing gates.

D. Brace thimbles internally during concrete placement.

E. Accurately place anchor bolts using templates furnished by the manufacturer and as specified in Section 05 50 00, Metal Fabrications.

F. Lubricate stems before operating.

3.2 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each slide gate.

B. Performance Test:

1. Conduct on each slide gate.
2. Perform under actual or approved simulated operating conditions.
3. Test for a continuous 3-hour period without malfunction.
4. Adjust, realign, or modify units and retest if necessary.

3.3 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner for minimum person-days listed below, travel time excluded:

1. Two person-days for installation assistance and inspection.
2. Two person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. Two person-days for prestartup classroom or Site training.
4. Two person-days for facility startup.
5. Two person-days for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Owner.

B. See Section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Testing, Integration, and Startup.

C. Provide manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection and certification of proper installation, equipment testing, startup assistance, and training of Owner's personnel for specified component, subsystem, equipment, or system.

END OF SECTION

SECTION 40 05 15
PIPING SUPPORT SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
2. American Society of Mechanical Engineers (ASME): B31.1, Power Piping.
3. ASTM International (ASTM):
   a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
   c. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
4. International Code Council (ICC):
5. California Building Code (CBC).
6. International Mechanical Code (IMC).
7. Manufacturers' Standardization Society (MSS):
   a. SP 58, Pipe Hangers and Supports—Materials, Design and Manufacture.
   b. SP 127, Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, and Application.

1.2 DEFINITIONS

A. Wetted or Submerged: Submerged, less than 1 foot above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

1.3 SUBMITTALS

A. Action Submittals:

1. Catalog information and drawings of piping support system, locating each support, sway brace, seismic brace, hanger, guide, component, and anchor for piping. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.
2. Calculations for each type of pipe support, attachment and anchor.

3. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.
4. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Maintenance information on piping support system.

1.4 QUALIFICATIONS

A. Piping support systems shall be designed and Shop Drawings prepared and sealed by a Registered Professional Engineer in the state where the Work is to be installed.

1.5 DESIGN REQUIREMENTS

A. General:

1. Design, size, and locate piping support systems throughout facility, whether shown or not.
2. Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.
3. Piping 30 Inches and Larger: Support systems have been designed for piping shown.
4. Meet requirements of MSS SP 58 and ASME B31.1 or as modified by this section.

B. Pipe Support Systems:

1. Design pipe support systems for gravity and thrust loads imposed by weight of pipes or internal pressures, including insulation and weight of fluid in pipes.
2. Seismic loads in accordance with governing codes and as shown on Structural General Drawings**.**
3. Wind loads in accordance with governing codes and as shown on Structural General Drawings**.**
4. Maximum Support Spacing and Minimum Rod Size: In accordance MSS SP 58 Table 3 and Table 4.
    a. Ductile-iron Pipe 8 Inches and Under: Maximum span limited to that for standard weight steel pipe for water service.
    b. Ductile-iron Pipe 10 Inches and Larger: Maximum span limited to 20 feet.

5. Electrical Conduit Support: Include in design of framing support system.

C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

D. Vertical Sway Bracing: 10-foot maximum centers or as shown.

E. Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show they are adequate for additional load, or if they are strengthened to support additional load.

PART 2 PRODUCTS

2.1 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated.

B. Special support and hanger details may be required for cases where standard catalog supports are not applicable.

C. Materials: In accordance with Table 1 and Table 2, attached as Supplements at end of section.

2.2 HANGERS

A. Clevis: MSS SP 58, Type 1:

1. Anvil; Figure 260 for steel pipe and Figure 590 for ductile-iron pipe, sizes 1/2 inch through 30 inches.
2. Insulated Steel Pipe: Anvil; Figure 260 with insulated saddle system (ISS), sizes 1/2 inch through 16 inches.
3. B-Line; Figure B3100, sizes 1/2 inch through 30 inches.

B. Adjustable Swivel Split-Ring Pipe Clamp: MSS SP 58, Type 6:

1. Anvil; Figure 104, sizes 3/4 inch through 8 inches.
2. B-Line; Figure B3171, sizes 3/4 inch through 8 inches.

C. Steel Yoke Pipe Rolls and Roller Supports: MSS SP 58, Type 41 or Type 43:

1. Anvil; Figure 181 for sizes 2-1/2 inches through 24 inches, and Figure 171 for sizes 1 inch through 30 inches.

2. B-Line; Figure B3110 for sizes 2 inches through 24 inches and Figure B3114 for 30 inches.

D. Pipe Rollers and Supports: MSS SP 58, Type 44:

1. Anvil; Figure 175, sizes 2 inches through 30 inches.
2. B-Line; Figure B3120, sizes 2 inches through 24 inches.

2.3 WALL BRACKETS, SUPPORTS, AND GUIDES

A. Welded Steel Wall Bracket: MSS SP 58, Type 33 (heavy-duty):

1. Anvil; Figure 199, 3,000-pound rating.
2. B-Line; Figure B3067, 3,000-pound rating.

B. Adjustable "J" hanger MSS SP 58, Type 5:

1. Anvil; Figure 67, sizes 1/2 inch through 8 inches.
2. B-Line; Figure B3690, sizes 1/2 inch through 8 inches.

C. Offset Pipe Clamp: Anvil; Figure 103, sizes 3/4 inch through 8 inches.

D. Channel Type:

1. Unistrut.
2. Anvil; Power-Strut.
3. B-Line; Strut System.
4. Aickinstrut (FRP).

2.4 PIPE SADDLES

A. Provide 90-degree to120-degree pipe saddle for pipe 6 inches and larger with baseplates drilled for anchors bolts.

1. In accordance with Standard Detail 4005-515.
2. Sizes 20 inches though 60 inches, Piping Technology & Products, Inc.; Fig. 2000.

B. Saddle Supports, Pedestal Type:

1. Minimum standard weight pipe stanchion, saddle, and anchoring flange.
2. Nonadjustable Saddle: MSS SP , Type 37 with U-bolt.
   a. Anvil; Figure 259, sizes 4 inches through 36 inches with Figure 63C base.
   b. B-Line; Figure B3095, sizes 1 inch through 36 inches with B3088S base.
3. Adjustable Saddle: MSS SP 58, Type 38 without clamp.

a. Anvil; Figure 264, sizes 2-1/2 inches through 36 inches with Figure 62C base.
b. B-Line; Figure B3092, sizes 3/4 inch through 36 inches with Figure B3088S base.

2.5 CHANNEL TYPE SUPPORT SYSTEMS

A. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, or 1-1/2-inch wide, minimum FRP.

B. Members and Connections: Design for loads using one-half of manufacturer's allowable loads.

C. Fasteners: Vinyl ester fiber, polyurethane base composite nuts and bolts, or encapsulated steel fasteners.

D. Manufacturers and Products:

1. B-Line; Strut System.
2. Unistrut.
3. Anvil; Power-Strut.
4. Aickinstrut (FRP System).
5. Enduro-Durostrut (FRP Systems).

2.6 FRP PIPE SUPPORTS SYSTEMS

A. General:

1. FRP with UV additive, protective veil, and vinyl ester resins resistance to chemicals listed in Supplement at end of section.
2. Fire Retardant: ASTM E84.
3. Include hangers, rods, attachments, and fasteners.

B. Clevis Hangers:

1. Factor of Safety: 3 to 1.
2. Minimum Design Load: 200 pounds.

C. Design:

1. Design pipe supports spacing, hanger rod sizing based upon manufacturer's recommendations.
2. Identify and highlight nonFRP fasteners or components in Shop Drawing.

D. Manufacturers:

1. Aickinstrut.
2. Enduro.
3. Century Composite.

2.7 PIPE CLAMPS

A. Riser Clamp: MSS SP 58, Type 8.

1. Anvil; Figure 261, sizes 3/4 inch through 24 inches.
2. B-Line; Figure B3373, sizes 1/2 inch through 30 inches.

2.8 ELBOW AND FLANGE SUPPORTS

A. Elbow with Adjustable Stanchion: Sizes 2 inches through 18 inches, Anvil; Figure 62C base.

B. Elbow with Nonadjustable Stanchion: Sizes 2-1/2 inches through 42 inches, Anvil; Figure 63A or Figure 63B base.

C. Flange Support with Adjustable Base: Sizes 2 inches through 24 inches, Standon; Model S89.

2.9 INTERMEDIATE PIPE GUIDES

A. Type: Hold down pipe guide.

1. Manufacturer and Product: B-Line; Figure B3552, 1-1/2 inches through 30 inches.

B. Type: U-bolts with double nuts to provide nominal 1/8-inch to 1/4-inch clearance around pipe; MSS SP 58, Type 24.

1. Anvil; Figure 137 and Figure 137S.
2. B-Line; Figure B3188 and Figure B3188NS.

2.10 PIPE ALIGNMENT GUIDES

A. Type: Spider.

B. Manufacturers and Products:

1. Anvil; Figure 255, sizes 1/2 inch through 24 inches.
2. B-Line; Figure B3281 through Figure B3287, sizes 1/2 inch through 24 inches.

2.11 PIPE ANCHORS

A. Type: Anchor chair with U-bolt strap.

B. Manufacturer and Product: B-Line; Figure B3147A or Figure B3147B.

2.12 SEISMIC RESTRAINTS

A. Solid pipe bracing attachment to pipe clevis with clevis cross brace and angle rod reinforcement.

B. Manufacturers:

1. Mason Industries.
2. B-Line.
3. Anvil.

2.13 ACCESSORIES

A. Anchor Bolts:

1. Size and Material: Sized by Contractor for required loads, 1/2-inch minimum diameter, and as specified in Section 05 50 00, Metal Fabrications.
2. Bolt Length (Extension Above Top of Nut):
   a. Minimum Length: Flush with top of nut preferred. If not flush, shall be no more than one thread recessed below top of nut.
   b. Maximum Length: No more than a full nut depth above top of nut.

B. Dielectric Barriers:

1. Plastic coated hangers, isolation cushion, or tape.
2. Manufacturer and Products:
   a. B-Line; B1999 Vibra Cushion.
   b. B-Line; Iso Pipe, Isolation Tape.

C. Insulation Shields:

1. Type: Galvanized steel or stainless steel, MSS SP 58, Type 40.
2. Manufacturers and Products:
   a. Anvil; Figure 167, sizes 1/2 inch through 24 inches.
   b. B-Line; Figure B3151, sizes 1/2 inch through 24 inches.

D. Welding Insulation Saddles:

1. Type: MSS SP 58, Type 39.
2. Manufacturers and Products:

a. Anvil; Figure Series 160, sizes 1 inch through 36 inches.
b. B-Line; Figure Series B3160, sizes 1/2 inch through 24 inches.

E. Plastic Pipe Support Channel:

1. Type: Continuous support for plastic pipe and to increase support spacing.
2. Manufacturer and Product: B-Line; Figure Series B3106V, sizes 1/2 inch through 6 inches with Figure B3106 Vee bottom hanger.

F. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

G. Attachments:

1. I-Beam Clamp: Concentric loading type, MSS SP 58, Type 21, Type 28, Type 29, or Type 30, which engage both sides of flange.
2. Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
3. Welded Beam Attachment: MSS SP 58, Type 22.
   a. Anvil; Figure 66.
   b. B-Line; Figure B3083.
4. U-Channel Concrete Inserts: As specified in Section 05 50 00, Metal Fabrications.
5. Concrete Attachment Plates:
   a. Anvil; Figure 47, Figure 49, or Figure 52.
   b. B-Line; Figure B3084, Figure B3085, or Figure B3086.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Install support systems in accordance with MSS SP 58, unless shown otherwise.
2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
3. Support piping connections to equipment by pipe support and not by equipment.
4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
5. Support no pipe from pipe above it.
6. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.

7. Do not use adhesive anchors for attachment of supports to ceiling or walls.
8. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
9. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
10. Install lateral supports for seismic loads at changes in direction.
11. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
12. Repair mounting surfaces to original condition after attachments are completed.

B. Standard Pipe Supports:

1. Horizontal Suspended Piping:
    a. Single Pipes: Clevis hangers or adjustable swivel split-ring.
    b. Grouped Pipes: Trapeze hanger system.
2. Horizontal Piping Supported from Walls:
    a. Single Pipes: Wall brackets, or attached to wall, or to wall mounted framing with anchors.
    b. Stacked Piping: Wall mounted framing system and "J" hangers acceptable for pipe smaller than 3-inch.
    c. Pipe clamp that resists axial movement of pipe through support is not acceptable. Use pipe rollers supported from wall bracket.
3. Horizontal Piping Supported from Floors:
    a. Saddle Supports:
        1) Pedestal Type, elbow and flange.
        2) Provide minimum 1-1/2-inch grout beneath baseplate.
    b. Floor Mounted Channel Supports:
        1) Use for pipe smaller than 3-inch running along floors and in trenches at pipe elevations lower than can be accommodated using pedestal pipe supports.
        2) Attach channel framing to floors with baseplate on minimum 1-1/2-inch nonshrink grout and with anchor bolts.
        3) Attach pipe to channel with clips or pipe clamps.
    c. Concrete Cradles: Use for pipe larger than 3 inches along floor and in trenches at pipe elevations lower than can be accommodated using stanchion type.
4. Insulated Pipe:
    a. Pipe hanger and support shall be on outside of insulation. Do not enclose within insulation.
    b. Provide precut 120-degree sections of rigid insulation (minimum length same as shield), shields and oversized hangers or insulated saddle system (ISS).
    c. Wall-mounted pipe clips not acceptable for insulated piping.

5. Vertical Pipe: Support with wall bracket and elbow support, or riser clamp on floor penetration.

C. Standard Attachments:

1. New Concrete Ceilings: Concrete inserts, concrete attachment plates, or concrete anchors as limited below:
   a. Single point attachment to ceiling allowed only for 3/4-inch rod and smaller (8 inches and smaller pipe).
   b. Where there is vibration or bending considerations, do not connect a single pipe support hanger rod directly to a drilled concrete anchor (single point attachment) regardless of size.
2. Existing Concrete Ceilings: Channel type support with minimum of two anchor points, concrete attachment plates or concrete anchors as limited below:
   a. Single point attachment to ceiling is allowed only for 3/4-inch rod and smaller (8 inches and smaller pipe).
   b. Where there is vibration or bending considerations do not connect a single pipe support hanger rod directly to a drilled concrete anchor (single point attachment) regardless of size.
3. Steel Beams: I-beam clamp or welded attachments.
4. Wooden Beams: Lag screws and angle clips to members not less than 2-1/2 inches thick.
5. Concrete Walls: Concrete inserts or brackets or clip angles with concrete anchors.
6. Concrete Beams: Concrete inserts, or if inserts are not used attach to vertical surface similar to concrete wall. Do not drill into beam bottom.

D. Saddles for Steel or Concrete Pipe: Provide 90-degree to 120-degree pipe saddle for pipe sizes 6 inches and larger when installed on top of steel or concrete beam or structure, pipe rack, trapeze, or where similar concentrated point supports would be encountered.

E. Intermediate and Pipe Alignment Guides:

1. Provide pipe alignment guides, or pipe supports that provide same function, at expansion joints and loops.
2. Guide pipe on each side of expansion joint or loop at 4 pipe and 14 pipe diameters from each joint or loop.
3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

F. Accessories:

1. Insulation Shield: Install on insulated piping with oversize rollers and supports.

2. Welding Insulation Saddle: Install on insulated steel pipe with oversize rollers and supports.
3. Dielectric Barrier:
    a. Provide between painted or galvanized carbon steel members and copper or stainless steel pipe or between stainless steel supports and non stainless steel ferrous metal piping.
    b. Install rubber wrap between submerged metal pipe and oversized clamps.

3.2 FIELD FINISHING

A. Paint atmospheric exposed surfaces hot-dip galvanized steel components as specified in Section 09 90 00, Painting and Coating.

3.3 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this specification:

1. Table 1: Nonchemical Areas.

END OF SECTION

Table 1 Nonchemical Areas	
Exposure Conditions	**Support Material**
Office Areas	Galvanized steel or precoated steel, plastic coated hangers for uninsulated copper or stainless steel piping
Shops and Warehouse Areas	Galvanized steel or precoated steel, plastic coated hangers for uninsulated copper or stainless steel piping
Pump Station and Screenings Facilities	Stainless steel or FRP
Process Areas: High Humidity or Hydrogen sulfide	Stainless steel or FRP
Process Areas: Wetted or Submerged	Stainless steel or FRP

SECTION 40 27 00
PROCESS PIPING—GENERAL

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:

1. Air Force: A-A-58092, Tape, Antiseize, Polytetrafluorethylene.
2. American Association of State Highway and Transportation Officials (AASHTO): HB-17, Standard Specifications for Highway Bridges.
3. American Petroleum Institute (API): SPEC 5L, Specification for Line Pipe.
4. American Society of Mechanical Engineers (ASME):
   a. Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
   b. B1.20.1, Pipe Threads, General Purpose (Inch).
   c. B16.1, Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
   d. B16.3, Malleable Iron Threaded Fittings Classes 150 and 300.
   e. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
   f. B16.9, Factory-Made Wrought Buttwelding Fittings.
   g. B16.11, Forged Fittings, Socket-Welding and Threaded.
   h. B16.15, Cast Copper Alloy Threaded Fittings Classes 125 and 250.
   i. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
   j. B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   k. B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings Classes 150, 300, 600, 900, 1500, and 2500.
   l. B16.25, Buttwelding Ends.
   m. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
   n. B31.1, Power Piping.
   o. B31.3, Process Piping.
   p. B31.9, Building Services Piping.
   q. B36.10M, Welded and Seamless Wrought Steel Pipe.
5. American Society for Nondestructive Testing (ASNT): SNT-TC-1A, Recommended Practice for Personal Qualification and Certification in Nondestructive Testing.

6. American Water Works Association (AWWA):
    a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
    b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
    c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
    d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
    e. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
    f. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast.
    g. C153/A21.53, Ductile-Iron Compact Fittings.
    h. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
    i. C606, Grooved and Shouldered Joints.

7. American Welding Society (AWS):
    a. Brazing Handbook.
    b. A5.8M/A5.8, Specification for Filler Metals for Brazing and Braze Welding.
    c. D1.1/D1.1M, Structural Welding Code - Steel.
    d. QC1, Standard for AWS Certification of Welding Inspectors.

8. ASTM International (ASTM):
    a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
    b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    c. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
    d. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
    e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    f. A135/A135M, Standard Specification for Electric-Resistance-Welder Steel Pipe.
    g. A139/A139M, Standard Specification for Electro-Fusion (Arc)–Welded Steel Pipe (NPS 4 Inches and Over).
    h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    i. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
    j. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
    k. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.

l. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
m. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
n. A197/A197M, Standard Specification for Cupola Malleable Iron.
o. A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
p. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
q. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
r. A276, Standard Specification for Stainless Steel Bars and Shapes.
s. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
t. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
u. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
v. A320/A320M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
w. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
x. A395/A395M, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
y. A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
z. A409/A409M, Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service.
aa. A536, Standard Specification for Ductile Iron Castings.
bb. A563, Standard Specification for Carbon and Alloy Steel Nuts.
cc. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
dd. A743/A743M, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
ee. A744/A744M, Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
ff. A774/A774M, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

gg. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
hh. B32, Standard Specification for Solder Metal.
ii. B43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
jj. B61, Standard Specification for Steam or Valve Bronze Castings.
kk. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
ll. B75/B75M, Standard Specification for Seamless Copper Tube.
mm. B88, Standard Specification for Seamless Copper Water Tube.
nn. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.
oo. B462, Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N10362, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
pp. B464, Standard Specification for Welded UNS N08020 Alloy Pipe.
qq. B474, Standard Specification for Electric Fusion Welded Nickel and Nickel Alloy Pipe.
rr. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
ss. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
tt. D413, Standard Test Methods for Rubber Property-Adhesion to Flexible Substrate.
uu. D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
vv. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
ww. D1330, Standard Specification for Rubber Sheet Gaskets.
xx. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
yy. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
zz. D2000, Standard Classification System for Rubber Products in Automotive Applications.
aaa. D2310, Standard Classification for Machine-Made “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

bbb. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
ccc. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
ddd. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
eee. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
fff. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
ggg. D2996, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
hhh. D3222, Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
iii. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
jjj. D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
kkk. D4894, Standard Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials.
lll. D4895, Standard Specification for Polytetrafluoroethylene (PTFE) Resin Produced from Dispersion.
mmm. F423, Standard Specification for Polytetrafluoroethylene (PTFE) Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges.
nnn. F436, Standard Specification for Hardened Steel Washers.
ooo. F437, Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
ppp. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
qqq. F441/F441M, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
rrr. F493, Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
sss. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ttt. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

9. FM Global (FM).

10. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP-43, Wrought and Fabricated Butt-Welding Fittings for Low-Pressure, Corrosion Resistant Applications.

11. NSF International (NSF):
    a. ANSI 61: Drinking Water System Components - Health Effects.
    b. ANSI 372: Drinking Water System Components - Lead Content.
12. National Electrical Manufacturers Association (NEMA): LI 1, Industrial Laminating Thermosetting Products.
13. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.2 DEFINITIONS

A. Submerged or Wetted:

1. Zone below elevation of liquid surface or within 1 foot above top of liquid service.

1.3 DESIGN REQUIREMENTS

A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:

1. Process Piping: ASME B31.3, normal fluid service unless otherwise specified.
2. Building Service Piping: ASME B31.9, as applicable.
3. Sanitary Building Drainage and Vent Systems: California plumbing code.
4. Buried Piping: H20-S16 traffic load with 1.5 impact factor, AASHTO HB-17, as applicable.
5. Thrust Restraints:
    a. Design for test pressure.
    b. Allowable Soil Pressure: 1,000 pounds per square foot or higher when approved by Project Geotechnical Engineer.
    c. Low Pressure Pipelines:
        1) When bearing surface of the fitting against soil provides an area equal to or greater than area required for thrust restraint, concrete thrust blocks will not be required.
        2) Determine bearing area for fittings without thrust blocks by projected area of 70 percent of internal diameter multiplied by chord length for fitting centerline curve.

1.4 SUBMITTALS

A. Action Submittals:

1. Shop Fabricated Piping:
    a. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.

b. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.

2. Pipe Wall Thickness: Identify wall thickness and rational method or standard applied to determine wall thickness for each size of each different service including exposed, submerged, buried, and concrete-encased installations for Contractor-designed piping.
3. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.
4. Thrust Blocks: Concrete quantity, bearing area on pipe, and fitting joint locations.
5. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.
6. Pipe Corrosion Protection: Product data.
7. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Manufacturer's Certification of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
   a. Pipe and fittings.
   b. Factory applied resins and coatings.
2. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
3. Flanged Pipe and Fittings: Manufacturer's product data sheets for gaskets including torqueing requirements and bolt tightening procedures.
4. Qualifications:
   a. Nondestructive Testing Personnel: SNT-TC-1A Level II certification and qualifications.
   b. AWS QC1 Certified Welding Inspector: Submit evidence of current certification prior to commencement of welding activities.
   c. Welders:
      1) Continuity log for welders and welding operators.
      2) Welder qualification test records conducted by Contractor or manufacturer.
5. Welding Procedures: Qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
6. Nondestructive inspection and testing procedures.
7. Test logs.
8. Pipe coating applicator certification.
9. Laboratory Testing Equipment: Certified calibrations, manufacturer's product data, and test procedures.
10. CWI inspection records and NDE test records.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Independent Inspection and Testing Agency:
    a. Experience in field of welding and welded pipe and fittings' testing required for this Project.
    b. Calibrated instruments and equipment, and documented standard procedures for performing specified testing.
    c. Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Project.
    d. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.
    e. Verification Welding Inspector: AWS QC1 Certified.
2. Welding Procedures: In accordance with ASME BPVC SEC IX (Forms QW-482 and QW-483) or AWS D1.1/D1.1M (Annex N Forms).
3. Welder Qualifications: In accordance ASME BPVC SEC IX (Form QW-484) or AWS D1.1/D1.1M (Annex N Forms).
4. Contractor's CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require approval by Engineer.
5. Solvent Welder for Double Wall Containment Piping: Qualified in accordance with Chapter VII of the ASME B31.3 Code, Part 9, Paragraph A328.

B. Quality Assurance: Special inspection to be provided by Owner and performed by independent inspection and testing agency for welding operations.

1. Note, the presence of Owner's Special Inspector or Verification CWI does not relieve Contractor from performing own quality control, including 100 percent visual inspection of welds.

1.6 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements, and:

1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
3. Linings and Coatings: Prevent excessive drying.
4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 PRODUCTS

2.1 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.2 PIPING

A. Provide material and size as shown on Drawings.

B. Diameters Shown:

1. Standardized Products: Nominal size.
2. Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.
3. Cement-Lined Steel Pipe: Lining inside diameter.

2.3 JOINTS

A. Grooved End System:

1. Rigid type.
2. Use of flexible grooved joints allowed where shown on Drawings or with prior approval by Engineer.
3. Flanges: When required, furnish with grooved type flange adapters of same manufacturer as grooved end couplings.

B. Flanged Joints:

1. Flat-faced, carbon steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.
2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

C. Threaded Joints: NPT taper pipe threads in accordance with ASME B1.20.1.

D. Mechanical Joint Anchor Gland Follower:

1. Ductile iron anchor type, wedge action, with break-off tightening bolts.
2. Thrust rated to 250 psi minimum.
3. Rated operating deflection not less than:

a. 3 degrees for sizes through 12 inches.
b. 2 degrees for sizes 14 inches through 16 inches.
c. 1.5 degrees for sizes 18 inches through 24 inches.
d. 1 degree for sizes 30 inches through 48 inches.

4. UL and FM approved.

E. Flexible Mechanical Compression Joint Coupling:

1. Stainless steel, ASTM A276, Type 305 bands.
2. Manufacturers:

a. Pipeline Products Corp.
b. Fernco Joint Sealer Co.

F. Mechanical connections of high-density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through-flanged connections consisting of the following:

1. Polyethylene stub end thermally butt-fused to end of pipe.
2. ASTM A240/A240M, Type 304 stainless steel backing flange, 125-pound, ASME B16.1 standard. Use insulating flanges where shown.
3. Bolts and nuts of sufficient length to show a minimum of three complete threads when joint is made and tightened to manufacturer's standard. Retorque nuts after 4 hours.
4. Gaskets as specified on Data Sheet.

2.4 GASKET LUBRICANT

A. Lubricant shall be supplied by pipe manufacturer and no substitute or "or-equal" will be allowed.

2.5 DOUBLE WALL CONTAINMENT PIPING SYSTEM

A. System components shall be pre-engineered, factory fabricated, tested, and assembled such that field assembly is minimized to primarily that of straight joints.

2.6 PIPE CORROSION PROTECTION

A. Coatings: See Section 09 90 00, Painting and Coating, for details of coating requirements.

B. Heat Shrink Wrap:

1. Type: Cross-linked polyolefin wrap or sleeve with mastic sealant.
2. Manufacturer and Product: Raychem; or approved equal.

C. Polyethylene Encasement (Bagging):

1. Encasement Tube: Black polyethylene encasement tube, 8 mils minimum thickness, conforming to AWWA C105/A21.5, free of gels, streaks, pinholes, foreign matter, undispersed raw materials, and visible defects such as tears, blisters, and thinning at folds.
2. Securing Tape: Thermoplastic tape, 8 mils minimum thickness, 1 inch wide, pressure sensitive adhesive face capable of bonding to metal, bituminous coating, and polyethylene encasement tube.

D. Insulating Flanges, Couplings, and Unions:

1. Materials:
   a. In accordance with applicable piping material specified in Pipe Data Sheet. Complete assembly shall have ASME B31.9 working pressure rating equal to or higher than that of joint and pipeline.
   b. Galvanically compatible with piping.
   c. Resistant for intended exposure, operating temperatures, and products in pipeline.
2. Union Type, 2 Inches and Smaller:
   a. Screwed or solder-joint.
   b. O-ring sealed with molded and bonded insulation to body.
3. Flange Type, 2-1/2 Inches and Larger:
   a. Flanged, complete with bolt insulators, dielectric gasket, bolts, and nuts.
   b. Bolt insulating sleeves shall be provided full length between insulating washers.
   c. Ensure fit-up of components of insulated flange assembly to provide a complete functioning installation.
   d. AWWA C207 steel flanges may be drilled oversize up to 1/8-inch to accommodate insulating sleeves.
   e. No less than minimum thread engagement in accordance with specified bolting standards will be permitted to accommodate thicknesses of required washers, flanges, and gasket.
4. Flange Insulating Kits and Couplings: Meet requirements of Spec Section 26 42 00.

2.7 STAINLESS-STEEL PIPING

A. Potable-water piping and components shall comply with NSF 61.

B. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 40.

C. Stainless-Steel Pipe Fittings: ASTM A 815/A 815M.

D. Appurtenances for Grooved-End, Stainless-Steel Pipe:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
      a. Anvil International.
      b. Grinnell Mechanical Products; Tyco Fire Products LP.
      c. Shurjoint Piping Products.
      d. Victaulic Company.

E. Fittings for Grooved-End, Stainless-Steel Pipe: Stainless-steel casting with dimensions matching stainless-steel pipe.

F. Mechanical Couplings for Grooved-End, Stainless-Steel Pipe:
   1. AWWA C606 for stainless-steel-pipe dimensions.
   2. Stainless-steel housing sections.
   3. Stainless-steel bolts and nuts.
   4. EPDM-rubber gaskets suitable for hot and cold water.
   5. Minimum Pressure Rating: 200 PSI

2.8 THRUST TIES

A. Steel Pipe: Fabricated lugs and rods in accordance with details shown on Drawings.

B. Buried Ductile Iron Pipe and Fittings: Unless restraint is otherwise specified or shown, conform to NFPA 24. Tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.

2.9 VENT AND DRAIN VALVES

A. Pipeline 2-Inch Diameter and Smaller: 1/2-inch vent, 1-inch drain, unless shown otherwise.

B. Pipelines 2-1/2-Inch Diameter and Larger: 3/4-inch vent, 1-inch drain, unless shown otherwise.

2.10 FABRICATION

A. Mark each pipe length on outside with the following:

   1. Size or diameter and class.

2. Manufacturer's identification and pipe serial number.
3. Location number on laying drawing.
4. Date of manufacture.

B. Code markings according to approved Shop Drawings.

C. Shop fabricate flanged pipe in shop, not in field, and delivered to Site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by manufacturer.

2.11 FINISHES

A. Factory prepare, prime, and finish coat in accordance with Pipe Data Sheet(s) and Piping Schedule.

B. Galvanizing:

1. Hot-dip applied, meeting requirements of ASTM A153/A153M.
2. Electroplated zinc or cadmium plating is unacceptable.
3. Stainless steel components may be substituted where galvanizing is specified only when approved by Engineer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

3.2 PREPARATION

A. See Piping Schedule and Section 09 90 00, Painting and Coating, for additional requirements.

B. Notify Engineer at least 2 weeks prior to field fabrication of pipe or fittings.

C. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

D. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions except for damaged glass-lined pipe or PVDF-lined pipe that is to be promptly removed from Site.

3.3 WELDING

A. Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.9 for Pressure Piping, as may be specified on Piping

Data Sheets, and if recommended by piping or fitting manufacturer.

B. Weld Identification: Keep paper record of which welder welded each joint.

C. Pipe End Preparation:

1. Machine Shaping: Preferred.
2. Oxygen or Arc Cutting: Smooth to touch, true, and slag removal by chipping or grinding.
3. Beveled Ends for Butt Welding: ASME B16.25.

D. Surfaces:

1. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
2. Clean stainless steel joints with stainless steel wire brushes or stainless steel wool prior to welding.
3. Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

E. Alignment and Spacing:

1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
2. Root Opening of Joint: As stated in qualified welding procedure.
3. Minimum Spacing of Circumferential Butt Welds: Minimum four times pipe wall thickness or 1 inch, whichever is greater.

F. Climatic Conditions:

1. Do not perform welding if there is impingement of any rain, snow, sleet, or wind exceeding 5 mph on the weld area, or if ambient temperature is below 32 degrees F.
2. If ambient is less than 32 degrees F, local preheating to a temperature warm to the hand is required.

G. Tack Welds: Performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

H. Surface Defects: Chip or grind out those affecting soundness of weld.

I. Weld Quality: Meet requirements of governing welding codes.

3.4 INSTALLATION—GENERAL

A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

B. Remove foreign objects prior to assembly and installation.

C. Flanged Joints:

1. Install perpendicular to pipe centerline.
2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
5. Grooved Joint Flange Adapters: Include stainless steel washer plates as required for mating to serrated faces and lined valves and equipment.
6. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.
7. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
8. Flange fillers are to be avoided, but if necessary, may be used to make up for small angles up to 6 degrees and for filling gaps up to 2 inches between flanges. Stacked flange fillers shall not be used.
9. Threaded flanged joints shall be shop fabricated and delivered to Site with flanges in-place and properly faced.
10. Manufacturer: Same as pipe manufacturer or grooved joint flange adapter manufacturer.

D. Threaded and Coupled Joints:

1. Conform to ASME B1.20.1.
2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
3. Countersink pipe ends, ream and clean chips and burrs after threading.
4. Make connections with not more than three threads exposed.
5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

E. Grooved-End Joints:

1. Piping shall be grooved in accordance with manufacturer's latest published instructions and shall be accurately cut with tools conforming to coupling manufacturer's standards and to AWWA C606.
2. Install grooved joint couplings and gaskets in accordance with manufacturer's latest published installation instructions.

A. Threaded and Coupled Joints:

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B. Grooved-End Joints:

1. Piping shall be grooved in accordance with manufacturer's latest published instructions and shall be accurately cut with tools conforming to coupling manufacturer's standards and to AWWA C606.
2. Install grooved joint couplings and gaskets in accordance with manufacturer's latest published installation instructions.

C. Soldered Joints:

1. Use only solder specified for particular service.
2. Cut pipe ends square and remove fins and burrs.
3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
4. Wipe excess solder from exterior of joint before hardened.
5. Before soldering, remove stems and washers from solder joint valves.

D. Brazed Joints for Refrigerant Piping:

1. Braze copper piping with silver solder complying with AWS A5.8/A5.8M

2. Construct joints according to AWS Brazing Handbook, Chapter Pipe and Tube.
3. Inside of tubing and fittings shall be free of flux.
4. Clean parts to be joined with emery cloth and keep hot until solder has penetrated the full depth of the fitting and extra flux has been expelled.
5. Cool joints in air and remove flame marks and traces of flux.
6. During brazing operation, prevent an oxide film from forming on inside of tubing by slowly flowing dry nitrogen to expel the air.
7. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.

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E. PVC Piping:

1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
3. Do not thread Schedule 40 pipe.

F. Ductile Iron Piping:

1. Cutting Pipe: Cut pipe with milling type cutter, rolling pipe cutter, or abrasive blade cutter. Do not flame cut.
2. Dressing Cut Ends:
   a. General: As required for the type of joint to be made.
   b. Rubber Gasketed Joints: Remove sharp edges or projections.
   c. Push-On Joints: Bevel, as recommended by pipe manufacturer.
   d. Flexible Couplings, Flanged Coupling Adapters, and Grooved End Pipe Couplings: As recommended by the coupling or adapter manufacturer.
3. Special Precautions at Flanges: Polyethylene pipe connected to heavy fittings, manholes, and rigid structures shall be supported in such a manner that no subsequent relative movement between polyethylene pipe at flanged joint and rigid structures is possible.

3.2 INSTALLATION—EXPOSED PIPING

A. Piping Runs:

1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports: As specified in Section 40 05 15, Piping Support Systems.

C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

F. Piping clearance, unless otherwise shown:

1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
3. From Adjacent Work: Minimum 2 inches from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

3.3 INSTALLATION—BURIED PIPE

A. Joints:

1. Dissimilar Buried Pipes:
   a. Provide flexible mechanical compression joints for pressure pipe.
   b. Provide concrete closure collar for gravity piping or as shown.
2. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown.

B. Placement:

1. Keep trench dry until pipe laying and joining are completed.
2. Pipe Base and Pipe Zone: As specified in Section 31 23 23.15, Trench Backfill.
3. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
4. Measure for grade at pipe invert, not at top of pipe.
5. Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.
6. Prevent foreign material from entering pipe during placement.
7. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
8. Lay pipe upgrade with bell ends pointing in direction of laying.
9. Install closure sections and adapters for gravity piping at locations where pipe laying changes direction.
10. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
    a. Shorter pipe lengths.
    b. Special mitered joints.
    c. Standard or special fabricated bends.
11. After joint has been made, check pipe alignment and grade.
12. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
13. Prevent uplift and floating of pipe prior to backfilling.

C. PVC Pipe Placement:

1. Lay pipe snaking from one side of trench to other.
2. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and during operation.
3. Do not lay pipe when temperature is below 40 degrees F, or above 90 degrees F when exposed to direct sunlight.
4. Shield ends to be joined from direct sunlight prior to and during the laying operation.

D. Tolerances:

1. Deflection from Horizontal Line 2 inches.
2. Deflection from Vertical Grade: Maximum 1/4 inch.
3. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.

4. Horizontal position of pipe centerline on alignment around curves maximum variation of 1.75 feet from position shown.
5. Pipe Cover: Minimum 4 feet, unless otherwise shown.

3.4 INSTALLATION—CONCRETE ENCASED

A. Provide reinforced concrete pipe encasement where shown on Drawings and where otherwise required. Some piping may be required to be concrete encased for pipe strength requirements that are included in the Specifications. Piping under and within the influence of buildings, utility trenches, vaults, slabs, and other structures shall be concrete encased. See details on Drawings for encasement requirements.

B. Where concrete encased piping crosses structure construction and expansion joints, provide flexible piping joints to coincide with structure joints to prevent excessive pipe stress and breakage.

3.5 PIPE CORROSION PROTECTION

A. Ductile Iron Pipe:

1. Reference Spec Sections 33 05 19 and 09 90 00.

B. Carbon Steel Pipe:

1. Reference Spec Sections 33 05 01.01 and 09 90 00.

C. Copper Pipe:

1. Reference Spec Section 33 05 17.

D. PVC Pipe, Exposed: As specified in Section 09 90 00, Painting and Coating.

E. Piping Accessories:

1. Exposed:
   a. Field paint black and galvanized steel, brass, copper, and bronze piping components as specified in Section 09 90 00, Painting and Coating, as applicable to base metal material.
   b. Accessories include, but are not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves, and fasteners.
2. Buried:
   a. Ferrous Metal and Stainless Steel Components: Coat with coal-tar epoxy as specified in Section 09 90 00, Painting and Coating.
   b. Bolts, Nuts, and Similar Items: Coat with bituminous paint.

c. Flexible Couplings Grooved Couplings, and Similar Items: Fusion-banded epoxy.
d. Buried Valves and Similar Elements on Wrapped Pipelines: Coat with bituminous paint and wrap entire valve in polyethylene encasement.
e. Cement-Coated Pipelines: Cement coat appurtenances same as pipe.

F. Polyethylene Encasement: Install in accordance with AWWA C105/A21.5 and manufacturer's instructions.

G. Tape Coating System: As specified in Section 09 90 00, Painting and Coating and Section 33 05 01.01, Carbon Steel Pipe and Fittings.

H. Heat Shrink Wrap: Apply in accordance with manufacturer's instructions to surfaces that are cleaned, prepared, and primed.

I. Insulating Flanges, Couplings, and Unions:

1. Applications:
   a. Dissimilar metal piping connections.
   b. Cathodically protected piping penetration to buildings and watertight structures**.**
   c. Submerged to unsubmerged metallic piping connections.
   d. Connections to existing metallic pipe**.**
   e. Where required for electrically insulated connection.
2. Pipe Installation:
   a. Insulating joints connecting immersed piping to non-immersed piping shall be installed above maximum water surface elevation.
   b. Submerged carbon steel, ductile iron, or galvanized piping in reinforced concrete shall be isolated from the concrete reinforcement steel.
   c. Align and install insulating joints as shown on the Drawings and according to manufacturer's recommendations. Bolt lubricants that contain graphite or other metallic or electrically conductive components that can interfere with the insulating capabilities of the completed flange shall not be used.

J. Pipe Bonding for Buried Piping: As specified in Section 26 42 00.

K. Cathodic Protection for Buried Piping: As specified in Section 26 42 00.

3.6 THRUST RESTRAINT

A. Location:

1. Buried Piping: Where shown and where required to restrain force developed at pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist because of hydrostatic testing and normal operating pressure.
2. Exposed Piping: At all joints in piping.

B. Thrust Ties:

1. Steel Pipe: Attach with lugs or joint harnesses fabricated in accordance with details shown on Drawings.
2. Ductile Iron Pipe: Attach with socket clamps anchored against grooved joint coupling or flange.
3. Flanged Coupling Adapters: For exposed installations, install manufacturer's anchor studs through coupling sleeve or use dismantling joints.

C. Mechanical Joint Valve Restraint in Proprietary Restrained Joint Piping: Install pipe joint manufacturer's adapter gland follower and pipe end retainer, or mechanical joint anchor gland follower.

D. Thrust Blocking:

1. Place between undisturbed ground and fitting to be anchored.
2. Quantity of Concrete: Sufficient to cover bearing area on pipe and provide required soil bearing area as shown.
3. Place blocking so that pipe and fitting joints will be accessible for repairs.

3.7 BRANCH CONNECTIONS

A. Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including first block valve in the line carrying the lower pressure, unless otherwise shown.

C. Threaded Pipe Tap Connections:

1. Ductile Iron Piping: Connect only with service saddle or at tapping boss of a fitting, valve body, or equipment casting.

2. Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.
3. Limitations: Threaded taps in pipe barrel are unacceptable.

3.8 VENTS AND DRAINS

A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines at all low and high point locations.

3.9 INSULATION

A. As shown on the Drawings.

3.10 DISINFECTION

A. See Section 33 13 00, Disinfecting of Water Utility Distribution.

3.11 FIELD FINISHING

A. Notify Engineer at least 3 days prior to start of surface preparation or coating application work.

B. As specified in Section 09 90 00, Painting and Coating.

3.12 PIPE IDENTIFICATION

A. As specified in Section 10 14 00, Signage.

3.13 FIELD QUALITY CONTROL

A. Minimum Duties of Welding Inspector:

1. Job material verification and storage.
2. Qualification of welders.
3. Certify conformance with approved welding procedures.
4. Maintenance of records and preparation of reports in a timely manner.
5. Notification to Engineer of unsatisfactory weld performance within 24 hours of weld test failure.

B. Required Weld Examinations:

1. Perform examinations in accordance with Piping Code ASME B31.3.
2. Perform examinations for every pipe thickness and for each welding procedure, progressively, for piping covered by this section.
3. Examine at least one of each type and position of weld made by each welder or welding operator.

4. For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the applicable Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two additional welds for each tracer examination found to be unsatisfactory.

C. Test containment piping leak detection system in accordance with system manufacturer's instructions and recommendations to verify proper operation.

3.14 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, to assist with unloading of the double wall containment piping system, system tests, containment pipe joint closure, installation and testing of leak detection system, and training of Owner's personnel in operation and maintenance of leak detection system. Manufacturer's representative shall complete a Manufacturer's Certificate of Proper Installation. Inspection and examination practices shall be according to ASME B31.3 for Normal Fluid Service.

3.15 CLEANING

A. Following assembly and testing, and prior to disinfection and final acceptance, flush pipelines, except as stated below, with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

3.16 DESIGNATION OF PIPE MATERIAL, SCHEDULE, AND LINING/COATING

A. Pipe material, schedule, pressure class, lining/coating designation shall be as shown on the Drawings and as designated in the Specifications. There is no common pipe schedule for the project. Hydrostatic test pressure shall be 120% of max rated working pressure as designated by Engineer during construction. Test with air or perform water-based gravity test, in lieu of hydrostatic testing, only where shown on the Drawings or Specifications.

END OF SECTION

SECTION 40 27 02
PROCESS VALVES AND OPERATORS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Gas Association (AGA): 3, Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids.
2. American National Standards Institute (ANSI): Z21.15, Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
3. American Society of Mechanical Engineers (ASME):
   a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   b. B16.44, Manually Operated Metallic Gas Valves for Use in Above Ground Piping Systems up to 5 psi.
4. American Society of Sanitary Engineers (ASSE): 1011, Performance Requirements for Hose Connection Vacuum Breakers.
5. American Water Works Association (AWWA):
   a. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   b. C500, Metal-Seated Gate Valves for Water Supply Service.
   c. C504, Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).
   d. C508, Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.
   e. C509, Resilient-Seated Gate Valves for Water Supply Service.
   f. C510, Double Check Valve Backflow Prevention Assembly.
   g. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
   h. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
   i. C515, Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
   j. C541, Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
   k. C542, Electric Motor Actuators for Valves and Slide Gates.
   l. C550, Protective Interior Coatings for Valves and Hydrants.
   m. C606, Grooved and Shouldered Joints.
   n. C800, Underground Service Line Valves and Fittings.
6. ASTM International (ASTM):

a. A276, Standard Specification for Stainless Steel Bars and Shapes.
b. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
c. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
d. A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
e. B61, Standard Specification for Steam or Valve Bronze Castings.
f. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
g. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
h. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
i. B139/B139, Standard Specification for Phosphor Bronze Rod, Bar and Shapes.
j. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
k. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
l. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
m. D429, Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
n. D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

7. Canadian Standards Association, Inc. (CSA): 9.1, Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
8. Chlorine Institute (CI): Pamphlet 6, Piping Systems for Dry Chlorine.
9. FM Global (FM).
10. Food and Drug Administration (FDA).
11. International Association of Plumbing and Mechanical Officials (IAPMO).
12. Manufacturers Standardization Society (MSS):
    a. SP-80, Bronze Gate, Globe, Angle, and Check Valves.
    b. SP-81, Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
    c. SP-85, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
    d. SP-88, Diaphragm Valves.
    e. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
13. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

14. NSF International (NSF):
    a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
    b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
15. Underwriters Laboratories (UL).
16. USC Foundation for Cross-Connection Control and Hydraulic Research.

1.2 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.
    b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
    c. Certification for compliance to NSF/ANSI 61 for valves used for drinking water service.
    d. Power and control wiring diagrams, including terminals and numbers.
    e. For each power actuator provided, manufacturer's standard data sheet, with application specific features and options clearly identified.
    f. Sizing calculations for open-close/throttle and modulating valves.
    g. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for:
    a. Electric actuators; full compliance with AWWA C542.
    b. Butterfly valves; full compliance with AWWA C504.
3. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection and Testing.
4. Tests and inspection data.
5. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
6. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS

2.1 GENERAL

A. Valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, operating nut, chain, wrench, and accessories to allow a complete operation from the intended operating level.

B. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

C. Valve same size as adjoining pipe, unless otherwise called out on Drawings or in Supplements.

D. Valve ends to suit adjacent piping.

E. Resilient seated valves shall have no leakage (drip-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this section or in stated valve standard.

F. Size operators and actuators to operate valve for full range of pressures and velocities.

G. Valve to open by turning counterclockwise, unless otherwise specified.

H. Factory mount operator, actuator, and accessories.

I. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.2 MATERIALS

A. Bronze and brass valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.

1. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100), B139/B139M (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
2. Stainless steel Alloy 18-8 may be substituted for bronze.

B. Valve materials in contact with or intended for drinking water service to meet the following requirements:

1. Materials to comply with requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements.
2. Coatings materials to be formulated from materials deemed acceptable to NSF/ANSI 61.
3. Supply certification product is certified as suitable for contact with drinking water by an accredited certification organization in accordance with NSF/ANSI 61. Provide certification for each valve type used for drinking water service.

2.3 FACTORY FINISHING

A. General:

1. Interior coatings for valves and hydrants shall be in accordance with AWWA C550, unless otherwise specified.
2. Exterior coating for valves and hydrants shall be in accordance with Section 09 90 00, Painting and Coating.
3. Material in contact with potable water shall conform to NSF/ANSI 61.
4. Exposed safety isolation valves and lockout valves with handles, handwheels, or chain wheels shall be “safety yellow.”

B. Where epoxy lining and coating are specified, factory finishing shall be as follows:

1. In accordance with AWWA C550.
2. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as “fusion” or “fusion bonded” epoxy.
3. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

2.4 VALVES

A. Ball Valves:

1. Type V300 Ball Valve 3 Inches and Smaller for General Water and Air Service:

a. Two-piece, standard port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.
b. Manufacturers and Products:
1) Threaded:
a) Conbraco Apollo; 70-100.
b) Nibco; T-580-70.
c) Or equal.
2) Soldered:
a) Conbraco Apollo; 70-200.
b) Nibco; S-580-70.
c) Or equal.

2. Type V301 Ball Valve 2 Inches and Smaller for General Water and Air Service:
a. Two-piece, full port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.
Manufacturers and Products:
1) Threaded:
a) Conbraco Apollo; 77-100.
b) Nibco; T-585-70.
c) Or equal.
2) Soldered:
a) Conbraco Apollo; 77-200.
b) Nibco; S-585-70.
c) Or equal.

3. Type V306 Stainless Steel Ball Valve 2 Inches and Smaller:
a. Two-piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece, NPT threaded ends, ASTM A276 Type 316 stainless steel ball, reinforced PTFE seats, seals, and packing, adjustable packing gland, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 1,000 psig CWP, complies with MSS SP-110.
b. Manufacturers and Products:
1) Conbraco Apollo; 76F-100 Series.
2) Nibco; T-585-S6-R-66-LL.
3) Or equal.

B. Plug Valves:

1. Type V407 Eccentric Plug Valve 24 Inches to 48 Inches:
    a. 100% Port, nonlubricated type rated 250 psig CWP, drip-tight shutoff with pressure from either direction, ductile-iron body, exposed service flanged ends with drilling per ANSI/ASME B16.1 Class 125 and flange rating of 250 psi flanged joints ends unless otherwise shown, eccentric plug, ductile iron plug material plug coated with NBR, seats welded nickel, stem bearings lubricated stainless steel or bronze, stem seal multiple V-rings or U-cups with O-rings of nitrile rubber, grit seals on both upper and lower bearings.
    b. Provide quarter-turn electric motor actuator with backup handwheel per requirements of this spec section.
    c. Manufacturers and Products:
        1) APCO DeZurik; Style PEF.
        2) Pratt.
        3) Milliken.
        4) Or equal.

C. Check and Flap Valves:

1. Type V608 Swing Check Valve 2 Inches to 24 Inches:
    a. AWWA C508, flange drilling confirming to ANSI/ASME B16.1, Class 125, with flange rating of 125 psi, ductile-iron body and ductile iron cover, NBR rubber disc sent, 316 stainless steel sent.
    b. Ductile-iron disc and disc arm.
    c. PTFE Packing.
    d. Type 316 stainless steel pivot shaft.
    e. Type 316 stainless steel bushings.
    f. Ductile-iron counterweight assembly.
    g. Provide air cushion cylinder with speed control assembly
    h. Valve shall have a working pressure rating of 250 psi.
    i. Manufacturers and Products:
        1) Dezurik, APCO CVS-250.
        2) Or equal.

D. Stainless Steel Check Valve (Scum Pumps)

1. Swing Check Valve 2 Inches to 24 Inches:
    a. Flange drilling confirming to ANSI/ASME B16.1, Class 125, with flange rating of 125 psi, stainless steel body and cover, NBR rubber disc sent, 316 stainless steel sent.
    b. Stainless Steel disc and disc arm.
    c. PTFE Packing.
    d. Type 316 stainless steel pivot shaft.
    e. Type 316 stainless steel bushings.

f. Stainless steel hing assembly.
g. Valve shall have a working pressure rating of 150 psi.
h. Manufacturers and Products:
    1) FNW 471A Steel Flanged Check Valve.
    2) Or equal.

E. Sewage Pressure Relief Valve

1. 4 Inches to 48 Inches:
    a. Valve body shall be constructed of gray iron casting that confirms to ASTM Specifications A 126 Class B. Internal stainless steel Components shall confirm to ASTM Specification A-743 Grade CF-8 or CF-8M. The threaded assembly shall confirm to ANSI standards.
    b. Type 316 stainless steel seat ring.
    c. Type 316 stainless steel bushings and fasteners
    d. Type 316 stainless steel seat support assembly
    e. The control assembly shall be rigid red brass no less than 0.5" in diameter.
    f. Valve shall have a working pressure rating of 250 psi.
    g. The valve shall be coated with NSF Certified Epoxy (Tenemec Series FC20 or approved equal). Coating shall be in accordance with ANSI/NSF Std. 61 and confirming to AWWA D102 Inside System No. 1
    h. Manufacturers and Products:
        1) Ross Series 70SWR-E
        2) Or equal.

F. Knife Gate Valves at Pump Station:

1. Body material: 316 stainless steel.
2. PTFE braided packing.
3. 304 stainless steel yoke.
4. 316 stainless steel gate.
5. Painted cast iron handwheel.
6. 420 stainless steel roll pin.
7. 316 stainless steel gland.
8. NBR seat ring
9. 304 stainless steel stem.
10. Pressure rating 150 psi.
11. Wafer-style flanges.
12. Provide multi-turn electric actuators.
13. Manufacturer: Dezurik/APCO or equal.

2.5 OPERATORS AND ACTUATORS

A. Manual Operators:

1. General:
   a. For AWWA valves, operator force not to exceed requirements of applicable valve standard. Provide gear reduction operator when force exceeds requirements.
   b. For non-AWWA valves, operator force not to exceed applicable industry standard or 80 pounds, whichever is less, under operating condition, including initial breakaway. Provide gear reduction operator when force exceeds requirements.
   c. Operator self-locking type or equipped with self-locking device.
   d. Position indicator on quarter-turn valves.
   e. Worm and gear operators one-piece design, worm-gears of gear bronze material. Worm of hardened alloy steel with thread ground and polished. Traveling nut type operator's threaded steel reach rod with internally threaded bronze or ductile iron nut.
2. Exposed Operator:
   a. Galvanized and painted handwheel.
   b. Cranks on gear type operator.
   c. Chain wheel operator with tieback, extension stem, floor stand, and other accessories to permit operation from normal operation level.
   d. Valve handles to take a padlock and wheels a chain and padlock.
3. Buried Operator:
   a. Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
   b. Buried service operators to be grease packed and gasketed to withstand submersion in water to 20 feet minimum.
   c. Buried valves shall have extension stems, bonnets, and valve boxes.

B. Electric Motor Actuators, 480 Volts:

1. General:
   a. Comply with latest version of AWWA C542.
   b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of valve.

c. Controls integral with actuator and fully equipped as specified in AWWA C542.
d. Stem protection for rising stem valves.

2. Actuator Operation—General:
   a. Suitable for full 90-degree rotation of quarter-turn valves or for use on multiturn valves, as applicable.
   b. Manual override handwheel.
   c. Valve position indication.
   d. Operate from FULL CLOSED to FULL OPEN positions or the reverse in the number of seconds given in Electric Actuated Valve Schedule.
   e. Nonintrusive Electronic Control: Local controls, diagnostics, and calibration, including limit and torque settings, shall be accomplished non-intrusively. Electronic valve position display with capability to show continuous torque output.
3. Open-Close(O/C)/Throttling(T) Service:
   a. Size motors for one complete OPEN-CLOSE-OPEN cycle no less than once every 10 minutes.
   b. Actuator suitable for throttling operation of valve at intermediate positions.
   c. LOCAL-OFF-REMOTE Selector Switch, padlockable in each position:
      1) Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.
      2) Remote OPEN-STOP-CLOSE momentary control dry contact inputs in REMOTE position. Integral seal-in circuits for remote OPEN and CLOSE commands; valve travel stops when remote STOP contact opens.
      3) Auxiliary contact that closes in REMOTE position.
   d. OPEN and CLOSED indicating lights.
   e. Integral reversing motor starter with built-in overload protection.
4. Limit Switch:
   a. Single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 5 amps at 120 volts ac.
   b. Each valve actuator to have a minimum of two auxiliary transfer contacts at end position, one for valve FULL OPEN and one for valve FULL CLOSED.
   c. Housed in actuator control enclosure.
5. Control Features: Electric motor actuators with features as noted above, and as modified/supplemented in Electric Actuated Valve Schedule.
6. Manufacturers and Products:
   a. Rotork Controls.
   b. Flowserve Limitorque.
   c. EIM.
   d. AUMA.

e. Or equal.

2.6 ACCESSORIES

A. Tagging: 1-1/2-inch diameter stainless steel tag attached with No. 16 solid brass or stainless steel jack chain for each valve operator, and valves 6-inch and larger.

B. Limit Switch:

1. Factory installed NEMA 4X limit switch by actuator manufacturer.

C. T-Handled Operating Wrench where shown on Drawings:

1. Each galvanized operating wrenches, 4 feet long.
2. Manufacturers and Products:
   a. Mueller; No. A-24610.
   b. Clow No.; F-2520.

D. Extension Bonnet for Valve Operator where shown on Drawings: Complete with enclosed stem, extension, support brackets, and accessories for valve and operator.

1. Manufacturers and Products:
   a. Pratt.
   b. DeZurik.

E. Floor Stand where shown on Drawings:

1. Nonrising, heavy pattern, indicating type.
2. Complete with solid extension stem, coupling, handwheel, stem guide brackets, and yoke attachment. Stem length as required to connect valve operating nut and floor stand.
3. Stem Guide: Space such that stem L/R ratio does not exceed 200.
4. Anchor Bolts: Type 304 stainless steel.
5. Manufacturers and Products:
   a. Clow; Figure F-5515.
   b. Mueller, Figure A-26426.

F. Floor Box where shown on Drawings:

1. Plain type, for support of nonrising type stem.
2. Complete with solid extension stem, operating nut, and stem guide brackets. Stem length as required to extend valve operating nut to within 3 inches of finish floor.
3. Stem Guide: Space such that stem L/R ratio does not exceed 200.

4. Anchor Bolts: Type 304 stainless steel.
5. Manufacturers and Products:
    a. Neenah Foundry; R 7506.
    b. Clow; No. F5690.

G. Chain Wheel and Guide where shown on Drawings:

1. Handwheel direct-mount type.
2. Complete with chain.
3. Galvanized or cadmium-plated.
4. Manufacturers and Products:
    a. Clow Corp.; Figure F-5680.
    b. Walworth Co.; Figure 804.
    c. DeZurik Corp.; Series W or LWG.

H. Cast-Iron Valve Box where shown on Drawings: Designed for traffic loads, sliding type, with minimum of 5-1/4-inch ID shaft.

1. Box: Cast iron with minimum depth of 9 inches.
2. Lid: Cast iron, minimum depth 3 inches locking type, marked WATER, or SEWER.
3. Extensions: Cast iron.
4. Two-piece box and lid for valves 4 inches through 12 inches, three-piece box and lid for valves larger than 12 inches with base sized for valve.
5. Valve extension stem for valves with operating nuts 3 feet or greater below finish grade.
6. Manufacturers and Products:
    a. East Jordan Iron Works; Cast-Iron Valve Boxes.
    b. Bingham & Taylor; Cast-Iron Valve Boxes.

I. Concrete Valve Box: Designed for traffic loads, sliding type, with minimum of 10-inch ID shaft.

1. Box: High-density, reinforced concrete, minimum depth 12 inches, cast-iron ring seat.
2. Lid: Cast iron, minimum depth 3 inches, marked WATER or SEWER.
3. Extensions: Concrete.
4. Manufacturers and Products:
    a. Christy Concrete Products; G Series.
    b. BES Concrete Products; G Series.

J. Indicator Post Assembly:

1. Cast or ductile iron post head, bell, and wrench with cast or ductile iron or steel barrel.

2. Plexiglas or equal protected window to indicate OPEN and CLOSED position.
3. Padlockable eye bolt for wrench.
4. Adjustable bury depth. Bury depth as required for valve installation.
5. UL Listed and FM Approved.
6. Manufacturers and Products:
    a. Clow; Style 2945.
    b. Mueller; A-20806.

PART 3 EXECUTION

3.1 INSTALLATION

A. Flange Ends:

1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:

1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

C. PVC Valves: Install using solvents approved for valve service conditions.

D. Valve Installation and Orientation:

1. General:
    a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
    b. Install valves in location for easy access for routine operation and maintenance.
    c. Install valves per manufacturer's recommendations.
2. Gate, Globe, and Ball Valves:
    a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
    b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.
3. Eccentric Plug Valves:
    a. Unless otherwise restricted or shown on Drawings, install valve as follows:
        1) Liquids with suspended solids service with horizontal flow: Install valve with stem in horizontal position with plug up

when valve is open. Install valve with seat end upstream (flow to produce unseating pressure).

2) Liquids with suspended solids service with vertical flow: Install valve with seat in highest portion of valve (seat up).

3) Clean Liquids and Gas Service: Install valve with seat end downstream of higher pressure when valve is closed (higher pressure forces plug into seat).

4. Butterfly Valves:
   a. Unless otherwise restricted or shown on Drawings, install valve a minimum of 8 diameters downstream of a horizontal elbow or branch tee with shaft in horizontal position.
   b. For vertical elbow or branch tee immediately upstream of valve, install valve with shaft in vertical position.
   c. For horizontal elbow or branch tee immediately upstream of valve, install valve with shaft in horizontal position.
   d. When installed immediately downstream of swing check, install valve with shaft perpendicular to swing check shaft.
   e. For free inlet or discharge into basins and tanks, install valve with shaft in vertical position.
5. Check Valves:
   a. Install valve in accordance with manufacturer's instructions and provide required distance from immediate upstream fitting.
   b. Install valve in vertical flow (up) piping only for gas services.
   c. Install swing check valve with shaft in horizontal position.
   d. Install double disc swing check valve to be perpendicular to flow pattern when discs are open.
6. Solenoid Valves: Install in accordance with manufacturer's instructions.

E. Install line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

F. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

G. Extension Stem for Operator: Where depth of valve operating nut is 3 feet or greater below finish grade, furnish operating extension stem with 2-inch operating nut to bring operating nut to a point within 6 inches of finish grade.

H. Torque Tube: Where operator for quarter-turn valve is located on floor stand, furnish extension stem torque tube of a type properly sized for maximum torque capacity of valve.

I. Floor Box and Stem: Steel extension stem length shall locate operating nut in floor box.

3.2 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.

C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.

D. Count and record number of turns to open and close valve; account for discrepancies with manufacturer's data.

E. Set, verify, and record set pressures for relief and regulating valves.

F. Automatic valves to be tested in conjunction with control system testing. Set opening and closing speeds, limit switches, as required or recommended by Engineer.

G. Test hydrostatic relief valve seating; record leakage. Adjust and retest to maximum leakage of 0.1 gpm per foot of seat periphery.

3.3 MANUFACTURER'S SERVICES

A. All valves in this project require manufacturer's field services:

B. Manufacturer's Representative: Present at Site for minimum person-days listed below, travel time excluded:

1. Five person-days for installation assistance and inspection.
2. Three person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

END OF SECTION

SECTION 40 80 01
PROCESS PIPING LEAKAGE TESTING

PART 1 GENERAL

1.1 SUBMITTALS

A. Informational Submittals:

1. Testing Plan:
   a. Submit prior to testing and include at least the information that follows.
      1) Testing dates.
      2) Piping systems and section(s) to be tested.
      3) Test type.
      4) Method of isolation.
      5) Calculation of maximum allowable leakage for piping section(s) to be tested.
2. Certifications of Calibration: Testing equipment.
3. Certified Test Report.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PREPARATION

A. Notify Engineer in writing **10** days in advance of testing. Perform testing in presence of Engineer.

B. Pressure Piping:

1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
2. Wait seven days minimum after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 3 days.
3. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
4. New Piping Connected to Existing Piping:
   a. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.

C. Test section may be filled with water and allowed to stand under low pressure prior to testing.

D. Gravity Piping:

1. Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.
2. Pipe 42 Inches Diameter and Larger: Joint testing device may be used to isolate and test individual joints.

3.2 HYDROSTATIC TEST FOR PRESSURE PIPING

A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.

B. Exposed Piping:

1. Perform testing on installed piping prior to application of insulation.
2. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.
3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
4. Maintain hydrostatic test pressure continuously for 120 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
5. Examine joints and connections for leakage.
6. Correct visible leakage and retest as specified.
7. Empty pipe of water prior to final cleaning or disinfection.

C. Buried Piping:

1. Test after backfilling has been completed.
2. Expel air from piping system during filling.
3. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
4. Maintain hydrostatic test pressure continuously for four (4) hours minimum, reopening isolation valve only as necessary to restore test pressure.
5. Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.
6. Maximum Allowable Leakage:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

where:

L = Allowable leakage, in gallons per hour.
S = Length of pipe tested, in feet.
D = Nominal diameter of pipe, in inches.
P = Test pressure during leakage test, in pounds per square inch.

7. Correct leakage greater than allowable, and retest as specified.

3.3 PNEUMATIC TEST FOR PRESSURE PIPING

A. Do not perform on:

1. PVC pipe.
2. Piping larger than 24 inches.
3. Buried and other non-exposed piping.

B. Fluid: Oil-free, dry air.

C. Procedure:

1. Apply preliminary pneumatic test pressure of 25 psig maximum to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections; examine for leakage.
2. Correct visible leaks and repeat preliminary test until visible leaks are corrected.
3. Gradually increase pressure in system to half of specified test pressure. Thereafter, increase pressure in steps of approximately one-tenth of specified test pressure until required test pressure is reached.
4. Maintain pneumatic test pressure continuously for minimum of 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.
5. Correct visible leakage and retest as specified.

D. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.

E. After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to assure no explosive mixtures will be present in system during filling process.

3.4 HYDROSTATIC TEST FOR GRAVITY PIPING

A. Testing Equipment Accuracy: Plus or minus ½ gallon water leakage under specified conditions.

B. Maximum Allowable Leakage: 0.16 gallon(s) per hour per inch diameter per 100 feet. Include service connection footage in test section, subjected to minimum head specified.

C. Gravity Sanitary and Roof Drain Piping: Test with 15 feet of water to include highest horizontal vent in filled piping. Where vertical drain and vent systems exceed 15 feet in height, test systems in 15-foot vertical sections as piping is installed.

D. Exfiltration Test:

1. Hydrostatic Head:
   a. At least 6 feet above maximum estimated groundwater level in section being tested.
   b. No less than 6 feet above inside top of highest section of pipe in test section, including service connections.
2. Length of Pipe Tested: Limit length such that pressure on invert of lower end of section does not exceed 30 feet of water column.

E. Infiltration Test:

1. Groundwater Level: At least 6 feet above inside top of highest section of pipe in test section, including service connections.

F. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.

G. Defective Piping Sections: Replace**,** and retest as specified.

3.5 PNEUMATIC TEST FOR GRAVITY PIPING

A. Equipment:

1. Calibrate gauges with standardized test gauge provided by Engineer at start of each testing day. Engineer will witness calibration.
2. Install gauges, air piping manifolds, and valves at ground surface.
3. Provide pressure release device, such as rupture disc or pressure relief valve, to relieve pressure at 6 psi or less.
4. Restrain plugs used to close sewer lines to prevent blowoff.

B. Procedure:

1. Require that no person enter manhole where pipe is under pressure.
2. Slowly introduce air into pipe section until internal air pressure reaches 4 psi greater than average back pressure of groundwater submerging pipe.
3. Allow 2 minutes minimum for air temperature to stabilize.

C. Allowable Leakage: Test section will be considered defective when time required for pressure to decrease from 3.5 psi to 2.5 psi greater than average back pressure of groundwater submerging pipe is less than that computed using values from following table:

Table 1*

A Pipe Diameter (Inches)	B Time per Foot up to Length in Col C (Seconds)	C Test Length (Feet)	D Test Time for any Length Between Col C & E (Min:Sec)	E Length at Which Time in Col F Applies (Feet)	F Time per Foot for Total Length (Seconds)
4	0.18	636	1:54	1,114	0.10
6	0.40	424	2:50	743	0.23
8	0.71	318	3:47	557	0.41
10	1.11	255	4:43	446	0.63
12	1.60	212	5:40	371	0.91
15	2.50	170	7:05	297	1.42
18	3.62	141	8:30	248	2.06
21	4.92	121	9:55	212	2.81
24	6.42	106	11:20	187	3.67

Example: 15-inch diameter pipe:
For 150 feet, T = 2.50 sec (Col B) x 150 ft = 375 sec = 6:15
For 250 feet, T = 7:05 (Col D)
For 500 feet, T = 1.42 sec (Col F) x 500 ft = 710 sec = 11:50

*Based on 0.003 cfm per square foot with a minimum significant loss of 2 cfm and a maximum loss of 3.5 cfm.

D. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.

E. Defective Piping Sections: Replace and retest as specified.

3.6 FIELD QUALITY CONTROL

A. Test Report Documentation:

1. Test date.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, including:
   a. Leaks (type, location).
   b. Repair/replacement performed to remedy excessive leakage.
6. Signed by Contractor and Engineer to represent that test has been satisfactorily completed.

END OF SECTION

SECTION 40 90 00
INSTRUMENTATION AND CONTROL

PART 1 GENERAL

1.1 WORK OF THIS SECTION

A. The Work of the following Divisions and Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Section 01 33 00, Submittal Procedures.
2. Division 26, Electrical.
3. Division 40, Process Integration.

B. The Work of this Section includes the general specification and requirements for the Instrumentation and Control (I&C) Work under this, and other applicable Specifications, including providing instrumentation and all related wiring as shown in these Contract Documents and Drawings. Detailed scope, and quantities are shown in Section 40 90 03, General Requirements, and Section 40 90 07, Scope of Work.

C. The Contractor shall be responsible for the design, procurement, installation, testing, training, and documentation for I&C systems provided under this Contract in accordance with this Section and Section 40 90 07, Scope of Work. A Distributed Control System (DCS), when applicable, as specified in Section 40 90 03, General Requirements, will be provided by the City's DCS provider, Emerson Process Management (EPM). The Contractor shall be responsible for terminating and integrating all I&C equipment with the EPM DCS systems.

1.2 SCOPE

A. The intent of this Section is that the Contractor will provide a complete and operational, turn-key, integrated I&C system, including all instrumentation and equipment as shown on Drawings and as specified herein.

B. The Contractor shall furnish all materials, tools, equipment, consumables and supplies and shall perform all labor required to complete the work in this Section.

1.3 REFERENCE, CODES AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
2. API RP-550, Manual on Installation of Refinery Instruments and Control Systems, Part 1 - Process Instrumentation and Control Sections 1 through 13.
3. ASTM A105, Specification for Forgings, Carbon Steel for Piping Components.
4. ASTM A193, Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service.
5. ASTM A194, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.
6. ASTM A283, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars.
7. ASTM A312, Stainless Steel Piping.
8. ISA-RP60.6, Nameplates, Labels, and Tags for Control Centers.
9. ISA-RP7.1, Pneumatic Control Circuit Pressure Test.
10. ISA-RP12.6, Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations.
11. ISA-S5.1, Instrument Symbols and Identification.
12. ISA-S5.4, Instrument Loop Diagrams.
13. ISA-S12.4, Instrument Purging for Reduction of Hazardous Area Classification.
14. ISA-S20, Specification Forms for Process Measurement and Control Instrumentation; Primary Elements and Control Valves.
15. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
16. ANSI/AWWA C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 In Through 144 In.
17. ANSI/AWWA C701, Cold-Water Meters - Turbine Type for Customer Service.
18. ANSI/AWWA C702, Cold-Water Meters - Compound Type.
19. AWWA C704, Cold-Water Meters - Propeller Type for Main Line Applications.
20. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
21. ASTM B61, Specification for Steam or Valve Bronze Castings.
22. ANSI/AWWA, Ductile-Iron and Gray-Iron Fittings, 3-In Through C110/A21.10 48-In for Water and Other Liquids.
23. ASME REPORT Fluid Meters, Sixth Edition, 1971.

B. Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. Uniform Fire Code.
2. National Electrical Code: NFPA 70
3. National Fire Protection Association: NFPA 70E.

C. UL: All I&C and instrument equipment furnished in this Section shall be listed by and shall bear the label of UL or of an independent testing laboratory acceptable to the City of San Diego (City).

D. No exposed voltage that would require PPE or work permits will be allowed.

1.4 SUBMITTALS

A. General:

1. All submittals shall be provided in accordance with Section 01 33 00, Submittal Procedures, as a minimum, and in accordance with specialty submittal requirements below.
2. All submittal of this section shall be provided with six hard copy and one soft copy [CD].
3. Submittals of this section shall be in Adobe Acrobat PDF format, unless otherwise specified. Vendor and Contractor shop drawings developed under this section shall be in Bentley Microstation (.dgn) format, utilizing monochrome.
    a. Documents not available in electronic format shall be scanned at 600 dpi, black and white) for documents without graphics, or color for documents with graphics and converted to Adobe Acrobat (PDF).
4. Operations and Maintenance (O&M) Submittal Requirements of this Section:
    a. Preliminary Submittal: Where required by Specification, two hard copies, and one PDF of the preliminary submittals shall be provided to the City's representative for review.
    b. Final Submittal: All Submittal documents in this section, including design and O&M documents, shall be provided on two CD's; One CD shall provide documents in native format (e.g. Microstation, MS Word, MS Excel, etc.), and the other CD shall provide documents in PDF format. Both CD shall use the same file naming convention, except that the suffixes shall be different (e.g. PDF, XLS, etc.).
    c. Each document shall be indexed, and a database table in Excel shall be provided, which includes the following data for each document:
        1) Document file name.
        2) Document description.
        3) Hard Copy Catalog No. (used by facility document coordinator).
        4) Document Type:
            a) Shop Drawings:
                (1) P&IDs.

(2) Loop Drawings.
(3) Instrument Data Sheets.
(4) Other.

b) Manufacturer's data.
c) Maintenance instructions.
d) Training.

5) Facility Name.
6) Specification Number.
7) Process Name.
8) Unit Process Number.

d. Provide a 4 set of CDs/USB drive containing PCM software, HMI screens and all Emerson provided files to maintain and update DCS.

e.

B. Presubmittal Conference:

1. The Contractor shall arrange and conduct a Presubmittal Conference within 60 days after award of the Contract. The purpose of the Presubmittal Conference is to review and approve the manner in which the Contractor intends to carry out Contractor's responsibilities for shop drawing submittal on the Work to be provided under this Section. The Contractor and the City Representative shall attend. Both the Contractor and the City Representative may invite additional parties at their discretion.
2. The Contractor shall allot a minimum of two 8-hour days for the Conference.
3. The Contractor shall prepare the following for discussion at the Conference:
   a. List of equipment and materials for the instrumentation and I&C systems, including proposed manufacturer names and model numbers.
   b. List of proposed clarifications to the indicated requirements plus a brief written explanation of each exception. Review and acceptance of proposed clarifications will be according to Section 01 33 00, Submittal Procedures.
   c. One complete example of each type of submittal proposed.
   d. A flow chart showing the steps the Contractor will take in preparing and coordinating each submittal to the City's Representative.
   e. A Gant-Chart type schedule for the Work provided under this Section, covering the time period beginning with the conference and ending after startup and acceptance. Dates for the beginning and ending of submittal preparation, submittal review periods, design, fabrication, programming, factory testing, delivery to the site, installation, field testing, and training shall be scheduled. The

schedule shall be subdivided into major items or groups of items which are on the same schedule.

4. The Contractor shall take formal minutes of the Presubmittal Conference, including all events, questions, and resolutions. Minutes shall be distributed to the City's Representative within 48 hours after the meeting.
5. The Contractor shall prepare a formal 'sign-in sheet for the pre-submittal meeting that captures the name, telephone number, affiliation/title and email address for each participant. Contractor shall deliver a copy of the sign-n sheet with the 'Minutes' as required above.

C. Informational Submittals:

1. Submittal List: The Contractor shall develop and deliver a detailed list of all submittals required by the specification, as well as all additional Submittal he/she envisions. This should be inclusive of Instruments and I&C hardware, software, reports, plans, status of schedules, testing documents and relevant maintenance documentation and forms.
2. I&C Schedule: Within 60 days of Contract NTP the Contractor shall develop and deliver a detailed base-line schedule for the Instrumentation and I&C disciplines of the Project. The base-line schedule shall reference each submittal shown on the 'Submittal List', as well as all design, engineering, fabrication, delivery, installation, testing and acceptance elements related to Instrumentation and I&C Work.
    a. The base-line schedule shall be prepared utilizing Primavera P6, or other project controls software standards that the city may direct.
    b. The base-line schedule shall ensure that each activity is tied to all appropriate predecessor(s) and successor(s) activities.
    c. 'Float' contained within the schedule shall be 'owned' by the City. Contractor utilization of schedule float is at the discretion of the City and the City may, at its sole discretion, require 'schedule recovery' efforts to regain float, to maintain Project delivery, if the City deems Contractor use of the float as deleterious to the Project.
    d. Contractor shall allocate a minimum of 1 day to present and explain the base-line schedule to the City's representative.
    e. The City will review, and approve, the Contractor's base- line schedule, and Contractor shall not proceed with any of the Work of this section until he has obtained Instrumentation and I&C schedule approval.
    f. The 'approved' base-line schedule shall be 'statused' and submitted to the City, no later than the fifth workday of each month, following the Work status period.

3. Shop Drawings: The Contractor shall submit a sample of each ‘type’ of Shop Drawing that Contractor anticipates for the Project.
4. Loop Drawings: The Contractor shall submit a sample for each ‘type’, Analog, Discrete and Foreign Device Interface (Data link), Loop Drawings.
    a. The Sample Loop Drawings will utilize a City Standard format which will be provided to the Contractor after Contract NTP. The loop drawing and DCS standards are available on the City’s website under the Clean Water Operations Management Network (COMNET) Project Standards and Procedures Manual webpage. The purpose of this is to prove that the Contractor understands the various steps necessary to deliver a final, as- constructed, set of Loop Drawings to the City.
5. Training Submittal: The Contractor shall submit a sample of a training syllabus, and his training Plan for each piece of Instrumentation and I&C and DCS system components and software.

D. Action Submittals:

1. General: The Contractor shall be responsible for providing instrument and I&C Submittals to be used in the generation of control-panel wiring diagrams and Loop Drawings which depict the interconnection between instruments, panels, valve actuators, MCCs, and the DCS.
2. Shop Drawings:
    a. Preparation of Shop Drawings shall not commence until completion of the Presubmittal Conference.
    b. Preliminary Shop Drawings shall be submitted as a single package at one time not later than 90 days after NTP.
    c. All systems, meters, instruments, and other elements shall be represented by symbology derived from the latest version of ANSI/ISA S5.1 and in accordance with Contract Documents and Drawings. The ISA nomenclature and numbers indicated herein shall be used exclusively in all Shop Drawings. No manufacturer's standard symbology or nomenclature shall replace those indicated in the Contract Documents.
    d. During Shop Drawing development, the Contractor shall maintain a direct, informal liaison with the City’s Representative, identified at the presubmittal conference, for exchange of technical information. As a result, certain minor refinements and revisions to the indicated systems may be authorized informally by the City’s Representative. However, these shall not alter the Work of this section and shall not cause increase or decrease in the Contract Price. No statement or direction by the City’s Representative shall be construed as approval of any component or method, or exception to, or deviation from these Contract Documents.

e. All Shop Drawings shall include the letterhead or title block of the Contractor. The title block shall include, as a minimum, the Contractor registered business name and address, project name, drawing name, revision level, and personnel responsible for drawing development and the name of the QA/QC reviewer.
    1) Shop drawing copies shall be submitted as standard size 3-ring, loose-leaf, vinyl plastic binders suitable for bookshelf storage.
    2) A complete index shall be placed at the front of each binder. All sections indexed shall be separated by Alpha-Numeric Tabs that match the index.
    3) A separate technical brochure or bulletin shall be included for each instrument, meter system, and other element. The brochures shall be indexed by systems or loops. If, within a single system or loop, a single item is employed more than once, one brochure may cover all identical uses of that item in the system. Each brochure shall include a list of tag numbers to which it applies. System groups shall be separated by labeled tags.

3. Loop Drawings:
    a. Contractor is responsible for the overall development, coordination efforts and final delivery of Loop Drawings. Special requirements are outlined below.
    b. Loop Diagrams: Loop diagrams shall be submitted in accordance with Section 01 33 00, Submittal Procedures, and the special requirements of this section. All Loop Drawings will conform to ISA 5.4 to verify DCS interface with all instrumentation and devices provided or installed under the project. The loop diagrams shall also define all interfaces with equipment provided by skid-mounted for Foreign Device interfaces.
    c. Loop Drawings shall be developed utilizing a three-sheet format. A sample of the City's Standard three-sheet format will be provided to the Contractor after NTP. The following three- sheet format is required:
        1) Sheet 1: Provide a device schedule developed from an electronic spreadsheet or database file, which will be submitted with the loop diagrams. The table will show the following:
            a) Device tag number, with Prefix, Unit Process, ISA Tag Prefix, Tag No. (a three or four-digit number based on the loop number) and Tag suffix.
            b) Equipment Service.
            c) Device Type.
            d) Location.
            e) Device Manufacturer.

f) Model No.
g) Spec. No.
h) Area Contractor (if applicable.
i) Submittal No.
j) Calibrated Range/Remarks.
k) Data Sheet No.
l) I/O Signal type (AI, AO, DI, or DO).
m) Signal Level.
n) Device Range (full available instrument range).
o) Engineering Units.
p) Process Set Point.
q) Loop Diagram No., reflecting the field instrument tag number.
r) Loop Drawing File Name.
s) Interconnect Drawing File Name.

2) Sheet 2: Loop Drawing meeting the Requirements of ANSI/ISA S5.4, except that intermediate terminal junction boxes may be omitted, and shall be shown on Page 3 for clarity. Butt splices and wire nuts shall be shown on as-builts, with the corresponding termination housing (JB, LB, etc. shown on Sheet 3. Datalinks, third-party I/O, and bus connections shall also be shown.
3) Sheet 3: (Expansion sheet - required if the number of intermediate devices or terminal junction boxes exceeds what can be legibly shown on Sheet 2). Abbreviated diagram showing instrument, wire and cable numbers, intermediate terminal junction boxes, and PCM terminations. Wire identification numbers will reflect the field instrument tag number, and not the DCS I/O number.
4) DCS I/O tag numbers will generally reflect the device tag number. Each I/O tag number will be unique. The tag prefix will be based on ISA-5.4, with the following additional special acronyms:

Acronym	Signal Use
YL	Ready Signals/ Status
ZL	In Computer status
ZSO	Device Open
ZSC	Device Closed
YL	Motor Run
HS	Equipment Start/Stop

d. The Contractor in concert with his I&C subcontractor shall be responsible for the preliminary development of all Loop

Drawings, in the format specified. The Contractor will develop a 'draft' of each loop drawing.

e. The Contractor will then coordinate with the DCS Controls Programmer (DCSCP), delivering draft loop drawings to the DCSP, who shall be responsible to filling out all the DCS-related addressing, software level Information, DCS termination numbering, etc.

f. The Contractor will then receive the draft loop drawings from the DCSP, and the Contractor shall finalize all Loop Drawings in Microstation. Contractor shall ensure that all 'as- constructed' information (such as I/O wiring being re-addressed at the DCS) has been incorporated onto the finalized loop drawings.

g. The Contractor shall deliver the finalized loop drawings to the project Design Engineer. The Design Engineer is responsible for Quality Assurance/Quality Control of the final loop drawings, and shall check all loop drawings against design P&IDs, electrical design, and Contractor's field as-constructed drawings. Contractor is responsible for all co-ordination with the Design Engineers and shall incorporate all changes and corrections required by the Design Engineer.

h. Contractor shall prepare and deliver all loop drawing packages in accordance with these specifications. Note: All Loop Drawings shall be submitted to the City's representative, prior to the start of any DCS cutover.

i. The City's representative will review and approve the Loop Drawing Submittal in accordance with Section 01 33 00, Submittal Procedures. The Contractor is responsible for making all changes and annotation to the final loop drawings, as may be dictated during the various testing procedures. Red-line mark-up of all annotated loop drawings shall be delivered to the City's representative at the conclusion of DCS testing activities.

4. Instruments and I&C Devices: For all Instruments and I&C devices provided under this section Contractor shall submit Technical brochures, bulletins and data sheets containing:

   a. Fully completed ISA S20 data sheets.
   b. Component functional descriptions.
   c. Locations or assembly at which component is to be installed.
   d. Materials of a component's parts which will be in contact with process fluids or gases.
   e. Instrument Factory Calibration Sheets: Where an instrument is of necessity, precalibrated at the factory, the Contractor shall submit all Factory Calibration Sheets to the City's representative immediately upon arrival.
   f. Instrument Bench Calibration Sheets: Contractor shall submit the calibration plan for bench calibration of each type of instruments.

Upon approval of the Bench Calibration Plant by the City, Contractor shall coordinate and commence Bench Calibration of all instruments, other than those containing Factory Calibration. Bench Calibration of Instruments will be witnessed by the City's representative, who may at his sole discretion, provide Contractor a waiver of witnessing. Upon completion of bench calibration Contractor shall submit Calibration Sheet documentation and shall affix calibration stickers to each instrument, indicating date of calibration and initials of person performing calibration.

5. Panels, Local Control Panels. Contractor shall supply:
   a. Schematic and wiring diagrams for control circuits shall be submitted in two stages. Initially, schematic control diagrams shall show complete details on the circuit interrelationships of all devices within and outside each Control Panel. Subsequent to acceptance of all schematic control diagrams, by the City's representative, piping and wiring diagrams shall be submitted. The diagrams shall consist of component layout drawings to scale, showing numbered terminals on components together with the unique number of the wire to be connected to each terminal.
   b. Piping and wiring diagrams shall show terminal assignments from all primary measurement devices, such as flow meters, and to all final control devices, such as pumps, valves, chemical feeders and local control panels. Wiring diagrams shall include MCC Panel, circuit, and breaker number for each power feed.
   c. Assembly and construction drawings for each Panel and Local Control Panel type. These drawings shall include dimensions, identification of all components, surface preparation and finish data, and nameplates. These drawings also shall include enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly; a finish treatment sample shall be included.
   d. Installation, mounting, and anchoring details for all components and assemblies to be field-mounted, including conduit connection or entry details. Where applicable and required by Code, Contractor shall include seismic calculations for the panel assembly and mounting, which shall be stamped by a California registered structural engineer.
   e. Complete control panel layouts, all drawn to a 1-1/2 inch equals 1 foot scale showing.
      1) Physical arrangements which define and quantify the physical groupings of annunciators, hand-stations, recorders, indicators, pilot lights and all other instrumentation devices associated with control panel sections, auxiliary panels, subpanels and racks.
      2) All cutout locations fully dimensioned. All outside panel dimensions shall be shown.

3) Locations of back-of-panel stiffeners.
4) Terminal point locations for all panel and back-of-panel piping and wiring connections. Terminations shall be coded with identifiers for wiring and piping connections for all electric, hydraulic and pneumatic terminations.

f. Contractor shall submit a complete Nameplate engraving list, annotating the size of each engraved plate, the material, font size, color and attaching methodology. [Note: Adhesive-backed mount is to be avoided, except in those cases where screw mounting is not possible.

g. A complete and detailed bill of material list shall be submitted for each field mounted device or assembly as well as cabinet assemblies and subassemblies. Bills of material shall include all items within an enclosure. An incomplete submittal shall be rejected and no further evaluation performed until a complete and detailed bill of material is submitted.

1.5 OWNER'S MANUAL

A. The Owner's Manual shall be submitted in both paper and electronic format. Electronic format shall conform to the Electronic Document Submittal Requirements for Shop Drawings.

B. Information included in the Owner's Manual shall comply with the requirements of Section 01 33 00, Submittal Procedures, with the following exceptions:

1. Two copies of the Owner's Manual shall be submitted after acceptance of all submittals. One set will be returned to the Contractor with comments.
2. Final copies of the Owner's Manual, after revision, shall be submitted to the City's representative 15 days prior to startup.

C. The following shall be included in the Owner's Manual in accordance with Section 01 33 00, Submittal Procedures.

1. Installation, connection, operating, troubleshooting, maintenance, and overhaul instructions from the manufacturer.
2. Exploded or details views of all instruments, assemblies, and accessory components.
3. Parts lists and ordering instructions.
4. Wiring diagrams.
5. A list of spare parts for 1 year operation recommended by the manufacturers of all DCS and analog equipment.
6. As-Built Drawings.

1.6 AS-BUILT DRAWINGS

A. As-built drawings shall be prepared in accordance with Section 01 33 00, Submittal Procedures, with the following exceptions and changes:

1. The Contractor shall keep current an approved set of complete loop diagrams and schematic diagrams which shall include all field and panel wiring, all piping and tubing runs, all routing, all mounting details, all point-to-point diagrams with cable, wire, tube and termination numbers. These drawings shall include all instruments and all instrument elements for the complete instrument loop as provided under equipment and electrical requirements of this Contract.
2. Two copies of each as-built drawing under this Section shall be submitted to the City's representative after completion of field checkout but before placing the systems in service for the Owner's use.
3. Drawings shall also be submitted in electronic format (Microstation) and in PDF.

1.7 SERVICES OF MANUFACTURER

A. Calibration, Testing and Startup: A technical service representative of the manufacturer shall visit the site and perform the following on all flow meters and analyzers.

1. Inspection, checking and calibrating the equipment.
2. Startup and field testing for proper operation.
3. Performing field adjustments to ensure that installation and operation comply with the Specifications.

B. Instruction of Owner's Personnel: The manufacturer's technical service representative shall instruct the Owner's personnel as indicated in Article Installation, Calibration, Testing, Precommissioning, Startup and Instruction.

1.8 SPECIAL GUARANTEE

A. The Contractor shall guarantee the Work of this section for 2 years following final acceptance of the Work. In making any warranty repairs, the Contractor shall utilize technical service personnel designated by the manufacturer of the failed device. Repairs shall be completed within 5 days after written notification by the Owner.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Products delivered to the site for incorporation into the Work of this Section shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

1.10 ENVIRONMENTAL CONDITIONS

A. General: All instrumentation and control system components and associated wiring shall be suitable for use in a treatment facility environment where there may be high energy ac fields, dc control pulses, and varying ground potentials between transducers and system components. The system design shall be adequate to provide proper protection against interferences from all such possible situations.

B. Field Situated Equipment: All devices shall be designed to exist in environments rated (G2)(G3)(GX) per ISA S71.04. The system design shall be adequate to provide proper protection the environment typically associated with these facilities. As a minimum, the instrumentation and control systems shall be designed and constructed for satisfactory operation and low maintenance requirements under the following environmental conditions:

1. Temperature Range: 0 through 50 degrees C (32 through 122 degrees F).
2. Thermal Shock: 0.55 degrees C per minute (1.0 degrees F per minute).
3. Relative Humidity: 20 percent through 95 percent (noncondensing).

C. Control Room Situated Equipment: Control rooms shall be air conditioned to achieve the environmental noted in item B herein. (No positive control of relative humidity is provided.) In the event of a failure of the air conditioning system, all components of the instrumentation and control system shall be rated to operate in an environment where the ambient temperature is 15 degrees C through 35 degrees C (59 degrees F through 95 degrees F) and the relative humidity is 20 percent to 95 percent (noncondensing).

D. Noise Tolerance: The instrumentation and control system components shall not exceed a dB level of 55 when monitored 3 feet away from the devices. If upon testing it is found that this limit is exceeded at the option of the City's representative and at no additional cost to the Owner, devices shall be replaced in order to achieve a maximum level of 55 dB or sound absorption materials shall be added.

1.11 CABLE NUMBERING

A. The first two characters denote the facility or area number.

B. The second group of characters identifies the device being served (field device).

C. The third section uses one of the four suffixes in the table below. Where multiple circuits of the same type are routed to the same endpoint, the suffix will be P1, P2, as required.

D. At each device or termination point, the circuit identification number is appended with the individual wire number. For Direct-Current (DC) circuits only, wire polarity is shown in parentheses as (+) or (-).

E. Spaces are not allowed, and letters are case-sensitive, written in upper case.

Suffix	Circuit Type	Example
(A)	24V dc analog (4 to 20 mA)	01FIT022(A)-1(+)
(C)	120V ac control	05P320(C)-2
(D)	24V dc digital status or control	55LSH201(D)-1(+)
(P)	Power (120-volt, 480V, 5 kV, 15 kV, etc.)	01MCC6101(P)-2

PART 2 PRODUCTS

2.1 GENERAL

A. All meters, all instruments, and all other components shall be of the most recent field- proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise indicated.

B. Panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be of one manufacturer.

C. Outdoor instrumentation shall be suitable for operation in the ambient conditions at the equipment installation locations. Heating, cooling, and dehumidifying devices shall be incorporated with the outdoor instrumentation in order to maintain it within its rated environmental operating ranges. The Contractor shall provide all power wiring for these devices. Outdoor enclosures suitable for the environment shall be provided.

D. All instrumentation in hazardous areas shall be intrinsically safe or be approved for use in the particular hazardous classification in which it is to be installed.

E. Mercury switches and components containing liquid mercury shall not be used.

F. Analog measurements and control signals shall be electrical and shall vary in direct linear proportion to the measured variable, except as indicated.

G. Electrical signals outside control board(s) shall be 4 mA dc to 20 mA dc except as noted. Analog instruments shall be provided with Highway Addressable Remote Transducer (HART) Protocol.

H. The accuracy of each instrumentation system or loop shall be expressed as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracies" of the designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of plus or minus 0.5 percent of full scale and a minimum repeatability of plus or minus 0.25 percent of full scale unless otherwise indicated. Instruments which do not conform to or improve upon these criteria are not acceptable.

I. Control panels shall be provided with redundant power supplies which are configured in a fault-tolerant manner to prevent interruption of service upon failure and interruption of service necessitated by the replacement of a power supply. All power supplies shall have an excess rated capacity of 40 percent. The failure of a power supply shall be annunciated locally and shall generate an alarm to the DCS.

2.2 CONTROL PANELS

A. General: Control Panels shall minimize the use of PLC's as it is the intent of the City to maximize the use of the DCS as the primary control system. PLC's may be used where 'package system' vendors require PLC use to provide warranty and support of their system. Where PLC's are utilized, they shall conform to the Allen Bradley ControlLogix or CompacLogix standards of the City.

1. When PLCs are utilized the Contractor shall interface the 'Package system' PLC to the DCS via TCP/IP using the Ethernet I/P protocol or Modbus protocol.

B. Control Panels shall be provided in accordance with Section 40 95 13 – Field Cabinetry.

2.3 GENERAL INSTRUMENTATION ENCLOSURE COMPONENTS

A. Signal Isolators, Converters, and Power Supplies: Signal isolators shall be provided in each measurement and control loop, wherever required, to match adjacent component impedances, or where feedback paths may be generated or to maintain loop integrity when the removal of a component of a loop is required. Signal converters shall be provided where required to resolve any signal incompatibilities. Signal power supplies shall be provided to supply sufficient power to each loop component.

B. General Purpose Relays: General purpose relays in the Control Panels shall be plug-in type with contacts rated 10 amperes at 120V ac; quantity and type of contacts shall be as indicated. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover. Sockets for relays shall have screw type terminals.

C. Time Delay Relays: Time delay relays shall be electronic on-delay or off-delay type with contacts rated 10 amperes at 120V ac. Units shall include adjustable dials with graduated scales covering the indicated time range.

D. Slave Relays: Slave relays shall be provided when the number or type of contacts indicated exceed the contact capacity of the indicated relays and timers.

E. Circuit Breakers: Circuit breakers shall be single pole, 120-volt, 15-ampere rating or as required to protect wiring and equipment. Circuit breakers shall be mounted inside the panels as shown.

2.4 FIELD INSTRUMENTATION

A. Provide components that are listed in the Instrument List in Article Supplements at the end of this Section. Specific component requirements are defined in the Instrument Data Sheets at the end of this Section.

B. First Named Manufacturer: I&C design is based on the listed first names manufacturers of equipment, materials, and software.

1. If an item is proposed from other than first named manufacturer, obtain approval from Engineer for such changes.
2. If proposed item requires, but not limited to, different installation, wiring, raceway, enclosure, intrinsically safe barriers, and accessories, provide such equipment and work.

2.5 CONTROL PANEL INSTRUMENTATION

A. Digital Indicators:

1. Digital indicators shall be self-contained instruments that display process signals directly in engineering units. The unit shall be suitable for panel mounting and shall utilize an LED display where numerals are no less than 0.5 inch height.
2. The input signal to the digital process indicator shall be 4 mA to 20 mA dc or 1 to 5V dc. The input sample rate of the unit shall be a minimum of 2 per second. The unit shall have an auto-zeroing feature and shall have provisions for field adjustable scaling and offset. Accuracy shall be plus or minus 1 least significant digit. Input power to the digital indicator shall be 120V ac, 60-Hz.

B. Current Alarm Trip Switches: Current alarm trips shall be single or dual type as indicated. Units shall accept voltage or current input signals. Dead bands shall be factory set at 1.0 percent of full span for dual trips and adjustable over 100 percent of span for single trips. Alarm trips shall be equipped with 10A DPDT contacts. Alarm trips shall include setpoint dials calibrated 0 percent to 100 percent for each trip point. Single alarm trips shall include a dead band adjustment dial calibrated 0 percent to 100 percent.

C. Selector and Pushbutton Switches: Selector and pushbutton switches shall be rated 10A at 600 volts, shall be heavy-duty, oil-tight, and shall have the number of positions and poles indicated. Operators shall be corrosion resistant.

D. Indicating Lights: Indication lights shall be incandescent push-to-test type and shall be heavy-duty, oil-tight. Each light shall have a screwed-on glass prismatic lens approximately 1-inch in diameter. Each light shall have a factory-engraved legend plate as indicated. Indicating lights shall be 120V ac type with transformers for use with 6.3-volt lamps.

2.6 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. Where required, the Contractor shall furnish, install, program, test, calibrate, fully configure and place into operation Programmable Logic Controllers (PLCs) as specified herein. These requirements also pertain to all PLCs provided under package system specifications and within the electrical specifications.

B. The PLC's shall be in compliance with Specification Section 40 94 43 – Programmable Logic Controllers.

C. General: The Contractor shall furnish all necessary interconnecting cables, all accessories, and all appurtenances as indicated herein or as required for proper operation of the system. All major PLC components of the system shall be of the same manufacturer and PLC family product line. All equipment shall be housed in an enclosure or control panel suitable for the intended operation and location. The PLC system shall be capable of tolerating and capable of riding through a power interruption of 8 milliseconds or less without interruption of normal operation. The PLC system shall be Allen Bradley Controllogix or Compactlogix to match existing.

PART 3 EXECUTION

3.1 INSTALLATION

A. The Contractor shall employ installers who are skilled and experienced in the installation and connection of all elements, all instruments, all accessories, and all assemblies provided under this Contract.

B. The Contractor shall install all instruments according to the manufacturer's installation instructions and the following:

1. Perform field engineering as required for mounting and supporting all field mounted components.
2. Prepare any additional schematic and interconnection diagrams required for installation.
3. Assemble and interconnect instrument components disconnected for shipping purposes.
4. Remove all temporary supports, bracing, and padding inserted in instrument control panels and other equipment to prevent damage during shipping, storage, or installation.
5. All piping shall be field measured prior to fabrication and erection. Any significant discrepancies between drawings and field conditions shall be reported to the City's representative. The Owner will not be responsible for any costs to the Contractor for rework because of Contractor failure to take measurements prior to fabrication.
6. Adequately support and protect capillary tubing. All extra tubing shall be carefully coiled, tied, and protected at the instrument location.
7.

C. It is the intent of the Contract Documents that all wiring external to Control Panels be provided under the requirements of Division 26, Electrical. Further, it is the general intent that all 4 mA to 20 mA signal circuits, process equipment control wiring, signal wiring to field instruments, and Control Panel input and output wiring, be provided under Division 26, Electrical and be terminated and identified under Division 40, Process Integration.

D. The Contractor's attention is directed to the electrical and mechanical schematics and details of this project. Referral to these portions of the Contract Documents shall be required in order to understand the full intent and scope of work required.

E. Monitoring and control system configurations are diagrammatic only. Locations of equipment are approximate unless dimensioned on Drawings. Exact locations and routing of wiring and cables shall be governed by structural conditions, physical interferences, and locations of electrical terminations on equipment.

F. Where job conditions require minor changes in approximated locations and arrangements, the Contractor shall make such changes without additional cost to the Owner.

G. All instruments shall be located and installed for ready access by the Owner's operation and maintenance staff. The Owner reserves the right to require minor changes in location of equipment prior to roughing without any additional cost to the Owner.

H. Meters shall be installed in easily accessible locations and orientated for ease of reading and maintenance, and where shown, for balancing flow. Wherever possible, meters shall be inserted in such a way to comply with the manufacturer's recommendations. Meters, shut-off and balancing valves shall be properly supported. In-line meters shall be installed to ensure full-line flow and not less than the manufacturer's recommended head at all times.

3.2 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring Installation: All wires shall be in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing-out panel to components on the fixed structure, and (4) wiring to panel-mounted components. Wiring from components on a swing-out panel to other components on fixed panels shall be tied into bundles with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

B. Wiring to control devices on the front panels shall be tied together at short intervals with nylon wire ties and secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

D. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be permanently marked heat-shrink plastic. See the sample loop diagrams for details of wire marking.

3.3 INSTRUMENT CABLE TESTS

A. General: The following tests shall be performed on each instrumentation and control system cable. All tests shall be end-to-end tests of installed cables with the ends supported in free air, not adjacent to any grounded object. All test

data shall be recorded on forms which are available from the City's representative. Complete records of all tests shall be made and delivered to the City's representative. Each form shall be signed by the City's representative who witnessed the testing.

B. Continuity tests shall be performed by measuring wire/shield loop resistance of each signal cable as the wires, taken one at a time, are shorted to the channel shield. No loop resistance measurement shall vary by more than plus or minus 2 ohms from the calculated average loop resistance value.

C. Insulation resistance tests shall be performed by using a 500-volt megometer to measure the insulation resistance between each channel wire, between each channel wire and the channel shield, between individual channel shields in a multichannel cable, between each individual channel shield and the overall cable shield in a multi-channel cable, between each wire and ground, and between each shield and ground. Values of resistance less than 1 megohms shall be unacceptable.

3.4 INSTALLATION, CALIBRATION, TESTING, PRECOMMISSIONING, STARTUP AND INSTRUCTION

A. Installation and Connection: The Contractor shall install and connect all field-mounted components and assemblies under the following criteria:

1. Process sensing lines and air signal tubing shall be installed to the installation of conduit indicated under Section 26 05 33, Raceways and Boxes. Individual tubes shall be run parallel and near the surfaces from which they are supported. Supports shall be used at intervals not longer than 3 feet of tubing.
2. Bends shall be formed with the proper tool and to uniform radii and shall be made without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square-cut and cleaned before insertion into fittings. Bulkhead fittings shall be provided at all panels requiring pipe or tubing entries.
3. All flexible cables and all capillary tubing shall be provided in flexible conduits. Lengths shall be sufficient to withdraw the cables and tubing for periodic maintenance.
4. Thermocouple lead wire shall be provided in dedicated conduit or wireway from the thermocouple to the control panel. Conduit or wireway shall be sized in accordance with the capacity of the instrument.
5. All power and all signal wires shall be terminated with spade type lugs.
6. All connectors shall be, as a minimum, watertight.
7. After all installation and connections have been completed, a technical field representative of the Contractor shall check the Work for polarity

of electric power and signal connections, leaks at all process connections, and conformance with requirements. The technical field representative shall certify in writing to the Contractor that each loop and system meets requirements.

8. All wire and all cable shall be connected from terminal to terminal without splices, arranged in a neat manner and securely supported in cable groups. All wiring shall be protected from sharp edges and corners.

B. Calibration: All analog instrumentation and all control system equipment shall be calibrated and tested after installation to verify that requirements are satisfied. The Contractor shall provide all necessary labor, tools, and equipment to calibrate and test each instrument in accordance with the manufacturer's instructions. Each instrument shall be calibrated at a minimum of three points using test equipment to simulate inputs and read outputs. All test equipment and all instruments used to simulate inputs and read outputs shall be suitable for the purpose intended and shall have an accuracy better than the required accuracy of the instrument being calibrated. Test equipment shall have accuracies traceable to the NIST as applicable. All analog instruments shall be calibrated and tested in place without removal. Test data, applicable accuracy requirements, all instrument manufacturer published performance specifications and all permissible tolerances at each point of calibration shall be entered on test forms available from the City's representative. These test forms shall verify compliance with all. A report shall be delivered to the City's representative for each instrument, certifying that the instrument has been calibrated in the presence of the [City's representative and meets contract and system requirements.

C. Analog Loop Tests: The Contractor shall be responsible for loop checking and testing all instrumentation loops with this project. The Contractor shall coordinate all loop check functions with the CSP to ensure that a single total loop check is conducted for each device. The intent of the loop checks is to confirm and document each loop's component specification conformance up to and including all field-situated CSP devices. The CSP will have all control room personnel present to witness and confirm loop check results at the CRT level. The Contractor shall provide all necessary labor, tools, and equipment to field test, inspect and adjust each instrument to its indicated performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or any published manufacturer performance specification for functional and operational parameters, whether or not indicated in the Contract Documents, shall be repaired or replaced, at the discretion of the City's representative at no additional cost to the Owner.

1. At least 15 working days before installation testing begins, the Contractor shall submit to the City's representative a detailed description, in duplicate, of the installation tests to be conducted to demonstrate correct installation of the instrumentation and control system and the anticipated dates the testing will occur.
2. Controllers and electronic function modules, shall be tested and exercised by the Contractor to demonstrate correct operation, first individually and then collectively as functional analog networks. Each hardwired analog control network shall be tested to verify proper performance within indicated accuracy tolerances. Accuracy tolerances for each analog network are defined as the root-mean-square-summation of individual component accuracy tolerances. Individual component accuracy tolerances shall be as indicated by contract requirements, or by published manufacturer accuracy specifications, whenever contract accuracy tolerances are not indicated.
3. Each analog network shall be tested by applying simulated inputs to the first element(s). Simulated sensor inputs corresponding to 10 percent, 50 percent, and 90 percent of span shall be applied, and the resulting outputs read to verify compliance to network accuracy tolerance requirements. All analog test equipment used to simulate or measure current/voltage signals shall be certified accurate within the previous 6 months by a recognized/certified testing facility. Actual equipment listed as customer spares or test equipment may not be used for these tests. Continuously variable analog inputs shall be applied to verify the proper operation of discrete devices. Temporary settings shall be made on controllers, alarms, etc., during analog loop tests. All analog loop test data shall be recorded on test forms, which include calculated root-mean-square-summation system accuracy tolerance requirements for each output.
4. Air systems shall be tested for leaks in compliance with ISA RP7.1.
5. When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of all test forms signed by the [City's representative as a witness, with test data entered, shall be submitted together with a clear and unequivocal statement that all instrumentation has been success fully calibrated, fully inspected, and fully tested.

D. Functional Testing: During the DCS Operational Readiness Testing (ORT), the Contractor shall be responsible for demonstrating the operability of all systems provided under this specification. The City will assist and coordinate the operability assessment with the Contractor. Functional Testing shall commence after acceptance of all wire, all calibrating and loop tests, all inspections have been conducted, and DCS ORT has been started. Functional Testing shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under actual operating conditions.

1. The Contractor shall develop and submit to the City's representative for approval a Functional Testing Plan which describes detailed test procedures, checklists, blank forms and data to be recorded, test equipment to be used and calculated tolerance limits.
2. Functional Testing activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. All hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady-state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers, as required, to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any) and making necessary controller adjustments, as required, to eliminate excessive oscillatory amplitudes and decay rates.
3. All control stations incorporating proportional, integral and/or differential (P&ID) control circuits shall be initially tuned using mathematical methods such as Ziegler-Nichols or Tyreus-Luyben rules in order to establish the initial parameters for closed loop control. The tuning parameters shall be refined experimentally, by applying control signal disturbances and adjusting the gain, reset and/or rate setting(s) as required to achieve a proper response. Measured final control element variable position/speed set-point settings shall be compared to measured final control element position/speed values at 10 percent, 50 percent and 90 percent of span and the results checked against specified accuracy tolerances. Specified accuracy tolerances are defined as the root-mean-square-summation of individual component accuracy requirements. Individual component accuracy requirements shall be as specified in the contract or as specified by published manufacturer accuracy specifications whenever contract accuracy requirements are not specified.
4. Individual component accuracy tolerances shall be as indicated in the Contract Documents or as specified by published manufacturer accuracy specifications whenever not indicated.

5. The Contractor shall submit an instrumentation and control system Functional Testing completion report which shall state that all Contract requirements have been met and which shall include a listing of all instrumentation and all control system maintenance and repair activities conducted during the pre-commissioning testing. The City's representative must accept the instrumentation and control system functional testing before the 30-day operational testing may begin. Final acceptance of the control system shall coincide with final acceptance of the Work.

E. 30-Day Operational Testing: The Contractor shall furnish his own personnel, electrical personnel, and any instrument manufacturers' representatives as required during the testing period required in Section 01 91 14, Equipment Testing and Facility Startup, to produce a fully operational system.

F. Instruction: The Contractor shall train the Owner's maintenance personnel in the maintenance, calibration and repair of all instruments provided under this Contract.

1. The training shall be scheduled a minimum of 3weeks in advance of the first session. The training shall be performed concurrent with the precommissioning in Subparagraph D.
2. The training shall be performed by qualified representatives of the instrument manufacturers and shall be specific to each instrument model provided. Instructors shall have training experience.
3. Each training class shall be a minimum of 8 hours in duration and shall cover Operational Theory, Maintenance, Trouble Shooting/Repair, and Calibration of the instrument.
4. Proposed training material, including resumes for the proposed instructors and a detailed outline of each lesson shall be submitted to the City's representative at least 30 days in advance of when the lesson is to be given. The City's representative shall review the submitted data for suitability and provide comments which shall be incorporated into the course.
5. Within 10 days after the completion of each lesson the Contractor shall present to the City's representative the following:
    a. A list of all Owner personnel that attended the lesson.
    b. An evaluation of Owner personnel knowledge through written testing or equivalent.
    c. A copy of text utilized during the lesson with all notes, diagrams, and comments.

3.5 PROCESS CONTROL STRATEGIES

A. The control strategies, shown in Appendix A, complement of the Process and Instrumentation Diagrams (P&IDs). All materials and components shall be

furnished, whether explicitly indicated or not, to effect the functional requirements defined on the P&IDs and in the process control strategy descriptions. The Contractor shall utilize the control strategies as a resource in generating control narratives to be included in the analog hardware submittal.

B. Common functions that are generally applicable to all strategies or to similar strategies are described under the heading "General Functions". These functions are not repeated in the descriptions for each strategy.

C. Each strategy is described as follows:

1. Overview: A brief description of the mission of the related strategy including the roles of logic, monitoring and control stations located/associated with MCCs, field situated, and DCS -based.
2. Detailed Strategy Functions: A detailed description of each and every monitoring and control function associated with the associated strategy. This description addresses the strategies reaction to sensor failures, process equipment failures, control device failures, DCS malfunctions, and power interruptions. All control modes (MCC, local hand station, local control panel, DCS keyboard) are fully described. These descriptions are augmented by a listing of all instruments, valves, control devices, process equipment, and DCS equipment associated with the noted strategy. All control sequences associated with equipment activation, deactivation, process startup and process shutdown are defined along with all required time delays.
3. Preface to Control Strategy Section:
    a. Tag numbering system definitions and terms.
    b. Controls and control functions provided for all equipment, unless otherwise noted Local control station at equipment.
    c. Local/DCS switch.
    d. Alarms Logic: Open contact for alarms (fail-safe).
4. Format for Each Strategy:
    a. General Description:
        1) An overall description of the process.
        2) Major control components (PCM, PLC, annunciator, panels).
        3) General function of each major control component.
        4) P&ID references for this strategy.
        5) Reference to I/O listing.
    b. Related equipment.
    c. Overview of strategy.
    d. Non-DCS Control:
        1) Local Manual Control: Description of monitoring and control from each equipment item. If this is covered by the general statement in the Preface, describe any deviations.

Example: “Because of inaccessibility location of this valve in the sump, a local control station is not provided.”

2) Remote Manual Control: Description of control from any local or area control panels. Other Control: Package system, PLC, etc.

e. DCS Alarm, Monitoring and Control Functions:
   1) DCS Manual Control.
   2) DCS Automatic Control.
   3) Alarms - define alarms and alarm priorities. Define level (1, 2, 3, or 4) for each alarm.

f. Failure modes.

g. Communications interfaces. Third party devices and connections to DCS, including any details that may not be present on Loop Drawings or other sources of documentation.

h. In-Service/Out of Service Algorithm: Description of devices which determine in/out of service status for each piece of equipment. (In- service (I/S)/out of service (OOS) algorithms mask or block out all or selected alarms associated with the OOS device (i.e., if a wet well is declared OSS, low level alarms shall be inhibited). Additionally, if a device has been designated OOS, all control routines shall declare the equipment as being unavailable for service.

i. See Appendix A for detailed descriptions of the process control strategies.

3.6 INSTRUMENT SUMMARY

A. General: The Instrument Summary (IS) shown in Appendix C itemizes the instrumentation devices, including control panels, to be furnished under this contract. Specific device requirements for the instrumentation referenced in Part 2 shall be included in the instrument summary such as meter size, ranges, scales, set points, NEMA ratings, flange sizes, pipe connection sizes, material types, probe types, etc.

B. Each column on the Instrument Summary is defined as follows:

1. Tag Number: The identifier assigned to a device which performs a function in the control system. The Contractor shall use this identifier in tagging devices in the field.
2. Loop Number: The number assigned to the control loop associated with the device.
3. Description: A process-oriented functional description which defines the measured/monitored/controlled parameter and the associated process/process equipment.
4. P&ID Drawing Number: The Process and Instrumentation drawing upon which the device appears.

5. Technical Specification Number: The number associated with the technical specification which describes the requirements associated with the device.
6. Specification Section Number: The specification section under which the device shall be provided.
7. Control Panel Number: The designation of the control panel where the device resides.
8. Control Panel Reference Number: The drawing or schedule number associated with the control panel's face-plate representation.
9. Mechanical Drawing Number: The mechanical drawing upon which the device appears.
10. Electrical Drawing Number: The electrical drawing upon which the device appears.
11. Installation Detail Number: The designation of the installation detail defining the installation requirements associated with the device.

3.7 INSTRUMENT DATA SHEETS

A. General: The Instrument Data Sheets shown in Appendix D provides specific device requirements for the instrumentation referenced in Appendix C, Instrument Summary such as meter size, ranges, scales, set points, NEMA ratings, flange sizes, pipe connection sizes, material types, probe types, etc.

3.8 DCS INPUT/OUTPUT (I/O) SUMMARY

A. General: The I/O list contained in Section 40 94 24, Process Inputs/Outputs (I/O), Supplements, itemizes all inputs and outputs to and from the DCS, both hardwired and data linked, which are furnished by the Contractor.

B. Each column on the I/O List is defined as follows:

1. Tag Number: The ISA identifier assigned to a device which performs a function in the control system. The Contractor shall use this identifier in tagging devices in the DCS.
2. Loop Number: The number assigned to the control loop associated with the I/O.
3. Description: A 30-character process-oriented functional description which defines the measured/monitored/controlled parameter and the associated process/process equipment.
4. Alarm Priority: A 1-4 designation that determines the severity of the alarm triggered with 1 being the highest (most severe) and 4 the lowest.
5. Scale: The top value and bottom value of the analog process variable to be displayed or controlled by the DCS.
6. Set: The status to be displayed on the alarm summary when a digital point is not activated or returns to its normal state

7. Reset: The status to be displayed on the alarm summary when a digital point is activated.
8. P&ID Drawing Number: The Process and Instrumentation drawing upon which the device appears.
9. I/O Type: The type of I/O required for current and future monitoring and control activities (spare I/O is not included).
    a. Analog Input (AI): If the tag number generates an AI, the quantity of AIs are listed in Section 40 94 24, Process Inputs/Outputs (I/O), Supplements.
    b. Analog Output (AO): If the tag number generates an AO, the quantity of AOs are listed in Section 40 94 24, Process Inputs/Outputs (I/O), Supplements.
    c. Discrete Input (DI): If the tag number generates a DI, the quantity of DIs are listed in Section 40 94 24, Process Inputs/Outputs (I/O), Supplements.
    d. Discrete Output (DO): If the tag number generates a DO, the quantity of DOs are listed in Section 40 94 24, Process Inputs/Outputs (I/O), Supplements.
10. Data link No.: The name of the data link the soft I/O point is associated with.
11. PCM /RIO/PLC/RTU Number: The designation of the PCM, RIO, PLC or RTU where the I/O resides.
12. Fail-safe: (Yes or No): For digital inputs, whether the field device is to be wired as “open contact on alarm”.
13. Remarks: Any clarifying remarks are made in this area such as pulse inputs, cross references to mechanical and electrical drawings on which the PCM appears.
14. Totals: A summary row shown at the bottom of the I/O list which indicates the total amount of each type of I/O associated with a PCM. I/O associated with future shall be separately tabulated.

3.9 SUPPLEMENT

A. The supplement listed below, following “End of Section,” is part of this Specification.

    1. Appendix A – Control Strategies.

END OF SECTION

APPENDIX A - CONTROL STRATEGIES

LEGEND

A. PCM: Process Control Module (All DCS components inside a common cabinet, consisting of the Controller, IO, Network Switches, etc.).

B. DCS: Distributed Control System (Plant Computer Control System).

C. UPS: Uninterruptable Power System (Provides battery back-up power to the PCM).

D. DH: Data Highway (Plant process network where all DCS components, such as the controllers, servers, workstations, historians, etc., communications take place).

E. DIN: District Information Network (Fiber Optic Transmission that connects all COMNET sites to one another.)

F. LCP: Local Control Panels.

G. PID: Proportional-Integral-Derivative.

H. PLC – Programmable Logic Controller.

I. RTU - Remote Terminal Unit.

PROJECT OVERALL CONTROL SYSTEM STRATEGY OVERVIEW

A. Provide a brief overall project control strategy overview.

B. See Appendix A to Section 40 90 07, Scope of Work.

GENERAL CONTROL AND MONITORING

A. These control strategies are not intended to be all-inclusive operational procedures for the operation of the complete facility. In general, control and monitoring functionality is as follows:

1. Alarm monitoring and generation, process sequencing, automatic control of auxiliary systems and equipment interlocking control strategies are resident within the DCS.
2. Fault tolerant controllers communicate with the DH and contain enhanced DCS automatic control algorithms for process sequencing control based on level, pressure, flow, or other conditions.

3. The DCS workstations shall serve as the operation staff's "window" into the process, enabling operations to locally monitor, interrogate, and manipulate plant processes.
4. The DCS shall provide reporting, historian, diagnostic, client access and other file server functions.
5. The DCS provides information to the District Information Network (DIN) via the communication link between DCS and DIN
6. All hardwired alarms shall be fail safe and activate upon loss of power.

COMMON CONTROLLER/PLC FUNCTIONS

A. Common functions and terms for basic monitoring and control operations are provided as a standard of implementation for the control system. These terms and functions address items that are typical for process control loops and most operator initiated actions. These functions are not necessarily repeated in each individual control strategy. Unless otherwise stated they are considered a part of each implemented control strategy.

B. Provision shall be made to include certain control functions that apply to all analog inputs, virtual variables, analog controllers and discrete control whether or not shown on the P&IDs, even though one or more of the functions may be disabled by the user for a given data base point:

1. Verification of Digital Outputs: In Semi-Auto and Auto mode each command will be monitored for the desired results before proceeding to the next step and if the sired results are not achieved in a certain predetermined time an alarm will be generated. The operator will have the ability to override and move to the next stage.
2. Analog Data Scaling: This control function shall scale all analog inputs to a common span and shall normalize the digital representation of each analog input to a percent of the operating span. The processed value shall be expressed as a binary number that specifies the analog input's position on a straight line lying between zero and full scale as defined for a given input by the zero span values in the data base.
3. Amplitude Limit Check: This control function shall perform dual level, high/low amplitude limit checking and shall identify a limit violation every time a measured or virtual variable goes out-of-limits and returns back into limits. The control function shall determine the time at which each limit excursion occurred. A dead-band shall be provided on each limit and shall be expressed as a percentage of span or in engineering units.

4. Engineering Unit Conversion: This control function shall convert scaled analog data to engineering units by means of the following equation:

$$Y = (H - L)\,(D/DH) + L$$

where:

Y = value in engineering units

H = high value of span, expressed in engineering units

L = low value of span, expressed in engineering units

D = digitized scale input value in counts

5. Discrete Event Monitor: This control function shall monitor an alarm (where appropriate) all discrete status changes.
6. Manual Control: It shall be possible for the operator or plant engineer to interrupt any sequence, loop or automatic operation and operate the same manually from remote.

C. The following terms are used in the descriptions of DCS/PLC functions:

1. Operator Settings (Set points): Operator set or entered values that are adjustable or set from operator displays. Examples of operator set or entered values are controller set points, batch set points, timers, counters, mode selection, etc. Specific values that are required to be operator settable are noted (bracketed [ ]) in the process control strategy descriptions. Unless otherwise stated to be tunable or fixed, a set point value is operator settable.
2. Tunable Values: Tunable values are set points that are adjustable at password protected engineer level displays without requiring any PLC or DCS software reconfiguration. Examples of tunable values are tunable time settings, tunable alarm set points, PID tuning constants, etc. These values are not adjustable from operator level displays. Tunable values are also identified and their preliminary values are shown in brackets [xxx].
3. Fixed Values: Fixed values are constants that are contained within the PLC or DCS control logic normally inaccessible by the DCS system. Modification of fixed values requires a modification to the control logic via the PLC or DCS programming, configuration and diagnostics software package.

4. Displayed Values: The term “displayed” means that the value, or information referred to, is displayed in an easily read and understood format on the DCS workstation. Values are identified by their device tag reference and associated equipment number. For analog variables the value is tagged and its associated engineering units are displayed.
5. Hardware Interlocks: Hardware interlocks refer to interlocks directly wired within the electrical control circuits of equipment that, when activated, shall cause the equipment to shutdown or otherwise prevent operation of the equipment. Hardware interlocks do not necessarily pass through or depend on the PLC or DCS to be operable. Status of hardwired interlocks shall be provided to the PLC/DCS.
    a. Hardware interlocks may also be derived by local control panels or switches wired directly to the PLC or DCS to provide direct hardwired alarm status to the PLC or DCS for processing.
6. Software Interlocks: Software interlocks refer to interlocks that are generated by the PLC or DCS logic or otherwise pass through the PLC or DCS. Software interlocks are not operable when the PLC is not operable or if for some reason equipment is operated while by-passing the PLC logic.
7. Hardware Generated Alarms: Hardware generated alarms are alarms that are generated external to the PLC by equipment such as local control panels, analytical devices and process switches.
    a. Direct wired alarms that do not depend on the PLC or DCS to be operable. An example would be a High H2S level signal from the H2S monitor and wired directly to an alarm light or horn.
    b. Direct PLC or DCS wired alarms such as a High-High pressure switch that interfaces directly with the PLC or DCS.
8. Software Generated Alarms: Alarms that are processed or generated by PLC or DCS logic are referred as software generated. Software generated alarms are displayed on the DCS workstation alarm screens and are available for archiving.
9. Local Automatic Control Mode: Local automatic control refers to control logic performed in a local control panel independent of the DCS. An example is a standalone blower package that, when in the local automatic control mode, automatically controls the blower to maintained air pressure within a fixed dead band.
10. Local Manual Control Mode: Local manual control refers to the mode where operators control equipment from the equipment location. Examples are hoist and trolley that may be stopped or started from the compressor’s local control panel (LCP), or a gate that may be opened or closed from the gate operator.

11. DCS Automatic Control Mode: In DCS automatic mode equipment is controlled automatically per predetermined control schemes residing in the DCS usually without operator intervention. However, in some cases the operators may be required to initiate certain automatic functions, or enter set points.
12. DCS Manual Control Mode: DCS manual control refers to the manual control of equipment from the DCS workstation. In this mode, the operators override the DCS automatic control logic but, usually, DCS safety interlock logic remains in effect.
13. DCS Override Control: DCS override control refers to the ability to override specific software interlocks and initiate control actions. Software interlocks or permissives that can be overridden are identified within the individual control strategies. Override control is an abnormal control operation and a "SAFETY INTERLOCK OVERRIDE ALARM" shall be initiated for the specific override condition whenever an override command is in effect.

D. COMMON DCS/PLC SOFTWARE FUNCTIONS

1. To provide for a standard of implementation, various software control and monitoring functions are defined. The standard functions may not be fully delineated within each control strategy, however, unless otherwise stated the standard function shall be utilized to provide the defined alarm, action, display or control action.
2. DCS is configured as the primary control system for all alarm monitoring, start/stop sequencing, shutdown and interlock and basic process control functions.
3. When delineated within individual control strategies as DCS controlled or DCS logic, the control program is resident within the DCS. Complex control algorithms and historical data calculations are normally performed by the DCS.
4. The following provides for common DCS software functions:
    a. All equipment status items monitored by the DCS and generated within the DCS control strategies are displayed by the DCS. Unless otherwise specified the following is displayed for each equipment item:
    b. Equipment READY status.
    c. Equipment RUNNING or ON status.
    d. Equipment OFF status.
    e. Equipment FAILURE alarm.
    f. Equipment FAIL-TO-OPERATE alarm.
    g. Equipment OUT-OF-SERVICE.

5. All analog inputs transmitted to the DCS shall have instrument bad/failure indications or alarms when the input is below 0 percent or above 100 percent.
6. All discrete alarm and failure inputs are alarmed by the DCS application software and displayed at the DCS. Each discrete alarm input shall have an associated alarm delay that prevents nuisance tripping.
7. Where alarms are specified in the control strategy descriptions, those alarms are initiated by the DCS control logic based on the applicable analog input signals. User tunable trip points shall be provided for each analog input to establish High-High, High, Low, Low- Low, and Rate-Of-Change events. Each trip point shall be provided with a user tunable dead band for set and reset operations. Individual signal trip points shall be provided with a tunable delay to alarm activation.
8. DCS alarm activation and annunciation shall adhere to a priority hierarchy that is established and maintained at the DCS system. Each alarm shall have an associated priority level defined as:
    a. Level 1: Life Threatening or Danger Conditions.
    b. Level 2: Critical process alarms that shall create a plant shutdown condition, cause a critical process failure or severely hinder plant operation.
    c. Level 3: Minor process alarms associated with warning conditions and minor equipment failures.
    d. Level 4: Informational alarms shall not hinder operation or cause equipment failure.
9. All process related analog inputs may be trended at the discretion of the operator.
10. All flow inputs and equipment run times are totalized, recorded and displayed at the DCS. Totalizers are resettable at the engineer level only.
11. Displays: DCS system shall have adequate number of displays for each system to enable the operator to effectively monitor and control the system. Displays are grouped functionally for ease of operation. Both analog and discrete functions associated with an item of equipment or a group of equipment shall be provided on the same display. Displays shall show process graphics, alarms, equipment status, system mode of operation, control strategy implementation, etc.
12. Most interlocks, permissives and start sequences are provided at the DCS level. Unless otherwise stated or shown, all discrete outputs shall be provided as follows:
    a. For equipment START functions, the PLC or DCS shall issue a maintained START command until a RUNNING state is detected or the START command is removed.

b. When a momentary command is required, the PLC or DCS shall issue the command for the minimum time required for the process to react to the command.

13. For equipment that the DCS/PLC is allowed to control, the DCS/PLC shall provide a FAIL-TO-OPERATE alarm if the equipment fails to comply with a DCS/PLC command signal. The (START, STOP, OPEN, CLOSE) shall has been present for more than a tunable time period. In this event, the command shall be removed subsequent to the expiration of the tunable time period and must be reset by the Operator before the logic will attempt to operate the device from the DCS.
14. In the event of a DCS system failure the system shall retain the last command from the DCS system for all equipment that is in service. All interlocks are enabled during a DCS communications or systems failure.
15. All PID control functions (P, PI, and PID) are provided with standard analog controller functions and operator interfaces including, but not limited to, the following:
    a. AUTO/MANUAL mode selection: In AUTO, the output of controller shall be based on the PID control calculation. In MANUAL, the output of the controller shall be operator adjustable from the DCS. Transfer between operational modes shall be bumpless.
    b. LOCAL/REMOTE set point selection: In LOCAL, the set point shall be operator adjustable from the equipment. In REMOTE, the set point shall be adjustable from a REMOTE set point input.
    c. Set point, process variable, and controller output shall be displayed. Provisions shall be included to prevent reset windup.
    d. Dead band limits shall be placed on PID control algorithms to avoid hunting and continuous change actions. Dead band limits shall maintain a constant control until the process variable exceeds the dead band boundaries. A dead band value of zero shall disable the dead band.
    e. Bumpless transition shall be provided when PID is invoked after a transition from manual to PID control or when pump start logic utilizes minimum speed controls for starting applications. The transition from current speed to calculated speed shall be provided as a user tunable set point percentage per second value.
    f. When main equipment is tagged OUT-OF-SERVICE, a DCS function, all associated equipment and devices are automatically placed in OUT-OF-SERVICE status and their alarms inhibited until the tagged equipment is tagged IN SERVICE. Associated equipment for each piece of main equipment shall be determined on a case by case basis.
16. Verification of Result: Whenever a command is issued, DCS/PLC shall verify that its command is implemented before proceeding to the next

step, e.g., a valve open command is issued, the DCS/PLC software shall verify that the valve open limit switch is activated after a preset time, before proceeding to the next step in the program. If no verification is received an alarm will be generated and operator intervention will be necessary to resume the automatic operation.

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FLOW ELEMENT & TRANSMITTER, ELECTROMAGNETIC

GENERAL	1	Tag Number	P&ID	FIT-102	I-12
	2	Loop Title		Pump Station Flow	
	3	Area Classification		Class 1 Div 2	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	24"	
PROCESS CONDITIONS	7	Fluid		Sewer	
	8				
	9	Min Flow	Max Flow	8000 GPM	27000 GPM
	10	Nominal Pressure		250 PSI	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
METERING ELEMENT	18	Element Tag		FE-102	
	19	Element Size		24"	
	20	Process Connection/Material		316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Polyurethane	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		Teflon	
	26	Range		8000 to 27000	
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
TRANSMITTER	36	Mounting		Wall	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range		8000 to 27000	
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
OPTIONS	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
	49				
PURCHASE	50	Manufacturer		Endress+Hauser	Krohne
	51	Model Number		Promag	Optiflux
	52				
	53	Purchase Note		1 year warranty	

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FLOW ELEMENT & TRANSMITTER, ELECTROMAGNETIC

NC Morena Pump Station and Pipelines Package A

FIT-102

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FLOW ELEMENT AND TRANSMITTER, THERMAL MASS
FLOW

GENERAL	1	Tag Number	P&ID	FIT-01	I-13
	2	Loop Title		Supply Fan 01 Discharge Flow	
	3	Area Classification		Class 1/ Div 2	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	As shown on Drawings	
	7				
PROCESS CONDITIONS	8	Fluid		Air	
	9				
	10	Min Flow	Max Flow	0 CFM	10000 CFM
	11	Pressure		1.8 inches WC	
	12	Temperature			
	13	Specific Gravity	Viscosity		
	14	Conductivity	Density		
	15	Vapor Pressure	Critical Pressure		
	16				
	17	Vacuum Possibility		No	
	18				
ELEMENT	19	Element Tag		FE-01	
	20	Meter Size			
	21	Insertion Length		As Noted	
	22	Process Connection		1 inch NPT	
	23	Wetted Material		316 Stainless Steel	
	24				
	25	Mounting Orientation		As Noted	
	26	Element Cable Length		As Required	
	27	Element Range		36.5 - 5700 scfm	
	28				
	29	Process Temperature Limits		-50 degrees F to 350 degrees F	
	30				
TRANSMITTER	31	Transmitter Tag		FIT-01	
	32	Mounting		Integral	
	33	Enclosure NEMA Rating		NEMA 4X	
	34	Power Supply	Voltage	4 - Wire	120 VAC
	35	Output Signal		Isolated 4 to 20 mA dc	
	36	Communication Protocol		HART	
	37				
	38	Ambient Temperature Limits		0 degF to 150 degF	
	39				
CALIBRATION	40	Calibrated Range		7000-9000 CFM	
	41	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	42				
	43	Accuracy	Repeatability	0.5 Pct of Full Scale	0.4 Percent
	44				
OPTIONS	45				
	46	Tagging		Affix stainless steel tag with Tag Number	
	47				
	48				
PURCHASE	49	Manufacturer		Endress + Hauser	FCI
	50	Model Number		65I	ST 50
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT & TRANSMITTER, THERMAL MASS FLOW

NC Morena Pump Station and Pipelines Package A

FIT-01

GENERAL	1	Tag Number	P&ID	FIT-02	I-13
	2	Loop Title		Supply Fan 02 Discharge Flow	
	3	Area Classification		Class 1/ Div 2	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	As shown on Drawings	
	7				
PROCESS CONDITIONS	8	Fluid		Air	
	9				
	10	Min Flow	Max Flow	0 CFM	15000 CFM
	11	Pressure		1.9 inches WC	
	12	Temperature			
	13	Specific Gravity	Viscosity		
	14	Conductivity	Density		
	15	Vapor Pressure	Critical Pressure		
	16				
	17	Vacuum Possibility		No	
	18				
ELEMENT	19	Element Tag		FE-02	
	20	Meter Size			
	21	Insertion Length		As Noted	
	22	Process Connection		1 inch NPT	
	23	Wetted Material		316 Stainless Steel	
	24				
	25	Mounting Orientation		As Noted	
	26	Element Cable Length		As Required	
	27	Element Range		36.5 - 5700 scfm	
	28				
	29	Process Temperature Limits		-50 degrees F to 350 degrees F	
	30				
TRANSMITTER	31	Transmitter Tag		FIT-02	
	32	Mounting		Integral	
	33	Enclosure NEMA Rating		NEMA 4X	
	34	Power Supply	Voltage	4 - Wire	120 VAC
	35	Output Signal		Isolated 4 to 20 mA dc	
	36	Communication Protocol		HART	
	37				
	38	Ambient Temperature Limits		0 degF to 150 degF	
	39				
CALIBRATION	40	Calibrated Range		11000 - 14000 CFM	
	41	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	42				
	43	Accuracy	Repeatability	0.5 Pct of Full Scale	0.4 Percent
	44				
OPTIONS	45				
	46	Tagging		Affix stainless steel tag with Tag Number	
	47				
	48				
PURCHASE	49	Manufacturer		Endress + Hauser	FCI
	50	Model Number		65I	ST 50
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT & TRANSMITTER, THERMAL MASS FLOW

NC Morena Pump Station and Pipelines Package A

FIT-02

GENERAL	1	Tag Number	P&ID	FIT-03	I-13
	2	Loop Title		Supply Fan 03 Discharge Flow	
	3	Area Classification		Class 1/ Div 2	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	As shown on Drawings	
	7				
PROCESS CONDITIONS	8	Fluid		Air	
	9				
	10	Min Flow	Max Flow	0 CFM	15000 CFM
	11	Pressure		1.8 inches WC	
	12	Temperature			
	13	Specific Gravity	Viscosity		
	14	Conductivity	Density		
	15	Vapor Pressure	Critical Pressure		
	16				
	17	Vacuum Possibility		No	
	18				
ELEMENT	19	Element Tag		FE-03	
	20	Meter Size			
	21	Insertion Length		As Noted	
	22	Process Connection		1 inch NPT	
	23	Wetted Material		316 Stainless Steel	
	24				
	25	Mounting Orientation		As Noted	
	26	Element Cable Length		As Required	
	27	Element Range		36.5 - 5700 scfm	
	28				
	29	Process Temperature Limits		-50 degrees F to 350 degrees F	
	30				
TRANSMITTER	31	Transmitter Tag		FIT-03	
	32	Mounting		Integral	
	33	Enclosure NEMA Rating		NEMA 4X	
	34	Power Supply	Voltage	4 - Wire	120 VAC
	35	Output Signal		Isolated 4 to 20 mA dc	
	36	Communication Protocol		HART	
	37				
	38	Ambient Temperature Limits		0 degF to 150 degF	
	39				
CALIBRATION	40	Calibrated Range		9000 - 12000 CFM	
	41	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	42				
	43	Accuracy	Repeatability	0.5 Pct of Full Scale	0.4 Percent
	44				
OPTIONS	45				
	46	Tagging		Affix stainless steel tag with Tag Number	
	47				
	48				
PURCHASE	49	Manufacturer		Endress + Hauser	FCI
	50	Model Number		65I	ST 50
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT & TRANSMITTER, THERMAL MASS FLOW

NC Morena Pump Station and Pipelines Package A

FIT-03

GENERAL	1	Tag Number	P&ID	FIT-04	I-13
	2	Loop Title		Supply Fan 04 Discharge Flow	
	3	Area Classification		Class 1/ Div 2	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	As shown on Drawings	
	7				
PROCESS CONDITIONS	8	Fluid		Air	
	9				
	10	Min Flow	Max Flow	0 CFM	15000 CFM
	11	Pressure		0.7 inches WC	
	12	Temperature			
	13	Specific Gravity	Viscosity		
	14	Conductivity	Density		
	15	Vapor Pressure	Critical Pressure		
	16				
	17	Vacuum Possibility		No	
	18				
ELEMENT	19	Element Tag		FE-04	
	20	Meter Size			
	21	Insertion Length		As Noted	
	22	Process Connection		1 inch NPT	
	23	Wetted Material		316 Stainless Steel	
	24				
	25	Mounting Orientation		As Noted	
	26	Element Cable Length		As Required	
	27	Element Range		36.5 - 5700 scfm	
	28				
	29	Process Temperature Limits		-50 degrees F to 350 degrees F	
	30				
TRANSMITTER	31	Transmitter Tag		FIT-04	
	32	Mounting		Integral	
	33	Enclosure NEMA Rating		NEMA 4X	
	34	Power Supply	Voltage	4 - Wire	120 VAC
	35	Output Signal		Isolated 4 to 20 mA dc	
	36	Communication Protocol		HART	
	37				
	38	Ambient Temperature Limits		0 degF to 150 degF	
	39				
CALIBRATION	40	Calibrated Range		9000 - 10500 CFM	
	41	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	42				
	43	Accuracy	Repeatability	0.5 Pct of Full Scale	0.4 Percent
	44				
OPTIONS	45				
	46	Tagging		Affix stainless steel tag with Tag Number	
	47				
	48				
PURCHASE	49	Manufacturer		Endress + Hauser	FCI
	50	Model Number		65I	ST 50
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT & TRANSMITTER, THERMAL MASS FLOW

NC Morena Pump Station and Pipelines Package A

FIT-04

GENERAL	1	Tag Number	P&ID	FIT-05	I-13
	2	Loop Title		Supply Fan 05 Discharge Flow	
	3	Area Classification		Class 1/ Div 2	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	As shown on Drawings	
	7				
PROCESS CONDITIONS	8	Fluid		Air	
	9				
	10	Min Flow	Max Flow	0 CFM	35000 CFM
	11	Pressure		1.5 inches WC	
	12	Temperature			
	13	Specific Gravity	Viscosity		
	14	Conductivity	Density		
	15	Vapor Pressure	Critical Pressure		
	16				
	17	Vacuum Possibility		No	
	18				
ELEMENT	19	Element Tag		FE-05	
	20	Meter Size			
	21	Insertion Length		As Noted	
	22	Process Connection		1 inch NPT	
	23	Wetted Material		316 Stainless Steel	
	24				
	25	Mounting Orientation		As Noted	
	26	Element Cable Length		As Required	
	27	Element Range		36.5 - 5700 scfm	
	28				
	29	Process Temperature Limits		-50 degrees F to 350 degrees F	
	30				
TRANSMITTER	31	Transmitter Tag		FIT-05	
	32	Mounting		Integral	
	33	Enclosure NEMA Rating		NEMA 4X	
	34	Power Supply	Voltage	4 - Wire	120 VAC
	35	Output Signal		Isolated 4 to 20 mA dc	
	36	Communication Protocol		HART	
	37				
	38	Ambient Temperature Limits		0 degF to 150 degF	
	39				
CALIBRATION	40	Calibrated Range		30000 - 32000 CFM	
	41	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	42				
	43	Accuracy	Repeatability	0.5 Pct of Full Scale	0.4 Percent
	44				
OPTIONS	45				
	46	Tagging		Affix stainless steel tag with Tag Number	
	47				
	48				
PURCHASE	49	Manufacturer		Endress + Hauser	FCI
	50	Model Number		65I	ST 50
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT & TRANSMITTER, THERMAL MASS FLOW

NC Morena Pump Station and Pipelines Package A

FIT-05

GENERAL	1	Tag Number	P&ID	FIT-11	I-14
	2	Loop Title		Exhaust Fan 1 Discharge Flow	
	3	Area Classification		Class 1/ Div 2	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	As shown on Drawings	
	7				
PROCESS CONDITIONS	8	Fluid		Air	
	9				
	10	Min Flow	Max Flow	0 CFM	17000 CFM
	11	Pressure		7.5 inches WC	
	12	Temperature			
	13	Specific Gravity	Viscosity		
	14	Conductivity	Density		
	15	Vapor Pressure	Critical Pressure		
	16				
	17	Vacuum Possibility		No	
	18				
ELEMENT	19	Element Tag		FE-11	
	20	Meter Size			
	21	Insertion Length		As Noted	
	22	Process Connection		1 inch NPT	
	23	Wetted Material		316 Stainless Steel	
	24				
	25	Mounting Orientation		As Noted	
	26	Element Cable Length		As Required	
	27	Element Range		36.5 - 5700 scfm	
	28				
	29	Process Temperature Limits		-50 degrees F to 350 degrees F	
	30				
TRANSMITTER	31	Transmitter Tag		FIT-11	
	32	Mounting		Integral	
	33	Enclosure NEMA Rating		NEMA 4X	
	34	Power Supply	Voltage	4 - Wire	120 VAC
	35	Output Signal		Isolated 4 to 20 mA dc	
	36	Communication Protocol		HART	
	37				
	38	Ambient Temperature Limits		0 degF to 150 degF	
	39				
CALIBRATION	40	Calibrated Range		15000 - 16500 CFM	
	41	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	42				
	43	Accuracy	Repeatability	0.5 Pct of Full Scale	0.4 Percent
	44				
OPTIONS	45				
	46	Tagging		Affix stainless steel tag with Tag Number	
	47				
	48				
PURCHASE	49	Manufacturer		Endress + Hauser	FCI
	50	Model Number		65I	ST 50
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT & TRANSMITTER, THERMAL MASS FLOW

NC Morena Pump Station and Pipelines Package A

FIT-11

GENERAL	1	Tag Number	P&ID	FIT-12	I-14
	2	Loop Title		Exhaust Fan 2 Discharge Flow	
	3	Area Classification		Class 1/ Div 2	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	As shown on Drawings	
	7				
PROCESS CONDITIONS	8	Fluid		Air	
	9				
	10	Min Flow	Max Flow	0 CFM	17000 CFM
	11	Pressure		7.5 inches WC	
	12	Temperature			
	13	Specific Gravity	Viscosity		
	14	Conductivity	Density		
	15	Vapor Pressure	Critical Pressure		
	16				
	17	Vacuum Possibility		No	
	18				
ELEMENT	19	Element Tag		FE-12	
	20	Meter Size			
	21	Insertion Length		As Noted	
	22	Process Connection		1 inch NPT	
	23	Wetted Material		316 Stainless Steel	
	24				
	25	Mounting Orientation		As Noted	
	26	Element Cable Length		As Required	
	27	Element Range		36.5 - 5700 scfm	
	28				
	29	Process Temperature Limits		-50 degrees F to 350 degrees F	
	30				
TRANSMITTER	31	Transmitter Tag		FIT-12	
	32	Mounting		Integral	
	33	Enclosure NEMA Rating		NEMA 4X	
	34	Power Exhaust	Voltage	4 - Wire	120 VAC
	35	Output Signal		Isolated 4 to 20 mA dc	
	36	Communication Protocol		HART	
	37				
	38	Ambient Temperature Limits		0 degF to 150 degF	
	39				
CALIBRATION	40	Calibrated Range		15000 - 16500 CFM	
	41	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	42				
	43	Accuracy	Repeatability	0.5 Pct of Full Scale	0.4 Percent
	44				
OPTIONS	45				
	46	Tagging		Affix stainless steel tag with Tag Number	
	47				
	48				
PURCHASE	49	Manufacturer		Endress + Hauser	FCI
	50	Model Number		65I	ST 50
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT & TRANSMITTER, THERMAL MASS FLOW

NC Morena Pump Station and Pipelines Package A

FIT-12

GENERAL	1	Tag Number	P&ID	FIT-13	I-14
	2	Loop Title		Exhaust Fan 3 Discharge Flow	
	3	Area Classification		Class 1/ Div 2	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	As shown on Drawings	
	7				
PROCESS CONDITIONS	8	Fluid		Air	
	9				
	10	Min Flow	Max Flow	0 CFM	45000 CFM
	11	Pressure		2.5 inches WC	
	12	Temperature			
	13	Specific Gravity	Viscosity		
	14	Conductivity	Density		
	15	Vapor Pressure	Critical Pressure		
	16				
	17	Vacuum Possibility		No	
	18				
ELEMENT	19	Element Tag		FE-13	
	20	Meter Size			
	21	Insertion Length		As Noted	
	22	Process Connection		1 inch NPT	
	23	Wetted Material		316 Stainless Steel	
	24				
	25	Mounting Orientation		As Noted	
	26	Element Cable Length		As Required	
	27	Element Range		36.5 - 5700 scfm	
	28				
	29	Process Temperature Limits		-50 degrees F to 350 degrees F	
	30				
TRANSMITTER	31	Transmitter Tag		FIT-13	
	32	Mounting		Integral	
	33	Enclosure NEMA Rating		NEMA 4X	
	34	Power Exhaust	Voltage	4 - Wire	120 VAC
	35	Output Signal		Isolated 4 to 20 mA dc	
	36	Communication Protocol		HART	
	37				
	38	Ambient Temperature Limits		0 degF to 150 degF	
	39				
CALIBRATION	40	Calibrated Range		40000 - 43000 CFM	
	41	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	42				
	43	Accuracy	Repeatability	0.5 Pct of Full Scale	0.4 Percent
	44				
OPTIONS	45				
	46	Tagging		Affix stainless steel tag with Tag Number	
	47				
	48				
PURCHASE	49	Manufacturer		Endress + Hauser	FCI
	50	Model Number		65I	ST 50
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT & TRANSMITTER, THERMAL MASS FLOW

NC Morena Pump Station and Pipelines Package A

FIT-13

GENERAL	1	Tag Number	P&ID	FIT-14	I-14
	2	Loop Title		Exhaust Fan 4 Discharge Flow	
	3	Area Classification		Class 1/ Div 2	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	As shown on Drawings	
	7				
PROCESS CONDITIONS	8	Fluid		Air	
	9				
	10	Min Flow	Max Flow	0 CFM	6000 CFM
	11	Pressure		6.3 inches WC	
	12	Temperature			
	13	Specific Gravity	Viscosity		
	14	Conductivity	Density		
	15	Vapor Pressure	Critical Pressure		
	16				
	17	Vacuum Possibility		No	
	18				
ELEMENT	19	Element Tag		FE-14	
	20	Meter Size			
	21	Insertion Length		As Noted	
	22	Process Connection		1 inch NPT	
	23	Wetted Material		316 Stainless Steel	
	24				
	25	Mounting Orientation		As Noted	
	26	Element Cable Length		As Required	
	27	Element Range		36.5 - 5700 scfm	
	28				
	29	Process Temperature Limits		-50 degrees F to 350 degrees F	
	30				
TRANSMITTER	31	Transmitter Tag		FIT-14	
	32	Mounting		Integral	
	33	Enclosure NEMA Rating		NEMA 4X	
	34	Power Exhaust	Voltage	4 - Wire	120 VAC
	35	Output Signal		Isolated 4 to 20 mA dc	
	36	Communication Protocol		HART	
	37				
	38	Ambient Temperature Limits		0 degF to 150 degF	
	39				
CALIBRATION	40	Calibrated Range		2500- 5500 CFM	
	41	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	42				
	43	Accuracy	Repeatability	0.5 Pct of Full Scale	0.4 Percent
	44				
OPTIONS	45				
	46	Tagging		Affix stainless steel tag with Tag Number	
	47				
	48				
PURCHASE	49	Manufacturer		Endress + Hauser	FCI
	50	Model Number		65I	ST 50
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT & TRANSMITTER, THERMAL MASS FLOW

NC Morena Pump Station and Pipelines Package A

FIT-14

GENERAL	1	Tag Number	P&ID	FIT-15	I-14
	2	Loop Title		Exhaust Fan 5 Discharge Flow	
	3	Area Classification		Class 1/ Div 2	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	As shown on Drawings	
	7				
PROCESS CONDITIONS	8	Fluid		Air	
	9				
	10	Min Flow	Max Flow	0 CFM	6000 CFM
	11	Pressure		6.3 inches WC	
	12	Temperature			
	13	Specific Gravity	Viscosity		
	14	Conductivity	Density		
	15	Vapor Pressure	Critical Pressure		
	16				
	17	Vacuum Possibility		No	
	18				
ELEMENT	19	Element Tag		FE-15	
	20	Meter Size			
	21	Insertion Length		As Noted	
	22	Process Connection		1 inch NPT	
	23	Wetted Material		316 Stainless Steel	
	24				
	25	Mounting Orientation		As Noted	
	26	Element Cable Length		As Required	
	27	Element Range		36.5 - 5700 scfm	
	28				
	29	Process Temperature Limits		-50 degrees F to 350 degrees F	
	30				
TRANSMITTER	31	Transmitter Tag		FIT-15	
	32	Mounting		Integral	
	33	Enclosure NEMA Rating		NEMA 4X	
	34	Power Exhaust	Voltage	4 - Wire	120 VAC
	35	Output Signal		Isolated 4 to 20 mA dc	
	36	Communication Protocol		HART	
	37				
	38	Ambient Temperature Limits		0 degF to 150 degF	
	39				
CALIBRATION	40	Calibrated Range		2500- 5500 CFM	
	41	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	42				
	43	Accuracy	Repeatability	0.5 Pct of Full Scale	0.4 Percent
	44				
OPTIONS	45				
	46	Tagging		Affix stainless steel tag with Tag Number	
	47				
	48				
PURCHASE	49	Manufacturer		Endress + Hauser	FCI
	50	Model Number		65I	ST 50
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT & TRANSMITTER, THERMAL MASS FLOW

NC Morena Pump Station and Pipelines Package A

FIT-15

L05
LEVEL ELEMENT & TRANSMITTER - ULTRASONIC

GENERAL	1	Tag Number	P&ID	LIT-100	I-07
	2	Loop Title		Junction Sturcture No. 1 Level	
	3	Area Classification		Class 1 Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
PROCESS CONDITIONS	7	Fluid		Sewer	
	8	Pressure			
	9	Temperature			
	10	Specific Gravity	Viscosity		
	11	Conductivity	Density		
	12	Vapor Pressure	Critical Pressure	Atmospheric	
	13				
ELEMENT	14	Element Tag		LIT-100	
	15	Element Type			
	16	Inactive Length (Blanking Distance)		1 Foot	
	17	NEMA Rating		NEMA 6P waterproof	
	18	Housing		PVDF	
	19	Process Connection		1 inch NPT, top mounted	
	20	Measurable Limits		33 Feet	
	21	Beam Angle		12 Degrees	
	22	Blanking Distance			
	23	Cable Length		As required for component locations	
	24	Operating Temperature Limits		-4 degF to 149 degF	
	25				
TRANSMITTER	26	Mounting		Wall	
	27	Enclosure NEMA Rating		NEMA 4X, Polycarbonate	
	28	Power Supply	Voltage	4 - Wire	120 VAC
	29	Output Signal		4 to 20 madc	
	30	Communication Protocol		HART	
	31	Range		As Noted	
	32	Operating Temperature Range		-4 degF to 113 degF	
SWITCH	33	Switch Type		2 Relay Outputs, minimum	
	34	Set Point		Adjustable and assignable	
	35	Set Point Direction			
	36	Deadband			
	37	Failure State			
	38	Voltage		120 VAC	
	39	Contact Arrangement		SPDT	
	40	Contact Rating		2 Amps	
	41				
CALIBRATION	42	Calibrated Range		As Noted	
	43	Zero Reference		As Noted	
	44	Vendor Calibration		No	
	45	Accuracy	Repeatability	+/- 0.25 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48	Sun Shield			
	49				
PURCHASE	50	Manufacturer		Endress+Hauser	Siemens
	51	Model Number Transmitter		FMU 42	Sitrans Probe LU
	52	Model Number Sensor			
	53	Purchase Note		1 year warranty	

L05

LEVEL TRANSMITTER - ULTRASONIC

NC Morena Pump Station and Pipelines Package A

As Noted

GENERAL	1	Tag Number	P&ID	LIT-101	I-05
	2	Loop Title		Diversion Sturcture No. 1 Level	
	3	Area Classification		Class 1 Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
PROCESS CONDITIONS	7	Fluid		Sewer	
	8	Pressure			
	9	Temperature			
	10	Specific Gravity	Viscosity		
	11	Conductivity	Density		
	12	Vapor Pressure	Critical Pressure	Atmospheric	
	13				
ELEMENT	14	Element Tag		LE-101	
	15	Element Type			
	16	Inactive Length (Blanking Distance)		1 Foot	
	17	NEMA Rating		NEMA 6P waterproof	
	18	Housing		PVDF	
	19	Process Connection		1 inch NPT, top mounted	
	20	Measurable Limits		33 Feet	
	21	Beam Angle		12 Degrees	
	22	Blanking Distance			
	23	Cable Length		As required for component locations	
	24	Operating Temperature Limits		-4 degF to 149 degF	
	25				
TRANSMITTER	26	Mounting		Wall	
	27	Enclosure NEMA Rating		NEMA 4X, Polycarbonate	
	28	Power Supply	Voltage	4 - Wire	120 VAC
	29	Output Signal		4 to 20 madc	
	30	Communication Protocol		HART	
	31	Range		As Noted	
	32	Operating Temperature Range		-4 degF to 113 degF	
SWITCH	33	Switch Type		2 Relay Outputs, minimum	
	34	Set Point		Adjustable and assignable	
	35	Set Point Direction			
	36	Deadband			
	37	Failure State			
	38	Voltage		120 VAC	
	39	Contact Arrangement		SPDT	
	40	Contact Rating		2 Amps	
	41				
CALIBRATION	42	Calibrated Range		As Noted	
	43	Zero Reference		As Noted	
	44	Vendor Calibration		No	
	45	Accuracy	Repeatability	+/- 0.25 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48	Sun Shield			
	49				
PURCHASE	50	Manufacturer		Endress+Hauser	Siemens
	51	Model Number Transmitter		FMU 95	Sitrans LUT400
	52	Model Number Sensor		Prosonic FDU	Echomax XPS
	53	Purchase Note		1 year warranty	

L05 **LEVEL TRANSMITTER - ULTRASONIC**	**NC Morena Pump Station and Pipelines Package A** **As Noted**

GENERAL	1	Tag Number	P&ID	LIT-102	I-05
	2	Loop Title		Diversion Sturcture No. 2 Level	
	3	Area Classification		Class 1 Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
PROCESS CONDITIONS	7	Fluid		Sewer	
	8	Pressure			
	9	Temperature			
	10	Specific Gravity	Viscosity		
	11	Conductivity	Density		
	12	Vapor Pressure	Critical Pressure	Atmospheric	
	13				
ELEMENT	14	Element Tag		LE-102	
	15	Element Type			
	16	Inactive Length (Blanking Distance)		1 Foot	
	17	NEMA Rating		NEMA 6P waterproof	
	18	Housing		PVDF	
	19	Process Connection		1 inch NPT, top mounted	
	20	Measurable Limits		33 Feet	
	21	Beam Angle		12 Degrees	
	22	Blanking Distance			
	23	Cable Length		As required for component locations	
	24	Operating Temperature Limits		-4 degF to 149 degF	
	25				
TRANSMITTER	26	Mounting		Wall	
	27	Enclosure NEMA Rating		NEMA 4X, Polycarbonate	
	28	Power Supply	Voltage	4 - Wire	120 VAC
	29	Output Signal		4 to 20 madc	
	30	Communication Protocol		HART	
	31	Range		As Noted	
	32	Operating Temperature Range		-4 degF to 113 degF	
SWITCH	33	Switch Type		2 Relay Outputs, minimum	
	34	Set Point		Adjustable and assignable	
	35	Set Point Direction			
	36	Deadband			
	37	Failure State			
	38	Voltage		120 VAC	
	39	Contact Arrangement		SPDT	
	40	Contact Rating		2 Amps	
	41				
CALIBRATION	42	Calibrated Range		As Noted	
	43	Zero Reference		As Noted	
	44	Vendor Calibration		No	
	45	Accuracy	Repeatability	+/- 0.25 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48	Sun Shield			
	49				
PURCHASE	50	Manufacturer		Endress+Hauser	Siemens
	51	Model Number Transmitter		FMU 95	Sitrans LUT400
	52	Model Number Sensor		Prosonic FDU	Echomax XPS
	53	Purchase Note		1 year warranty	

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LEVEL TRANSMITTER - ULTRASONIC

NC Morena Pump Station and Pipelines Package A

As Noted

GENERAL	1	Tag Number	P&ID	LIT-103	I-06
	2	Loop Title		Diversion Sturcture No. 3 Level	
	3	Area Classification		Class 1 Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
PROCESS CONDITIONS	7	Fluid		Sewer	
	8	Pressure			
	9	Temperature			
	10	Specific Gravity	Viscosity		
	11	Conductivity	Density		
	12	Vapor Pressure	Critical Pressure	Atmospheric	
	13				
ELEMENT	14	Element Tag		LE-103	
	15	Element Type			
	16	Inactive Length (Blanking Distance)		1 Foot	
	17	NEMA Rating		NEMA 6P waterproof	
	18	Housing		PVDF	
	19	Process Connection		1 inch NPT, top mounted	
	20	Measurable Limits		33 Feet	
	21	Beam Angle		12 Degrees	
	22	Blanking Distance			
	23	Cable Length		As required for component locations	
	24	Operating Temperature Limits		-4 degF to 149 degF	
	25				
TRANSMITTER	26	Mounting		Wall	
	27	Enclosure NEMA Rating		NEMA 4X, Polycarbonate	
	28	Power Supply	Voltage	4 - Wire	120 VAC
	29	Output Signal		4 to 20 madc	
	30	Communication Protocol		HART	
	31	Range		As Noted	
	32	Operating Temperature Range		-4 degF to 113 degF	
SWITCH	33	Switch Type		2 Relay Outputs, minimum	
	34	Set Point		Adjustable and assignable	
	35	Set Point Direction			
	36	Deadband			
	37	Failure State			
	38	Voltage		120 VAC	
	39	Contact Arrangement		SPDT	
	40	Contact Rating		2 Amps	
	41				
CALIBRATION	42	Calibrated Range		As Noted	
	43	Zero Reference		As Noted	
	44	Vendor Calibration		No	
	45	Accuracy	Repeatability	+/- 0.25 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48	Sun Shield			
	49				
PURCHASE	50	Manufacturer		Endress+Hauser	Siemens
	51	Model Number Transmitter		FMU 95	Sitrans LUT400
	52	Model Number Sensor		Prosonic FDU	Echomax XPS
	53	Purchase Note		1 year warranty	

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LEVEL TRANSMITTER - ULTRASONIC

NC Morena Pump Station and Pipelines Package A

As Noted

GENERAL	1	Tag Number	P&ID	LIT-201A	I-08
	2	Loop Title		Mechanical Screen 1 Upstream Level	
	3	Area Classification		Class 1 Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
PROCESS CONDITIONS	7	Fluid		Sewer	
	8	Pressure			
	9	Temperature			
	10	Specific Gravity	Viscosity		
	11	Conductivity	Density		
	12	Vapor Pressure	Critical Pressure	Atmospheric	
	13				
ELEMENT	14	Element Tag		LE-210A	
	15	Element Type			
	16	Inactive Length (Blanking Distance)		1 Foot	
	17	NEMA Rating		NEMA 6P waterproof	
	18	Housing		PVDF	
	19	Process Connection		1 inch NPT, top mounted	
	20	Measurable Limits		33 Feet	
	21	Beam Angle		12 Degrees	
	22	Blanking Distance			
	23	Cable Length		As required for component locations	
	24	Operating Temperature Limits		-4 degF to 149 degF	
	25				
TRANSMITTER	26	Mounting		Wall	
	27	Enclosure NEMA Rating		NEMA 4X, Polycarbonate	
	28	Power Supply	Voltage	4 - Wire	120 VAC
	29	Output Signal		4 to 20 madc	
	30	Communication Protocol		HART	
	31	Range		As Noted	
	32	Operating Temperature Range		-4 degF to 113 degF	
SWITCH	33	Switch Type		2 Relay Outputs, minimum	
	34	Set Point		Adjustable and assignable	
	35	Set Point Direction			
	36	Deadband			
	37	Failure State			
	38	Voltage		120 VAC	
	39	Contact Arrangement		SPDT	
	40	Contact Rating		2 Amps	
	41				
CALIBRATION	42	Calibrated Range		As Noted	
	43	Zero Reference		As Noted	
	44	Vendor Calibration		No	
	45	Accuracy	Repeatability	+/- 0.25 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48	Sun Shield			
	49				
PURCHASE	50	Manufacturer		Endress+Hauser	Siemens
	51	Model Number Transmitter		FMU 95	Sitrans LUT400
	52	Model Number Sensor		Prosonic FDU	Echomax XPS
	53	Purchase Note		1 year warranty	

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LEVEL TRANSMITTER - ULTRASONIC

NC Morena Pump Station and Pipelines Package A

As Noted

GENERAL	1	Tag Number	P&ID	LIT-201B	I-08
	2	Loop Title		Mechanical Screen 1 Upstream Level	
	3	Area Classification		Class 1 Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
PROCESS CONDITIONS	7	Fluid		Sewer	
	8	Pressure			
	9	Temperature			
	10	Specific Gravity	Viscosity		
	11	Conductivity	Density		
	12	Vapor Pressure	Critical Pressure	Atmospheric	
	13				
ELEMENT	14	Element Tag		LE-201B	
	15	Element Type			
	16	Inactive Length (Blanking Distance)		1 Foot	
	17	NEMA Rating		NEMA 6P waterproof	
	18	Housing		PVDF	
	19	Process Connection		1 inch NPT, top mounted	
	20	Measurable Limits		33 Feet	
	21	Beam Angle		12 Degrees	
	22	Blanking Distance			
	23	Cable Length		As required for component locations	
	24	Operating Temperature Limits		-4 degF to 149 degF	
	25				
TRANSMITTER	26	Mounting		Wall	
	27	Enclosure NEMA Rating		NEMA 4X, Polycarbonate	
	28	Power Supply	Voltage	4 - Wire	120 VAC
	29	Output Signal		4 to 20 madc	
	30	Communication Protocol		HART	
	31	Range		As Noted	
	32	Operating Temperature Range		-4 degF to 113 degF	
SWITCH	33	Switch Type		2 Relay Outputs, minimum	
	34	Set Point		Adjustable and assignable	
	35	Set Point Direction			
	36	Deadband			
	37	Failure State			
	38	Voltage		120 VAC	
	39	Contact Arrangement		SPDT	
	40	Contact Rating		2 Amps	
	41				
CALIBRATION	42	Calibrated Range		As Noted	
	43	Zero Reference		As Noted	
	44	Vendor Calibration		No	
	45	Accuracy	Repeatability	+/- 0.25 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48	Sun Shield			
	49				
PURCHASE	50	Manufacturer		Endress+Hauser	Siemens
	51	Model Number Transmitter		FMU 95	Sitrans LUT400
	52	Model Number Sensor		Prosonic FDU	Echomax XPS
	53	Purchase Note		1 year warranty	

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LEVEL TRANSMITTER - ULTRASONIC

NC Morena Pump Station and Pipelines Package A

As Noted

GENERAL	1	Tag Number	P&ID	LIT-202A	I-09
	2	Loop Title		Diversion Sturcture No. 1 Level	
	3	Area Classification		Class 1 Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
PROCESS CONDITIONS	7	Fluid		Sewer	
	8	Pressure			
	9	Temperature			
	10	Specific Gravity	Viscosity		
	11	Conductivity	Density		
	12	Vapor Pressure	Critical Pressure	Atmospheric	
	13				
ELEMENT	14	Element Tag		LE-202A	
	15	Element Type			
	16	Inactive Length (Blanking Distance)		1 Foot	
	17	NEMA Rating		NEMA 6P waterproof	
	18	Housing		PVDF	
	19	Process Connection		1 inch NPT, top mounted	
	20	Measurable Limits		33 Feet	
	21	Beam Angle		12 Degrees	
	22	Blanking Distance			
	23	Cable Length		`	
	24	Operating Temperature Limits		-4 degF to 149 degF	
	25				
TRANSMITTER	26	Mounting		Wall	
	27	Enclosure NEMA Rating		NEMA 4X, Polycarbonate	
	28	Power Supply	Voltage	4 - Wire	120 VAC
	29	Output Signal		4 to 20 madc	
	30	Communication Protocol		HART	
	31	Range		As Noted	
	32	Operating Temperature Range		-4 degF to 113 degF	
SWITCH	33	Switch Type		2 Relay Outputs, minimum	
	34	Set Point		Adjustable and assignable	
	35	Set Point Direction			
	36	Deadband			
	37	Failure State			
	38	Voltage		120 VAC	
	39	Contact Arrangement		SPDT	
	40	Contact Rating		2 Amps	
	41				
CALIBRATION	42	Calibrated Range		As Noted	
	43	Zero Reference		As Noted	
	44	Vendor Calibration		No	
	45	Accuracy	Repeatability	+/- 0.25 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48	Sun Shield			
	49				
PURCHASE	50	Manufacturer		Endress+Hauser	Siemens
	51	Model Number Transmitter		FMU 95	Sitrans LUT400
	52	Model Number Sensor		Prosonic FDU	Echomax XPS
	53	Purchase Note		1 year warranty	

L05 **LEVEL TRANSMITTER - ULTRASONIC**	**NC Morena Pump Station and Pipelines Package A** **As Noted**

GENERAL	1	Tag Number	P&ID	LIT-202B	I-09
	2	Loop Title		Diversion Sturcture No. 1 Level	
	3	Area Classification		Class 1 Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
PROCESS CONDITIONS	7	Fluid		Sewer	
	8	Pressure			
	9	Temperature			
	10	Specific Gravity	Viscosity		
	11	Conductivity	Density		
	12	Vapor Pressure	Critical Pressure	Atmospheric	
	13				
ELEMENT	14	Element Tag		LE-202B	
	15	Element Type			
	16	Inactive Length (Blanking Distance)		1 Foot	
	17	NEMA Rating		NEMA 6P waterproof	
	18	Housing		PVDF	
	19	Process Connection		1 inch NPT, top mounted	
	20	Measurable Limits		33 Feet	
	21	Beam Angle		12 Degrees	
	22	Blanking Distance			
	23	Cable Length		As required for component locations	
	24	Operating Temperature Limits		-4 degF to 149 degF	
	25				
TRANSMITTER	26	Mounting		Wall	
	27	Enclosure NEMA Rating		NEMA 4X, Polycarbonate	
	28	Power Supply	Voltage	4 - Wire	120 VAC
	29	Output Signal		4 to 20 madc	
	30	Communication Protocol		HART	
	31	Range		As Noted	
	32	Operating Temperature Range		-4 degF to 113 degF	
SWITCH	33	Switch Type		2 Relay Outputs, minimum	
	34	Set Point		Adjustable and assignable	
	35	Set Point Direction			
	36	Deadband			
	37	Failure State			
	38	Voltage		120 VAC	
	39	Contact Arrangement		SPDT	
	40	Contact Rating		2 Amps	
	41				
CALIBRATION	42	Calibrated Range		As Noted	
	43	Zero Reference		As Noted	
	44	Vendor Calibration		No	
	45	Accuracy	Repeatability	+/- 0.25 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48	Sun Shield			
	49				
PURCHASE	50	Manufacturer		Endress+Hauser	Siemens
	51	Model Number Transmitter		FMU 95	Sitrans LUT400
	52	Model Number Sensor		Prosonic FDU	Echomax XPS
	53	Purchase Note		1 year warranty	

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LEVEL TRANSMITTER - ULTRASONIC

NC Morena Pump Station and Pipelines Package A

As Noted

GENERAL	1	Tag Number	P&ID	LIT-106	I-11
	2	Loop Title		Wetwell Level	
	3	Area Classification		Class 1 Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
PROCESS CONDITIONS	7	Fluid		Sewer	
	8	Pressure			
	9	Temperature			
	10	Specific Gravity	Viscosity		
	11	Conductivity	Density		
	12	Vapor Pressure	Critical Pressure	Atmospheric	
	13				
ELEMENT	14	Element Tag		LE-106	
	15	Element Type			
	16	Inactive Length (Blanking Distance)		1 Foot	
	17	NEMA Rating		NEMA 6P waterproof	
	18	Housing		PVDF	
	19	Process Connection		1 inch NPT, top mounted	
	20	Measurable Limits		33 Feet	
	21	Beam Angle		12 Degrees	
	22	Blanking Distance			
	23	Cable Length		`	
	24	Operating Temperature Limits		-4 degF to 149 degF	
	25				
TRANSMITTER	26	Mounting		Wall	
	27	Enclosure NEMA Rating		NEMA 4X, Polycarbonate	
	28	Power Supply	Voltage	4 - Wire	120 VAC
	29	Output Signal		4 to 20 madc	
	30	Communication Protocol		HART	
	31	Range		As Noted	
	32	Operating Temperature Range		-4 degF to 113 degF	
SWITCH	33	Switch Type		2 Relay Outputs, minimum	
	34	Set Point		Adjustable and assignable	
	35	Set Point Direction			
	36	Deadband			
	37	Failure State			
	38	Voltage		120 VAC	
	39	Contact Arrangement		SPDT	
	40	Contact Rating		2 Amps	
	41				
CALIBRATION	42	Calibrated Range		As Noted	
	43	Zero Reference		As Noted	
	44	Vendor Calibration		No	
	45	Accuracy	Repeatability	+/- 0.25 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48	Sun Shield			
	49				
PURCHASE	50	Manufacturer		Endress+Hauser	Siemens
	51	Model Number Transmitter		FMU 95	Sitrans LUT400
	52	Model Number Sensor		Prosonic FDU	Echomax XPS
	53	Purchase Note		1 year warranty	

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LEVEL TRANSMITTER - ULTRASONIC

NC Morena Pump Station and Pipelines Package A

As Noted

GENERAL	1	Tag Number	P&ID	LIT-107	I-11
	2	Loop Title		Wetwell Level	
	3	Area Classification		Class 1 Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
PROCESS CONDITIONS	7	Fluid		Sewer	
	8	Pressure			
	9	Temperature			
	10	Specific Gravity	Viscosity		
	11	Conductivity	Density		
	12	Vapor Pressure	Critical Pressure	Atmospheric	
	13				
ELEMENT	14	Element Tag		LE-107	
	15	Element Type			
	16	Inactive Length (Blanking Distance)		1 Foot	
	17	NEMA Rating		NEMA 6P waterproof	
	18	Housing		PVDF	
	19	Process Connection		1 inch NPT, top mounted	
	20	Measurable Limits		33 Feet	
	21	Beam Angle		12 Degrees	
	22	Blanking Distance			
	23	Cable Length		As required for component locations	
	24	Operating Temperature Limits		-4 degF to 149 degF	
	25				
TRANSMITTER	26	Mounting		Wall	
	27	Enclosure NEMA Rating		NEMA 4X, Polycarbonate	
	28	Power Supply	Voltage	4 - Wire	120 VAC
	29	Output Signal		4 to 20 madc	
	30	Communication Protocol		HART	
	31	Range		As Noted	
	32	Operating Temperature Range		-4 degF to 113 degF	
SWITCH	33	Switch Type		2 Relay Outputs, minimum	
	34	Set Point		Adjustable and assignable	
	35	Set Point Direction			
	36	Deadband			
	37	Failure State			
	38	Voltage		120 VAC	
	39	Contact Arrangement		SPDT	
	40	Contact Rating		2 Amps	
	41				
CALIBRATION	42	Calibrated Range		As Noted	
	43	Zero Reference		As Noted	
	44	Vendor Calibration		No	
	45	Accuracy	Repeatability	+/- 0.25 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48	Sun Shield			
	49				
PURCHASE	50	Manufacturer		Endress+Hauser	Siemens
	51	Model Number Transmitter		FMU 95	Sitrans LUT400
	52	Model Number Sensor		Prosonic FDU	Echomax XPS
	53	Purchase Note		1 year warranty	

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LEVEL TRANSMITTER - ULTRASONIC

NC Morena Pump Station and Pipelines Package A

As Noted

P09 PRESSURE TRANSMITTER

GENERAL	1	Tag Number	P&ID	P-011	I-10
	2	Loop Title		Pump 01 Discharge Pressure	
	3	Area Classification		Class I Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule	24"	
PROCESS CONDITIONS	6	Fluid		Sewer	
	7	Min Pressure	Max Pressure	150 PSI	300 PSI
	8	Temperature		70 Degrees	
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Prssure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL - ANNULA R SEAL	22	Type		As Noted	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		316L Stainless Steel	
	25	Diaphragm / Sleeve Material		Teflon	
	26				
	27	Calillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer		Same as transmitter	
	33	Model Number		Same as transmitter	
TRANSMITTER	34	Mounting		Pipe	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range		150-300 PSI	
	40				
CALIBRATION	41	Calibrated Range		200-250 PSI	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer		Smar	Rosemount
	51	Model Number		LD 301	3051
	52	3-valve SS Manifolds mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 PRESSURE

TRANSMITTER

NC MORENA PUMP STATION AND PIPELINES PACKAGE A

P-011

GENERAL	1	Tag Number	P&ID	P-012	I-10
	2	Loop Title		Pump 02 Discharge Pressure	
	3	Area Classification		Class I Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule	24"	
PROCESS CONDITIONS	6	Fluid		Sewer	
	7	Min Pressure	Max Pressure	150 PSI	300 PSI
	8	Temperature		70 Degrees	
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Prssure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL - ANNULA R SEAL	22	Type		As Noted	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		316L Stainless Steel	
	25	Diaphragm / Sleeve Material		Teflon	
	26				
	27	Calillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer		Same as transmitter	
	33	Model Number		Same as transmitter	
TRANSMITTER	34	Mounting		Pipe	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range		150-300 PSI	
	40				
CALIBRATION	41	Calibrated Range		200-250 PSI	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer		Smar	Rosemount
	51	Model Number		LD 301	3051
	52	3-valve SS Manifolds mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 PRESSURE

TRANSMITTER

NC MORENA PUMP STATION AND PIPELINES PACKAGE A

P-012

GENERAL	1	Tag Number	P&ID	P-021	I-10
	2	Loop Title		Pump 03 Discharge Pressure	
	3	Area Classification		Class I Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule	24"	
PROCESS CONDITIONS	6	Fluid		Sewer	
	7	Min Pressure	Max Pressure	150 PSI	300 PSI
	8	Temperature		70 Degrees	
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Prssure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL - ANNULA R SEAL	22	Type		As Noted	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		316L Stainless Steel	
	25	Diaphragm / Sleeve Material		Teflon	
	26				
	27	Calillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer		Same as transmitter	
	33	Model Number		Same as transmitter	
TRANSMITTER	34	Mounting		Pipe	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range		150-300 PSI	
	40				
CALIBRATION	41	Calibrated Range		200-250 PSI	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer		Smar	Rosemount
	51	Model Number		LD 301	3051
	52	3-valve SS Manifolds mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 PRESSURE

TRANSMITTER

NC MORENA PUMP STATION AND PIPELINES PACKAGE A

P-021

GENERAL	1	Tag Number	P&ID	P-022	I-10
	2	Loop Title		Pump 04 Discharge Pressure	
	3	Area Classification		Class I Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule	24"	
PROCESS CONDITIONS	6	Fluid		Sewer	
	7	Min Pressure	Max Pressure	150 PSI	300 PSI
	8	Temperature		70 Degrees	
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Prssure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL - ANNULAR SEAL	22	Type		As Noted	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		316L Stainless Steel	
	25	Diaphragm / Sleeve Material		Teflon	
	26				
	27	Calillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer		Same as transmitter	
	33	Model Number		Same as transmitter	
TRANSMITTER	34	Mounting		Pipe	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range		150-300 PSI	
	40				
CALIBRATION	41	Calibrated Range		200-250 PSI	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer		Smar	Rosemount
	51	Model Number		LD 301	3051
	52	3-valve SS Manifolds mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 PRESSURE

TRANSMITTER

NC MORENA PUMP STATION AND PIPELINES PACKAGE A

P-022

GENERAL	1	Tag Number	P&ID	P-031	I-11
	2	Loop Title		Pump 05 Discharge Pressure	
	3	Area Classification		Class I Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule	24"	
PROCESS CONDITIONS	6	Fluid		Sewer	
	7	Min Pressure	Max Pressure	150 PSI	300 PSI
	8	Temperature		70 Degrees	
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Prssure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL - ANNULA R SEAL	22	Type		As Noted	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		316L Stainless Steel	
	25	Diaphragm / Sleeve Material		Teflon	
	26				
	27	Calillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer		Same as transmitter	
	33	Model Number		Same as transmitter	
TRANSMITTER	34	Mounting		Pipe	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range		150-300 PSI	
	40				
CALIBRATION	41	Calibrated Range		200-250 PSI	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer		Smar	Rosemount
	51	Model Number		LD 301	3051
	52	3-valve SS Manifolds mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 PRESSURE

TRANSMITTER

NC MORENA PUMP STATION AND PIPELINES PACKAGE A

P-031

GENERAL	1	Tag Number	P&ID	P-032	I-11
	2	Loop Title		Pump 06 Discharge Pressure	
	3	Area Classification		Class I Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule	24"	
PROCESS CONDITIONS	6	Fluid		Sewer	
	7	Min Pressure	Max Pressure	150 PSI	300 PSI
	8	Temperature		70 Degrees	
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Prssure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL - ANNULAR SEAL	22	Type		As Noted	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		316L Stainless Steel	
	25	Diaphragm / Sleeve Material		Teflon	
	26				
	27	Calillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer		Same as transmitter	
	33	Model Number		Same as transmitter	
TRANSMITTER	34	Mounting		Pipe	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range		150 - 300 PSI	
	40				
CALIBRATION	41	Calibrated Range		200 - 250 PSI	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer		Smar	Rosemount
	51	Model Number		LD 301	3051
	52	3-valve SS Manifolds mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 PRESSURE

TRANSMITTER

NC MORENA PUMP STATION AND PIPELINES PACKAGE A

P-032

GENERAL	1	Tag Number	P&ID	P-041	I-12
	2	Loop Title		Pump 07 Discharge Pressure	
	3	Area Classification		Class I Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule	24"	
PROCESS CONDITIONS	6	Fluid		Sewer	
	7	Min Pressure	Max Pressure	150 PSI	300 PSI
	8	Temperature		70 Degrees	
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Prssure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL - ANNULA R SEAL	22	Type		As Noted	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		316L Stainless Steel	
	25	Diaphragm / Sleeve Material		Teflon	
	26				
	27	Calillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer		Same as transmitter	
	33	Model Number		Same as transmitter	
TRANSMITTER	34	Mounting		Pipe	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range		150-300 PSI	
	40				
CALIBRATION	41	Calibrated Range		200 - 250 PSI	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer		Smar	Rosemount
	51	Model Number		LD 301	3051
	52	3-valve SS Manifolds mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 PRESSURE

TRANSMITTER

NC MORENA PUMP STATION AND PIPELINES PACKAGE A

P-041

GENERAL	1	Tag Number	P&ID	P-042	I-12
	2	Loop Title		Pump 08 Discharge Pressure	
	3	Area Classification		Class I Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule	24"	
PROCESS CONDITIONS	6	Fluid		Sewer	
	7	Min Pressure	Max Pressure	150 PSI	300 PSI
	8	Temperature		70 Degrees	
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Prssure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL - ANNULA R SEAL	22	Type		As Noted	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		316L Stainless Steel	
	25	Diaphragm / Sleeve Material		Teflon	
	26				
	27	Calillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer		Same as transmitter	
	33	Model Number		Same as transmitter	
TRANSMITTER	34	Mounting		Pipe	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range		150 - 300 PSI	
	40				
CALIBRATION	41	Calibrated Range		200 - 250 PSI	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer		Smar	Rosemount
	51	Model Number		LD 301	3051
	52	3-valve SS Manifolds mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 PRESSURE

TRANSMITTER

NC MORENA PUMP STATION AND PIPELINES PACKAGE A

P-042

GENERAL	1	Tag Number	P&ID	P-051	I-12
	2	Loop Title		Pump 09 Discharge Pressure	
	3	Area Classification		Class I Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule	24"	
PROCESS CONDITIONS	6	Fluid		Sewer	
	7	Min Pressure	Max Pressure	150 PSI	300 PSI
	8	Temperature		70 degrees	
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Prssure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL - ANNULA R SEAL	22	Type		As Noted	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		316L Stainless Steel	
	25	Diaphragm / Sleeve Material		Teflon	
	26				
	27	Calillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer		Same as transmitter	
	33	Model Number		Same as transmitter	
TRANSMITTER	34	Mounting		Pipe	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range		150 - 300 PSI	
	40				
CALIBRATION	41	Calibrated Range		200 to 250 PSI	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer		Smar	Rosemount
	51	Model Number		LD 301	3051
	52	3-valve SS Manifolds mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 PRESSURE

TRANSMITTER

NC MORENA PUMP STATION AND PIPELINES PACKAGE A

P-051

GENERAL	1	Tag Number	P&ID	P-052	I-12
	2	Loop Title		Pump 10 Discharge Pressure	
	3	Area Classification		Class I Div 2	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule	24"	
PROCESS CONDITIONS	6	Fluid		Sewer	
	7	Min Pressure	Max Pressure	150 PSI	300 PSI
	8	Temperature		70 degrees	
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Prssure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL - ANNULA R SEAL	22	Type		As Noted	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		316L Stainless Steel	
	25	Diaphragm / Sleeve Material		Teflon	
	26				
	27	Calillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer		Same as transmitter	
	33	Model Number		Same as transmitter	
TRANSMITTER	34	Mounting		Pipe	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range		150 - 300 PSI	
	40				
CALIBRATION	41	Calibrated Range		200 -250 PSI	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer		Smar	Rosemount
	51	Model Number		LD 301	3051
	52	3-valve SS Manifolds mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 PRESSURE

TRANSMITTER

NC MORENA PUMP STATION AND PIPELINES PACKAGE A

P-052

SECTION 40 90 03
GENERAL REQUIREMENTS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. GENERAL

The DISTRIBUTED CONTROL SYSTEM PROVIDER (DCSP) shall furnish all equipment and provide all applicable engineering for a fully functional distributed control system, that complies with the technical requirements of the contract documents including, but not limited to, project management, design assistance, coordinate with on-site area contractors, detailed system design and integration, conducting graphic design workshops, equipment supply and shipment, storage, job site delivery, programming and configuration, installation oversight, testing, commissioning and start up, integration with the existing Cleanwater Operation and Management Network (COMNET), and training.

1. The DCS Work shall be as defined within Division 01 and these Specifications.
2. The Work covered by this specification and all of its sub parts shall include, but not limited to, field verification of all existing conditions, engineering and design of system and components, manufacture and/or procurement of all necessary equipment, components, material, transportation, labor, special tools, factory testing, application programming, shipment, storage, and jobsite delivery, operational readiness testing, installation of equipment, system integration, startup operation, site testing, training and documentation, support, maintenance/warranty of a complete, integrated and operational Distributed Control System (DCS) for the City of San Diego.
3. The statements of Work contained herein are necessarily general in nature and should not be construed as an all-inclusive list of devices, equipment, software and services necessary for successful completion of the Work.
4. It shall be the responsibilities of the DCSP to coordinate and project manage the Work, as set forth in this section of the Specifications, with work and equipment specified under other sections of the Specifications, in order to provide a complete and satisfactory installation.
5. To ensure that the distributed control system shall be a standard system of Emerson Process Management, Ovation family. With a complete repertoire of pre-existing software modules running in a familiar hardware environment and free from hardware/software incompatibilities.
6. This specification is generic to all Facilities and applicable sections shall be delivered for each process segment of the Work as defined in these Specifications and project Contract Documents.
7. The DCSP shall be responsible for coordination, installation and testing of DCS. The Prime Contractor is responsible for termination of I/O signals,

power and ground utilities for all DCS equipment. The DCSP shall review and inspect all current designs and all Contract Documents to assess space allocations, power allotments and available grounds. If the DCSP's requirements for power, grounding or spatial requirements differ from that shown within the Contract Documents, the DCSP shall include all required engineering, design and construction details to the Prime Contractor and City's representative immediately.

8. The DCSP shall be responsible for providing all equipment, installation supervision, engineering, programming, configuration, management and services associated with integrating all instrumentation and control devices, and special systems, including Foreign Device Interfaces (FDI), into the DCS in a transparent and seamless manner. The use of a third party, system house, or system integrators for the above service is not acceptable.
9. DCSP shall be fully responsible for the implementation, installation, and integration of the DCS as outlined in this specification.
10. The provisions of this Section shall apply to all items specified in the various Sections of Division 40 and all other Divisions.
11. DCSP shall be responsible for interfacing to all existing instrumentation and all other Input/Output (I/O)devices.
12. During field functional testing the DCSP shall verify the operation of all instruments and field devices and associated wiring (from instrument/device to DCS) and notify the City's representative and Prime Contractor of any deficiencies that exist.

B. SCOPE OF WORK

1. The Work generally consists of the supply of all labor, tools, services and provision of all products required, for a complete, integrated, operational DCS control system in accordance with the Contract Specification and Drawings.
2. Identify other on-going projects/systems development that are not part of this contract. Ensure other ongoing activities, in close proximity or otherwise, do not disturb or interrupt the operation of the existing systems or the work already commissioned or placed into operation. Should any such activity pose a risk to this work or to the system operation, advise the City immediately.
3. In general, the work involves the supply, installation and commissioning of the DCS control system as indicated on the drawings and specification sheets, and as defined in the Matrix of Responsibilities in D. The following is a summary of the major works:
    a. Engineer to provide a high-level description of the project specific work including provision of all instruments, hardware, software,

network, cabling, and services such as testing, commissioning, training, documentation.

b. Following the instructions in D, Provide, test and commission all field instrumentation including field wiring, instrument control panels, and control system hardware including all lightning & surge protection, and all peripheral devices necessary.

c. Conduits and Wires:

1) All conduits, including those for the district information network (DIN), plant information network (PIN) and facility information network (FIN), will be furnished and installed by the Prime Contractor. All conductors, including power and grounding for DCSP furnished equipment will be furnished and installed by the Prime Contractor. DCS grounding will use a special triad grounding system; specifications for this system are provided in the contract documents in accordance with the DCSP requirements. All signal conductors, except for PIN, and FIN fiber optic and coaxial cables, will be provided and installed by the Prime Contractor.

2) The PIN and FIN fiber optic and coaxial cables will be furnished, installed and terminated by the Prime Contractor. DIN fiber optic cable will be furnished by the Prime Contractor up to the first termination point within a facility.

3) Cables and conduits for non-DCS communications systems, such as the telephone system, will be furnished and installed by the Prime Contractor.

d. Provide all programming and microprocessor-based instrument configuration.

e. Provide all required testing, commissioning and start up services. Allow in the Contract Price, for any additional time deemed necessary to meet the testing and commission requirements.

f. Provide Factory Acceptance Testing (FAT) to demonstrate the operational functionality of hardware and communications per specifications.

g. Provide Operational Readiness Testing (ORT) to demonstrate the correct operation of the control system with both hardware and software in place per specifications.

h. Provide Performance Acceptance Test to ensure entire system functions properly per specifications.

i. Provide all required training per specifications.

j. Provide warranty services per contract requirements.

4. Interfacing and Responsibilities of Prime Contractor and DCSP:
The following Table 1 shows the procurement, installation, and labor responsibilities of the DCSP and the GC. All field instrumentation

devices and final control elements which are needed to support DCS functionality will be wired to process control modules (PCMs). Tables 2 and Table 3 define in greater detail of the responsibilities assigned to the Prime Contractor and the DCSP.

Table 1: Matrix of Responsibilities - Equipment/Devices/Materials

Product	Supply	Install
DCS Process Control Modules (PCMs)	DCSP	GC
DCS Workstations (WSs)	DCSP	DCSP
DCS Historian System (HS)	DCSP	DCSP
DCS PIN/FIN Hubs and network equipment	DCSP	DCSP
DCS Printers and Stands	DCSP	DCSP
Fiber Optic Network Cables (PIN and FIN cables)	GC	GC
Fiber Optic "DIN Cables"	GC	GC
All Other Communication Cables which Interconnect DCS Equipment	DCSP	DCSP
UPS Systems and Ancillaries for DCSP provided equipment	DCSP	GC
Instrumentation Panels (including PLCs) and racks provided by DCSP	DCSP	GC
Panels (including PLCs) and racks provided by GCs	GC	GC
Instrumentation provided by GCs	GC	GC
Instrumentation provided by DCSP within panels (including specialized communications cables required.)	DCSP	GC
Interposing relays to interface DCS control commands with equipment controls FIE	GC	GC
DCS Isolated (Reference) Grounding Cables and Rods	GC	GC
Large Screen Control Room Video System	DCSP	GC

Table 2: Matrix of Responsibilities - Wire/Conduit/Terminations

Description	Supply	Install	Terminate
Power conduits and wire to GC furnished equipment and devices	GC	GC	GC

Power conduits and wire to DCSP furnished equipment and devices	GC	GC	GC
Signal conduits from DCSP or GC furnished instruments to DCSP or GC furnished equipment and device	GC	GC	---
Signal wire/cable from DCSP or GC furnished instruments to DCSP or GC furnished equipment and devices	GC	GC	GC
All conduits associated with the PIN, FIN, DIN and other communication links	GC	GC	----
PIN and FIN fiber optic, unshielded twisted-pair and coaxial cables	GC	GC	GC
Other communications cables from GC-supplied equipment to the DCS	GC	GC	GC
All cable associated with the DIN	DCSP	GC	DCSP
All conduits associated with the fire alarm, CCTV, page party and security/card reader systems, as required	GC	GC	----
All signal wire/cable associated with the fire alarm, CCTV, page party, and security/card reader systems	GC	GC	GC
All power wire/cable associated with the fire alarm, CCTV, page party and security/card reader systems	GC	GC	GC
Ground conduits and wire/cable from power panel to PCM or any other DCSP furnished equipment	GC	GC	GC

Table 3: Matrix of Responsibilities - Testing and Services

Task	DCSP	GC
Prepare DCS hardware/installation submittals (PCM; WSs; HS; CM; UPS; fire alarm system, if required)	X	
Prepare DCS software submittal	X	
Provide SAMA functional diagrams	X	
Prepare annotated software listings of all GC-furnished PLCs and other programmable equipment		X
Prepare instrument submittal		X
Calibrate instruments		X
Prepare GC panel submittals		X
Prepare loop drawings to support the termination of all DCS I/O and the installation of all instruments		X

Prepare DCS hardware/installation submittals (PCM; WSs; HS; CM; UPS; fire alarm system, if required)	X	
Coordinate all control systems integration (instrumentation, PLCs, DCS, network, communications and data exchange) amongst various subs		X
Perform factory acceptance test (FAT) of DCS	X	
Perform factory acceptance test of GC panels		X
Perform operational readiness test (ORT) of DCS	X	
Perform ORT test of GC panels		X
Perform loop tests	X	X
Participate in plant startup	X	X
Provide DCS information to support GC development of loop drawings	X	

1.2 RELATED SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

1.3 SPECIFICATIONS, CODES AND STANDARDS

A. The Work shall comply with the current editions of the publication and codes identified in Section 40 90 04 References and herein.

1.4 DEFINITIONS

A. Definitions of acronyms are identified in Section 40 90 05.

1.5 SUBMITTALS

A. The DCSP shall develop and submit within the first 45 days after NTP, a detailed list of submittals required by all Contract Documents for review and approval. The list shall contain the title of each submittal, detailed description of its contents and the applicable reference Sections. Submittal shall be grouped, organized and sequenced logically such that it facilitates the City's representative's review process. This requirement extends to all Work required by all other Divisions.

B. NOT USED.

C. NOT USED.

D. All Submittals shall be executed in accordance with Specification 01 33 00, Submittal Procedures.

E. The DCSP shall conduct a pre-submittal conference. At a minimum, the following shall be presented at the conference:

1. A list of equipment and materials required for the applicable submittal content.
2. A list of proposed exceptions to the Specifications and Drawings, along with a brief explanation of each.
3. An exact one-to-one sample of each type of document to be submitted.
4. Any implementation and construction documentation associated with the submittal.
5. A schedule or schedule fragment that applies to the submittal.

F. The DCSP shall coordinate the WORK of the DCS with the Contractor and its subcontractor so that a complete DCS package will be provided inclusive of accurate shop drawings and record drawings. The DCSP shall prepare and submit complete and organized shop drawings, as specified herein. Incomplete or partial submittals are not acceptable. All shop drawings and record drawings shall be submitted in accordance with Specification 01 33 00, Submittal Procedures.

1. Plant-wide loop drawing submittal (PLDS) to verify the DCS interfaces with all instrumentation and devices being provided or installed under this project are to be developed by the Contractor or its subcontractor with the assistance of DCSP. The Loop Drawings shall define all interfaces with equipment provided by the DCSP and as such the DCSP is responsible for providing all necessary information to the Contractor on a timely basis. The Loop Drawings shall be developed in accordance with existing City Loop Drawing standards, as follows:

The loop drawing shall be composed of three sections:

Page 1: A device schedule with a table showing the following:

a. Device tag number, with Prefix, Unit Process, ISA Tag Prefix, Tag No, Tag suffix
b. Equipment Service
c. Device Type
d. Location
e. Device Manufacturer
f. Model No.
g. Spec. No.
h. Area Contractor (if applicable
i. Submittal No.
j. Remarks
k. Data Sheet No.
l. I/O Signal (AI, AO, DI, or DO)
m. Signal Level
n. Device Range
o. Engineering Units
p. Process Set Point
q. Loop Diagram No.
r. Loop Drawing File Name
s. Interconnect Drawing File Name
t. For third-party devices, should also include: IP (if applicable), module addresses, data registers, IO Tag Names (AB), protocols etc.

Page 2: Loop drawing meeting the Requirements of ANSI/ISA S5.4, except that intermediate terminal junction boxes may omitted and be shown on Page 3 for clarity.

Page 3: Abbreviated diagram showing instrument, wire and cable numbers, intermediate terminal junction boxes, and PCM terminations.

2. The DCSP shall augment the content of the Loop Drawings by providing all of the requisite data relating to the DCS. For each DCS input/output, the DCSP shall note on the PLDS the following information:

a. PCM number, and physical location
b. Controller Number
c. Type of input.
d. I/O card location and address.

e. All DCS-dependent displayed functions using ISA symbology.
f. Drawing reference for DCS software content.

3. In these Contract Documents all systems, all meters, all instruments, and all other elements are represented schematically, and are designated by symbology as derived from International Society of Automation ISA S5.1 (latest revision). The nomenclature and numbers designated herein and on the Drawings, shall be employed exclusively throughout shop drawings, and similar materials. Any other symbols, designations, and nomenclature unique to any manufacturer's standard methods shall not replace those prescribed above, used herein, and on the Drawings.
4. All shop drawings shall include a City-approved title block. The title block shall include, as a minimum, business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing. Loop Drawing Submittals shall be submitted in accordance with Specification 01 33 00, Submittal Procedures.

G. The DCS hardware submittal (DCSHS) shall be singular and all inclusive, submitted in accordance with Specification 01 33 00, Submittal Procedures. The DCS Hardware Submittal shall include, but not be limited to:
1. A complete set of system diagrams which depict:
a. All Process Control Modules (PCMs), Workstations (WSs), video devices, printers, UPS, Foreign Device Interfaces (Data Link) telemetry devices, communication devices, and communication links.
b. A one-line showing the designed conduit and wire required to support the power, ground, Input/Output, and communication requirements of the system.
c. A complete I/O Database showing all I/Os, annotated in ISA format, which depicts all designed I/O, both external and internal hard-wired and data-linked, inclusive of DCS termination locations.
d. A Complete one-line diagram showing all power wiring and ground wiring, including UPS power, Utility (non-UPS) power and any other external D.C. or A.C. sources for each PCM.
2. A complete set of Factory Data sheets for every DCS component. This shall include layout drawings that show enclosure details, including seismic mounting, as well as the location of each component within the DCS PCM enclosure. Drawings shall contain a scaled representation of the

placement of all DCS equipment being provided under this contract and its spatial relationship to all other equipment (both new and existing) located in the abutting and adjoining areas. All acquired access and clearances associated with the DCS equipment and other equipment must be shown with a statement of compliance to DCSP requirements, NEC, NFPA and other applicable codes.

3. Detailed installation, mounting and anchoring details for all components and assemblies to be field mounted, including access requirements, conduit connections or entry details shall be provided.
4. DCSP shall provide Seismic calculations for each DCS PCM enclosure and UPS installation, or other anchored apparatus, based on the proposed mounting arrangement. Installation/Mounting/Anchoring drawings shall be stamped by a Structural Engineer, registered with the State of California. Each individual anchoring drawing, as well as the seismic calculations drawings, shall be stamped by the structural engineer.
5. A complete, and detailed, bill of material (BOM) shall be provided. The BOM shall show the factory model number for each component within the DCS.

H. The DCS Network submittal (DCSNS) shall be singular and all inclusive, submitted in accordance with Specification 01 33 00, Submittal Procedures. The DCS Hardware Submittal shall include, but not be limited to:
   1. A complete set of network diagrams which depict:
      a. All Process Control Modules (PCMs), Workstations (WSs), video devices, printers, UPS, Foreign Device Interfaces (Data Link) telemetry devices, communication devices, and communication links.
      b. A one-line showing the designed conduit and wire required to support the power, ground, Input/Output, and communication requirements of the system.
      c. A complete network design report including IP scheme, traffic planning and control, QoS, configuration of every network equipment including routers, switches and firewalls.
      d. A Complete fiber connection diagrams including fiber routing plans, fiber details, link budget calculations etc.,
      e. A complete, and detailed, bill of material (BOM) shall be provided. The BOM shall show the factory model number for each component within the DCS.

2. A complete set of Factory Data sheets for every network component.

I. The DCS Software Submittal (DCSSS) shall be singular and all inclusive, submitted in accordance with Specification 01 33 00, Submittal Procedures. The DCS Software Submittal shall include, but not be limited to:
   1. A complete set of all available software algorithms.
   2. A complete set of Designer control strategies, with annotations provided by the DCSP depicting engineering details to show how all monitoring and control functions, on a loop by loop basis, will be accomplished. So operators can understand how the process will respond to his actions through DCS interfaces.
   3. An English narrative of each data acquisition or control loop mission and anticipated action. Narratives shall enumerate the signal point name, signal descriptor, associated PCM number, associated system template displays, system functions activated by signal (i.e., interlocks, alarms, logs, etc.).
   4. A complete set of PCM configuration sheets depicting each loop linkage. Each loop shall be on its own 11" x 17" sheet.
   5. A complete listing of the DCS data base listing for each data point's relevant parameters such as range, contact orientation, limits, incremental limits, I/O card type, I/O hardware address and assignment, including ALL Macros used/created for the Software.

J. The DCS Graphic Submittal (DCSGS) shall be singular and all inclusive, submitted in accordance with Specification 01 33 00, Submittal Procedures. The DCS Graphics Submittal shall include, but not be limited to:
   1. One complete set of all WS-accessible displays which are unique to this project (i.e., process global, system global, process regional, systems regional, process group, process loop, process component, integrated tutorials, integrated process tutorials, integrated documentation, user assistance).
   2. The DCSP shall ensure that all graphics development, and graphics submittal, conform to the existing graphics layouts, linkages and formats used throughout the COMNET Enterprise.
   3. The Graphics Submittals shall contain displays in full size color graphic format and replicate the proposed screen contents. All background colors shall be identical to that of the screen content. All displays shall be arranged in a hierarchical order with references to associated WSs.
   4. A system display linkage diagram which defines the hierarchical order and the linkages via page, down, left, right commands.

5. A definition of each displays data fields by tag numbers, utilizing the existing DCS COMNET standard.
6. A definition of each displays dynamic elements which shall blink, change color, rotate or change shape in response to process changes, and conforms to the existing COMNET standard.
7. A listing of all "help" text associated with each display screen, arranges in conformance to the COMNET standard.

K. The DCSP shall prepare and submit plans for the Factory Acceptance Test (FAT) and Operation Readiness Tests (ORT). The FAT and ORT plans shall be submitted in accordance with Specification 01 33 00, Submittal Procedures. The ORT and FAT Plans shall each be a single-source document which shall encompasses means and methods for testing the complete DCS for this Project segment.
   1. The ORT and FAT Plans shall provide testing of all DCS hardware, software, graphics, alarms and network communications.
   2. The FAT Plan shall elaborate on the simulator to be utilized to provide proof of performance testing for the I&C and DCS functions of the project.
   3. The ORT and FAT Plans shall provide sample sheets depicting all I/O, hardware, Data Links, communication Networking and internally generated alarms and I/O points. Once approved conceptually by the City, these forms will be populated and utilized by the DCSP in the submission of each PCM individual FAT and ORT submittal.

L. The DCSP shall prepare a complete Training Plan. The Training Plan shall be submitted in accordance with Specification 01 33 00, Submittal Procedures. The DCS Training Plan will provide the structure and syllabus for training sessions as follows:
   1. Operator Training: Shall provide instruction to Operators already familiar with the operation of the Enterprise DCS, and shall be tailored to the new I/O, process controls, P&ID schemes and specialty consideration for the controls for this Project.
   2. Maintenance Training; Shall provide training to City DCS Staff on all enhancements to the DCS, new-generation components and all other hardware, software or graphics maintenance requirements, not currently covered in the City's existing Enterprise DCS.
   3. The DCSP shall allow for a minimum of four (4) sessions of each class outlined in the Training Plan to ensure staff availability and shift-differential considerations are facilitated.

4. Resumes of all Training Instructors to be utilized in DCS training shall be included in the Training Plan submittal.
5. After approval of the Training Plan, the DCSP is responsible for coordinating with City DCS Staff, or the City's project representative, to schedule training classes at appropriate times in advance of cut-over and start-up.

PART 2 – PRODUCTS

2.1 CURRENT TECHNOLOGY:

A. All hardware and software shall be the product of Emerson Process Management (EPM) and shall be of the Ovation family of DCS.

B. All products shall be the latest available version of a product or module.

C. The DCS should utilize state-of-the-art products in the DCSP's product line. However, the DCSP must ensure that all products used for this Project are compatible, and will fully integrate into the City's existing enterprise wide COMNET DCS.

D. Successful operation and calculation shall be demonstrated during Factory Acceptance Testing (FAT), Operational Readiness Testing (ORT) and Functional Testing phases.

2.2 HARDWARE AND SOFTWARE COMMONALITY:

A. Where there is more than one item of similar equipment being furnished, all such similar equipment shall be the of the same Ovation family series.

B. The DCSP shall submit a plan in case of a discontinued or upgraded product, or other cases where changing technology requires changes in equipment, the DCSP shall submit a Substitute Item Request Form.

C. All equipment shall be of modular design to facilitate interchangeability of parts and to assure ease of servicing. This interchangeability shall apply to the following components, as a minimum, of the DCS.
   1. Processor Modules
   2. Bulk Memory Modules
   3. Communication Interface Modules
   4. Analog and Discrete Signal Modules
   5. Power Supply Modules, and UPS devices
   6. Workstations and operator interface devices
   7. Software licenses

2.3 DCS PRIMARY ARCHITECTURAL COMPONENTS:

A. The DCS supplied by DCSP shall consist of, but not be limited to, the following primary architectural components:
   1. Operator, engineering, instructor, and field workstations.
   2. Copper and fiber optic communications network (at DCS PCMs, etc.)
   3. DCS OS Software for alarms, events, monitoring and control and configuration tools.
   4. Security.
   5. Historian/Historical data recording and reporting.
   6. System Configuration (Application Software) of I/O database, displays, control loops, and human machine interfaces (HMI) graphics.
   7. Process Control Modules (PCM).
   8. Input/output (I/O) cards and devices, I/O racks, I/O units, remote IO, and Termination Cabinets.

B. In addition, components associated with the DCS are:

   1. Control room furniture as shown on drawings and contained in these Specification, peripherals such as large screen displays, alarm printers, etc.)
   2. Services related to DCS (including system maintenance, upgrading, and third party and enterprise integration)
   3. Enclosures, termination panels, power, UPS, and ground termination busses, etc.
   4. PLC's, RTU's, Foreign Device Interface (FDI) modules for PCM's

2.4 SUPPORTING COMPONENTS:

A. The supporting components and associated application software shall consist of the following:
   1. DCSLAN Switches.
   2. DCSLAN/DCSWAN Routers.
   3. Patch Management Server (when specified herein).
   4. Security hardware and software, including Antivirus software and malware detection.

PART 3 – EXECUTION

3.1 PROJECT EXECUTION AND PROJECT MANAGEMENT SERVICES:

A. The DCSP shall prosecute all Work in strict accordance with the sequence and schedule of the Prime Contractor's Master Baseline Schedule.

B. The DCSP'S attention is called to the Contract Documents and Division 40 for specific administrative and commercial requirements of the Work.

C. The DCSP shall provide all project management services required to complete the Work of these documents. At a minimum project management services shall include:
   1. Progress Review Meetings.
   2. Meeting and workshops to develop project requirements and design details.
   3. Regular meetings on scheduling and invoicing.
   4. All required meetings for design and submittal reviews.
   5. Coordination of support and warranty.
   6. Coordination of training.
   7. Development and delivery of DCS project controls and document management that coordinates with that of the Prime Contractor.
   8. Attend coordination meetings with Prime Contractor, City's representative, plant staff and other City entities as they relate to the delivery of DCS Work.
   9. Respond to City representative's requests for information and project documentation.
   10. Respond to RFI reviews, as requested by the Design Engineer through the City's representative.
   11. As defined in Section 40 98 00, project Management Services.

D. The DCSP shall provide all labor, equipment, materials and furniture for the tenant improvements required for the approved staging site at the sole expense of the DCSP.

3.2 ENGINEERING & DESIGN PHASE:

A. The DCSP shall provide all engineering, resources, equipment, and labor required to successfully:
   1. Produce all submittals, in accordance with Specification 01 33 00, Submittal Procedures and Division 40 requirements.
   2. Program, configure, and test of all hardware and software as required by these specifications
   3. Design and specify the enterprise inter-site WAN interface at Project site for communications interface with the existing COMNET DCS.
   4. Develop the classroom and computer-based-training for all system elements.
   5. Execute field verification and documentation of all conditions, and develop installation drawings and accurate as-constructed documents to successfully complete the Work.
   6. Setup, stage and test the Work of each process segment and perform FAT, witnessed by the City's representative at the approved Staging Area prior to any installation.

7. Put into service all system elements by detailed I/O tests, loop checks, and commissioning. Develop and perform functional and performance testing.
8. Document all system elements, software and custom applications
9. Maintain, upgrade and warrant all Work required by the Prime Contract.
10. Design, develop, program, and test Integration of DCS with other systems.
11. The DCSP shall develop and submit a uniform and standardized IO tag name convention, and follow the ISA tagging scheme standardly used by the COMNET DCS.
12. As defined in Section 40 98 01, Engineering and Design Services.

3.3 PROCUREMENT, STAGING, PROGRAMMING, AND TESTING PHASE:

A. The DCSP shall provide all engineering, resources, equipment, and labor required to:
   1. Procure all goods and services required to conform to these specifications.
   2. Perform all shipments required by the Work.
   3. Ship all equipment and software to the approved staging facility, including deliveries from approved Staging Site to Project site.
   4. As defined in Section 40 98 02, Procurement, Staging, Programming

B. Assemble, stage and program each Segment of Work at the approved Staging area and perform FA T prior to delivery for installation. All tests shall be performed in accordance with Division 40 specifications and approved test procedures.

C. The system elements (i.e. WS, PCM, FHS, etc.) may be assembled at the DCSP'S facility and shipped to the approved Staging area for staging, programming and testing. However, the CITY reserves the right to inspect these system elements prior to shipment, and again prior to delivery from the Staging site to the Project site.

3.4 FIELD CONSTRUCTION/ COMMISSIONING PHASE:

A. Provide all engineering, resources, equipment and labor required to:
   1. Oversee the physical install, by others, of all Process Control Modules (PCM) and Remote IO (RIO) enclosures and electronics.
   2. Oversee termination, by others, of all field wiring in 'B' or PCM Cabinets.
   3. Run new wires from Cabinet to DCS IO where required.
   4. Design, install, and test foreign devices including serial or networked I/O.
   5. Oversee supply and termination of power and grounding of all devices, by others.
   6. Test all signal grounding and certify proper installation and function.

7. Deliver U ninterruptible Power Supplies, for installation by others under Division 26.
8. Obtain and manage all required Intra-Plant permits
9. Install and test all DCS-related networking hardware and cabling.
10. Test all workstations, hardened workstations, PCM and RIO cabinetry and enclosures.
11. The DCSP shall support as-built documentation including DCS loop diagram information and P&ID information. As specified.
12. Conduct a functional test, and site acceptance test to verify DCS performance.
13. Update and submit all specified documentation to reflect "as-built" or record conditions.
14. Support the Integration Period Testing as specified.

As defined in Section 40 98 04, Field Construction/Commissioning Services.

3.5 MAINTENANCE AND UPGRADE SERVICES PHASE:

A. The DCSP shall Warrant all parts and services for a period as specified for the Prim Contract, after Final DCS Acceptance.

3.6 ENVIRONMENTAL SUITABILITY:

A. All DCS devices provided under this contract shall be provided with enclosures which are suitable for use in a treatment facility environment where there are typically high energy AC fields, DC control pulses, and varying ground potentials between the transducers or process instrument locations and those occupied by DCS components.

B. The system design shall be adequate to provide proper protection against interferences from all such possible situations.

C. As a minimum, all DCS equipment shall be resistive to airborne contaminants commonly found in wastewater treatment facilities, and be suitable for installation in an environment which conforms to a G2 classification as defined by ISA-S71.04.

D. Field-Situated Equipment:
1. DCS equipment being furnished under this contract shall be suitable for use in wastewater treatment facilities, some of which are in an environment of air with traces of methane and hydrogen purging sulfide. The system design shall be adequate to provide proper protection against such an environment.
2. All field-situated components including PCMs shall be UL-listed or approved by an independent certification agency acceptable to the City of San Diego.
3. All DCS devices shall be housed in an enclosure suitable for its intended service and installation location.

4. All DCS devices to be installed in MCC or other protected areas shall be furnished in NEMA 12 rated enclosure.
5. All DCS devices to be installed in indoor protected areas shall be furnished in NEMA 12 rated enclosures.
6. All DCS devices to be installed in indoor unprotected or areas subject to hose-down conditions, or outdoor areas, shall be furnished in 316SS NEMA 4X rated enclosures.
7. At a minimum, the DCS shall be designed and constructed for satisfactory, long, and low maintenance operation under the following environmental conditions:
    a. Temperature Range: 0 through 50 degrees C (32 through 122 degrees F).
    b. Thermal Shock: 0.55 degrees C (1-degree F per minute maximum).
    c. Relative Humidity: 5 through 95 percent (non-condensing).
8. The mounting of all enclosures shall meet the requirements as specified in Division 26, and shall be seismically braced as required by code for this seismic zone.

END SECTION

SECTION 40 90 04
REFERENCES

PART 1– GENERAL

1.1 GENERAL:

A. Where the requirements set forth in the Contract Documents are greater or more rigid than the mandatory requirements referenced herein the applicable portions of the Contract Documents shall govern.

B. In the case of conflict between any mandatory requirements and the Contract Documents, the mandatory requirement shall be followed in each case, but only after submitting such proposed changes to the City's representative for approval.

C. Nothing contained in the Contract Documents shall be so construed to conflict with any national state, municipal, or local laws or regulations governing the installation of Work specified herein, and all such acts, ordinance, and regulations, including the National Electrical Code, are hereby incorporated and made a part of the Contract Documents. All such requirements shall be satisfied by the DCSP at no additional expense to the City.

1.2 PERMITS:

A. Construction permits are the responsibility of the Contractor. However, The DCSP shall be responsible for obtaining any Plant permits, 'outage requests' etc. imposed by the City and Plant standard operating procedure.

1.3 REFERENCES:

A. The equipment materials, installation, and other work shall conform to all the following applicable regulations, standards, specifications, and codes unless a more current version is applicable:

1. American National Standards Institute (ANSI):
   a. ANSI INCITS 154 (2004), Office Machines and Supplies Alphanumeric Machines - Keyboard Arrangement.
   b. ANSI ISO/IEC 17799 (2005), Information Technology Security Techniques Code of Practice for Information Security Management.
   c. ANSI C80.1 (2005), Standard for Rigid Steel Electrical Conduit
2. ASTM International (ASTM):
   a. ASTM D 709 (2007), Standard Specification for Laminated

Thermosetting Materials (Nameplates).

b. ASTM E 814 (2006), Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
c. ASTM F 512 (2006), Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation.

3. American Society for Quality (ASQ): ASQ C1, Specification of General Requirements for a Quality Plan.
4. California State Codes:
   a. California State Administrative Code, Title 24, State Building Standard.
   b. (CAL/OSHA) California State Occupational Safety and Health Act.
   c. California State Fire Marshal Standards.
5. City of San Diego:
   a. Green Book, City of San Diego Standard Plans and Specifications.
   b. City of San Diego Municipal Code.
   c. City of San Diego Electrical Code as adopted from NEC.
   d. Latest City of San Diego Electrical, Fire and Building Codes and California Building Code.
6. IEC/EN Standards Institution:
   a. EN 55022: 1998, based on CISPR 22, is used in the EU and worldwide for measuring radiated and line conducted emissions from ITE (Information Technology Equipment).
   b. BS EN 55011 (2007), Industrial, Scientific, and Medical (ISM) Radio-Frequency Equipment – Electromagnetic Disturbance Characteristics - Limits and Methods of Measurement.
   c. IEC 61000-4-2 (2001), Electrostatic Discharge Immunity Test, supersedes/replaces IEC 801-2
   d. BS EN 61000-4-3 (2006), Electromagnetic Compatibility (EMC) Part 4-3: Testing and Measurement Techniques – Radiated, Radio-Frequency, Electromagnetic Field Immunity Test, supersedes/replaces IEC 801-3.
   e. IEC 61000-4-4 (2004), Electrical Fast Transient/Burst Immunity Test, supersedes/replaces IEC 801-4.
   f. IEC 61000-4-5 (2005), Surge Immunity Test, supersedes/replaces IEC 801-5.
   g. BS EN 61000-4-6 (2007), Electromagnetic Compatibility (EMC) Part 4-6: Testing and Measurement Techniques - Immunity to Conducted Disturbances, Induced by Radio Frequency Fields, supersedes/replaces IEC 801-6.
   h. BS EN 61000-4-11 (2004), Electromagnetic Compatibility (EMC) Part 4-11: Testing and Measurement Techniques - Voltage Dips, Short Interruptions, and Voltage Variations Immunity Tests.
   i. EN 61000-6-4:2007, Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial

environments.

7. International Electrotechnical Commission (IEC):
   a. IEC 60068-2-6 (1995), Swept Vibration.
   b. IEC 60068-2-27 (2004), Shock.
   c. IEC 60068-2-34, Random Vibration.
   d. IEC 61158, Foundation Fieldbus.
   e. IEC 61131-3 (2003), Deals with programming languages and defines three graphical and two textual PLC programming language standards.
   f. IEC 61131-8 (2003), Guidelines for the Application and Implementation of Programming Languages.
   g. IEC 61499 (2005), Function Block Standard.
8. Institute of Electrical and Electronics Engineers (IEEE)
   a. IEEE C2 (2007), National Electrical Safety Code.
   b. IEEE C37.90.1 (1989 R 2002), Standard for SWC Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
   c. IEEE C57.13 (1993; R 2003), Standard Requirements for Instrument Transformers.
   d. IEEE C62.41.2 (2002), Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
   e. IEEE 81 (1983), Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
   f. IEEE 100 (2000), The Authoritative Dictionary of IEEE Standards Terms.
   g. IEEE 315 (1995; R 2002), Graphic Symbols for Electrical and Electronics Diagrams.
   h. IEEE 484 (2002), Recommended Practice for Installation Design and Implementation of Vented Lead-acid Batteries for Stationary Applications.
   i. IEEE 485 (1997; R 2003), Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications.
   j. IEEE 754, Standard for Floating Point Arithmetic
   k. IEEE 802.1AB - Station and Media Access Control Connectivity Discovery.
   l. IEEE 802.1D (2004), Media Access Control Bridges.
   m. IEEE 802.2 (1998; R 2003), Standards for Local Area Networks: Logical Link Control.
   n. IEEE 802.3 (2005), Carrier Sense Multiple Access with Collision Detection (CSMA/CD) (Ethernet).
   o. IEEE 802.3z, Gigabit/s Ethernet Operation.
   p. IEEE 802.3ae, 10 Gigabit/s Ethernet Operation.
   q. IEEE 802.3af, Data Terminal Equipment (DTE) Power via MDI.
   r. IEEE 802.1p, Traffic Classification/Prioritization.

s. IEEE 802.1q, Virtual Local Area Networks (LANs).
t. IEEE 802.1x, Comprehensive security framework.
u. IEEE 1100 (2005), Recommended Practice for Powering and Grounding Electronic Equipment.

9. Instrumentation, Systems, and Automation Society (ISA):
   a. ISA S5.1 (1984; R 1992), Instrumentation Symbols and Identification.
   b. ISA S5.2 (1976; R 1992), Binary Logic Diagrams for Process Operations.
   c. ISA S5.4 (1991), most enhanced, Instrument Loop Diagrams.
   d. ISA S5.5 (1985), Graphic Symbols for Process Displays.
   e. ISA 77.20 (1993; R 2005), Fossil Fuel Power Plant Simulators – Functional Requirements.
   f. ISA TR 99.00.01 (2004), Security Technologies for Manufacturing and Control Systems.
   g. ISA TR 99.00.02 (2004), Integrating Electronic Security into the Manufacturing and Control Systems.
10. The Internet Engineering Task Force (IETF):
   a. RFC 1112 (1989), Host Extensions for Internet Protocol (IP) Multicasting.
   b. RFC 768 (1980), User Datagram Protocol (UDP).
   c. RFC 791 (1981), Internet Protocol (IP).
   d. RFC 792 (1981), Internet Control Message Protocol (ICMP).
   e. RFC 793 (1981), Transmission Control Protocol (TCP).
   f. RFC 826 (1982), Ethernet Address Resolution Protocol (ARP).
   g. RFCs 1155, 1157, and 1212, The SNMPv1 NMF
   h. RFCs 1441 through 1452 SNMPv2 NMF.
   i. RFC 1812 (1995), Requirements for IP Version 4 Routers.
   j. RFC 1918 (1996), Address Allocation for Private Internets.
   k. RFC 2131 (1997), Dynamic Host Configuration Protocol (DHCP).
   l. RFC 2784 (2000), Generic Routing Encapsulation (GRE).
   m. RFC 2821 (2001), Simple Mail Transfer Protocol (SMTP).
11. International Organization for Standardization (ISO)
   a. ISO OSI Model, Open Systems Interconnection Reference Model.
   b. ISO/IEC 9899 (1999; R 2005), Programming Languages: C.
   c. ISO 11064-1:2000, Ergonomic design of control centers -- Part 1: Principles for the design of control centers, Part 2: Principles for the arrangement of control suites, Part 3: Control room layout, Part 4: Layout and dimensions of workstations, Part 6: Environmental requirements for control centers.
   d. ISO/IEC 11801 (2002), Information Technology – General Cabling for Customer Premises.
   e. ISO 15408-1 (2005), Security Techniques – Evaluation Criteria for IT Security.

f. ISO/IEC 15802-3 (1998), Information Technology – Telecommunications and Information Exchange between Systems – Media Access Control (MAC) Bridges.
g. ISO 60300 (2004), Dependability Management.
h. ISO 60409 (1981), Guide for the Inclusion of Reliability Clauses into Specifications for Components (or Parts) for Electronic Equipment.
i. ISO 60605 (2001), Equipment Reliability Testing.
j. ISO 60706 (2006), Maintainability of Equipment.

12. International Telecommunication Union:
    a. ITU-T G.652C & D Characteristics of single-mode optical fiber and cable.
13. Military Standards:
    a. Military Standard 810E, Laptop Shock/Vibration and drop requirements.
14. National Electrical Manufacturers Association (NEMA):
    a. NEMA 250 (2003), Enclosures for Electrical Equipment (1000 Volts Maximum).
    b. NEMA ICS 1 (2000; R 2005), Standards for Industrial Control and Systems: General Requirements.
    c. NEMA ICS 2 (2000; R 2005), Standards for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment.
    d. NEMA ICS 4 (2005), Standards for Industrial Control and Systems: Terminal Blocks.
    e. NEMA ICS 6 (2006), Standards for Industrial Control and Systems Enclosures.
    f. NEMA WD 1 (1999; R 2005), General Color Requirements for Wiring Devices.
    g. NEMA WD 6 (2002), Wiring Devices – Dimensional Requirements.
    h. NEMA PE 1 (2003; R 2003), Uninterruptible Power Systems – Specification and Performance Verification.
    i. NEMA TC 2 (2003), Electrical Polyvinyl Chloride (PVC) Conduit.

15. National Fire Protection Association (NFPA) – All applicable sections including, but not limited to: NFPA 70 (2005), National Electrical Code.
    a. NFPA 72 (2006), National Fire Alarm Code.
    b. NFPA 70E (2015), Standard for Electrical Safety in the workplace
    c. NFPA 101 (2005), Life Safety Code.
    d. NFPA 110 (2005), Standard for Emergency and Standby Power Systems.
    e. NFPA 262 (2006), Test for Flame Travel and Smoke of Wires and Cables for Use in Air--handling Spaces.

f. NFPA 820 (2007), Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

16. National Institute Standards Technology (NIST):
    a. System Protection Profile, (2004), Industrial Control Systems, Version 1.0. Decisive Analytics. NIST.
    b. NIST SP 800-12 (1995), An Introduction to Computer Security: The NIST Handbook.
    c. NIST SP 800-14 (1996), Generally Accepted Principles and Practices for Securing Information Technology Systems.
    d. NIST SP 800-82-A (2004), Engineering Principles for Information Technology Security (A Baseline for Achieving Security).
17. Scientific Apparatus Makers Association (SAMA):
    a. SAMA have taken their standards out of circulation and declared that they are out of date.
        1) SAMA PMC 32.1 1976, A Guide for Process Measurement and Control Instrumentation Reliability Techniques is for reference only and can be obtained at www.measure.org, and was re-published in 1981.
        2) SAMA PMC 33.1 replaced by FCC and EN standards.
18. Telecommunications Industry Association (TIA):
    a. TIA-455-13-A (1996; R 2002), FOTP-13 Visual and Mechanical Inspection of Fiber Optic Components, Devices, and Assemblies.
    b. ANSI/TIA-455-78-B (2002), Optical Fibers Part 1-40: Measurement Methods and Text Procedures – Attenuation.
    c. TIA-455-133-A (2003), Optical Fibers - Part 1-22: Measurement Methods and Test Procedures - Length Measurement.
    d. TIA/EIA-568-B.1 (2001 Addendums 2001, 2003, 2003, 2003, 2004, 2007), Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements.
    e. TIA/EIA-568-B.2 (2002), Commercial Building Telecommunications Cabling Standard.
    f. TIA/EIA-568-B.3 (2000), Optical Fiber Cabling Components Standard.
    g. TIA/EIA-606-A (2002), Administration Standard for the Telecommunications Infrastructure.
    h. TIA J-STD-607-A (2002), Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
19. U.S. Department of Defense (DOD), MIL-STD-2202A (1994), Energy Monitoring and Control Systems, Factory Tests.
20. U.S. Federal Communications Commission (FCC), FCC 47 CFR Part 15 (2006), Radio Frequency Devices Electromagnetic Compliance Requirements.
21. Underwriters Laboratories (UL)
    a. UL 6 (2004), Standard for Safety Electrical Rigid Metal Conduit

Steel.

b. UL 44 (2005), Standard for Safety Thermoset-Insulated Wires and Cables.
c. UL 467 (2007), Standard for Grounding and Bonding Equipment. PlantUL 651 (2005), Standard for Safety Schedule 40 and 80 Rigid PVC Conduit and Fittings.
d. UL 916 (1998; Revised through March 2006), Energy Management Equipment.
e. UL 1479 (2003), Fire Tests of Through-Penetration Firestops.
f. UL 1778 (2005), Uninterruptible Power Systems.
g. UL 60950 (2000), Safety of Information Technology Equipment.

22. Web Service Standards:
    a. WS-Policy.
    b. WS-Security.
    c. WS-Reliable Messaging.
    d. WS-Addressing.
    e. WSDL1.1.
    f. SOAP 1.1.
23. Uniform Fire Code (UFC):
24. Occupational Safety and Health Act (OSHA)
25. Department of Homeland Security: "Cyber Security Procurement Language for Control Systems", August 2008.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END SECTION

SECTION 40 90 05
DEFINITIONS

PART 1 – GENERAL

1.1 DEFINITIONS

A. Terms used in this section:

1. ACAD: AutoCAD
2. AP: Access Point. A wireless access point (WAP or AP) is a device that "connects" wireless communication devices together to create a wireless network.
3. API: Application Programming Interface are a set of definitions of the ways in which 1 piece of computer software communicates with another. It is a method of achieving abstraction, usually (but not necessarily) between lower-level and higher-level software.
4. AMS: Asset Management System
5. Authentication: Authentication is the process of verifying an identity claimed by or for a system entity.
6. Authorization: Authorization is a right or a permission that is granted to a system entity to access a system resource.
7. Analog range: An analog range is the minimum to maximum value that a device is expected to have in the field. A/D: Analog to digital conversion.
8. AWG: American wire gauge.
9. CCTV: Closed Circuit Television.
10. CFC: California Fire Code.
11. CMMS: Computerized Maintenance Management System
12. COMNET: Cleanwater Operations Management Network. COMNET is a dedicated term for City's existing enterprise level of wastewater operation systems.
13. COMC: Central Control Room
14. CoSD: City of San Diego
15. COTS: Commercial off-the-shelf.
16. CPU: Central Processing Unit.
17. CSMA/CD: Carrier Sense Multiple Access with Collision Detection.
18. CSU: Channel Service Unit.
19. D/A: Digital to analog conversion.
20. DCS: Distributed Control System
21. DCSP: Distributed Control System Provider
22. DIN: Department Information Network. DIN is a dedicated term for City's COMNET system. The DIN shall provide connectivity between

all Department facilities and resources by virtue of a network which incorporates high-speed fiber, telephone data links and radio technology.

23. DCSLAN: Distributed Control System intra-plant Local Area Network located within the plant to interconnect various controllers, workstations, printers and servers. DCS Tag: Tag assigned to a loop for identification purposes and reference inside DCS and on P&ID's (without plant identifier)
24. DCSWAN: Distributed Control System Wide Area Network, used to connect plant-based DCSs together
25. DHCP: Dynamic Host Configuration Protocol.
26. DIN: Deutsches Institut für Normung eV (German Institute for Standardization; similar to US ANSI)
27. DMZ: Demilitarized Zone. Isolation zone between a protected control network (CN) and external users, such that all production traffic "flowing" between the CN and those external users actually flows through an access control device, such as a firewall.
28. DSU: Data Service Unit.
29. EHWS: Environmentally Hardened Workstation. The EHWS shall have a 316-stainless steel enclosure rated as NEMA 4X. The EHWS shall be configured in the range of 32 to 104 degrees F, and humidity of 95% non-condensing.
30. EMI: electromagnetic interference.
31. ESD: emergency shutdown.
32. Ethernet: Ethernet is a frame-based computer networking technology for local area networks (LANs). It defines wiring and signaling for the physical layer, and frame formats and protocols for the media access control (MAC)/data link layer of the OSI model. Ethernet is mostly standardized as IEEE 802.3.
33. EWS: Engineers Workstation(s)
34. FAT: Factory Acceptance Test. A test conducted at the DCSP or Vendor premise to ensure operability of a system according to specifications.
35. FCC: U.S. Federal Communications Commission
36. FDDI: Fiber Distributed Data Interface, a protocol used in early version of Emerson Ovation systems.
37. FIN: Facility Information Network. FIN is a dedicated term for City's COMNET system. The FIN shall provide connectivity between the DCS and plant facility management systems. The FIN shall specifically have connectivity to WS and HS devices.
38. FWS: Field Workstation(s).
39. GFCI: Ground-fault circuit interrupting receptacle.
40. HART: Highway Addressable Remote Transducer

41. HMI: Human-Machine Interface. A term that refers to the “layer” that separates a human that is operating a machine from the machine itself. One example of a HMI is the computer hardware and software that enables a single operator to monitor and control large machinery remotely.
42. HOR: Hand-Off-Remote
43. HS: Historian Server.
44. HSE: health and safety equipment.
45. IEC: International Electro-technical Commission, is a European standards body which has developed IEC60870-5 series of SCADA protocols. IEC is now working on IEC-62351 a secure protocol envelope for DNP3 and IEC60870-5.
46. IEEE: Institute of Electrical and Electronics Engineers.
47. I/O: Input and Output: I/O is used by the DCS for receiving and sending signals to and from the field to the DCS. I/O types are:
48. AI: Analog Input
49. AO: Analog Output
50. DI: Digital Input
51. DO: Digital Output
52. I/O Card: Input/Output (I/O) cards refer to the devices used by the DCS to communicate with field devices. I/O cards consist of digital-in (DI), for on/off detection, analog-in (AI), to measure a range of a device in the field, digital-out (DO), to send on-off signals, or analog-out (AO) to control field devices. IP: Internet Protocol. A data-oriented protocol used by source and destination hosts for communicating data across a packet-switched inter- network. Data in an IP inter-network are sent in blocks referred to as packets or datagrams (the terms are basically synonymous in IP).
53. ISA: International Society of Automation
54. ISO: International Organization for Standardization. The International Organization for Standardization, also known as ISO, is global network of the national standards bodies of 156 countries dedicated to technical standards development.
55. IWS: Instructor Workstation(s)
56. LAN: Local Area Network.
57. LIMS: Laboratory Information Management System
58. LCP: Local Control Panel
59. LOR: Local-Off-Remote
60. LOS: Lock-Out Stop
61. L/R: Local/Remote
62. Malware: Malware is malicious software designed to infiltrate or damage a computer system, without the owner's consent. Malware is commonly taken to include computer viruses, worms, Trojan horses,

rootkits, spyware and adware.

63. MBC: Metropolitan Biosolids Center
64. MTBF: Mean Time Before Failure
65. MTTR: Mean Time To Repair
66. MOC II: Metropolitan Operations Center
67. MOV: Motor Operated Valve
68. NCWRP: North City Water Reclamation Plant
69. NEC: National Electrical Code
70. NEMA: National Electrical Manufacturers Association
71. NFPA: National Fire Protection Association
72. NIC: Network Interface Card.
73. NMS: Network Management System
74. NIST: National Institute of Standards and Technology
75. NRC: National Research Council
76. NTP: Notice-to-Proceed
77. OPC: Open Connectivity via Open Standards. OPC is open connectivity in industrial automation and the enterprise systems that support industry. Interoperability is assured through the creation and maintenance of open standards specifications. OPC has been termed Object Linking Embedding [OLE] for Process Control or "OLE for Process Control".
78. OPH: Ovation Process Historian. OPH is a dedicated term for City's COMNET system.
79. ORT: Operational Readiness Test. Operational Readiness Testing is completed at the final stage of the DCS installation to verify the installed system is ready for live deployment and Functional Testing of Unit Processes.
80. OS: Operating System
81. OSC: Ovation Security Center.
82. OSI: Open Systems Interconnection Reference Model (OSI) — The Open Systems Interconnection Reference Model is a layered abstract description for communications and computer network protocol design, developed as part of the Open Systems Interconnect initiative.
83. OSHA: Occupational Safety and Health Standards
84. OWS: Operator Workstation(s)
85. PCM: Process Control Module. PCM is a dedicated term for City's COMNET system. A PCM refers a combination of various modules including central processing unit/modules, network modules, I/O modules, and/or other special modules, these modules are normally located in the same enclosure, and function together to accomplish data acquisition, alarming and implementation of control strategies for a designated process area.
86. P&ID: Piping and Instrumentation Diagram

87. PID: Proportional-Integral-Derivative controller. A standard feedback loop component in industrial control applications. It measures an "output" of a process and controls an "input", with a goal of maintaining the output at a target value, which is called the "setpoint".
88. PIN: Process Information Network. PIN is a dedicated term for the existing COMNET system. The PIN provides connectivity between the WSs, PCMs, and the Historian System (HS) to enable the timely update and archiving of process information and timely control response.
89. PLC: Programmable Logic Controller.
90. PLWTP: Point Loma Wastewater Treatment Plant
91. PMS: Power Monitoring System
92. PPS: Penasquitos Pump Station
93. QA: Quality Assurance
94. QC: Quality Control
95. QoS: Quality of Service
96. RAID: Redundant Array of Independent Disks
97. RDT: Remote Desk Top
98. RDS: Remote Data Server
99. RFP: Request for Proposal
100. RSSI: Receive Signal Strength Indicator
101. RTU: Remote Terminal Unit. An RTU, or Remote Terminal Unit is a device which interfaces objects in the physical world to a DCS or SCADA system by transmitting telemetry data to the system and/or altering the state of connected objects based on control messages received from the system.
102. SBWRP: South Bay Water Reclamation Plant
103. SCADA: Supervisory Control and Data Acquisition.
104. SOP: Standard Operating Procedures
105. SS: Selector Switch
106. S/S: Start/Stop
107. SAT: Site Acceptance Testing
108. SNMP: Simple Network Management Protocol
109. TCP: Transmission Control Protocol
110. TCP/IP: Transmission Control Protocol/Internet Protocol
111. TIA: Telecommunications Industry Association
112. Terminal Server: a hardware device or server that provides terminals (PCs, printers, and other devices) with a common connection point to a local or wide area network.
113. UFC: Uniform Fire Code
114. UL: Underwriters Laboratories. Standards to measure performance, environmental health and sustainability.
115. UPS: Uninterruptible Power Supply
116. VLAN: Virtual LAN. A virtual LAN, commonly known as a VLAN, is

a logically segmented network mapped over physical hardware.

117. VFD: Variable Frequency Drive
118. VoIP: Voice over Internet Protocol (also called VoIP, IP Telephony, Internet telephony, and Digital Phone) is the routing of voice conversations over the Internet or any other IP-based network. The voice data flows over a general-purpose packet-switched network, instead of traditional dedicated, circuit-switched voice transmission lines.
119. VPN: Virtual Private Network. A private, encrypted communications network usually used within a company, or by several different companies or organizations, used for communicating in a software tunnel over a public network.
120. WAN: Wide Area Network
121. WDPF II: Westinghouse Distributed Processing Family, 2nd Generation
122. WiFi: Wireless Fidelity. Short for wireless fidelity and is meant to be used generically when referring of any type of 802.11 network, whether 802.11b/a/g dual-band, etc.
123. WiMax: Worldwide Interoperability of Microwave Access. WiMax is the name commonly given to the IEEE 802.16 standard. A wireless protocol designed for distances as far as 30 miles but more commonly 3 – 5 miles.
124. WS: Workstation(s), see also EWS, FWS, IWS, OWS

B. Types of Variables:

1. Calculated Analog Points (CA): Analog variables computed from inputs, manual inputs, calculated discrete points, and other calculated analog points.
2. Calculated Discrete Points (CD): Discrete variables computed from inputs, manual inputs, calculated analog points, and other calculated discrete points.
3. Manual Inputs (MI): Variables whose values are manually entered, e.g., laboratory data.
4. Process Variables (PV): Analog variables from analog inputs and calculated analog points.
5. Report Variables: Variables computed by report generator.

1.2 RELATED SECTIONS

A. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END SECTION

SECTION 40 90 06
DCS BILL OF MATERIALS AND QUANTITIES

TABLE A-1
DROP 01 – 01PCM01A DCS HARDWARE

Item	Manufacturer	EMOD Model Number	PMOD Model Number	Qty	Notes
Ovation Controller Module [Redundant]	Emerson	5X00481G01		1	
I/O Interface Module	Emerson	5X00226G03		0	
Analog Input [HART] Module	Emerson	1C31129G03	1C31132G01	56	8-Point
RTD Input Module	Emerson	5X00119G01	5X00121G01	0	8-Point
Analog Output Module	Emerson	5X00062G01	5X00063G01	1	8-Point
Digital Input Module	Emerson	1C31107G02	1C31110G02	15	16-Point
Digital Output Module	Emerson	5A26457G01	NONE	4	12-Point [Relay]
Serial Link Module [RS232]	Emerson	1C31166G02	1C31169G01	0	
Ethernet Link Controller Module	Emerson	5X00419G01	1X00569H01	0	
All required additional or ancillary components and cables shall be provided as required to provide a complete and functional DCS.					

SECTION 40 90 07
SCOPE OF WORK

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. GENERAL

1. The intent of this section is to provide the DCSP direction in the specific and unique tasks of Work related to the Project segment of the delivery. All other requirements of these specifications apply.
2. The Work includes, but is not limited to the design, procurement, installation, staging, testing, warranty maintenance, and documentation, of a distributed control system (DCS) for the Morena Pump Station And Conveyance System, which includes all process area of the Project required by the Contract Documents.
3. The new DCS equipment is being provided under a proprietary sole-source agreement, and must be fully compatible with, and integrate ~~onto~~ into the existing City of San Diego (City) Enterprise wide COMNET DCS.

1.2 RELATED SECTIONS

A. The Work described in the following Sections applies to the Work identified in this Section.
1. Division 01 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

1.3 SPECIFICATIONS, CODES AND STANDARDS

A. The Work shall comply with the current editions of the publication and codes identified in Section 40 90 04, References.

1.4 DEFINITIONS

A. Definitions of acronyms are identified in Section 40 90 05, Definitions.

1.5 SUBMITTALS

A. All DCSP required submittals are referenced through Division 40 of the Project Specifications as well as Division 01. All required DCSP

Submittals shall be submitted in accordance with Section 01 33 00, Submittal Procedures.

PART 2 – PRODUCTS

2.1 REQUIREMENTS

A. The requirements of each product, material or other are contained in the specifications below. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Division 26 – Electrical
2. Division 40 – Process Integration
3. Other Technical Specifications

PART 3 – EXECUTION

3.1 REQUIREMENTS FOR THE MORENA PUMP STATION AND CONVEYANCE SYSTEM - Project

A. The DCSP shall provide the following I/O and all required control logic, distributed in the PCM's by process area according to the control narratives, exhibits and drawings identified in the Project Contract documents and, in addition, provide spare capacity of 20% I/O in each PCM.
[Design engineer to populate the I/O counts in the table below, on a process-area by process-area basis]

PROCESS AREA	AI	AO	DI	DO	TOTAL
First Process Area	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**
Last Process Area	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**

B. DCSP shall segment all I/O and cards to increase the reliability of all systems and limit any single I/O card failure causing an outage to a process or process area.

C. The DCSP shall perform all necessary drawing reviews and site investigations to provide the specified DCS portions of the Loop Diagrams, which are the

responsibility of the General Contractor to create.

D. DCSP shall provide all DCS furniture, enclosures and associated equipment, where shown on the design drawings.

E. New fiber optic and copper based intra-site LAN communications is being installed and terminated by others under Division 26. However, the DCSP shall witness the installation and testing of fiber optic cabling provided by the Contractor in accordance with the specification 40 95 34 Fiber Optics. The DCSP shall provide oversight of the cable installation and termination to Patch or Termination panels provided by the DCSP under this specification.

F. The exact locations and routing of wiring and cables shall be provided by the Design Engineer on the Drawings. However, the DCSP shall ensure that fiber optic cabling is installed in accordance with manufacturer's recommendations, particularly in regard to pulling methodology and bend radiuses.

G. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. All code space-clearance requirements of NEC shall be adhered to.

H. Minimum Workstation Requirements

1.
2. DCSP shall provide Operator Workstations (OWS), in accordance with quantities listed on the Appendix and as shown on the Drawings.
3. DCSP shall provide color laser printers, color printer/scanners and black & white laser printers, in accordance with quantities listed on the Appendix and as shown on the Drawings.
4. DCSP shall provide Engineering Workstations (EWS), in accordance with quantities listed on the Appendix and as shown on the Drawings.
5.
6. DCSP shall be responsible to install, in locations shown on Drawings, a suitable network switch with a minimum of two ports to access the DCSLAN with the laptop computers.
7. DCSP shall provide large screen video displays, in accordance with quantities listed on the Appendix and as shown on the Drawings.

3.2 SPECIFIC REQUIREMENTS OF MORENA PUMP STATION AND CONVEYANCE SYSTEM – ENGINEERING & DESIGN PHASE

A. The DCSP shall provide all submittals required by these specifications to provide a complete final design for the new DCS equipment at the Project. The DCSP submittals shall fully detail DCSP'S engineered design, addressing, at a minimum, the following:

1. All administrative submittals
2. Staging Area modifications at approve Staging Site.
3. Configuration/Architecture, equipment locations, programming and testing of all hardware and software required by these specifications.
4. Plant Server Room final design for all servers, including DMZ servers, and communications equipment. DCSP to provide one-line networking and security topography drawings.
5. Review of design and specification of the DCSLAN for communications, including verification of signal loss budgets.
6. DCSWAN interface
7. Design, construction, and commissioning of DMZ between DCSLAN, DCSWAN and City, and Plant, Business Network
8. Classroom and computer based training
9. Pre-installation staging and witnessed Operational Readiness Testing (ORT) Approved Staging Area
10. System commissioning including DCS-end; Loop checks, functional testing, and performance testing. Prime Contractor is responsible for field-end staffing and testing for all referenced testing regimens.
11. Provide DCS-related information (e.g. PCM termination nomenclature, software level addressing, etc.) required to support the General Contractor to produce the as-constructed Loop Diagrams and P&IDs
12. As built documents of all system elements, software and custom applications
13. Warranty services required by Contract documents.

B. When necessary to accomplish the Work of the DCS, the DCSP shall request through the City representative and then facilitate all workshops necessary to gather information, reach consensus and deliver design submittals in accordance with the milestones contained in the Prime Contractors Master Baseline Schedule.

C. The DCSP shall immediately, if needed, on notice-to-proceed design, build and furnish the Approved Staging Area adequately to, support their proposed staff, test all systems and equipment, provide long term maintenance and storage for spare parts for the life of the Project segments.

D. The DCSP shall perform project management, engineering, programming and staging work at the Approved staging area.

E. The DCSP shall design, provide and oversee installation of new Uninterruptible Power Supplies (UPS) for the Work as defined in Division 26.

F. The DCSP shall provide oversight of the DCS Signal Grounding System, as

defined in Section 40 95 15 DCS Equipment Grounding. The DCSP shall be responsible for testing ground resistivity in accordance with the Specifications to ensure proper signal grounding of the PCM, RIO, etc.

3.3 SPECIFIC REQUIREMENTS OF PROJECT PROCUREMENT, STAGING, PROGRAMMING AND TESTING PHASE

A. Procurement and Staging

1. The DCSP shall develop the Approved Staging Area as the basis of their operations where DCSP staff provides all labor for the entire project. The design and build out of the Staging area shall commence with the notice to proceed of the Project , unless DCSP is using a Staging Area previously developed. The DCSP shall be responsible for providing a safe, secure, maintained area for the Staging area, including janitorial service and supplies, security systems, power and sanitary services.
2. DCSP shall procure, pr og r a m a nd stage, all system elements at the Approved Staging Area to build a complete and operable DCS, including DMZ.
3. DCSP shall provide a DMZLAN containing two (2) firewalls for connection to the dual redundant DCSLAN, or as shown on the plans and drawings.
4. All equipment shall be delivered FO B to the DCSP Approved Staging Area. DCSP shall provide all labor and materials including but not limited to, shipping, logistics, material training tracking, and insurance required Bonds and setup/testing costs.

B. Programming and Testing Phase

1. DCSP shall program system elements at the Staging Area to build a complete and operable DCS, including programming and configuration of system elements in the DMZ, using the latest Ovation version as currently employed in other customer locations and successfully operating to the Owner's satisfaction.

2. DCSP shall provide any and all configuration and programming required to create a fully functional DCS for t h e Project, including but not limited to:
   a. DCSP shall create all graphics to operate with the new DCS.
   b. DCSP shall create all trends/trend groups commonly used on the City's DCS to operate with the new DCS.
   c. DCSP shall create all control programming to operate with the new DCS.
   d. DCSP shall create all reports to operate with the new DCS, and integrate with the Enterprise DCS Reports generation system. The existing types and quantities of the reports for Project are as

appropriate to the project, but at a minimum as follows:

1) 10 Plant level reports
2) 5 state/regulatory level reports
3) 5 enterprise level reports

e. In addition, when requested by the City, the DCSP shall facilitate a minimum of five (5) meetings/workshops with the City's representative for the DCSP to design, program, install, and test the following:

1) An additional 5 (design engineer top specify quantity) three-dimensional main graphic process screens as defined by user workshops.
2) An additional 10 (design engineer top specify quantity) Main Graphic process screens as defined by user workshops.
3) An additional 50 (design engineer top specify quantity) sub graphic (windows) process screens as defined by user workshops.
4) An additional eight (design engineer top specify quantity) plant-level reports as defined by user workshops.
5) An additional five (design engineer top specify quantity) state/regulatory reports as defined by user workshops.
6) An additional five (design engineer top specify quantity) enterprise level reports as defined by user workshops.
7) An additional five (design engineer top specify quantity) trend groups as defined by user workshops.

2. DCSP shall provide any and all configuration and programming required to create a fully functional DCS for the Project including, but not limited to, all intermediate or calculated values, I/O database, control and graphic programming, report and historian programming and trending.
3. In addition to all the other requirements of the DCS identified throughout Division 40, the DCSP shall provide an additional 20% of software database I/O of each I/O type for integration to other systems or as directed by the City's representative. These I/O, if needed, will be defined during the course of the delivery by DCSP facilitated workshops with the City's representative.
4. The DCSP shall provide all necessary products, services and materials as required by these specifications for the DCSLAN. All DCSLAN equipment shall be staged and tested during the FAT.
5. DCSP shall conduct all Factory Acceptance Testing (FAT) at the Approved Staging Area.

3.4 SPECIFIC REQUIREMENTS MORENA PUMP STATION AND CONVEYANCE SYSTEM FIELD CONSTRUCTION AND COMMISSIONING PHASE

A. The DCSP shall obtain all required in tr a - pl a nt permits and approvals for the DCS construction.

B. The DCSP shall witness the installation of final termination in PCM, RIO, etc. for all new Uninterruptible Power Supplies for the DCS as defined in Division 26.

C. The DCSP shall perform the Operational Readiness Testing (ORT) in the field, working in conjunction with the General Contractor.

D. DCSP shall perform all testing requirements including but not limited to; complete testing of all DCS – ends of loops, functional testing and other field testing as required .

E. The DCSP shall provide all materials and labor to connect the DCSWAN to the City or Plant Business Network via the DMZ, in concert with City COMNET Network staff.

3.5 SPECIFIC REQUIREMENTS OF PROJECT WARRANTY SERVICES PHASE

A. Work shall be performed pursuant to Prime Contract warranty requirements of Division 01. The City may, at its sole discretion, contract with the DCSP for an extended warranty and maintenance period.

END OF SECTION

SECTION 40 94 00
DISTRIBUTED CONTROL SYSTEM GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. The intent of this section is to provide the Distributed Control System Provider (DCSP) direction in specific and unique tasks of Work related to the Project segment of the delivery. All other requirements of these Specifications apply.

B. The Work includes but is not limited to the design, procurement, installation, staging, testing, warranty maintenance, and documentation of a distributed control system (DCS) for the project, which includes all process areas of the project required by the Contract Documents.

C. The new DCS components is being provided under a proprietary sole-source agreement, and must be fully compatible with and integrated into the existing City of San Diego Enterprise-wide COMNET DCS.

1.2 THE REQUIREMENT

A. Major Work Items: Includes but is not limited to engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and training for complete PLC.

1. Distributed Control System (DCS)
2. Computers and networks for Human Machine Interface (HMI).
3. Applications Software: Provided by the Distributed Control System
4. Provider (DCSP) for DCS and HMI.
5.

B. GENERAL: The DISTRIBUTED CONTROL SYSTEM PROVIDER (DCSP) shall furnish all equipment and provide all applicable engineering for a fully functional distributed control system, that complies with the technical requirements of the contract documents including, but not limited to, project management, design assistance, coordinate with on-site area contractors, detailed system design and integration, conducting graphic design workshops, equipment supply and shipment, storage, job site delivery, programming and configuration, installation oversight, testing, commissioning and start up, integration with the existing City-wide Operation and Management Network (COMNET), and training.

1. The DCS Work shall be as defined within Division 01 and these Specifications.
2. The Work covered by this specification and all of its sub parts shall include, but not limited to, field verification of all existing conditions, engineering and design of system and components, manufacture and/or procurement of all necessary equipment, components, material, transportation, labor, special tools, factory testing, application programming, shipment, storage, and jobsite delivery, operational readiness testing, installation of equipment, system integration, startup operation, site testing, training and documentation, support, maintenance/warranty of a complete, integrated and operational Distributed Control System (DCS) for the City of San Diego.
3. The statements of Work contained herein are necessarily general in nature and should not be construed as an all-inclusive list of devices, equipment, software and services necessary for successful completion of the Work.
4. It shall be the responsibilities of the DCSP to coordinate and project manage the Work, as set forth in this section of the Specifications, with work and equipment specified under other sections of the Specifications, in order to provide a complete and satisfactory installation.
5. To ensure that the distributed control system shall be a standard system of Emerson Process Management, Ovation family. With a complete repertoire of pre-existing software modules running in a familiar hardware environment and free from hardware/software incompatibilities.
6. This specification is generic to all Facilities and applicable sections shall be delivered for each process segment of the Work as defined in these Specifications and project Contract Documents.
7. The DCSP shall be responsible for coordination, installation and testing of DCS. The Prime Contractor is responsible for termination of I/O signals, power and ground utilities for all DCS equipment. The DCSP shall review and inspect all current designs and all Contract Documents to assess space allocations, power allotments and available grounds. If the DCSP's requirements for power, grounding or spatial requirements differ from that shown within the Contract Documents, the DCSP shall include all required engineering, design and construction details to the Prime Contractor and City's representative immediately.
8. The DCSP shall be responsible for providing all equipment, installation supervision, engineering, programming, configuration, management and services associated with integrating all instrumentation and control devices, and special systems, including Foreign Device Interfaces (FDI), into the DCS in a transparent and seamless manner. The use of a third party, system house, or system integrators for the above service is not acceptable.
9. DCSP shall be fully responsible for the implementation, installation, and integration of the DCS as outlined in this specification.
10. The provisions of this Section shall apply to all items specified in the various Sections of Division 40 and all other Divisions.

11. DCSP shall be responsible for interfacing to all existing instrumentation and all other Input/Output (I/O) devices.
12. During field functional testing the DCSP shall verify the operation of all instruments and field devices and associated wiring (from instrument/device to DCS) and notify the City's representative and Prime Contractor of any deficiencies that exist.

C. Scope of Work:

1. The Work generally consists of the supply of all labor, tools, services and provision of all products required, for a complete, integrated, operational DCS control system in accordance with the Contract Specification and Drawings.
2. Identify other on-going projects/systems development that are not part of this contract. Ensure other ongoing activities, in close proximity or otherwise, do not disturb or interrupt the operation of the existing systems or the work already commissioned or placed into operation. Should any such activity pose a risk to this work or to the system operation, advise the City immediately.
3. In general, the work involves the supply, installation and commissioning of the DCS control system as indicated on the drawings and specification sheets, and as defined in the Matrix of Responsibilities in D. The following is a summary of the major works:
    a. Engineer to provide a high-level description of the project specific work including provision of all instruments, hardware, software, network, cabling, and services such as testing, commissioning, training, documentation.
    b. Following the instructions in D, Provide, test and commission all field instrumentation including field wiring, instrument control panels, and control system hardware including all lightning & surge protection, and all peripheral devices necessary.
    c. Conduits and Wires:
        1) All conduits, including those for the district information network (DIN), plant information network (PIN) and facility information network (FIN), will be furnished and installed by the Contractor. All conductors, including power and grounding for DCSP furnished equipment will be furnished and installed by the Contractor. DCS grounding will use a special triad grounding system; specifications for this system are provided in the contract documents in accordance with the DCSP requirements. All signal conductors, except for PIN, and FIN fiber optic and coaxial cables, will be provided and installed by the General Contractor.

2) The PIN and FIN fiber optic and coaxial cables will be furnished, installed and terminated by the DCSP. DIN fiber optic cable will be furnished by the DCSP and installed by the Contractor up to the first termination point within a facility. All wire termination except for PIN, FIN and DIN cables will be performed by the General Contractor.
3) Cables and conduits for non-DCS communications systems, such as the telephone system, will be furnished and installed by the General Contractor.
    a) Provide all programming and microprocessor-based instrument configuration.
    b) Provide all required testing, commissioning and start up services. Allow in the Contract Price, for any additional time deemed necessary to meet the testing and commission requirements.
    c) Provide Factory Acceptance Testing (FAT) to demonstrate the operational functionality of hardware and communications per specifications.
    d) Provide Operational Readiness Testing (ORT) to demonstrate the correct operation of the control system with both hardware and software in place per specifications.
    e) Provide Performance Acceptance Test to ensure entire system functions properly per specifications.
    f) Provide all required training per specifications.
    g) Provide warranty services per contract requirements.

4. Interfacing and Responsibilities of General Contractor (GC) and DCSP:
    a. The following Table 1 shows the procurement, installation, and labor responsibilities of the DCSP and the GC. All field instrumentation devices and final control elements which are needed to support DCS functionality will be wired to process control modules (PCMs). Table 2 and Table 3 define in greater detail of the responsibilities assigned to the General Contractor and the DCSP.

Table 1: Matrix of Responsibilities - Equipment/Devices/Materials

Product	Supply	Install
DCS Process Control Modules (PCMs)	DCSP	GC
DCS Workstations (WSs)	DCSP	DCSP
DCS Historian System (HS)	DCSP	DCSP
DCS PIN/FIN Hubs and network equipment	DCSP	DCSP
DCS Printers and Stands	DCSP	DCSP

Table 1: Matrix of Responsibilities - Equipment/Devices/Materials		
Product	**Supply**	**Install**
Fiber Optic Network Cables (PIN and FIN cables)	DCSP	DCSP
Fiber Optic "DIN Cables"	DCSP	GC
All Other Communication Cables which Interconnect DCS Equipment	DCSP	DCSP
UPS Systems and Ancillaries for DCSP provided equipment	DCSP	GC
Instrumentation Panels (including PLCs) and racks provided by DCSP	DCSP	GC
Panels (including PLCs) and racks provided by GCs	GC	GC
Instrumentation provided by GCs	GC	GC
Instrumentation provided by DCSP (including specialized communications cables required.)	DCSP	GC
Interposing relays to interface DCS control commands with equipment controls FIE	GC	GC
DCS Isolated (Reference) Grounding Cables and Rods	GC	GC
Large Screen Control Room Video System	DCSP	GC

Table 2: Matrix of Responsibilities - Wire/Conduit/Terminations			
Description	**Supply**	**Install**	**Terminate**
Power conduits and wire to GC furnished equipment and devices	GC	GC	GC
Power conduits and wire to DCSP furnished equipment and devices	GC	GC	GC
Signal conduits from DCSP or GC furnished instruments to DCSP or GC furnished equipment and device	GC	GC	---
Signal wire/cable from DCSP or GC furnished instruments to DCSP or GC furnished equipment and devices	GC	GC	GC

Table 2: Matrix of Responsibilities - Wire/Conduit/Terminations			
Description	**Supply**	**Install**	**Terminate**
All conduits associated with the PIN, FIN, DIN and other communication links	GC	GC	----
PIN and FIN fiber optic, unshielded twisted-pair and coaxial cables	DCSP	DCSP	DCSP
Other communications cables from GC-supplied equipment to the DCS	GC	GC	GC
All cable associated with the DIN	DCSP	GC	DCSP
All conduits associated with the fire alarm, CCTV, page party and security/card reader systems, as required	GC	GC	----
All signal wire/cable associated with the fire alarm, CCTV, page party, and security/card reader systems	GC	GC	GC
All power wire/cable associated with the fire alarm, CCTV, page party and security/card reader systems	GC	GC	GC
Ground conduits and wire/cable from power panel to PCM or any other DCSP furnished equipment	GC	GC	GC

Table 3: Matrix of Responsibilities - Testing and Services		
Task	**DCSP**	**GC**
Prepare DCS hardware/installation submittals (PCM; WSs; HS; CM; UPS; fire alarm system, if required)	X	
Prepare DCS software submittal	X	
Provide SAMA functional diagrams	X	
Prepare annotated software listings of all GC-furnished PLCs and other programmable equipment		X
Prepare instrument submittal		X
Calibrate instruments		X
Prepare GC panel submittals		X

Table 3: Matrix of Responsibilities - Testing and Services		
Task	**DCSP**	**GC**
Prepare DCS hardware/installation submittals (PCM; WSs; HS; CM; UPS; fire alarm system, if required)	X	
Prepare loop drawings to support the termination of all DCS I/O and the installation of all instruments		X
Coordinate all control systems integration (instrumentation, PLCs, DCS, network, communications and data exchange) amongst various subs		X
Perform operational readiness test (ORT) of DCS	X	
Perform ORT test of GC panels		X
Perform loop tests	X	X
Participate in plant startup	X	X
Provide DCS information to support GC development of loop drawings	X	

1.3 RELATED SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 01, General Requirements.
2. Section 01 33 00, Submittal Procedures.
3. Division 26, Electrical.
4. Division 40, Process Integration.

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

1.4 SPECIFICATIONS, CODES AND STANDARDS

A. The Work shall comply with the current editions of the publication and codes identified in Section 40 90 04 References, and herein.

1.5 DEFINITIONS

A. Definitions of acronyms are identified in Section 40 90 05, Definitions.

1.6 SUBMITTALS

A. The DCSP shall develop and submit within the first 45 days after NTP, a detailed list of submittals required by all Contract Documents for review and approval. The list shall contain the title of each submittal, detailed description of its contents and the applicable reference Sections. Submittal shall be grouped, organized and sequenced logically such that it facilitates the City's representative's review process. This requirement extends to all Work required by all other Divisions.

B. All Submittals shall be executed in accordance with Section 01 33 00, Submittal Procedures.

C. The DCSP shall conduct a pre-submittal conference. At a minimum, the following shall be presented at the conference:

1. A list of equipment and materials required for the applicable submittal content.
2. A list of proposed exceptions to the Specifications and Drawings, along with a brief explanation of each.
3. An exact one-to-one sample of each type of document to be submitted.
4. Any implementation and construction documentation associated with the submittal.
5. A schedule or schedule fragment that applies to the submittal.

D. The DCSP shall coordinate the Work of the DCS with the Contractor and its subcontractor so that a complete DCS package will be provided inclusive of accurate shop drawings and record drawings. The DCSP shall prepare and submit complete and organized shop drawings, as specified herein. Incomplete or partial submittals are not acceptable. All Shop Drawings and Record Drawings shall be submitted in accordance with Section 01 33 00, Submittal Procedures.

1. Plant-wide loop drawing submittal (PLDS) to verify the DCS interfaces with all instrumentation and devices being provided or installed under this project are to be developed by the Contractor or its subcontractor with the assistance of DCSP. The Loop Drawings shall define all interfaces with equipment provided by the DCSP and as such the DCSP is responsible for providing all necessary information to the Contractor on a timely basis. The Loop Drawings shall be developed in accordance with existing City Loop Drawing standards, as follows:
   a. The loop drawing shall be composed of three sections:
   b. Page 1: A device schedule with a table showing the following:

1) Device tag number, with Prefix, Unit Process, ISA Tag Prefix, Tag No, Tag suffix.
2) Equipment Service.
3) Device Type.
4) Location.
5) Device Manufacturer.
6) Model No.
7) Spec. No.
8) Area Contractor (if applicable).
9) Submittal No.
10) Remarks.
11) Data Sheet No.
12) I/O Signal (AI, AO, DI, or DO).
13) Signal Level.
14) Device Range.
15) Engineering Units.
16) Process Set Point.
17) Loop Diagram No.
18) Loop Drawing File Name.
19) Interconnect Drawing File Name.
20) For third-party devices, should also include: IP (if applicable), module addresses, data registers, IO Tag Names (AB), protocols etc.

c. Page 2: Loop drawing meeting the Requirements of ANSI/ISA S5.4, except that intermediate terminal junction boxes may omitted and be shown on Page 3 for clarity.
d. Page 3: Abbreviated diagram showing instrument, wire and cable numbers, intermediate terminal junction boxes, and PCM terminations.

2. The DCSP shall augment the content of the Loop Drawings by providing all of the requisite data relating to the DCS. For each DCS input/output, the DCSP shall note on the PLDS the following information:
   a. PCM number, and physical location.
   b. Controller Number.
   c. Type of input.
   d. I/O card location and address.
   e. All DCS-dependent displayed functions using ISA symbology.
   f. Drawing reference for DCS software content.
3. In these Contract Documents all systems, all meters, all instruments, and all other elements are represented schematically, and are designated by symbology as derived from International Society of Automation ISA S5.1 (latest revision). The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout shop drawings, and

similar materials. Any other symbols, designations, and nomenclature unique to any manufacturer's standard methods shall not replace those prescribed above, used herein, and on the Drawings.

4. All shop drawings shall include a City-approved title block. The title block shall include, as a minimum, business name and address, project name, drawing name, revision level, and personnel responsible for the content of Drawing. Loop Drawing Submittals shall be submitted in accordance with Section 01 33 00, Submittal Procedures.

E. The DCS hardware submittal (DCSHS) shall be singular and all inclusive, submitted in accordance with Section 01 33 00, Submittal Procedures. The DCS Hardware Submittal shall include, but not be limited to:

1. A complete set of system diagrams which depict:

    a. All Process Control Modules (PCMs), Workstations (WSs), video devices, printers, UPS, Foreign Device Interfaces (Data Link) telemetry devices, communication devices, and communication links.
    b. A one-line showing the designed conduit and wire required to support the power, ground, Input/Output, and communication requirements of the system.
    c. A complete I/O Database showing all I/Os, annotated in ISA format, which depicts all designed I/O, both external and internal hard-wired and data-linked, inclusive of DCS termination locations.
    d. A Complete one-line diagram showing all power wiring and ground wiring, including UPS power, Utility (non-UPS) power and any other external D.C. or A.C. sources for each PCM.

2. A complete set of Factory Data sheets for every DCS component. This shall include layout drawings that show enclosure details, including seismic mounting, as well as the location of each component within the DCS PCM enclosure. Drawings shall contain a scaled representation of the placement of all DCS equipment being provided under this contract and its spatial relationship to all other equipment (both new and existing) located in the abutting and adjoining areas. All acquired access and clearances associated with the DCS equipment and other equipment must be shown with a statement of compliance to DCSP requirements, NEC, NFPS and other applicable codes.
3. Detailed installation, mounting and anchoring details for all components and assemblies to be field mounted, including access requirements, conduit connections or entry details shall be provided.
    a. DCSP shall provide Seismic calculations for each DCS PCM enclosure, or other anchored apparatus, based on the proposed mounting arrangement. Installation/Mounting/Anchoring drawings shall be stamped by a Structural Engineer, registered with the State of

California. Each individual anchoring drawing, as well as the seismic calculations drawings, shall be stamped by the structural engineer.

b. A complete, and detailed, bill of material (BOM) shall be provided. The BOM shall show the factory model number for each component within the DCS.

F. The DCS Network submittal (DCSNS) shall be singular and all inclusive, submitted in accordance with Section 01 33 00, Submittal Procedures. The DCS Hardware Submittal shall include, but not be limited to:

1. A complete set of network diagrams which depict:
   a. All Process Control Modules (PCMs), Workstations (WSs), video devices, printers, UPS, Foreign Device Interfaces (Data Link) telemetry devices, communication devices, and communication links.
   b. A one-line showing the designed conduit and wire required to support the power, ground, Input/Output, and communication requirements of the system.
   c. A complete network design report including IP scheme, traffic planning and control, QoS, configuration of every network equipment including routers, switches and firewalls.
   d. A Complete fiber connection diagrams including fiber routing plans, fiber details, link budget calculations etc.,
   e. A complete, and detailed, bill of material (BOM) shall be provided. The BOM shall show the factory model number for each component within the DCS.
2. A complete set of Factory Data sheets for every network component.

G. The DCS Software Submittal (DCSSS) shall be singular and all inclusive, submitted in accordance with Section 01 33 00, Submittal Procedures. The DCS Software Submittal shall include, but not be limited to:

1. A complete set of all available software algorithms.
2. A complete set of Designer control strategies, with annotations provided by the DCSP depicting engineering details to show how all monitoring and control functions, on a loop by loop basis, will be accomplished. So operators can understand how the process will respond to his actions through DCS interfaces.
3. An English narrative of each data acquisition or control loop mission and anticipated action. Narratives shall enumerate the signal point name, signal descriptor, associated PCM number, associated system template displays, system functions activated by signal (i.e., interlocks, alarms, logs, etc.).
4. A complete set of PCM configuration sheets depicting each loop linkage. Each loop shall be on its own 8 1/2-inch by 11-inch sheet.

5. A complete listing of the DCS data base listing for each data point's relevant parameters such as range, contact orientation, limits, incremental limits, I/O card type, I/O hardware address and assignment, including ALL Macros used/created for the Software.

H. The DCS Graphic Submittal (DCSGS) shall be singular and all inclusive, submitted in accordance with Section 01 33 00, Submittal Procedures. The DCS Graphics Submittal shall include, but not be limited to:

1. One complete set of all WS-accessible displays which are unique to this project (i.e., process global, system global, process regional, systems regional, process group, process loop, process component, integrated tutorials, integrated process tutorials, integrated documentation, user assistance).
2. The DCSP shall ensure that all graphics development, and graphics submittal, conform to the existing graphics layouts, linkages and formats used throughout the COMNET Enterprise.
3. The Graphics Submittals shall contain displays in full size color graphic format and replicate the proposed screen contents. All background colors shall be identical to that of the screen content. All displays shall be arranged in a hierarchical order with references to associated WSs.
4. A system display linkage diagram which defines the hierarchical order and the linkages via page, down, left, right commands.
5. A definition of each displays data fields by tag numbers, utilizing the existing DCS COMNET standard.
6. A definition of each displays dynamic elements which shall blink, change color, rotate or change shape in response to process changes, and conforms to the existing COMNET standard.
7. A listing of all "help" text associated with each display screen, arranges in conformance to the COMNET standard.

I. The DCSP shall prepare and submit a Plan for the Operation Readiness Tests (ORT). The ORT plan shall be submitted in accordance with Specification 01 33 00, Submittal Procedures. The ORT Plan shall be a single-source document which shall encompasses means and methods for testing the complete DCS for this Project segment.

1. The ORT Plan shall provide testing of all DCS hardware, software, graphics, alarms and network communications.
2. The ORT Plan shall elaborate on the simulator to be utilized to provide proof of performance testing for the I&C and DCS functions of the project.
3. The ORT Plan shall provide sample sheets depicting all I/O, hardware, Data Links, communication Networking and internally generated alarms and I/O points. Once approved conceptually by the City, these forms will be

populated and utilized by the DCSP in the submission of each PCM individual ORT submittal.

J. The DCSP shall prepare a complete Training Plan. The Training Plan shall be submitted in accordance with Section 01 33 00, Submittal Procedures. The DCS Training Plan will provide the structure and syllabus for training sessions as follows:

1. Operator Training: Shall provide instruction to Operators already familiar with the operation of the Enterprise DCS, and shall be tailored to the new I/O, process controls, P&ID schemes and specialty consideration for the controls for this Project.
2. Maintenance Training; Shall provide training to City DCS Staff on all enhancements to the DCS, new-generation components and all other hardware, software or graphics maintenance requirements, not currently covered in the City's existing Enterprise DCS.
3. The DCSP shall allow for a minimum of four (4) sessions of each class outlined in the Training Plan to ensure staff availability and shift-differential considerations are facilitated.
4. Resumes of all Training Instructors to be utilized in DCS training shall be included in the Training Plan submittal.
5. After approval of the Training Plan, the DCSP is responsible for coordinating with City DCS Staff, or the City's project representative, to schedule training classes at appropriate times in advance of cut-over and start-up.

PART 2 PRODUCTS

2.1 CURRENT TECHNOLOGY

A. All hardware and software shall be the product of Emerson Process Management (EPM) and shall be of the Ovation family of DCS.

B. The DCS should utilize state-of-the-art products in the DCSP's product line. However, the DCSP must ensure that all products used for this Project are compatible, and will fully integrate into the City's existing enterprise wide COMNET DCS.

C. Successful operation and calculation shall be demonstrated during Factory Acceptance Testing (FAT), Operational Readiness Testing (ORT) and Functional Testing phases.

2.2 HARDWARE AND SOFTWARE COMMONALITY

A. Where there is more than one item of similar equipment being furnished, all such similar equipment shall be the of the same Ovation family series.

B. The DCSP shall submit a plan in case of a discontinued or upgraded product, or other cases where changing technology requires changes in equipment, the DCSP shall submit a Substitute Item Request Form.

C. All equipment shall be of modular design to facilitate interchangeability of parts and to assure ease of servicing. This interchangeability shall apply to the following components, as a minimum, of the DCS.

1. Processor Modules.
2. Bulk Memory Modules.
3. Communication Interface Modules.
4. Analog and Discrete Signal Modules.
5. Power Supply Modules, and UPS devices.
6. Workstations and operator interface devices.
7. Software licenses.

2.3 DCS PRIMARY ARCHITECTURAL COMPONENTS

A. The DCS supplied by EPM shall consist of, but not be limited to, the following primary architectural components:

1. Operator, engineering, instructor, and field workstations.
2. Copper and fiber optic communications network (at DCS PCMs, etc).
3. DCS OS Software for alarms, events, monitoring and control and configuration tools.
4. Security.
5. Historian/Historical data recording and reporting.
6. System Configuration (Application Software) of I/O database, displays, control loops, and human machine interfaces (HMI) graphics.
7. Process Control Modules (PCM).
8. Input/output (I/O) cards and devices, I/O racks, I/O units, remote IO, and Termination Cabinets.
9. PLC's, RTU's, Foreign Device Interface (FDI) modules for PCM's

B. In addition, components associated with the DCS are:

1. Control room furniture as shown on drawings and contained in these Specification, peripherals such as large screen displays, alarm printers, etc).
2. Services related to DCS (including system maintenance, upgrading, and third party and enterprise integration).

3. Enclosures, termination panels, power, UPS, and ground termination busses, etc.

2.4 INTEGRATION COMPONENTS

A. The Integration components shall consist of the following:

1. Integration Server (where show on design drawings and specified herein).
2. Integration Adapters.
3. Software Integration Services.
4. Web Services (when required by specifications).

2.5 SUPPORTING COMPONENTS:

A. The supporting components and associated application software shall consist of the following:

1. DCSLAN Switches.
2. DCSLAN/DCSWAN Routers.
3. Patch Management Server (when specified herein).
4. Security hardware and software, including Antivirus software and malware detection.

PART 3 EXECUTION

3.1 PROJECT EXECUTION AND PROJECT MANAGEMENT SERVICES

A. The DCSP shall prosecute all Work in strict accordance with the sequence and schedule of the Prime Contractor's Master Baseline Schedule.

B. The DCSP'S attention is called to the Contract Documents and Division 40 for specific administrative and commercial requirements of the Work.

C. The DCSP shall provide all project management services required to complete the Work of these documents. At a minimum project management services shall include:

1. Progress Review Meetings.
2. Meeting and workshops to develop project requirements and design details.
3. Regular meetings on scheduling and invoicing.
4. All required meetings for design and submittal reviews.
5. Coordination of support and warranty.
6. Coordination of training.

7. Development and delivery of DCS project controls and document management that coordinates with that of the Prime Contractor.
8. Attend coordination meetings with Prime Contractor, City's representative, plant staff and other City entities as they relate to the delivery of DCS Work.
9. Respond to City representative's requests for information and project documentation.
10. Respond to RFI reviews, as requested by the Design Engineer through the City's representative.

D. The DCSP shall provide all labor, equipment, materials and furniture for the tenant improvements required for the approved staging site at the sole expense of the DCSP.

3.2 ENGINEERING & DESIGN PHASE

A. The DCSP shall provide all engineering, resources, equipment, and labor required to successfully:

1. Produce all submittals, in accordance with Section 01 33 00, Submittal Procedures, and Division 40 requirements.
2. Program, configure, and test of all hardware and software as required by these specifications.
3. Design and specify the enterprise inter-site WAN interface at Project site for communications interface with the existing COMNET DCS.
4. Develop the classroom and computer-based-training for all system elements.
5. Execute field verification and documentation of all conditions, and develop installation drawings and accurate as-constructed documents to successfully complete the Work.
6. Setup, stage and test the Work of each process segment and perform ORT, witnessed by the City's representative at the approved Staging Area prior to any installation.
7. Put into service all system elements by detailed I/O tests, loop checks, and commissioning. Develop and perform functional and performance testing.
8. Develop and submit PCM-by-PCM cutover plans for approval by the City's representative.
9. Document all system elements, software and custom applications
10. Maintain, upgrade and warrant all Work required by the Prime Contract.
11. Design, develop, program, test, and commission Integration of DCS with other systems, see Section 40 90 00, Instrumentation and Control..
12. The DCSP shall develop and submit a uniform and standardized IO tag name convention, and follow the ISA tagging scheme standardly used by the COMNET DCS.

3.3 PROCUREMENT, STAGING, PROGRAMMING, AND TESTING PHASE:

A. The DCSP shall provide all engineering, resources, equipment, and labor required to:

1. Procure all goods and services required to conform to these specifications.
2. Perform all shipments required by the Work.
3. Ship all equipment and software to the approved staging facility, including deliveries from approved Staging Site to Project site.

B. Assemble, stage and program each Segment of Work at the approved Staging area and perform ORT prior to delivery for installation. All tests shall be performed in accordance with Division 40 specifications and approved test procedures.

C. The system elements (i.e. WS, PCM, FHS, etc.) may be assembled at the DCSPS facility and shipped to the approved Staging area for staging, programming and testing. However, the CITY reserves the right to inspect these system elements prior to shipment, and again prior to delivery from the Staging site to the Project site.

3.4 FIELD CONSTRUCTION/ COMMISSIONING PHASE

A. Provide all engineering, resources, equipment and labor required to:

1. Oversee the physical install, by others, of all Process Control Modules (PCM) and Remote IO (RIO) enclosures and electronics.
2. Oversee termination, by others, of all field wiring in 'B' or PCM Cabinets.
3. Run new wires from Cabinet to DCS IO where required.
4. Design, install, and test foreign devices including serial or networked I/O.
5. Oversee Supply and termination of power and grounding of all devices, by others.
6. Test all signal grounding and certify proper installation and function.
7. Deliver Uninterruptible Power Supplies, for installation by others under Division 26.
8. Obtain and manage all required Intra-Plant permits.
9. Install and test all DCS-related networking hardware and cabling.
10. Test all workstations, hardened workstations, PCM and RIO cabinetry and enclosures.
11. Manage and deliver as-built documentation including DCS loop diagram information and P&IDs information. As specified.
12. Conduct a functional test, and site acceptance test to verify DCS performance.
13. Update and submit all specified documentation to reflect "as-built" or record conditions.

3.5 MAINTENANCE AND UPGRADE SERVICES PHASE

A. The DCSP shall Warrant all parts and services for a period as specified for the Prim Contract, after Final DCS Acceptance.

3.6 ENVIRONMENTAL SUITABILITY

A. All DCS devices provided under this contract shall be provided with enclosures which are suitable for use in a treatment facility environment where there are typically high energy AC fields, DC control pulses, and varying ground potentials between the transducers or process instrument locations and those occupied by DCS components.

B. The system design shall be adequate to provide proper protection against interferences from all such possible situations.

C. As a minimum, all DCS equipment shall be resistive to airborne contaminants commonly found in wastewater treatment facilities, and be suitable for installation in an environment which conforms to a G2 classification as defined by ISA-S71.04.

D. Field-Situated Equipment:

1. DCS equipment being furnished under this contract shall be suitable for use in wastewater treatment facilities, some of which are in an environment of air with traces of methane and hydrogen purging sulfide. The system design shall be adequate to provide proper protection against such an environment.
2. All field-situated components including PCMs shall be UL-listed or approved LABOS by an independent certification agency acceptable to the City of San Diego.
3. All DCS devices shall be housed in an enclosure suitable for its intended service and installation location.
4. All DCS devices to be installed in MCC or other protected areas shall be furnished in NEMA 12 rated enclosure.
5. All DCS devices to be installed in indoor protected areas shall be furnished in NEMA 12 rated enclosures.
6. All DCS devices to be installed in indoor unprotected or areas subject to hose-down conditions, or outdoor areas, shall be furnished in 316SS NEMA 4X rated enclosures.
7. At a minimum, the DCS shall be designed and constructed for satisfactory, long, and low maintenance operation under the following environmental conditions:
    a. Temperature Range: 0 degree C through 50 degrees C (32 degrees F through 122 degrees F).
    b. Thermal Shock: 0.55 degrees C (1 degree F per minute maximum).
    c. Relative Humidity: 5 through 95 percent (non-condensing).

8. The mounting of all enclosures shall meet the requirements as specified in Division 26, and shall be seismically braced as required by code for this seismic zone.

END SECTION

SECTION 40 94 23
PROCESS CONTROL MODULE (PCM)

PART 1 – GENERAL

1.1 REQUIREMENT

A. This specification section covers furnishing all labor, materials, equipment and programming for the provision of the required Process Control Modules (PCMs) to complete this WORK.

B. Named types:
   1. Process Control Modules (PCM) Type

C. At a minimum, a PCM shall include the redundant controller processors, redundant memory and communication modules, redundant power supplies with arbitration control, redundant I/O communication processors, NEMA enclosure and backplane, all wiring, power and ground distribution, mounting and anchoring hardware. If part of the manufacturer's standard assembly, it shall also include the chassis to facilitate the I/O modules.

D. Fault Tolerant:
   1. Where a system processor or a system is required to be redundant, that unit shall function as a fault tolerant device.
   2. Fault tolerant processing shall consist of two parallel-operation processors (electronics) with separate connections to the system communication network. Both processors shall receive and process information simultaneously, with faults detected by the processors themselves.
   3. A fault tolerant configuration shall provide synchronous read/execute/compare capabilities with no database transfer.
   4. Upon detection of a fault, self-diagnostics shall be run by both processors to determine which processor is defective. The non-defective processor shall then assume communication and control without affecting normal system operation. Upon replacement of the defective processor the system shall automatically - or the operator may initiate – download of the data base to the replaced processor and assume communications via the network without affecting normal system operation. The use of backup, "hot standby", or "automatic and bumpless switch over" configurations are acceptable if the transition from failed device to backup device does not degrade the process monitoring and control system or the system's availability.

1.2 RELATED SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

1.3 SUBMITTALS

A. The DCSP shall provide all Submittals in accordance with the requirements of Specification 01 33 00, Submittal Procedures. In addition, the DCSP shall provide PCM Component Data: Manufacturer's standard catalog data, including a description and depiction of all control devices and instruments in sufficient detail to demonstrate complete specification compliance. If standard catalog data does not contain sufficient detail to verify compliance, then the DCSP shall submit supplementary documentation to verify compliance.

B. PCM Design: Layout and shop drawings, including the following:
1. Panel layout, including fully dimensioned and detailed external spatial views and internal layout.
2. Electrical schematics, including, new panel wiring, instrument wiring and power and grounding.
3. Layout of relays, breakers, switches and instrumentation provided, and applicable single line and wiring diagrams.
4. IO Card Placement and layout.
5. Enclosures, including all associated hardware devices.
6. Detailed description and associated diagrams of all software components of the PCM.

1.4 CODES AND REGULATORY REQUIREMENTS

A. Instrument Society of America: ISA S5.1 (ANSI/ISA-5.01.01) Instrument Symbols and Identification.

B. National Electric Manufacturers Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment
2. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

C. National Fire Protection Association (NFPA): NFPA 70, National Electrical Code.

1.5 DEFINITIONS

A. Definitions of acronyms are identified in Section 40 90 05, Definitions.

PART 2 - PRODUCTS

2.1 PCM REQUIREMENTS

A. All DCS Controllers shall be manufactured by Emerson Process Management (EPM) and shall be of the OVATION family line. All I/O modules shall match existing and shall be compatible with and seamlessly integrate onto the existing Enterprise wide COMNET DCS

B. DCS Controllers shall be directly or remotely connected to field Input/Output (I/O) modules.

C. All requirements for Process Control Modules (PCM) enclosures shall apply to a RIO enclosure

D. Examples of PLCs provided as a part of a vendor's standard package system are: UV disinfection controls, RO filtration units, HVAC controls and generator controls. This application is distinguished by extensive use of packaged control software and a substantial number of I/O's which are of secondary interest and do not directly affect the major treatment processes (monitoring of lamp status in UV systems, for example). Many of these systems are provided standard with separate operator interfaces. Because of limited space and maintenance requirements, panel-mounted color LCD operator interfaces for these packaged control systems are preferred over desktop personal computers. For these systems, the DCS will be used for supervisory control and monitoring via a communications link, preferably Modbus/TCP, with the PLC operating in the "slave" mode.

All PLCs and local operator interface panels provided for a packaged system project will be of a common manufacturer. Furthermore, the Design Consultant will consult with City prior to the naming of acceptable PLC manufacturers. The PLC programmer will include a heartbeat bit to be exchanged between the PLC and the DCS, and the designer will include this bit in the MODBUS I/O list. The City's standard PLC is Allen Bradley. Designers must carefully select I/Opoints included in PLC to DCS communications. Points transmitted must support the control strategies, necessary alarms, or otherwise be useful to the operator.

Simply specifying that all PLC points will be transmitted to the DCS is not acceptable.

E. All remote I/O (RIO) shall be physically connected to its associated, PCM. Wireless communication is not acceptable.

F. NOT USED

G. NOT USED

H. Each PCM shall contain all of the required IO, inclusive of all attributes, data, alarming, and control strategies required to monitor and control its associated process.

I. PCMs, including remote IO, shall receive power from a dedicated UPS branch circuit and from an additional secondary branch power source (other than the circuit feed to the UPS) to create a redundant bumpless transfer of power to the PCM and/or RIO. UPS and utility power circuits are to be provided to the PCM and RIO by others, under Division 26.

J. PCMs shall be configured, programmed and loaded utilizing engineering functions found in Ovation Developer Studio. The number of user licenses required for each engineering function for each project will be identified in the scope of work.

K. PCMs shall be dual network ported to communicate with other DCS devices over the fault tolerant DCSLAN.

L. PCMs shall communicate with the Workstations (WS) over the DCSLAN.

M. Each PCM shall be able to communicate with every other PCM directly in a peer-to-peer manner using peerprotocol.

N. Each process location shall be provided with dual redundant DCS Controllers (excluding I/O) configured for fault tolerant processing via standard system configuration procedures.

O. Each DCS Controller shall be redundant and provide complete "bumpless" automatic failover to a backup PCM controller in the event of Primary PCM failure.

P. Each PCM enclosure shall be provided with an interior cabinet temperature sensor and security switch to report "real-time temperature" and "door ajar" conditions, respectively.

Q. Each PCM enclosure with additional air purge shall be equipped with a sensor to report air purge system fail

R. NOT USED

S. PCM Interface to Packaged System PLCs

1. PLCs shall interface to the DCS through Foreign Device Interfaces (FDI) which is defined as follows;
    a. The DCS shall be provided with an integrated fault tolerant FDI in the PCM which supports monitoring and control of the PLC.
    b. The FDI shall be fault-tolerant and redundant where indicated.
    c. The DCS shall have an open architecture which shall enable the FDI to provide a means of integration with multiple vendors in a manner which is transparent to the user at the WS level. All of the data associated with the FPI shall appear at the WS –in a similar format and presentation to data derived from PCMs. All WS interaction functions that the operator uses to monitor and control inputs/outputs associated with the PLC(s) shall be similar to those used by the operator to interact with inputs / outputs associated with the PCM(s).
    d. The FDIs provided shall interface with all existing packaged system PLCs that are connected to inputs/outputs on the plant.
    e. All self-documentation features which relate to DCS devices shall also relate to the documentation of PLC configurations made at the DCS. All documentation produced shall be in like format as that for all other DCS components.
    f. The FDI shall support existing field workstations which are part of the existing or packaged system PLC.
    g. DCSP shall include all research, development of drivers (if necessary), I/O maps, I/O register address / protocol maps, configure and startup all FDIs.
    h. As an alternative to the above, if the FDI utilizes custom software drivers to communicate with various manufacturers PLCs/PLC networks, the DCSP shall include all costs associated with providing, licensing, documenting, and revising these software drivers throughout the duration of this contract. If a software driver is used at more than one location, the DCSP shall furnish the additional software driver(s) at no additional cost. A minimum of one (1) set of hardware and all required software shall be furnished to interface with each of the PLCs and PLC communications networks listed below.

i. The DCSP shall provide all hardware, software, to interface to the existing PLCs. FDI network cabling will be supplied and installed by others, under Division 26.

2. The following interface communication protocols and support management shall be provided via the FDI for third-party PLC integration:
   a. Allen Bradley (EIP, TCP and serial DF-1).
   b. Modbus (TCP and serial).
   c. DNP3

T. Process Database:
1. PCMs shall support the following types of Database Points:
   a. I/O Points from I/O resident in PCMs, remote I/O, or OWS.
   b. I/O points from FDIs.
   c. DCS calculated analog and calculated discrete points.
   d. DCS manual inputs.
   e. PLC/RTU registers.
2. The PCM shall store the following configurable/default fields about each Database Point:
   a. DCS Tag Numbers: 16 characters, minimum, assigned as follows:
      1) Characters 1-3 to identify each plant/collection system, e.g. 'DCT'
      2) Characters 4-X pad with zeros (0's)
      3) DCS Point Naming Guidelines: Below are naming guidelines for DCS I/O points and user-created internal DCS points that are visible to Operations (such as derived alarm points that are shown on Alarm Screens, calculated points that are collected by the Historian, or shown on Reports, Graphics, or on Trend screens).
         a) For all such points, the recommended tag structure is:

<Plant> <Plant Area> <ISA Acronym> <Loop Number> <Suffix>, where:
<Plant> = A single letter to designate the Plant or system as follows
"M" for Metropolitan Biosolids Center (MBC),
"N" for North City WRP,
"P" for Point Loma WTP,
"S" for South Bay WRP,
"T" for Pump Stations 1 and 2
"I" for Pump Stations 64 and 65
"E" for East Mission Gorge Pump Station
"Q" for Penasquitos Pump Station
"C" for SCADA
"G" for Grove Avenue Pump Station (GAPS)

"O" for Otay Pump Station

<Plant Area> = Two-digit Plant Area code

For example, "05" is commonly used for the "Headworks" area.

<ISA Acronym> = Two or more Identification Letters chosen based on "ISA-5.4 Appendix B"

If an appropriate ISA Acronym is not readily identifiable, the letter "X" ("Unclassified") may be used.

<Loop Number> = Four Digit Loop Number

For points that are derived from an I/O point or associated with a device for which a loop number is defined, the loop number should be readily identifiable. If an appropriate Loop number is not readily identifiable, the number "0" may be used, or any number in the range 0-999 chosen at the discretion of the programmer (for example unit number, system number).

<Suffix> = A multi alpha-numeric character string that begins with a letter. The string is chosen at the discretion of the programmer to make the point unique and/or to clarify point use.

b) DCS point names should be composed of alpha-numeric characters only (i.e. characters A through Z and 0 through 9). They should not include any special characters such as #, $, &, (, %, -, and so on.

c) For all such user-created points, Engineering Descriptions should be provided. For packed points, where individual bits are used for separate functions, descriptions should be provided for any individual bits that are used.

d) DCS Point names must be unique.

2.2 PCM HARDWARE COMPONENT PLATFORM:

A. Each PCM shall use minimum 32 BIT processor.

B. Redundancy – Fully Redundant Pairs:

1. The PCM cabinet shall be provided with the following redundancy unless specified otherwise:
   a. Dual functional processors.
   b. Dual redundant network interfaces.
   c. Dual processor power supplies.
   d. Dual I/O power supplies.
   e. Dual input power feeds.

f. Dual I/O interfaces not dual I/O.
g. Dual Auxiliary power supplies (loop power).
h. Auto fail over from active PCM to standby PCM for all sites that contain dual PCMs.
i. Hot programming of backup module.

PART 3 – EXECUTION

3.1 GENERAL

A. The DCSP shall furnish all materials, tools, equipment, consumables and supplies, hardware, firmware, software and software licenses, and shall perform all labor required to complete the work in this specification.

B. All I/O tags shall be incorporated as defined elsewhere in these specifications required for the Process Database as defined in these specifications.

C. The International Society of Automation (ISA) Standards will be used if there are no conflicts with existing codes. If there is a conflict between existing Enterprise DCS Facility DCS Tag Codes and the current published ISA table which lists the ISA identifiers, it shall be brought to the attention of the City's representative and the fix coordinated with the City COMNET staff and Project Design Engineers.

D. Spares, Tools, and Test Equipment: General – The DCSP shall furnish all spare parts, tools and test equipment, which may be unique to the Hardware or Software provided under this Contract, which is required to repair and calibrate the DCS and maintain it in good operating condition. In addition, the DCSP shall provide the following spare parts and supplies:

1. One (1) of each type of processor board associated with PCM's, WS's and peripheral devices.
2. One (1) spare I/O card, of each type used, for every PCM provided under this Contract.
3. One (1) of each type of communication board.
4. Three (3) of each type power supplies, utilized in any DCS component of the Contract.

END OF SECTION

SECTION 40 94 24
PROCESS INPUTS/OUTPUTS (I/O)

PART 1 – GENERAL

1.1 REQUIREMENT

A. Process I/O to and from the DCS shall be provided primarily through I/O modules connected to each PCM.

B. I/O Modules shall be modular plug-in components.

C. Analog Input modules shall be available for analog-to digital conversion, including 4-20mA, 1-5 Vdc or RTD input signals.

D. Analog Output modules shall be 24 VDC and generate 4-20mA output signals.

E. Digital and Analog I/O modules shall be 24 VDC.

F. Digital Output modules shall be available with current sinking and relay outputs.

G. Intelligent Device Modules (e.g. Hart, DeviceNet, Fieldbus, etc.) shall be a requirement.

H. Foreign Processor Interface (FPI) referenced in Section 40 94 23 Process Control Modules.

1.2 RELATED SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego

1.3 SUBMITTALS

A. The DCSP shall provide Submittals in accordance with the requirement in Section 01 33 00, Submittal Procedures

1.4 CODES AND REGULATORY REQUIREMENTS

A. The WORK shall comply with the current editions of the publication and codes identified in Section 40 90 04, References.

1.5 DEFINITIONS

A. Definitions of acronyms are identified in Section 40 90 05, Definitions.

PART 2 - PRODUCTS

2.1 GENERAL

A. All I/O products shall be manufactured by Emerson Process Management (EPM) and shall be of the OVATION family line. All I/O modules shall match existing and shall be compatible with and seamlessly integrate onto the existing Enterprise wide COMNET DCS.

B. All process I/O modules shall be located in an enclosure that is proximal or integral to the associated PCM.

C. All I/O modules shall be 24Vdc maximum. Connection to external 120VAC and other foreign voltages shall use interposing relays. Interposing or slave relays shall also be provided in cases where the number, type or rating of the DO module output are incompatible with the electrical circuit to which it is connected. All interposing relays switching 120 VAC shall be isolated from low voltage I/O in accordance with NFPA.

D. Boards or modules shall be provided to interface with process I/O and intelligent transmitters as follows:
   1. Analog Inputs HART (AI):
      a. Maximum 8 AI per Analog Input Module
      b. Four wire transmitters shall provide an isolated 4 to 20 mA signal.
      c. Two wire transmitters shall provide an isolated 4 to 20 mA signal powered from DC power supplies internal or external to the DCS.
      d. Sink/source selection shall be available by hard jumper or software configuration on a point-by-point basis.
      e. All AI's shall be HART protocol compatible
      f. DCS analog inputs shall have a load of 250 ohms.

g. Each analog input shall have a minimum of 12-bit resolution, accuracy of 0.25 percent, and a dedicated A/D converter.

2. Thermocouple Inputs and RTD Modules
   a. Maximum 8 RTD per RTD input module.
   b. Thermocouple input cards shall be able to receive signals from type J, K, and T thermocouples.
   c. Thermocouple type shall be selectable on a point-by-point basis.
   d. Each RTD or thermocouple input shall have a minimum of 12-bit resolution, accuracy of 0.25 percent, and a dedicated D/A converter.
3. Analog Outputs (AO):
   a. Maximum 8 AO per Analog Output Module
   b. Analog output boards shall provide isolated 4 to 20 mA output signals.
   c. Signals shall be capable of driving a loop impedance of at least six hundred (600) ohms.
   d. Each analog output shall have a minimum of 12-bit resolution, accuracy of 0.25 percent, and a dedicated D/A converter.
4. Discrete Inputs (DI)
   a. Maximum 16 DI per Digital Input Module
   b. Discrete inputs shall be powered by the DCS
   c. 24 VDC signals shall be available
   d. Field contacts shall be dry isolated inputs to the DCS
   e. Field contacts that are used for alarms or control purposes shall be wired in a fail-safe manner; i.e. an open wire will result in an alarm and/or in the DCS controlling the system to a safe state.
5. Discrete Outputs (DO)
   a. Maximum 12 DO per Digital Output Module
   b. Discrete outputs shall be dry, isolated relay contacts capable of switching a minimum of 2 Amps, at 24 VDC, or bussed 24VDC current sinking output (maximum 0.5-amp per channel and 6- amp per module), depending on the application.
   c. Power for sensing ("wetting") discrete outputs shall be provided external to the DCS.
   d. Output signal shall use interposing or slave relays.
6. Intelligent Transmitters
   a. Intelligent Transmitter Modules (ITM) that provides bi-directional communications with smart transmitters shall be available.
   b. The PCM shall allow remote transmitter configuration that simultaneously updates the DCS database, excluding DeviceNet.
   c. All digital communication with the intelligent process instrumentation from the DCS WS shall be in engineering units and shall be received a minimum of ten times per second.
   d. ITMs shall be available that communicate using Foundation Fieldbus, Profibus, etc.

e. Each message shall contain the following information with analog values specified in standard IEEE 754 32-bit floating-point:
    1) Primary measurement information such as flow, pressure, level, etc.
    2) Transmitter temperature readings.
    3) Data security information.
    4) Diagnostic information.
    5) Message checking.

7. Configuration and status information shall be accessible at any DCS workstation, and shall include:
    a. The assignment of configurable parameters such as tag number, location, address, tag name, upper and lower range values, zero elevation or suppression, linear or square root output for d/p cells, and damping time
    b. I/O card diagnostics graphic display
    c. Display of the process value in terms of percent of span, engineering units, or current level.
    d. Diagnostics, card faults, and communications errors.
    e. DCS sites that contain AMS shall be up dated with new HART I/O when added by contract.

PART 3 – EXECUTION

3.1 GENERAL

A. The DCSP shall furnish and install all I/O Boards and related equipment as shown on the Contract Drawings and called for in the Project Specifications.

B. Modules will be configures using:
    1. Established format of the Fully Qualified Module Record Point Names with full English Descriptions
    2. AC Line Frequency set at 60 Hz.
    3. Suppress Point Fault Module Alarm Active
    4. Blown Fuse Detection Enabled

3.2 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are part of this Specification.
    1. DCS Input/Output List

END OF SECTION

FACILIT	ARE	ISA	LOOP	SUFFI	DCS TAG	LOOP NO.	DESCRIPTION	ALARM	FAIL	P&ID	EQUIPMENT	DATA	RANGE	CONTROL	PCM/PLC	EQUIPMENT	AREA
R	01	YA	101	A	R01YA101A	YA-101A	DIVERSION STRUCTURE NO. 1 G-01 FAILED TO OPEN-			I-05	G-01	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 1
R	01	YL	101		R01YL101	YL-101	DIVERSION STRUCTURE NO. 1 G-01 IN REMOTE			I-05	G-01	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 1
R	01	ZLC	101		R01ZLC101	ZLC-101	DIVERSION STRUCTURE NO. 1 G-01 CLOSE STATUS			I-05	G-01	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 1
R	01	ZL	101		R01ZLO101	ZLO-101	DIVERSION STRUCTURE NO. 1 G-01 OPEN STATUS			I-05	G-01	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 1
R	01	HS	101		R01HS101	HS-101	DIVERSION STRUCTURE NO. 1 G-01 OPEN/CLOSE			I-05	G-01	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 1
R	01	YA	102	A	R01YA102A	YA-102A	DIVERSION STRUCTURE NO. 2 G-02 FAILED TO OPEN-			I-05	G-02	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 2
R	01	YL	102		R01YL102	YL-102	DIVERSION STRUCTURE NO. 2 G-02 IN REMOTE			I-05	G-02	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 2
R	01	ZLC	102		R01ZLC102	ZLC-102	DIVERSION STRUCTURE NO. 2 G-02 CLOSE STATUS			I-05	G-02	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 2
R	01	ZL	102		R01ZLO102	ZLO-102	DIVERSION STRUCTURE NO. 2 G-02 OPEN STATUS			I-05	G-02	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 2
R	01	HS	102		R01HS102	HS-102	DIVERSION STRUCTURE NO. 2 G-02 OPEN/CLOSE			I-05	G-02	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 2
R	01	YA	111	A	R01YA111A	YA-111A	DIVERSION STRUCTURE NO. 1 SG-01 FAILED TO OPEN-			I-05	SG-01	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 1
R	01	YL	111		R01YL111	YL-111	DIVERSION STRUCTURE NO. 1 SG-01 IN REMOTE			I-05	SG-01	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 1
R	01	ZLC	111		R01ZLC111	ZLC-111	DIVERSION STRUCTURE NO. 1 SG-01 CLOSE STATUS			I-05	SG-01	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 1
R	01	ZL	111		R01ZLO111	ZLO-111	DIVERSION STRUCTURE NO. 1 SG-01 OPEN STATUS			I-05	SG-01	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 1
R	01	HS	111		R01HS111	HS-111	DIVERSION STRUCTURE NO. 1 SG-01 OPEN/CLOSE			I-05	SG-01	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 1
R	01	LI	101		R01LI101	LN-101	DIVERSION STRUCTURE NO. 1 LEVEL			I-05	LIT-101	DN	FT			LEVEL TRANSMITTER	DIVERSION STRUCTURE NO. 1
R	01	LI	102		R01LI102	LN-102	DIVERSION STRUCTURE NO. 2 LEVEL			I-05	LIT-102	DN	FT			LEVEL TRANSMITTER	DIVERSION STRUCTURE NO. 2
R	01	YA	112	A	R01YA112A	YA-112A	DIVERSION STRUCTURE NO. 2 SG-02 FAILED TO OPEN-			I-05	SG-02	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 2
R	01	YL	112		R01YL112	YL-112	DIVERSION STRUCTURE NO. 2 SG-02 IN REMOTE			I-05	SG-02	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 2
R	01	ZLC	112		R01ZLC112	ZLC-112	DIVERSION STRUCTURE NO. 2 SG-02 CLOSE STATUS			I-05	SG-02	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 2
R	01	ZL	112		R01ZLO112	ZLO-112	DIVERSION STRUCTURE NO. 2 SG-02 OPEN STATUS			I-05	SG-02	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 2
R	01	HS	112		R01HS112	HS-112	DIVERSION STRUCTURE NO. 2 SG-02 OPEN/CLOSE			I-05	SG-02	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 2
R	01	YA	103	A	R01YA103A	YA-103A	DIVERSION STRUCTURE NO. 3 G-03 FAILED TO OPEN-			I-06	G-03	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 3
R	01	YL	103		R01YL103	YL-103	DIVERSION STRUCTURE NO. 3 G-03 IN REMOTE			I-06	G-03	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 3
R	01	ZLC	103		R01ZLC103	ZLC-103	DIVERSION STRUCTURE NO. 3 G-03 CLOSE STATUS			I-06	G-03	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 3
R	01	ZL	103		R01ZLO103	ZLO-103	DIVERSION STRUCTURE NO. 3 G-03 OPEN STATUS			I-06	G-03	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 3
R	01	HS	103		R01HS103	HS-103	DIVERSION STRUCTURE NO. 3 G-03 OPEN/CLOSE			I-06	G-03	DN	N/A			MOTORIZED GATE	DIVERSION STRUCTURE NO. 3
R	01	LI	103		R01LI103	LN-103	DIVERSION STRUCTURE NO. 3 LEVEL			I-06	LIT-103	DN	FT			LEVEL TRANSMITTER	DIVERSION STRUCTURE NO. 3
R	01	YA	113	A	R01YA113A	YA-113A	DIVERSION STRUCTURE NO. 3 SG-03 FAILED TO OPEN-			I-06	SG-03	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 3
R	01	YL	113		R01YL113	YL-113	DIVERSION STRUCTURE NO. 3 SG-03 IN REMOTE			I-06	SG-03	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 3
R	01	ZLC	113		R01ZLC113	ZLC-113	DIVERSION STRUCTURE NO. 3 SG-03 CLOSE STATUS			I-06	SG-03	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 3
R	01	ZL	113		R01ZLO113	ZLO-113	DIVERSION STRUCTURE NO. 3 SG-03 OPEN STATUS			I-06	SG-03	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 3
R	01	HS	113		R01HS113	HS-113	DIVERSION STRUCTURE NO. 3 SG-03 OPEN/CLOSE			I-06	SG-03	DN	N/A			MOTORIZED SLUICE GATE	DIVERSION STRUCTURE NO. 3
R	01	LI	100		R01LI100	LN-100	JUNCTION STRUCTURE NO. 1 LEVEL			I-07	LT-100	AI	FT			LEVEL TRANSMITTER	JUNCTION STRUCTURE NO. 1
R	01	YA	104	A	R01YA104A	YA-104A	SCREEN INFLUENT GATE G-04 FAILED TO OPEN			I-08	G-04	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YL	104		R01YL104	YL-104	SCREEN INFLUENT GATE G-04 IN REMOTE			I-08	G-04	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLC	104		R01ZLC104	ZLC-104	SCREEN INFLUENT GATE G-04 CLOSE STATUS			I-08	G-04	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZL	104		R01ZLO104	ZLO-104	SCREEN INFLUENT GATE G-04 OPEN STATUS			I-08	G-04	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	HS	104		R01HS104	HS-104	SCREEN INFLUENT GATE G-04 OPEN/CLOSE COMMAND			I-08	G-04	DO	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YA	105	A	R01YA105A	YA-105A	SCREEN INFLUENT GATE G-05 FAILED TO OPEN			I-08	G-05	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YL	105		R01YL105	YL-105	SCREEN INFLUENT GATE G-05 IN REMOTE			I-08	G-05	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLC	105		R01ZLC105	ZLC-105	SCREEN INFLUENT GATE G-05 CLOSE STATUS			I-08	G-05	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLO	105		R01ZLO105	ZLO-105	SCREEN INFLUENT GATE G-05 OPEN STATUS			I-08	G-05	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	HS	105		R01HS105	HS-105	SCREEN INFLUENT GATE G-05 OPEN/CLOSE COMMAND			I-08	G-05	DO	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YA	106	A	R01YA106A	YA-106A	SCREEN INFLUENT GATE G-06 FAILED TO OPEN			I-08	G-06	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YL	106		R01YL106	YL-106	SCREEN INFLUENT GATE G-06 IN REMOTE			I-08	G-06	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLC	106		R01ZLC106	ZLC-106	SCREEN INFLUENT GATE G-06 CLOSE STATUS			I-08	G-06	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLO	106		R01ZLO106	ZLO-106	SCREEN INFLUENT GATE G-06 OPEN STATUS			I-08	G-06	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	HS	106		R01HS106	HS-106	SCREEN INFLUENT GATE G-06 OPEN/CLOSE COMMAND			I-08	G-06	DO	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YA	110	A	R01YA110A	YA-110A	SCREEN INFLUENT GATE G-10 FAILED TO OPEN			I-08	G-10	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YL	110		R01YL110	YL-110	SCREEN INFLUENT GATE G-10 IN REMOTE			I-08	G-10	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLC	110		R01ZLC110	ZLC-110	SCREEN INFLUENT GATE G-10 CLOSE STATUS			I-08	G-10	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLO	110		R01ZLO110	ZLO-110	SCREEN INFLUENT GATE G-10 OPEN STATUS			I-08	G-10	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	HS	110		R01HS110	HS-110	SCREEN INFLUENT GATE G-10 OPEN/CLOSE COMMAND			I-08	G-10	DO	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	LI	201	A	R01LI201A	LN-201A	SCREENING CHANNEL 1 INFLUENT LEVEL			I-08	LIT-201A	AI	FT			LEVEL TRANSMITTER	SCREENING STRUCTURE
R	01	LI	201	B	R01LI201B	LN-201B	SCREENING CHANNEL 1 EFFLUENT LEVEL			I-08	LIT-201B	AI	FT			LEVEL TRANSMITTER	SCREENING STRUCTURE
R	01	YA	201		R01YA201	YA-201	MECHANICAL SCREEN-01 FAIL			I-08	ME-01	DI	N/A			MECHANICAL SCREEN	SCREENING STRUCTURE

FACILIT	ARE	ISA	LOOP	SUFFI	DCS TAG	LOOP NO.	DESCRIPTION	ALARM	FAIL	P&ID	EQUIPMENT	DATA	RANGE	CONTROL	PCM/PLC	EQUIPMENT	AREA
R	01	YL	201	A	R01YL201A	YL-201A	MECHANICAL SCREEN-01 RUN			I-08	ME-01	DI	N/A			MECHANICAL SCREEN	SCREENING STRUCTURE
R	01	YL	201	B	R01YL201B	YL-201B	MECHANICAL SCREEN-01 IN REMOTE			I-08	ME-01	DI	N/A			MECHANICAL SCREEN	SCREENING STRUCTURE
R	01	HS	201		R01HS201	HS-201	MECHANICAL SCREEN-01 RUN COMMAND			I-08	ME-01	DO	N/A			MECHANICAL SCREEN	SCREENING STRUCTURE
R	01	HS	200		R01HS200	HS-200	SCREEN DUTY/STANDBY SELECTOR SWITCH			I-08	ME-01/02	SOFT	N/A			MECHANICAL SCREEN	SCREENING STRUCTURE
R	01	YA	107	A	R01YA107A	YA-107A	SCREEN EFFLUENT GATE G-07 FAILED TO OPEN			I-09	G-07	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YL	107		R01YL107	YL-107	SCREEN EFFLUENT GATE G-07 IN REMOTE			I-09	G-07	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLC	107		R01ZLC107	ZLC-107	SCREEN EFFLUENT GATE G-07 CLOSE STATUS			I-09	G-07	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLO	107		R01ZLO107	ZLO-107	SCREEN EFFLUENT GATE G-07 OPEN STATUS			I-09	G-07	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	HS	107		R01HS107	HS-107	SCREEN EFFLUENT GATE G-07 OPEN/CLOSE COMMAND			I-09	G-07	DO	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YA	108	A	R01YA108A	YA-108A	SCREEN EFFLUENT GATE G-08 FAILED TO OPEN			I-09	G-08	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YL	108		R01YL108	YL-108	SCREEN EFFLUENT GATE G-08 IN REMOTE			I-09	G-08	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLC	108		R01ZLC108	ZLC-108	SCREEN EFFLUENT GATE G-08 CLOSE STATUS			I-09	G-08	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLO	108		R01ZLO108	ZLO-108	SCREEN EFFLUENT GATE G-08 OPEN STATUS			I-09	G-08	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	HS	108		R01HS108	HS-108	SCREEN EFFLUENT GATE G-08 OPEN/CLOSE COMMAND			I-09	G-08	DO	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YA	109	A	R01YA109A	YA-109A	SCREEN EFFLUENT GATE G-09 FAILED TO OPEN			I-09	G-09	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	YL	109		R01YL109	YL-109	SCREEN EFFLUENT GATE G-09 IN REMOTE			I-09	G-09	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLC	109		R01ZLC109	ZLC-109	SCREEN EFFLUENT GATE G-09 CLOSE STATUS			I-09	G-09	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	ZLO	109		R01ZLO109	ZLO-109	SCREEN EFFLUENT GATE G-09 OPEN STATUS			I-09	G-09	DI	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	HS	109		R01HS109	HS-109	SCREEN EFFLUENT GATE G-09 OPEN/CLOSE COMMAND			I-09	G-09	DO	N/A			MOTORIZED GATE	SCREENING STRUCTURE
R	01	LI	202	A	R01LI202A	LN-202A	SCREENING CHANNEL 2 INFLUENT LEVEL			I-09	LIT-202A	AI	FT			LEVEL TRANSMITTER	SCREENING STRUCTURE
R	01	LI	202	B	R01LI202B	LN-202B	SCREENING CHANNEL 2 EFFLUENT LEVEL			I-09	LIT-202B	AI	FT			LEVEL TRANSMITTER	SCREENING STRUCTURE
R	01	YA	202		R01YA202	YA-202	MECHANICAL SCREEN-02 FAIL			I-09	ME-02	DI	N/A			MECHANICAL SCREEN	SCREENING STRUCTURE
R	01	YL	202	A	R01YL202A	YL-202A	MECHANICAL SCREEN-02 RUN			I-09	ME-02	DI	N/A			MECHANICAL SCREEN	SCREENING STRUCTURE
R	01	YL	202	B	R01YL202B	YL-202B	MECHANICAL SCREEN-02 IN REMOTE			I-09	ME-02	DI	N/A			MECHANICAL SCREEN	SCREENING STRUCTURE
R	01	HS	202		R01HS202	HS-202	MECHANICAL SCREEN-02 RUN COMMAND			I-09	ME-02	DO	N/A			MECHANICAL SCREEN	SCREENING STRUCTURE
R	01	ZLC	301		R01ZLC301	ZLC-301	KNIFE GATE VALVE KGV-01 CLOSE STATUS			I-10	KGV-01	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	YA	301	A	R01YA301A	YA-301A	KNIFE GATE VALVE KGV-01 FAILED TO OPEN/CLOSE			I-10	KGV-01	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	YL	301		R01YL301	YL-301	KNIFE GATE VALVE KGV-01 IN REMOTE			I-10	KGV-01	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	ZLO	301		R01ZLO301	ZLO-301	KNIFE GATE VALVE KGV-01 OPEN STATUS			I-10	KGV-01	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	HS	301		R01HS301	HS-301	KNIFE GATE VALVE KGV-01 OPEN/CLOSE COMMAND			I-10	KGV-01	DO	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	HS	302		R01HS302	HS-302	PLUG VALVE PV-01 OPEN/CLOSE COMMAND			I-10	PV-01	DO	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	YA	302	A	R01YA302A	YA-302A	PLUG VALVE PV-01 FAILED TO OPEN/CLOSE			I-10	PV-01	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	YL	302		R01YL302	YL-302	PLUG VALVE PV-01 IN REMOTE			I-10	PV-01	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLC	302		R01ZLC302	ZLC-302	PLUG VALVE PV-01 CLOSE STATUS			I-10	PV-01	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLO	302		R01ZLO302	ZLO-302	PLUG VALVE PV-01 OPEN STATUS			I-10	PV-01	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLC	303		R01ZLC303	ZLC-303	KNIFE GATE VALVE KGV-02 CLOSE STATUS			I-10	KGV-02	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	YA	303	A	R01YA303A	YA-303A	KNIFE GATE VALVE KGV-02 FAILED TO OPEN/CLOSE			I-10	KGV-02	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	YL	303		R01YL303	YL-303	KNIFE GATE VALVE KGV-02 IN REMOTE			I-10	KGV-02	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	ZLO	303		R01ZLO303	ZLO-303	KNIFE GATE VALVE KGV-02 OPEN STATUS			I-10	KGV-02	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	HS	303		R01HS303	HS-303	KNIFE GATE VALVE KGV-02 OPEN/CLOSE COMMAND			I-10	KGV-02	DO	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	HS	304		R01HS304	HS-304	PLUG VALVE PV-02 OPEN/CLOSE COMMAND			I-10	PV-02	DO	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	YA	304	A	R01YA304A	YA-304A	PLUG VALVE PV-02 FAILED TO OPEN/CLOSE			I-10	PV-02	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	YL	304		R01YL304	YL-304	PLUG VALVE PV-02 IN REMOTE			I-10	PV-02	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLC	304		R01ZLC304	ZLC-304	PLUG VALVE PV-02 CLOSE STATUS			I-10	PV-02	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLO	304		R01ZLO304	ZLO-304	PLUG VALVE PV-02 OPEN STATUS			I-10	PV-02	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	SI	010		R01SI010	SI-010	VFD-01 SPEED FEEDBACK			I-10	VFD-01	AI	0-100%			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	SC	010		R01SC010	SC-010	VFD-01 SPEED SETPOINT			I-10	VFD-01	AO	0-100%			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	010		R01YA010	YA-010	VFD-01 FAIL			I-10	VFD-01	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YL	010		R01YL010	YL-010	VFD-01 RUN			I-10	VFD-01	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	HS	010		R01HS010	HS-010	VFD-01 CALL			I-10	VFD-01	DO	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	PI	011		R01PI011	PN-011	PUMP-01 DISCHARGE PRESSURE			I-10	PIT-011	AI	PSI			PRESSURE TRANSMITTER	PUMP STATION
R	01	YA	011	A	R01YA011A	YA-010A	P-01 TEMPERATURE WARNING			I-10	VFD-01	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	011	B	R01YA011B	YA-010C	P-01 TEMPERATURE SHUTDOWN			I-10	VFD-01	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	012		R01YA012	YA-012	CHECK VALVE CV-01 CLOSED			I-10	CV-01	DI	N/A			CHECK VALVE	PUMP STATION
R	01	PI	012		R01PI012	PN-012	PUMP-02 DISCHARGE PRESSURE			I-10	PIT-012	AI	PSI			PRESSURE TRANSMITTER	PUMP STATION
R	01	YA	012	A	R01YA012A	YA-010B	P-02 TEMPERATURE WARNING			I-10	VFD-01	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	012	B	R01YA012B	YA-010D	P-02 TEMPERATURE SHUTDOWN			I-10	VFD-01	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM

FACILIT	ARE	ISA	LOOP	SUFFI	DCS TAG	LOOP NO.	DESCRIPTION	ALARM	FAIL	P&ID	EQUIPMENT	DATA	RANGE	CONTROL	PCM/PLC	EQUIPMENT	AREA
R	01	SI	020		R01SI020	SI-020	VFD-02 SPEED FEEDBACK			I-10	VFD-02	AI	0-100 %			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	SC	020		R01SC020	SC-020	VFD-02 SPEED SETPOINT			I-10	VFD-02	AO	0-100%			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	020		R01YA020	YA-020	VFD-02 FAIL			I-10	VFD-02	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YL	020		R01YL020	YL-020	VFD-02 RUN			I-10	VFD-02	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	HS	020		R01HS020	HS-020	VFD-02 CALL			I-10	VFD-02	DO	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	PI	021		R01PI021	PN-021	PUMP-03 DISCHARGE PRESSURE			I-10	PIT-021	AI	PSI			PRESSURE TRANSMITTER	PUMP STATION
R	01	YA	021	A	R01YA021A	YA-020A	P-03 TEMPERATURE WARNING			I-10	VFD-02	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	021	B	R01YA021B	YA-020C	P-03 TEMPERATURE SHUTDOWN			I-10	VFD-02	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	022		R01YA022	YA-022	CHECK VALVE CV-02 CLOSED			I-10	CV-02	DI	N/A			CHECK VALVE	PUMP STATION
R	01	PI	022		R01PI022	PN-022	PUMP-04 DISCHARGE PRESSURE			I-10	PIT-022	AI	PSI			PRESSURE TRANSMITTER	PUMP STATION
R	01	YA	022	A	R01YA022A	YA-020B	P-04 TEMPERATURE WARNING			I-10	VFD-02	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	022	B	R01YA022B	YA-020D	P-04 TEMPERATURE SHUTDOWN			I-10	VFD-02	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	ZLC	305		R01ZLC305	ZLC-305	KNIFE GATE VALVE KGV-03 CLOSE STATUS			I-11	KGV-03	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	YA	305	A	R01YA305A	YA-305A	KNIFE GATE VALVE KGV-03 FAILED TO OPEN/CLOSE			I-11	KGV-03	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	YL	305		R01YL305	YL-305	KNIFE GATE VALVE KGV-03 IN REMOTE			I-11	KGV-03	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	ZLO	305		R01ZLO305	ZLO-305	KNIFE GATE VALVE KGV-03 OPEN STATUS			I-11	KGV-03	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	HS	305		R01HS305	HS-305	KNIFE GATE VALVE KGV-03 OPEN/CLOSE COMMAND			I-11	KGV-03	DO	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	HS	306		R01HS306	HS-306	PLUG VALVE PV-03 OPEN/CLOSE COMMAND			I-11	PV-03	DO	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	YA	306	A	R01YA306A	YA-306A	PLUG VALVE PV-03 FAILED TO OPEN/CLOSE			I-11	PV-03	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	YL	306		R01YL306	YL-306	PLUG VALVE PV-03 IN REMOTE			I-11	PV-03	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLC	306		R01ZLC306	ZLC-306	PLUG VALVE PV-03 CLOSE STATUS			I-11	PV-03	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLO	306		R01ZLO306	ZLO-306	PLUG VALVE PV-03 OPEN STATUS			I-11	PV-03	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	SI	030		R01SI030	SI-030	VFD-03 SPEED FEEDBACK			I-11	VFD-03	AI	0-100 %			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	SC	030		R01SC030	SC-030	VFD-03 SPEED SETPOINT			I-11	VFD-03	AO	0-100%			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	030		R01YA030	YA-030	VFD-03 FAIL			I-11	VFD-03	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YL	030		R01YL030	YL-030	VFD-03 RUN			I-11	VFD-03	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	HS	030		R01HS030	HS-030	VFD-03 CALL			I-11	VFD-03	DO	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	PI	031		R01PI031	PN-031	PUMP-05 DISCHARGE PRESSURE			I-11	PIT-031	AI	PSI			PRESSURE TRANSMITTER	PUMP STATION
R	01	YA	030	A	R01YA030A	YA-030A	P-05 TEMPERATURE WARNING			I-11	VFD-03	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	030	C	R01YA030C	YA-030C	P-05 TEMPERATURE SHUTDOWN			I-11	VFD-03	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	032		R01YA032	YA-032	CHECK VALVE CV-03 CLOSED			I-11	CV-03	DI	N/A			CHECK VALVE	PUMP STATION
R	01	PI	032		R01PI032	PN-032	PUMP-06 DISCHARGE PRESSURE			I-11	PIT-032	AI	PSI			PRESSURE TRANSMITTER	PUMP STATION
R	01	YA	030	B	R01YA030B	YA-030B	P-06 TEMPERATURE WARNING			I-11	VFD-03	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	030	D	R01YA030D	YA-030D	P-06 TEMPERATURE SHUTDOWN			I-11	VFD-03	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	060		R01YA060	YA-060	SCUM PUMP P-13 FAIL			I-11	P-13	DI	N/A			SCUM PUMP	PUMP STATION
R	01	YL	060		R01YL060	YL-060	SCUM PUMP P-13 RUN			I-11	P-13	DI	N/A			SCUM PUMP	PUMP STATION
R	01	YA	070		R01YA070	YA-070	SCUM PUMP P-14 FAIL			I-11	P-14	DI	N/A			SCUM PUMP	PUMP STATION
R	01	YL	070		R01YL070	YL-070	SCUM PUMP P-14 RUN			I-11	P-14	DI	N/A			SCUM PUMP	PUMP STATION
R	01	YA	065	A	R01YA065A	YA-065A	SCUM PUMP LOW LEVEL FLOAT ALARM			I-11	P-13/14	DI	N/A			SCUM PUMP	PUMP STATION
R	01	YA	065	B	R01YA065B	YA-065B	SCUM PUMP HIGH LEVEL FLOAT ALARM			I-11	P-13/14	DI	N/A			SCUM PUMP	PUMP STATION
R	01	YA	065	C	R01YA065C	YA-065C	SCUM PUMP HIGH HIGH LEVEL FLOAT ALARM			I-11	P-13/14	DI	N/A			SCUM PUMP	PUMP STATION
R	01	YA	080		R01YA080	YA-080	SUMP PUMP P-11 FAIL			I-11	P-11	DI	N/A			SUMP PUMP	PUMP STATION
R	01	YL	080		R01YL080	YL-080	SUMP PUMP P-11 RUN			I-11	P-11	DI	N/A			SUMP PUMP	PUMP STATION
R	01	YA	090		R01YA090	YA-090	SUMP PUMP P-12 FAIL			I-11	P-12	DI	N/A			SUMP PUMP	PUMP STATION
R	01	YL	090		R01YL090	YL-090	SUMP PUMP P-12 RUN			I-11	P-12	DI	N/A			SUMP PUMP	PUMP STATION
R	01	YA	085	A	R01YA085A	YA-085A	SUMP PUMP LOW LEVEL FLOAT ALARM			I-11	P-11/12	DI	N/A			SUMP PUMP	PUMP STATION
R	01	YA	085	B	R01YA085B	YA-085B	SUMP PUMP HIGH LEVEL FLOAT ALARM			I-11	P-11/12	DI	N/A			SUMP PUMP	PUMP STATION
R	01	YA	085	C	R01YA085C	YA-085C	SUMP PUMP HIGH HIGH LEVEL FLOAT ALARM			I-11	P-11/12	DI	N/A			SUMP PUMP	PUMP STATION
R	01	LI	106		R01LI106	LN-106	WET WELL LEVEL			I-11	LIT-106	AI	FT			LEVEL TRANSMITTER	PUMP STATION
R	01	LI	107		R01LI107	LN-107	WET WELL LEVEL			I-11	LIT-107	AI	FT			LEVEL TRANSMITTER	PUMP STATION
R	01	FI	102		R01FI102	FN-102	PUMP STATION EFFLUENT FLOW			I-12	FIT-102	AI	N/A			FLOW METER	PUMP STATION
R	01	YA	102		R01YA102	YA-102	PUMP STATION EFFLUENT FLOWMETER FAIL			I-12	FIT-102	DI	N/A			FLOW METER	PUMP STATION
R	01	FQI	102		R01FQI102	FQI-102	PUMP STATION EFFLUENT TOTAL FLOW			I-12	FIT-102	DI	N/A			FLOW METER	PUMP STATION
R	01	ZLC	307		R01ZLC307	ZLC-307	KNIFE GATE VALVE KGV-04 CLOSE STATUS			I-12	KGV-04	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	YA	307	A	R01YA307A	YA-307A	KNIFE GATE VALVE KGV-04 FAILED TO OPEN/CLOSE			I-12	KGV-04	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	YL	307		R01YL307	YL-307	KNIFE GATE VALVE KGV-04 IN REMOTE			I-12	KGV-04	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	ZL	307		R01ZLO307	ZLO-307	KNIFE GATE VALVE KGV-04 OPEN STATUS			I-12	KGV-04	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION

FACILIT	ARE	ISA	LOOP	SUFFI	DCS TAG	LOOP NO.	DESCRIPTION	ALARM	FAIL	P&ID	EQUIPMENT	DATA	RANGE	CONTROL	PCM/PLC	EQUIPMENT	AREA
R	01	HS	307		R01HS307	HS-307	KNIFE GATE VALVE KGV-04 OPEN/CLOSE COMMAND			I-12	KGV-04	DO	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	HS	308		R01HS308	HS-308	PLUG VALVE PV-04 OPEN/CLOSE COMMAND			I-12	PV-04	DO	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	YA	308	A	R01YA308A	YA-308A	PLUG VALVE PV-04 FAILED TO OPEN/CLOSE			I-12	PV-04	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	YL	308		R01YL308	YL-308	PLUG VALVE PV-04 IN REMOTE			I-12	PV-04	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLC	308		R01ZLC308	ZLC-308	PLUG VALVE PV-04 CLOSE STATUS			I-12	PV-04	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLO	308		R01ZLO308	ZLO-308	PLUG VALVE PV-04 OPEN STATUS			I-12	PV-04	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLC	309		R01ZLC309	ZLC-309	KNIFE GATE VALVE KGV-05 CLOSE STATUS			I-12	KGV-05	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	YA	309	A	R01YA309A	YA-309A	KNIFE GATE VALVE KGV-05 FAILED TO OPEN/CLOSE			I-12	KGV-05	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	YL	309		R01YL309	YL-309	KNIFE GATE VALVE KGV-05 IN REMOTE			I-12	KGV-05	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	ZLO	309		R01ZLO309	ZLO-309	KNIFE GATE VALVE KGV-05 OPEN STATUS			I-12	KGV-05	DI	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	HS	309		R01HS309	HS-309	KNIFE GATE VALVE KGV-05 OPEN/CLOSE COMMAND			I-12	KGV-05	DO	N/A			MOTORIZED KNIFE VALVE	PUMP STATION
R	01	HS	310		R01HS310	HS-310	PLUG VALVE PV-05 OPEN/CLOSE COMMAND			I-12	PV-05	DO	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	YA	310	A	R01YA310A	YA-310A	PLUG VALVE PV-05 FAILED TO OPEN/CLOSE			I-12	PV-05	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	YL	310		R01YL310	YL-310	PLUG VALVE PV-05 IN REMOTE			I-12	PV-05	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLC	310		R01ZLC310	ZLC-310	PLUG VALVE PV-05 CLOSE STATUS			I-12	PV-05	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	ZLO	310		R01ZLO310	ZLO-310	PLUG VALVE PV-05 OPEN STATUS			I-12	PV-05	DI	N/A			MOTORIZED PLUG VALVE	PUMP STATION
R	01	SC	040		R01SC040	SC-040	VFD-04 SPEED SETPOINT			I-12	VFD-04	AO	0-100%			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	SI	040		R01SI040	SI-040	VFD-04 SPEED FEEDBACK			I-12	VFD-04	AI	0-100 %			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	040		R01YA040	YA-040	VFD-04 FAIL			I-12	VFD-04	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YL	040		R01YL040	YL-040	VFD-04 RUN			I-12	VFD-04	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	HS	040		R01HS040	HS-040	VFD-04 CALL			I-12	VFD-04	DO	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	PI	041		R01PI041	PN-041	PUMP-07 DISCHARGE PRESSURE			I-12	PIT-041	AI	PSI			PRESSURE TRANSMITTER	PUMP STATION
R	01	YA	040	A	R01YA040A	YA-040A	P-07 TEMPERATURE WARNING			I-12	VFD-04	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	040	C	R01YA040C	YA-040C	P-07 TEMPERATURE SHUTDOWN			I-12	VFD-04	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	042		R01YA042	YA-042	CHECK VALVE CV-04 CLOSED			I-12	CV-04	DI	N/A			CHECK VALVE	PUMP STATION
R	01	PI	042		R01PI042	PN-042	PUMP-08 DISCHARGE PRESSURE			I-12	PIT-042	AI	PSI			PRESSURE TRANSMITTER	PUMP STATION
R	01	YA	040	B	R01YA040B	YA-040B	P-08 TEMPERATURE WARNING			I-12	VFD-04	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	040	D	R01YA040D	YA-040D	P-08 TEMPERATURE SHUTDOWN			I-12	VFD-04	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	SC	050		R01SC050	SC-050	VFD-05 SPEED SETPOINT			I-12	VFD-05	AO	0-100%			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	SI	050		R01SI050	SI-050	VFD-05 SPEED FEEDBACK			I-12	VFD-05	AI	0-100 %			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	050		R01YA050	YA-050	VFD-05 FAIL			I-12	VFD-05	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YL	050		R01YL050	YL-050	VFD-05 RUN			I-12	VFD-05	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	HS	050		R01HS050	HS-050	VFD-05 CALL			I-12	VFD-05	DO	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	PI	051		R01PI051	PN-051	PUMP-09 DISCHARGE PRESSURE			I-12	PIT-051	AI	PSI			PRESSURE TRANSMITTER	PUMP STATION
R	01	YA	050	A	R01YA050A	YA-050A	P-09 TEMPERATURE WARNING			I-12	VFD-05	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	050	C	R01YA050C	YA-050C	P-09 TEMPERATURE SHUTDOWN			I-12	VFD-05	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	052		R01YA052	YA-052	CHECK VALVE CV-05 CLOSED			I-12	CV-05	DI	N/A			CHECK VALVE	PUMP STATION
R	01	PI	052		R01PI052	PN-052	PUMP-10 DISCHARGE PRESSURE			I-12	PIT-052	AI	PSI			PRESSURE TRANSMITTER	PUMP STATION
R	01	YA	050	B	R01YA050B	YA-050B	P-10 TEMPERATURE WARNING			I-12	VFD-05	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	050	D	R01YA050D	YA-050D	P-10 TEMPERATURE SHUTDOWN			I-12	VFD-05	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YL	401	A	R01YL401A	YL-401A	SUPPLY FAN SF-01 RUNNING			I-13	SF-01	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YL	401	B	R01YL401B	YL-401B	SUPPLY FAN SF-01 IN REMOTE			I-13	SF-01	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YA	401		R01YA401	YA-401	SUPPLY FAN SF-01 FAULT			I-13	SF-01	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	HS	401		R01HS401	HS-401	SUPPLY FAN SF-01 CALL			I-13	SF-01	DO	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YL	402	A	R01YL402A	YL-402A	SUPPLY FAN SF-02 RUNNING			I-13	SF-02	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YL	402	B	R01YL402B	YL-402B	SUPPLY FAN SF-02 IN REMOTE			I-13	SF-02	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YA	402		R01YA402	YA-402	SUPPLY FAN SF-02 FAULT			I-13	SF-02	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	HS	402		R01HS402	HS-402	SUPPLY FAN SF-02 CALL			I-13	SF-02	DO	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YL	403	A	R01YL403A	YL-403A	SUPPLY FAN SF-03 RUNNING			I-13	SF-03	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YL	403	B	R01YL403B	YL-403B	SUPPLY FAN SF-03 IN REMOTE			I-13	SF-03	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YA	403		R01YA403	YA-403	SUPPLY FAN SF-03 FAULT			I-13	SF-03	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	HS	403		R01HS403	HS-403	SUPPLY FAN SF-03 CALL			I-13	SF-03	DO	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YA	404		R01YA404	YA-404	SUPPLY FAN SF-04 FAULT			I-13	SF-04	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YL	404	A	R01YL404A	YL-404A	SUPPLY FAN SF-04 RUNNING			I-13	SF-04	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YL	404	B	R01YL404B	YL-404B	SUPPLY FAN SF-04 IN REMOTE			I-13	SF-04	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	HS	404		R01HS404	HS-404	SUPPLY FAN SF-04 CALL			I-13	SF-04	DO	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YA	405		R01YA405	YA-405	SUPPLY FAN SF-05 FAULT			I-13	SF-05	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT

FACILIT	ARE	ISA	LOOP	SUFFI	DCS TAG	LOOP NO.	DESCRIPTION	ALARM	FAIL	P&ID	EQUIPMENT	DATA	RANGE	CONTROL	PCM/PLC	EQUIPMENT	AREA
R	01	YL	405	A	R01YL405A	YL-405A	SUPPLY FAN SF-05 RUNNING			I-13	SF-05	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	YL	405	B	R01YL405B	YL-405B	SUPPLY FAN SF-05 IN REMOTE			I-13	SF-05	DI	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	HS	405		R01HS405	HS-405	SUPPLY FAN SF-05 CALL			I-13	SF-05	DO	N/A			SUPPLY FAN	ODOR CONTROL UNIT
R	01	FI	01		R01FI01	FN-01	SUPPLY FAN SF-01 AIR FLOW			I-13	SF-01	AI	PSI			SUPPLY FAN	ODOR CONTROL UNIT
R	01	FI	02		R01FI02	FN-02	SUPPLY FAN SF-02 AIR FLOW			I-13	SF-02	AI	PSI			SUPPLY FAN	ODOR CONTROL UNIT
R	01	FI	03		R01FI03	FN-03	SUPPLY FAN SF-03 AIR FLOW			I-13	SF-03	AI	PSI			SUPPLY FAN	ODOR CONTROL UNIT
R	01	FI	04		R01FI04	FN-04	SUPPLY FAN SF-04 AIR FLOW			I-13	SF-04	AI	PSI			SUPPLY FAN	ODOR CONTROL UNIT
R	01	FI	05		R01FI05	FN-05	SUPPLY FAN SF-05 AIR FLOW			I-13	SF-05	AI	PSI			SUPPLY FAN	ODOR CONTROL UNIT
R	01	HS	411		R01HS411	HS-411	EXHAUST FAN EF-01 CALL			I-14	EF-01	DO	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YA	411		R01YA411	YA-411	EXHAUST FAN EF-01 FAULT			I-14	EF-01	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YL	411	A	R01YL411A	YL-411A	EXHAUST FAN EF-01 RUNNING			I-14	EF-01	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YL	411	B	R01YL411B	YL-411B	EXHAUST FAN EF-01 IN REMOTE			I-14	EF-01	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	HS	412		R01HS412	HS-412	EXHAUST FAN EF-02 CALL			I-14	EF-02	DO	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YA	412		R01YA412	YA-412	EXHAUST FAN EF-02 FAULT			I-14	EF-02	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YL	412	A	R01YL412A	YL-412A	EXHAUST FAN EF-02 RUNNING			I-14	EF-02	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YL	412	B	R01YL412B	YL-412B	EXHAUST FAN EF-02 IN REMOTE			I-14	EF-02	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	HS	413		R01HS413	HS-413	EXHAUST FAN EF-03 CALL			I-14	EF-03	DO	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YA	413		R01YA413	YA-413	EXHAUST FAN EF-03 FAULT			I-14	EF-03	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YL	413	A	R01YL413A	YL-413A	EXHAUST FAN EF-03 RUNNING			I-14	EF-03	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YL	413	B	R01YL413B	YL-413B	EXHAUST FAN EF-03 IN REMOTE			I-14	EF-03	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	HS	414		R01HS414	HS-414	EXHAUST FAN EF-04 CALL			I-14	EF-04	DO	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YA	414		R01YA414	YA-414	EXHAUST FAN EF-04 FAULT			I-14	EF-04	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YL	414	A	R01YL414A	YL-414A	EXHAUST FAN EF-04 RUNNING			I-14	EF-04	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YL	414	B	R01YL414B	YL-414B	EXHAUST FAN EF-04 IN REMOTE			I-14	EF-04	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	HS	415		R01HS415	HS-415	EXHAUST FAN EF-05 CALL			I-14	EF-05	DO	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YA	415		R01YA415	YA-415	EXHAUST FAN EF-05 FAULT			I-14	EF-05	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YL	415	A	R01YL415A	YL-415A	EXHAUST FAN EF-05 RUNNING			I-14	EF-05	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YL	415	B	R01YL415B	YL-415B	EXHAUST FAN EF-05 IN REMOTE			I-14	EF-05	DI	N/A			EXHAUST FAN	ODOR CONTROL UNIT
R	01	FI	11		R01FI11	FN-11	EXHAUST FAN EF-01 AIR FLOW			I-14	EF-01	AI	PSI			EXHAUST FAN	ODOR CONTROL UNIT
R	01	FI	12		R01FI12	FN-12	EXHAUST FAN EF-02 AIR FLOW			I-14	EF-02	AI	PSI			EXHAUST FAN	ODOR CONTROL UNIT
R	01	FI	13		R01FI13	FN-13	EXHAUST FAN EF-03 AIR FLOW			I-14	EF-03	AI	PSI			EXHAUST FAN	ODOR CONTROL UNIT
R	01	FI	14		R01FI14	FN-14	EXHAUST FAN EF-04 AIR FLOW			I-14	EF-04	AI	PSI			EXHAUST FAN	ODOR CONTROL UNIT
R	01	FI	15		R01FI15	FN-15	EXHAUST FAN EF-05 AIR FLOW			I-14	EF-05	AI	PSI			EXHAUST FAN	ODOR CONTROL UNIT
R	01	YA	701	A	R01YA701A	YA-701A	LP-UPS-1 FAIL			I-15	LP-UPS-01	DI	N/A			UPS	ELECTRICAL ROOM
R	01	YA	701	B	R01YA701B	YA-701B	LP-UPS-1 ON BATTERY			I-15	LP-UPS-01	DI	N/A			UPS	ELECTRICAL ROOM
R	01	YA	702	A	R01YA702A	YA-702A	LP-UPS-2 FAIL			I-15	LP-UPS-02	DI	N/A			UPS	ELECTRICAL ROOM
R	01	YA	702	B	R01YA702B	YA-702B	LP-UPS-2 ON BATTERY			I-15	LP-UPS-02	DI	N/A			UPS	ELECTRICAL ROOM
R	01	YA	703	A	R01YA703A	YA-703A	LP-UPS-3 FAIL			I-15	LP-UPS-03	DI	N/A			UPS	ELECTRICAL ROOM
R	01	YA	703	B	R01YA703B	YA-703B	LP-UPS-3 ON BATTERY			I-15	LP-UPS-03	DI	N/A			UPS	ELECTRICAL ROOM
R	01	YA	801	A	R01YA801A	YA-801A	VFD-01 BREAKER OPEN			I-15	VFD-01	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	801	B	R01YA801B	YA-801B	VFD-01 BREAKER CLOSE			I-15	VFD-01	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	HS	801		R01HS801	HS-801	VFD-01 BREAKER OPEN/CLOSE			I-15	VFD-01	DO	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	802	A	R01YA802A	YA-802A	VFD-02 BREAKER OPEN			I-15	VFD-02	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	802	B	R01YA802B	YA-802B	VFD-02 BREAKER CLOSE			I-15	VFD-02	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	HS	802		R01HS802	HS-802	VFD-02 BREAKER OPEN/CLOSE			I-15	VFD-02	DO	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	803	A	R01YA803A	YA-803A	VFD-03 BREAKER OPEN			I-15	VFD-03	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	803	B	R01YA803B	YA-803B	VFD-03 BREAKER CLOSE			I-15	VFD-03	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	HS	803		R01HS803	HS-803	VFD-03 BREAKER OPEN/CLOSE			I-15	VFD-03	DO	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	804	A	R01YA804A	YA-804A	VFD-04 BREAKER OPEN			I-15	VFD-04	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	804	B	R01YA804B	YA-804B	VFD-04 BREAKER CLOSE			I-15	VFD-04	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	HS	804		R01HS804	HS-804	VFD-04 BREAKER OPEN/CLOSE			I-15	VFD-04	DO	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	805	A	R01YA805A	YA-805A	VFD-05 BREAKER OPEN			I-15	VFD-05	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	805	B	R01YA805B	YA-805B	VFD-05 BREAKER CLOSE			I-15	VFD-05	DI	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	HS	805		R01HS805	HS-805	VFD-05 BREAKER OPEN/CLOSE			I-15	VFD-05	DO	N/A			VARIABLE FREQUENCY	ELECTRICAL ROOM
R	01	YA	806	A	R01YA806A	YA-806A	SFG-01 A-SIDE BREAKER OPEN			I-15	SFG-01	DI	N/A			SWITCHGEAR	ELECTRICAL ROOM
R	01	YA	806	B	R01YA806B	YA-806B	SFG-01 A-SIDE BREAKER CLOSE			I-15	SFG-01	DI	N/A			SWITCHGEAR	ELECTRICAL ROOM
R	01	HS	806		R01HS806	HS-806	SFG-01 A-SIDE BREAKER OPEN/CLOSE			I-15	SFG-01	DO	N/A			SWITCHGEAR	ELECTRICAL ROOM

FACILIT	ARE	ISA	LOOP	SUFFI	DCS TAG	LOOP NO.	DESCRIPTION	ALARM	FAIL	P&ID	EQUIPMENT	DATA	RANGE	CONTROL	PCM/PLC	EQUIPMENT	AREA
R	01	YA	807	A	R01YA807A	YA-807A	SFG-01 B-SIDE BREAKER OPEN			I-15	SFG-01	DI	N/A			SWITCHGEAR	ELECTRICAL ROOM
R	01	YA	807	B	R01YA807B	YA-807B	SFG-01 B-SIDE BREAKER CLOSE			I-15	SFG-01	DI	N/A			SWITCHGEAR	ELECTRICAL ROOM
R	01	HS	807		R01HS807	HS-807	SFG-01 B-SIDE BREAKER OPEN/CLOSE			I-15	SFG-01	DO	N/A			SWITCHGEAR	ELECTRICAL ROOM
R	01	YA	808	A	R01YA808A	YA-808A	SFG-01 SWITCHGEAR BREAKER OPEN			I-15	SFG-01	DI	N/A			SWITCHGEAR	ELECTRICAL ROOM
R	01	YA	808	B	R01YA808B	YA-808B	SFG-01 SWITCHGEAR BREAKER CLOSE			I-15	SFG-01	DI	N/A			SWITCHGEAR	ELECTRICAL ROOM
R	01	HS	808		R01HS808	HS-808	SFG-01 SWITCHGEAR BREAKER OPEN/CLOSE			I-15	SFG-01	DO	N/A			SWITCHGEAR	ELECTRICAL ROOM

SECTION 40 94 33
WORKSTATIONS (WS) - PRODUCTS

PART 1 GENERAL

1.1 REQUIREMENT

A. The DCSP is responsible for furnishing several types of workstations that will be used in the operation of the Distributed Control System (DCS).

B. The categories of acceptable workstations include the following:

1. Workstation (WS), generic workstation type that includes all workstations.
2. Operator Workstation (OWS), desktop type.

C. The DCSP is responsible for meeting the requirements for each type of workstation, which are specified in this section. Workstations shall be the standard product of the DCSP and shall be fully compatible with, and integrate onto the existing Enterprise wide COMNET DCS.

1.2 RELATED SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

1.3 SUBMITTALS

A. The DCSP shall submit technical submittals in accordance with Section 01 33 00, Submittal Procedures.

B. The DCSP shall submit a detailed listing of each type, quantity, and location of the workstations required to complete the Work, as shown on the drawings and specified within this section.

1.4 CODES AND REGULATORY REQUIREMENTS

A. Workstations shall conform to the following standards:

1. Military Standards (Military Standard 810E).
2. American National Standards Institute (ANSI).
3. IEEE-754, Standard for Floating Point Arithmetic.
4. IEEE-802.3, Carrier Sense Multiple Access with Collision Detection (CSMA/CD) (Ethernet).
5. IEEE 802.3z, Gigabit/s Ethernet Operation.
6. IEEE 802.3ae, 10 Gigabit/s Ethernet Operation.
7. IEEE 802.3af, Data Terminal Equipment (DTE) Power via MDI.
8. RFC 791 (1981), Internet Protocol (IP).
9. RFC 793 (1981), Transmission Control Protocol (TCP).

1.5 DEFINITIONS

A. Definitions of acronyms are identified in Section 40 90 05, Definitions.

PART 2 PRODUCTS

2.1 WORKSTATIONS (WS)

A. All workstations shall be the standard offering of Emerson Process Management (EPM) and shall be fully compatible with the Ovation DCS family line. All Workstations shall match existing, or the current City COMNET standard in place at the time of this Project. All Workstations shall be compatible with and seamlessly integrate onto the existing Enterprise wide COMNET DCS.

B. All workstations shall be the most current product that is compatible with the City's Ovation DCS.

C. Minimum General Requirements:

1. The standard WS dictionary shall be U.S. English.
2. Each WS platform shall feature graphics, multitasking with preemptive priority scheduling, virtual memory to enable concurrent processing without degradation of response times required for critical tasks, and networking capabilities that enable the workstations to run sophisticated applications and bridge the gap between various MIS functions and the process.
3. Workstations shall function as a process monitoring/control and system configuration device.
4. Workstations shall present a windowed, high resolution, color-graphic interface to the operator in the depiction of present and past values of process.

5. Workstations shall be configured for multiple concurrent displays.
6. Workstation-devices shall be dual ported to the DCSLAN to provide the operations staff with an object oriented advanced Graphical User Interface (GUI) used to monitor and intervene in the control of process areas.
7. All WS shall be standard Microsoft Windows workstation devices
8. All Desktop Workstations shall be the same hardware family and contain the same software revisions.
9. All non-portable WS shall be provided with UPS power. UPS power circuits shall be provided by others, under Division 26.

D. Operator Workstations (OWS):

1. OWS General Requirements:
   a. All WS shall be designed to function as a workstation for operations, maintenance, and other staff. The WS interface shall operate in both fill-in-the blanks wizard like mode wherein the user interacts through an interactive prompt and response sequence and graphics/CAD-like mode wherein the user implements and uses control logic and graphics thru the use of a series of graphical interfaces. The CAD-like graphical interface shall also permit the user to diagnose, simulate, and debug control logic by displaying current process values/logic states and calculated outputs.
      1) Each WS shall be configured to be universal in scope (e.g. has access to all system displays and data.)
      2) Each WS shall have a password security authentication to prevent the unauthorized access of system configuration activities.
      3) The security system shall limit or allow access to some or all of the process plant(s) and functionality using role-based authorization.
      4) The Operator shall be provided with a means of interacting with the various displays which assist monitoring (overviews), permit control intervention (groups), provide parameter review and adjustment (detail), are historical (archiving) and assist the Operator in diagnostics (alarms, schematics, menus) and prediction (using graphical trending or archived data points.)
      5) All screen selections shall be based on intuitive "picking" of display objects and menus on the screen. A common menu bar structure with pull-down menus shall be presented at the top of all displays to enable fast access amongst available WS functions. Multiple windows with icons shall also be available. Content of the menus shall form the display hierarchy.

6) The Operator shall interact with these displays, order changes in values, and modify configurations in a human- machine conversational mode via the following:
   a) Soft-desk interface (track ball/mouse, a full ASCII-QWERTY keyboard).
   b) Hard-desk interface (arranged by work cell (trackball, specialized keys, and keyboard layout for navigation and control action).
7) The entry device shall be integrated with the human- machine design structure to enable a minimum number of key strokes in common operations such as "Alarm Acknowledge" and "On/Off", "Fast/Slow" manipulations.
8) Long strings of alphanumeric codes or command line entries via buttons are unacceptable for process operating procedures.
9) In operations mode, all process graphic displays shall reside in non-volatile storage media resident in each WS and be updated in accordance with the display response time requirements specified herein.
10) All process graphics shall utilize advanced graphic features such as isometric representation of process equipment, tanks, and flow lines; line-fills which use the dynamic movement of color and patterns to indicate the current process flow routing in pipelines or channels; permissive dialog boxes which itemize all of the per missives, and their current state, associated with control strategies related to the currently displayed process graphic.
11) The graphic display hierarchy shall follow DCSP's graphic standards and library
12) Each WS shall be configured with displays arranged in a hierarchical manner which enable rapid movement between various levels via paging or other logic oriented functions. The hierarchy shall apply to both process and system oriented displays.
13) Additional graphical requirements and symbols shall conform to ISA 5.5 Graphic Symbols for Process Display.
14) Each WS shall have its own Real-Time Data Base (RTDB) that reflects the current state of all process variables.
15) All real-time process data shall be resident in the WS.

b. WS Tools Platforms (TP):
   1) The TP shall extend the functionality of the multitasking OS by providing application tools or extensions of the OS platform.
   2) The TP shall provide software to support:

a) User-operating system interface (shells) to allow the user to manipulate files and run application programs in a concurrent manner.
b) Database Management Systems (DBMS) which employ Structured Query Language (SQL) interface to a relational database.
c) Multimedia input/output to mass storage and image input/output i.e., optical disks using mapped files and special storage device drivers incorporated into the OS platform.

3) The display software furnished shall enable any WS to interact with any and all of the real-time plant, field, and process data that is provided in the system. Areas of operational access or "modes" for the WS shall be changeable on-line and shall be pre-configured by using a password mode configurator.
4) The WS shall support either single-screen or multiple-screen operation, as required by the design drawings and specification for each facility.
5) Multiple displays shall operate in a coordinated arrangement. As a minimum, multi-screen WS software shall provide the following:
   a) Direct input devices such as a mouse, trackball, or keyboard to operate with multiple screens. The monitoring and control actions shall be associated with the screen to which focus is applied via the pointing device or keyboard.
   b) Enable/disable input devices on-line.
   c) Redirect displays from one screen in the cluster to another and toggle any screen between multi-screen and single- screen mode.
   d) Call up multiple displays simultaneously with a single request.
   e) Determine on-line those screens that are to be allocated to multi-screen use.
6) Microsoft Windows and menus shall be used for the Graphical User Interface (GUI) to provide an intuitive windows mode. Windowing shall take advantage of the multi-tasking operating system capability. It shall allow a task to begin in one window while continuing work in another. It shall also allow a single interface within the system. As a minimum, the following applications that concurrently appear in its own window shall be:
   a) Network Manager
   b) Display Manager

c) Data Acquisition and Control Configurator
d) Report Configurator
e) Historian Configurator
f) Operator Message Interface
g) Trending
h) Spreadsheet
i) Virtual Terminal Mode
j) Help Functions

7) The following standards shall apply to maximize the interoperability and connectivity of the system and to provide object code compatibility between all hardware platforms used on this project:
   a) Floating point processor shall comply with IEEE-754.
   b) Network communications shall comply with IEEE-802.3/802.4.
   c) Compatible with network protocols TCP/IP.
8) WS devices shall also be dual ported to the DCSLAN, which provides an interface into all DCSLAN connected devices. This interconnectivity shall enable all WS, independent of their physical locations, to access all information which is available to another WS. All WS functionality shall be regulated by password authorization.
9) A collection of pre-built (preformatted) display fields that show lines (trends) representing changing data values from the real-time database and from the historical database shall be provided.
   a) The Trend Subsystem shall be able to trend any variable in the data base, both analog and discrete.
   b) The maximum number of trends shall be limited only by the display storage media capacity.
   c) Each trend line shall be capable of at least 900 samples of the process variable.
   d) Historical trend data shall be capable of being archived to hard drive, USB thumb drive, or CDRW to be displayed at any future date.
   e) Trends shall represent changing data values from the real- time database and from the historical database.
   f) Trends shall be configured on-line with the display configurator, and shall be laid out using the group display configurator.
   g) The on-line trend configurator shall be selectable from a Detail display, to allow change of trend area attributes and trend line attributes without disrupting the process.

h) A library of standard trend areas, X/Y plot areas, and profile plot areas which can be copied into any display shall be furnished. The trend areas shall vary in size (resolution) and shall be of two types: real-time and historical. The X/Y and profile plot areas shall also vary in size. The display builder and display configurator software shall include these areas in user-defined displays, and the display configurator shall be used to assign the desired configurable options. Trend areas to include as a minimum:

(1) Up to eight trend lines per trend area representing variable data types (Boolean, signed integer, real, and signed long integer).
(2) Tick marks indicating division of the axis.
(3) Time axis length shall be chosen freely.
(4) Y-axis scaling shall be independent of its length.
(5) Off-normal limits shall be available in different colors.
(6) Background color of a trend area shall be changeable.
(7) Trend line color shall be changeable per trend line.
(8) Solid trend shall be drawn instead of a line trend.
(9) X-Y trend objects (one variable versus another.)
(10) Reassignment to any process variable in the system.
(11) Text fields shall be defined and configured:
    (a) Loop Tag
    (b) Loop Descriptor
    (c) Any parameter engineering unit
    (d) Engineering Unit Descriptor
    (e) Scroll frequency for an entire trend area (limited to real-time trend objects)
    (f) Per-trend variable:
        - High range value
        - Low range value
        - Value at ruler (for direct readout)
        - Off-normal limits

i) Real-time trend areas shall scroll dynamically as data changes occur according to the selected scroll frequency (e.g., 1, 2, 5, 10, 30, 60 seconds).

j) Scrolling and updating of real-time trends start immediately after calling up the display.

k) Real time trends shall be capable of collecting and displaying all 1 second samples without averaging or compression.

l) Historical trend areas shall provide purely historized data from the historical database files, which shall include sample data and reduction group data; archived sample group data and archive reduction group data; restored archive sample group and archive reduction group data

m) Historical trend variables shall incorporate any data reduction and archiving functions thereof. On-line Historical Trend Area interactions shall include:

(1) Selection of parameters to be viewed from the Historian database

(2) Specification of the high and low scale of the Y-axis for each variable for more or less detail

(3) User definition of the time window (base time and/or time span) specified by the time axis in order to view another portion of the history or to view a portion in more or less detail.

(4) Use of a moveable ruler to position and numerically read out historical variables within a displayed time window

(5) Specification of off-normal limits

(6) Zero axis readings.

10) The X/Y plots shall contain two variables which are plotted against each other.

11) These variables shall be real-time data taken from object manager-connectable variables within the system or a file of X/Y pairs.

12) The data points shall be collected at a configured scan rate and displayed as a series of points or markers that can be connected.

13) Color shall be used to designate the latest X/Y pair and previously plotted points.

14) Via the use of colors, file data shall be visually compared to recent real-time data. Plots shall include as a minimum:

a) Background color of X/Y plot shall be changeable.

b) Objects shall be capable of being added to the background area.

c) Style selection of real-time and file plot data

d) Standard grid

e) Multiple colors for representing the most recent data point, real data, and file data.

15) The X/Y plot line attributes for each variable shall include: high scale value, low scale value, and delta change value (for

real-time data). Default values for these attributes shall be accessed directly.

16) The profile plot area shall display data accessed from a data array of the following type of data: float, long, integer, or byte.
17) The plot shall display each data point along the X-axis with the value of each point associated with the Y-axis.
18) The profile line shall include: high and low scale values, high and low alarm values, the start and end offset for the data array, and the location to which a selected point value is to be sent.
19) The profile style shall be either line profile or bar profile and updates occur simultaneously or by exception.
20) The Plot shall include as a minimum:
    a) Up to four lines of bar lines per plot area.
    b) A reference line representing the median value for each line
    c) Line color specified per lot line under normal conditions
    d) Off-normal limits specified in a different color
    e) Reference line color
    f) Lines or bar lines shall be mirrored along the Y-axis

c. Automatically Generated Displays:
    1) Automatically generated displays shall be fully operational displays, which are presented in three levels of control hierarchy:
        a) Station display: A station algorithm shall convey information about the system capacity parameters for a Process Control Module type station. This algorithm shall be installed automatically when the database is downloaded, and provides global data storage for system functions. Information displayed includes: percent of CPU time used for processing input/output, all algorithms and continuous control algorithms; free memory available; Object Manager scanner data; cumulative algorithm processor overruns; total DPU connections; and peer-to-peer point connection status.
        b) Control strategy and algorithm overview display: To access a control scheme without configuring displays, the operator shall be able to request the Control strategy and Algorithm Overview display. The current level of criticality (the highest priority alarm that exists in any algorithm within the control strategy) and relevant data shall be displayed for each control strategy and algorithm. All alarm information displayed or set by Default Displays shall be received from or sent to

Processors. This includes the acknowledged and/or unacknowledged status of the alarms. Displays for individual control strategies shall be accessed from the compound and algorithm overview display. Control strategy displays shall be live displays that allow interaction with all algorithms within a single control strategy. Control strategies from several processors shall be grouped and turned on or off as a group.

(1) Detail display: Detail displays for individual algorithms shall be accessible from the Control strategy and Algorithm Overview, Alarm History and Current Alarm displays. Detail displays shall allow operator manipulation of all valid algorithm parameters. They shall show all connectable algorithm parameters, a faceplate area and a real-time trend area (for continuous control algorithms). In graphic format and in a small area, faceplates shall provide information as to algorithm type and description; measurement, setpoint, output values; algorithm state and status; alarm condition; auto/manual and remote/local designation.

2) Preformatted Displays:

a) Preformatted displays provided shall be modified or new ones created through a menu-driven configuration and editing process.

b) Preformatted displays shall be linked to each other and to graphics to form a user-defined display hierarchy.

c) The group display shall present information for up to eight control algorithms in a four-over-four screen layout. It shall show each algorithm as a faceplate with a unique layout available for each algorithm type.

d) The display shall contain faceplates, trends, or X/Y plots or a combination of all three. The display builder and display configurator shall be used to edit displays.

e) Sequence algorithms shall be intermingled with Continuous algorithms n the group display when required. All control algorithm types/domains shall be supported. Group display interactions shall be performed with screen functions keys. Interactions to include as a minimum:

(1) Control and alarm monitoring of algorithms.

(2) Ramping or numeric entry of set points, ratios, targets, outputs, etc.

(3) Toggling discrete values and controller states.

(4) Requesting the Detail display for a selected algorithm.

(5) Direct access to the previous display.

3) Invoking Default Displays:

a) Default displays, preformatted displays, and user-defined displays must all be invoked in an identical manner.

b) Any specific pre-defined display shall be assigned to and called from any menu, attached to a hard annunciator key or soft (screen) key, called via an application program, or attached to an active display object with a display.

2.

E. WS Hardware Component Platform:

1. All hardware platforms which comprise the DCS shall exhibit object code compatibility in that the same object code can be executed on all hardware platform implementations without the need to recompile, relink, or change formats.

PART 3- EXECUTION (NOT USED)

END OF SECTION

SECTION 40 94 34
PRINTERS AND SCANNERS

PART 1 – GENERAL

1.1 REQUIREMENT

A. The DCSP is responsible for furnishing several types of printers and scanners that will be used in the operation of the DCS.

B. The categories of printers include the following:
1. Color Laser Printer (CP), desktop type
2. Black & White Laser Printer (BWP), desktop type
3. Color Scanner w/Printer (SCAN), desktop type
4. Multi-function Network Printer, floor standing type

C. The DCSP is responsible for meeting the requirements for each type of printer, which are specified in this section. As printer technology changes rapidly, the DCSP shall utilize printers that are (A) Current Generation and technology and (B) are of a brand and model used by the City of San Diego COMNET DCS

1.2 APPLICABLE SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego

1.3 RELATED SECTIONS

A. The location and quantities of printers are detailed in the design drawings and various specification sections within Division 40.

1.4 SUBMITTALS

A. The DCSP shall provide Submittals in accordance with Specification 01 33 00, Submittal Procedures.

1.5 SCOPE OF WORK

A. The DCSP shall furnish, install, and test laser color, black and white and multi-function where shown in the design drawings and contained in these specifications.

1.6 SPECIFICATION, CODES AND STANDARDS

A. The WORK shall comply with the current editions of the publication and codes identified in Section 40 90 04, References.

1.7 DEFINITIONS

A. Definitions of acronyms are identified in Section 40 90 05, Definitions.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The DCSP shall furnish and install printers which are "network ready", with a pre-installed network interface card to allow easy connection to an Ethernet-based local area network. Include any related network printer management utilities.

B. The network interface card supplied shall be compatible with the operating system which is used for the operator workstations.

C. The DCSP shall furnish and install any additional hardware and software necessary to allow graphic printouts from the OWS, EWS, Laptops, and IWS.

D. The DCSP shall furnish and install cables and any other required devices to connect the printer to an Ethernet-based local area network.

2.2 ACCEPTABLE PRODUCTS

A. The DCSP shall ensure that the printers selected are fully compatible with the existing Enterprise wide COMNET DCS.

B. Prior to selecting and submitting on printers, the DCSP shall determine if the City has a COMNET standard printer manufacturer at the time of Project

contract. If a current standard exists, the DCSP shall utilize the City's standard manufacturer.

C. If no City COMNET standard for printers exists at the time of Project Contract, the DCSP shall provide products manufactured by either Hewlett Packard or RICOH.

PART 3 – EXECUTION

3.1 RESPONSIBILITIES OF THE DCSP

A. The DCSP shall furnish, install, and test the required number of printers as shown on the design drawings as required in these specifications.

B. Prior to startup, the DCSP shall deliver spare parts and service manuals for all printers provided.
   1. Network IP address will be provided by City.

C. The DCSP shall follow manufacturer recommended procedures for installation and startup.

D. The DCSP shall coordinate the installation and interfacing requirements among all items installed.

E. The DCSP shall maintain printers, including consumables (ink cartridges) for the duration of the Warranty Period as specified in the Project Prime Contract.

END OF SECTION

SECTION 40 94 43
PROGRAMMABLE LOGIC CONTROLLER SYSTEM

PART 1 - GENERAL

1.1 GENERAL:

A. Function: Used for process monitoring and control, by emulating functions of conventional panel mounted equipment such as relays, timers, counters, current switches, calculation modules, PID controllers, stepping switches, and drum programmers.

B. Programmable Logic Controller based systems are typically used in wastewater collection, pumping stations, Package Systems provided by equipment vendor.

C. DCSP shall provide integration services to integrate all PLCs used in the project. The integration services include but are not limited to the following:
   1. Lead all integration activities such as coordination meetings, joint testing and site commissioning etc.
   2. Provide information necessary for PLC configuration such as IP, port assignment, and others.
   3. Define data exchange requirements between PLC and DCS, and send the requirements to Package Systems vendor.
   4. Establish and test communication between PLC and DCS.
   5. Map PLC data into DCS database.
   6. Create and monitor diagnostic info of the communication between PLC and DCS.

1.2 APPLICABLE SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

   1. Division 1 – General Requirements
   2. Specification 01 33 00 – Submittal Procedures
   3. Division 26 – Electrical
   4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

1.3 SUBMITTALS

A. PLC Component Data: all submittals shall be in accordance with Sections 01 33 00, Submittal Procedures.

B. PLC Design: In addition to the submittal requirements, the DCSP shall provide all layout and shop drawings, including the following:
   1. Panel layout, including fully dimensioned and detailed external spatial views and internal layout
   2. Electrical schematics, including, new panel wiring, instrument wiring and power and grounding
   3. Layout of relays, breakers, switches and instrumentation provided, and applicable single line and wiring diagrams
   4. I/O Card Placement and layout
   5. Enclosures, including all associated hardware devices
   6. Detailed description and associated diagrams of all software components and firmware of the PLC

C. Operations and Maintenance Manuals: PLC O&M manual shall be provided as part of its Package Systems in accordance with applicable sections.

1.4 COORDINATION AND PROGRESS MEETING:

A. DCSP shall be responsible for the scheduling of meetings/workshops with parties that supplied Package Systems to coordinate the PLC integration and complete PLC integration into DCS system.

B. The purpose of the meetings shall be to review the requirements of data exchange, define data mapping between PLC and DCS and testing.

C. Representatives at the meetings shall have the competence and authority to make any and all necessary decisions.

PART 2- PRODUCT

2.1 TYPE:

A. PLC shall be Allen Bradley Logix family including ControlLogix, CompactLogix to match existing City standard.

B. PLC shall be capable to communicate with Emerson Ovation DCS system directly over Ethernet using Ethernet/IP protocol.

2.2 PARTS:

A. The PLC based systems shall include, as a minimum: Central processing unit (CPU), power supplies, input/output modules, controllers, I/O bases (chassis/rack), and factory assembled interconnecting cables. Provide all components required to make a complete and operational system.

B. PLC system shall include the following as a minimum:

1. CPU: Latest version of AB Logix family with appropriate Memory size. Provide redundancy CPUs if required by the contract document.
2. Power supply module: Shall use the latest version, 120 V ac, 60-Hz or 24 V dc. Provide redundant power supply module if required by the contract document.
3. Input/Output:

Discrete Input Modules:

a. Voltage: 120 V ac, 60-Hz or 24 V dc
b. Operating Power: 2 watts
c. Points per Module: 16 maximum
d. LED status indicator for each point
e. Isolation: Between input point and PLC, 1,500 volts rms.

Discrete Output Modules:

a. Voltage: 120 V ac, 60-Hz or 24 V dc
b. Operating Power: 2 watts
c. Load Rating: 2 amps continuous
d. Isolation: Between PLC and output point, 1,500 volts rms.
e. Points per Module: 16 maximum
f. LED status indicator for each point

Isolated Discrete Output Modules:

a. Type: Isolated Form C relay
b. Voltage: 120 V ac, 60-Hz or 24 V dc.
c. Isolated Outputs per Module: 8
d. Load Rating: 5 amps continuous.
e. Operating Power: 2.5 watts
f. Points Per Module: 8 maximum.
g. LED status indicator and fuse for each point.
h. Isolation: Between PLC and output point, 1,500 volts rms.

Analog Input/Output Modules:

a. Voltage: 4 – 20 ma and 1 – 5 volts.
b. Power: 3 watts
c. Differential Analog Points Per Module: 8 maximum.
d. Isolated Analog Output Points Per Module: 8 maximum
e. Isolation: Between PLC and I/O point and between I/O points, 1,500 volts rms
f. Input modules shall be HART.

Pulse Input Modules:

a. Input Voltage: 5V or 12-24V (user selectable)
b. Input Current: 7 mA at 5V; 7.0 to 1.5 mA at 12-24V
c. Points per Module: 4, maximum
d. Maximum Input Frequency: 100 KHz in counter mode
e. Maximum Count Value: 0-999,999 (programmable)

4. Communication Network module:
   a. Latest version of Ethernet Network module from AB Logix family product line for Ethernet/IP protocol.
5. Interface Products:
   a. Provide any hardware, such as interfacing cables required for accessing/programming/modifying logic or I/O configuration.
6. PLC Programming:
   1)
   b. Application program: Provide final PLC application program at the end of the project to the City. If it is password protected, the password shall be provided. Provide complete annotated soft copies of the developed application software complete with I/O assignments and network configurations.
   c. Application program shall be programmed based on City's standard using IEC 1131-3 standard languages including FB, Ladder logic, structured text and sequential flow chart.
7. Spare Parts:
   a. CPU: one (1)
   b. Power supply: three (3)
   c. Communication/network module: one (1)
   d. Spare I/O Cards Installed in I/O racks: For each type of I/O card, quantity = ten (10) percent of each type and size used, minimum one (1) each.
   e. Spare I/O Cards Provided Loose (Shelf Spares): For each type of I/O card, quantity = ten (10) percent of each type and size used, minimum one (1) each.
   f. Data Highway Card: One (1)
   g. I/O Rack: One (1)

C. Controller: The controller shall have its control strategies programmed in a "ladder logic" language. It shall be easily reprogrammed with a laptop computer as specified below. The PLC system shall be programmed by the Contractor to perform the specified control strategies and monitoring functions. Two documented copies, in hardcopy and electronic format, of the operating PLC program(s) shall be furnished to the Owner which shall allow direct, step-by-step, reloading of the PLC system program(s). The ladder logic shall reflect equipment name designations used in the PLC as well as the Contract Drawing equipment name designations (i.e., timer "Q" in the Contract Drawing may become timer OL in PLC program).

D. Communications: If the PLC is required to interface with the DCS via a datalink, is shall be done so by an Ethernet IP link. The serial link type used shall be determined by distances. The PLC system shall be provided with all appurtenances to support this requirement. The communications protocol shall be MODBUS with the PLC configured in a slave mode. The DCS will operate in the master mode.

E. PLC Control System Software: This Section covers the furnishing of standard and customized software, fully installed and fully configured in the control systems specified herein. It is the intent of this specification to have the PLC System Supplier furnish his latest generation, standard, field proven, fully debugged and supported software package for this application with a minimum of additions or changes. Customized or specially written software shall be furnished if required to meet all of the functional requirements specified herein. Any custom applications software required shall be fully integrated into the basic software and shall not require unique command structures. Software specified herein is described in broad, functional categories. The System Supplier shall furnish a complete software package including the functional requirements specified herein along with whatever additional software is required by the supplier for proper and efficient operation of the PLC Control System. All logic developed must be fully annotated with point tag names that match or comply with City standards and DCS I/O. Program subroutines will contain useful descriptions as to the functionality of the logic. Special programming to accommodate other systems will be fully annotated. All points, I/O and internal will have meaningful English Descriptions to identify the purpose of the point. All network paths and IP parameters will be fully identified, all serial connections (if any) will be fully disclosed and identified. No attempt has been made to list all software or list all characteristics of software required by the System Supplier to meet the functional requirements specified herein.

1. General: The software package shall provide a system capable of controlling system level activities and a higher level process control language allowing the operator to monitor and control the process through an interactive human interface. The software environment shall support a multi-programming atmosphere allowing concurrent execution of more than one program in a background/foreground mode or multi-tasking mode.
2. Throughout the execution of all software modules, the operator shall be presented with all of the command or operation choices available at that point in the program using sufficient verbiage or symbols to make the choices self-explanatory and unambiguous. Question and answer or fill-in-the-blank requests shall only be permitted where file names, tag names, or other unique text or numerical information is required.
3. System-level software shall include a real-time operating system, a calendar/time program, a file management program and a system of

diagnostic routines in addition to any compilers, editors, loaders, or assemblers required to support the process control software language.

4. All programs shall be self-configuring, such that they obtain the size and configuration of the system from parameters contained in the various files created during system generation. No parameters related to the hardware configuration shall be hard coded into any of the software.
5. System Level Software: System-level software shall include a complete and unmodified operating system furnished by the System Supplier that provides system-level functions as specified herein. Operating system software shall function automatically without operator intervention, except as required to establish file names and similar information.
6. Operating System Software: The real-time operating system software shall be the standard uncorrupted product of the host computer and shall provide the following minimum functions:
    a. Respond to demands from a program request or to demands from an operator.
    b. Dynamic allocation of the resources available in the system. These resources shall include main memory usage, computation time, peripheral usage, and I/O channel usage.
    c. Allotment of system resources on the basis of task priority levels such that a logical allocation of resources and suitable response times are assured.
    d. Queuing of requests in order of priority if one or more requested resources are unavailable.
    e. Resolution of contending requests for the same resource in accordance with priority.
    f. Service requests for execution of one program by another.
    g. Transfer data between programs as requested.
    h. Management of all information transfers to and from peripheral devices.
    i. Control and recovery from all program fault conditions.
    j. Diagnose and report real-time hardware device errors.
7. Program execution shall be scheduled on a priority basis. A multilevel priority interrupt structure is required. A program interrupted by a higher priority program shall be entered into a list of pending programs. Its execution shall be resumed once it becomes the currently highest priority program. Initiation of programs shall, as a minimum, be activated in the following ways:
    a. In response to external interrupts.
    b. At a scheduled time of the day.
    c. On an elapsed-time interval basis.
    d. On request by another program.
    e. On request from the data access panel.

8. The system shall allow periodic programs to be scheduled. The allocation of resources to a time scheduled program shall be based on its relative priority and the availability of computer system resources.
9. Start-up and Restart:
    a. Software shall be provided which initializes and brings a computer or any microprocessor based hardware unit from an inactive condition to a state of operational readiness.
    b. Initialization shall include determination of computer system status prior to start- up of initializing operating system software and initializing application software. Initialization shall also include the loading of all memory resident software, initialization of timers, counters, and queues, and initialization of all dynamic database values.
10. Shutdown: The software shall provide an orderly shutdown capability for shutdowns resulting from equipment failure, including computer processor failure, primary power failure, or a manually entered shutdown command. When the loss of primary power is sensed, a high-priority hardware interrupt shall initiate software for an immediate, orderly shutdown. When a shutdown occurs in response to a command or malfunction, the software shall control the affected hardware quickly and automatically to a secure state.
11. Diagnostics:
    a. Diagnostic programs shall be furnished with the software package to detect and isolate hardware problems and assist maintenance personnel in discovering the causes for system failures. The system manufacturer's standard diagnostic routines shall be used as much as possible. Diagnostic software and test programs shall be furnished for each significant component in the system.
    b. Diagnostic routines shall test for power supply, central processing unit, memory, and I/O bus failures as a minimum.
12. Calendar/Time Program: The calendar/time program shall update the second, minute, hour, day, month and year in the operating system and transfer accurate time and date information to all system level and application software. Variations in the number of days in each month and in leap years shall be handled automatically by the program. The operator shall be able to set or correct the time and date from the data access panel, only at the highest security level.

F. Operator Interface:
13. System-level software shall provide for creation and modification of alphanumeric displays, compression of display information for storage, and linking of dynamic files to database variables. Each display screen shall be able to be made up of static and dynamic alphanumeric information. The system shall be furnished with standard displays as specified herein. The system shall be capable of storing and utilizing all standard display formats.

14. Additionally, all display screens shall include a dedicated area that shall display the current time and date, and at least one line for system-level messages.

G. Standard Displays: The operator interface systems shall include at least the following standard, nonconfigurable displays.
   15. Current Alarm Summary: As specified in the alarm processing section of this Document.
   16. System Overview: Displaying the current status of major systems hardware components including the input/output hardware.
   17. Menu Displays: Indicating the various displays and application level choice available to the operator.
   18. Point Displays: Detailed displays in a standard format for all types of points in the system. Any point in the system shall be able to be displayed indicating all parameters associated with the point. Each entry in the display shall be labeled in engineering units.

H. Algorithms: System software shall support the implementation of algorithms for the determinations of control actions and special calculations involving analog and discrete inputs. These algorithms shall be capable of outputting positional or incremental control outputs or providing the product of calculations. The algorithms shall include alarm checks where appropriate. As a minimum, the following types of algorithms shall be provided:
   19. A calculator algorithm which performs functions such as summing several variables, raising to a power, roots, dividing, multiplying, and subtracting.
   20. A switch algorithm which reads the current value from its input address and stored it as the value of its output address. Two types of switches shall be accommodated, two outputs with one input and one output with two inputs.
   21. A 3 mode Proportional-integral-Derivative (PID) controller algorithm, with each of the 3 modes independently adjustable. The algorithm shall support both direct and reverse acting modes.
   22. Algorithms for lead, lag, dead time, and ration compensators.
   23. Algorithms to perform integration and totalization of analog process variables.
   24. Algorithms that drive the set point of a controller shall include provisions for bumpless transfer, which shall be implemented by use of a bias value.
   25. Algorithms shall be implemented and modified in the system at any time through the use of interactive software modules in a manner consistent with other interactive modules and shall not require any direct source of code changes.

I. Alarm Processing:
   26. Alarm processing software shall be provided to recognize and report alarm events and conditions to the Local Control Panel in an organized, unambiguous, clear, and convenient manner. Alarms shall be classified into at least two priority levels and at least two independent classes.

27. Alarm processing software shall generate alarms for the following conditions:
    a. Discrete input or output change of state is defined as an alarm in the control software.
    b. Analog value exceeding alarm limits defined in the control software.
    c. Analog rate of change exceeding limits defined in the control software.
    d. Failure of the PLC processor, mass memory device, process input/output hardware, or other major hardware component.
    e. Alarms shall be generated in each case above at the time of occurrence and at the time the condition returns to normal.

J. Testing: The City's representative shall witness testing of the PLC system. Solid-state logic systems shall be tested as complete assemblies. Testing of individual components or modules shall not be acceptable. The testing shall include a simulated test with the DCS interface to ensure the accurate passing of data between the systems.

K. Training: A manufacturer's representative shall supply two 8 hour days of onsite training for the Owner's personnel. The training shall include but not be restricted to, operation of programming unit, trouble shooting of system hardware and software, and program development.

L. 30 Day Acceptance Test:

28. After startup has been completed, the system shall undergo a 30 day acceptance test. The system must run continuously for 30 consecutive days. During this period, all system functions shall be exercised. Any System interruption and accompanying component, subsystem, or program failure shall be logged for cause of failure, as well as time of occurrence and duration of each failure. A failure shall cause termination of the 30 day acceptance test. When the cause of a failure has been corrected, a new 30 day acceptance test shall be started.
29. Each time the Contractor's technician is required to respond to a system malfunction, he must complete a report which shall include details concerning the nature of the complaint or malfunction and the resulting repair action required and taken.
30. The 30 day acceptance test shall be performed jointly with the DCSP during its 30 day DCS acceptance test.

M. Operations and Maintenance Manuals:

31. The Contractor shall furnish to the Owner five complete sets of operation and maintenance manuals. The manuals shall include date, information drawings, etc., for the system, subsystem, and all components, and shall include names, addresses and telephone numbers of equipment suppliers, representatives and repair facilities.
32. This shall include a complete description of the recommended operating procedures, maintenance procedures, and spare/replacement parts list for equipment items with catalog data, diagrams, and drawings or cuts describing the equipment. Each set shall include full size assembly and

wiring diagrams; drawings showing "as-build" conditions shall be furnished to the Owner.

33. This shall include backup programming on disc or thumb drive, all programming hardware and software (including all software packages must be licensed to the City). All configuration parameters, IP addresses, settings, network paths and gateways, serial port connection parameters, IO tag descriptors (and/or register addresses) will be identified.

PART 3 EXECUTION

3.2 GENERAL

A. Where shown on drawings, or specified, the DCSP shall furnish all materials, tools, equipment, consumables and supplies, hardware, firmware, software, and shall perform all labor required to integrate all PLCs in conjunction with the DCS.

B. The DCSP shall connect all PLCs to a network access point switch associated with the process control area, or nearest physical PCMs approved by the City's representative.

C. DCS shall connect each PLC via Ethernet Link Controller (ELC), as specified in 2.1.D of Section 40 94 23, Process Control Modules.

3.3 TRAINING

A. Training shall be provided in accordance with Section 40 98 06 – TRAINING

3.4 ENCLOSURES: CABINETRY

A. The PLC Field Cabinetry hardware and submittal requirements shall conform to the requirements of Section 40 95 13, Field Cabinetry.

END OF SECTION

SECTION 40 95 13
FIELD CABINETRY

PART 1 -- GENERAL

1.1 GENERAL

A. The DCSP shall provide a complete and operational, turn-key, Distributed Control System (DCS) capable of supporting all process operations for Project as specified in these Contract documents.

B. The DCSP shall furnish all materials, tools, equipment, consumables and supplies and shall perform all labor required to complete the work in this Specification.

C. This section identifies the different types of DCS cabinets to be provided under this Specification, e.g., the Process Control Module (PCM) Cabinet, Remote Input/Output (RIO) Cabinet, Patch Panels, and the Field Termination Cabinets.

1. As the names imply, the PCM cabinet shall house the DCS processors and related equipment, including redundant Power Supplies, electrical protective devices electrical grounding strips and Fiber Optic Patch Panels (specified elsewhere – if DCSPS equipment allows)
2. The RIO cabinet shall house DCS remote I/O modules, applicable redundant Power Supplies and related hardware, electrical grounding strips and electrical protective devices.
3. The PCM or Termination Cabinets shall contain all terminals and related hardware for termination of field inputs and outputs (I/O). This cabinet will provide terminal isolation between Discrete I/O (DI & DO) and Analog I/O (AI & AO) and shall contain all required I/O electrical protective devices for field wiring. The Termination Cabinet, when utilized, will contain screw-type termination (spring-pressure termination is not allowed) for all I/O wiring (including Analog shields) under the screw terminal. All I/O wiring shall be crimped to snap-tight type spade lugs as manufactured by T&B. No alternate is allowed.
4. It is the intent that each PCM and RIO cabinet shall be provided with an associated Termination Cabinet (as needed) to isolate the DCS hardware from the field hardware and to provide orderly single-point termination of all I/O. Direct termination of field wiring to the I/O modules is allowed without the written consent of the City's representative.

D. This section provides specific requirements for each cabinet and includes the design, testing and shipping of the Hardware described herein.

1.2 RELATED SECTION

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 - Submittals
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

1.3 REQUIREMENT

A. The DCSP, as part of their final design, shall be responsible for providing seismic analysis reports for each cabinet for the applicable Seismic Zone, and shall provide all required seismic bracing of cabinets.
   1. The DCSP shall submit six (6) hard copies and one (1) soft copy of all seismic reports to the City's representative prior to beginning any installation of cabinets. Submission shall be made in accordance with Specification 01 33 00, Submittal Procedures.

B. The DCSP shall be responsible for design review of all concrete 'house-keeping pads' required by the cabinets and any other structural modification necessary for installation. In the event the DCSP finds the housekeeping pad design is deficient, he shall immediately notify the City's representative and the Prime Contractor.

1.4 DESIGN CRITERIA

A. Environmental Conditions – Unless otherwise noted, provide cabinets suitable for the following environmental conditions:
   1. Indoor Environment – Process Area:
      a. Temperature: 50 degrees to 120 degrees F.
      b. Relative Humidity: 10 to 60 percent non-condensing.
      c. Enclosure Rating: NEMA 4X, 316 stainless steel
      d. Classification: non-hazardous
   2. Indoor Environment – Electrical / Control Room
      a. Temperature: 50 degrees to 78 degrees F.
      b. Relative Humidity: 10 to 60 percent, non-condensing.
      c. Enclosure Rating: NEMA 12, painted steel
      d. Classification: non-hazardous

3. Outdoor Environment:
    a. Temperature: 20 degrees to 120 degrees F.
    b. Relative Humidity: zero to 95 percent, non-condensing.
    c. Enclosure Rating: NEMA 4X, 316 stainless steel
    d. Classification: non-hazardous
4. Hazardous (classified) Environment:
    a. Temperature: 20 degrees to 120 degrees F.
    b. Relative Humidity: zero to 100 Percent non-condensing
    c. Enclosure Rating: NEMA 7 Class 1 Div I&II, Class A, B, C, or D, 316 stainless steel.
    d. Classification Area: Hazardous

1.5 CODES AND REGULATORY REQUIREMENTS

A. Fabricate and install cabinet and enclosures to the following industrial standards:
1. NEMA Standards Publication ICS6, Enclosures for Industrial Controls and Systems
2. UL 508A, Industrial Control Cabinet and/or CSA Standard C22.2
3. IEC 529, Classification of Degrees of Protection provided by enclosures
4. NFPA 79, Electrical Standards for Industrial Machinery
5. OSHA Standard 1920.147 – The Control of Hazardous Energy (Lockout/Tagout)
6. International Society of Automation (ISA)
7. American Petroleum Institute (API)
8. American National Standards Institute (ANSI)
9. Military Standards (MIL Standards)
10. National Fire Protection Association (NFPA)
11. Institute of Electrical and Electronic Engineers (IEEE)

B. Perform the design, and provide all enclosure work in compliance with the requirement of Underwriters Laboratories (UL) Bulletin 508A.

C. All electrical equipment, components, devices, etc. installed within the cabinet, shall be Underwriters Laboratories (UL) certified.

D. The DCSP shall install cabinets in compliance with requirements of all State and local Codes with respect to clearances and area classifications, and in accordance with seismic requirements.

E. The DCSP shall obtain seismic calculations and mounting details for each cabinet. Seismic calculations and mounting details shall be stamped, on each page of the submittal, by a registered structural engineer in the state of California. Coast for all seismic certifications shall be borne by the DCSP. Seismic calculations and mounting drawings shall be submitted in accordance with Specification 01 33 00, Submittal Procedures. No DCS related cabinet

shall be installed on site until seismic submittals have been returned "Approved".

1.6 DELIVERY, STORAGE, AND HANDLING

A. The DCSP shall provide protection for materials, components and equipment against loss or damage and from the effect of weather while in fabrication and at the approved staging area. Upon deliver to site, the Prime Contractor is responsible for protection of the DCS equipment during construction and installation. Prior to shipment to Project site, the DCSP shall store items in an indoor dry location, inclusive of corrosive-inhibitive vapor capsules in shipping containers, and related equipment as recommended by the capsule manufacturer. Provide a suitable controlled environment in storage areas for items subject to corrosion under damp conditions.

B. Provide protection for cabinets against loss or damage from the effects of weather upon receipt, and a suitable controlled environment for storage of cabinets, while stored in the approved staging area.

1.7 SUBMITTALS

A. The hardware submittal shall be in accordance with Section 01 33 00, Submittal Procedures. The submittal shall be provided in a singular, all-inclusive submittal which shall include but not be limited to:
   1. The DCSP shall provide all submittals in accordance with all requirements of the Specifications and shall submit hardware catalog information and specification sheets with selected model numbers identified.
   2. The DCSP shall provide six (6) hard copies and one (1) soft copy of complete cabinet shop drawings prior to fabrication of cabinets. The DCSP shall not begin cabinet fabrication until City's representative approval is obtained for its design. Details shall include location and dimensions of cabinet cutouts, location of any/all back of cabinet stiffeners and cabinet face to exact scale, terminations with their identification indicated, and the location and size of all equipment and devices to be mounted within and on the cabinet. The allowable conduit entrance area shall also be depicted. All shall be drawn to scale and accurately depict all information in sufficient detail to allow City's representative to determine compliance with the Contract Requirements. Poorly drawn details and/or lack of accuracy shall be grounds for rejection.
   3. Bill of Materials:
      a. Contractor will provide a complete and detailed Bill of Material (BOM) for each field mounted device and assembly as well as cabinet assemblies and sub-assemblies

b. BOM shall include all items within an enclosure. Each BOM shall be delineated by Process segment and on a PCM/RIO unique basis. Incomplete submittals may be rejected without further review.

4. Schematic and Wiring Diagrams:
   a. DCSP will provide six (6) hard copies and one (1) soft copy of all drawings showing both schematic and wiring diagrams for all circuits. Complete details on the circuit interrelationship of all internal, and external, devices associated with each Enclosure shall be submitted first, using schematic control diagrams.
   b. Subsequent to return of this first submittal, the DCSP shall submit six (6) hard copies and one (1) soft copy of all cabinet wiring diagrams. The Diagrams shall be submitted in accordance with Specification 01300 and shall contain:
      1) Component layout drawings (proportional layout), showing numbered terminals on components together with the unique number of the wire to be connected to each terminal.
      2) Wiring diagrams shall show terminal assignments including tagging identifying field primary and final measurement and control devices.
   c. As Constructed Drawings made during the project which differ from the original drawings, and/or the shop drawings shall be documented and shall be submitted to the Prime Contractor as "red-lined Record Drawings".
      1) Record Drawings shall be reviewed by City's representative prior to the acceptance of the project. The DCSP shall respond to all comments on the shop drawings made by City's representative either by making required corrections, or stating why corrections were not possible.
5. Assembly and Construction Drawings:
   a. DCSP shall provide six (6) hard copies and one (1) soft copy of assembly and construction drawings for each DCS enclosure to facilitate field installation: These drawings shall include dimensions, identification of all components, surface preparation, and finish data, nameplates, safety placarding, etc. These drawings also shall include room identification and enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly.
6. Installation, Mounting, and Anchoring Details:
   a. The DCSP shall provide six (6) hard copies and one (1) soft copy of installation, mounting and anchoring details, including housekeep pad size requirements and details, for all components and assemblies to be field-mounted, including conduit connection and entry details. Seismic calculations for the cabinet and mounting details shall be included as specified elsewhere.

7. Uninterruptible Power Supply:
    a. Complete product literature.
    b. Electrical load calculations showing the electrical loads and battery backup time under full loading.
    c. Wiring and connection diagrams
    d. The UPS submittal shall include Modbus Addressing and Network Configuration Data for monitoring the status of the UPS.
8. Calculations for sizing of Cabinetry Uninterruptible Power Supplies and Air Conditioning Units
    a. The DCSP will provide six (6) hard copies and one (1) soft copy of all calculations, as a submittal to determine the requirements for:
        1) Uninterruptible Power Supply Systems (UPS)
        2) Thermal Management System:
            a) DCSP to provide six (6) hard copies and one (1) soft copy (CD/DVD) of submittals depicting calculated heat gain for each PCM, RIO, Termination Cabinet or Local Cabinet which contains electronics. Calculations shall take into account the maximum ambient air temperature anticipated.
                (1) Where DCSP heat gain calculations indicate that cabinet temperatures for PCM, RIO and Termination Cabinets containing electronics cannot be held at or below 75 degrees F, the DCSP shall provide a Thermal Management System for the Cabinet. In the case of Local Cabinets containing electronics, the temperature shall be held 10 degrees F below the maximum temperature rating of the lowest-rated piece of cabinet electronics.
                (2) All Thermal Management Systems provided shall be housed in enclosures of the same material used for its associated electronics cabinet.
                (3) If cabinet-mounted Air Conditioners are used, the DCSP shall provide a means acceptable to the City's representative for disposal of any condensate generated.
                (4) A separate, non-UPS source of power (utility power), fed from an existing Lighting or Power Panel, to feed Thermal Management Systems shall be provided by others under Division 26. Thermal Management Systems utilizing 'Plant Air' shall not be used.

1.8 QUALITY ASSURANCE

A. The DCSP shall achieve product quality assurance by possessing the following:

1. System of traceability of the manufactured unit throughout production and testing in compliance with applicable Standards or other approved Quality Assurance Programs.
2. System of "burn-in" for all components and available supportive documents in compliance with applicable Standards or other approved Quality Assurance Programs.
3. Demonstrated record of prompt positive response to field failures
4. Documented program of failure analysis
5. Proof of compliance with relevant regulations, standards, specifications, and/or codes of the following sources: ISA, API, UL, NEMA, OSHA, ANSI, MIL, NFPA, JIC, IEEE, NEC, ICEA, and any other national state, municipal, and local laws, regulations, and codes.
6. Documented product safety policy relevant to all products intended to be furnished under this Contract.

PART 2 -- PRODUCTS

2.1 GENERAL

A. All cabinets to be located in process areas or outdoors shall be provided with an integral thermostatically controlled Thermal Management Systems as required under Part 1. Indoor cabinets mounted in conditions areas, or conditioned electrical rooms, may contain cleanable/replaceable filters and circulation fans to maintain cabinet temperature.

B. Field I/O wiring shall be terminated in the PCM cabinet, by others, or preferably. Termination in Termination Cabinets adjacent to or integral to, the PCM or RIO Cabinet. For integral configurations, two completely separate compartments must be maintained with individually lockable doors. All internal hardware to the individual cabinets shall be designed as if they were standalone cabinets.

C. Enclosures shall contain only those openings required for cabling and ventilation in accordance with area classification.

D. The cabinets shall be free from waves and other imperfections. Cabinet fronts shall not be recessed at the base. Adjoining cabinet sections shall be accurately shop- fitted to ensure satisfactory assembly in the field.

E. Check with the design drawings to determine where front-only, or front & rear, opening cabinets can be used based on space availability. All equipment and

wiring shall be accessible from the front and rear of the enclosure as appropriate.

F. Field wire entry capability shall be from the top and the bottom of the cabinet as required by the specific application and in accordance with DCSP submittal showing acceptable conduit entrance areas. Each cabinet shall, wherever possible, be one of the DCSP's standard sizes; however, the height shall not exceed 96 inches. All indoor cabinets shall be sized so that they can be moved through a 36-inch-wide doorway.

G. Ventilation openings in enclosures in all areas, based on area classification, shall be provided with dust filters and insect screens. Ventilation shall be provided with cleanable/replaceable filter backed louvers at top and bottom. Thermostatically controlled fans shall be located at air inlets so that the enclosure interior is pressurized. Filters shall be capable of removal and reinstallation without the use of tools. Exhaust vents shall contain the same dust filters and insect screens and shall be placed so as to facilitate cabinet top heat gain. Where area classification precludes ventilation opening, a recirculation type Thermal Management System shall be utilized.

H. Cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 200 pounds on their top after erection, and shall be rated for Seismic Zone 4 requirements.

I. Each freestanding enclosure shall be mounted on a concrete housekeeping pad that elevates the cabinet in accordance with the Design Engineer's standard pad design.

J. Utility and UPS branch power shall be installed and terminated by others under Division 26. Each cabinet, as specified below, shall have an externally-mounted, weatherproof, modular (plug in) RJ-45 type Data Jack to support connection of the Industrial Hardened Workstations (FHS). Addition of the Data Jack shall not violate the NEMA integrity of the cabinet. Where possible Data Jacks shall be mounted 12 inches above grade.

K. All cabinets shall be provided with a temperature sensor to monitor cabinet temperature. The sensor shall provide a hardwired analog input signal to the DCS.

L. All cabinet doors shall be provided with limit switches which shall activate when the door is opened. Switches shall be double pole; one pole operating the cabinet light and the other pole providing supervised, 'door-open' indication to the DCS I/O. These points shall provide a hardwired digital input signal to the DCS.

M. Control panels, including those furnished by equipment manufacturers shall be provided according to the following requirements:
    1. Where indicated, control panels shall be provided with all required taps, fittings, rotameters, regulation and alarm interlocks to enable the implementation of a purge system which is in conformance with ISA S12.4 Type Z requirements. Dimensions shall be in accordance with manufacturer's requirements. Elevations and horizontal spacing shall be subject to City's representative approval.
    2. Panels shall be fabricated, piped and wired by fully qualified panel shop who are properly trained, experienced and supervised.
    3. See Section 40 90 07, Scope of Work, for control panels to be provided under this Contract.

N. Materials:
    1. Panel section faces shall be No. 10 gauge minimum thickness steel for free standing panels and No. 14 gauge minimum thickness steel for smaller panels. All materials shall be selected for levelness and smoothness.
    2. Relay rack high density type panels shall utilize standard relay racks with No. 14 gauge steel frame and supports.
    3. Structural Shapes and Strap Steel: ASTM A283.
    4. Bolting Material: Commercial quality carbon steel bolts, nuts and washers, all 1/2 inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex head machine bolts. All nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. All other bolted joints shall have S.A.E. standard lock washers.

O. Fabrication:
    1. End plates, top plates and top closure panels shall be furnished when required. End plates, top plates and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be furnished in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4 feet 6 inches wide or five 2 feet 0 inches wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.
    2. End closure or rear closure doors shall be provided. Such doors shall be flush fitting and gasketed and be of the hinged lift-off type with lockable door handles. A common key shall be provided for all doors on one panel assembly. Where removable access panels are indicated, they shall be furnished with dished handle fasteners. Screw driver 1/4 turn type fasteners are not acceptable.
        a. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.
        b. The face of the panel shall be true and level after flanging.

c. All panel cut-outs and holes may be cut or drilled by any standard method that will not cause deformation. Burrs shall be ground smooth.
d. Adjacent panels shall be assembled with faces flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.
e. Stiffeners shall be welded to the back of panels, as required to prevent panel deformation due to the weight of front of panel mounted instruments.
f. Panels shall be self-supporting as defined below.

P. Framework and Supports:
1. The rear of each panel section shall have a steel framework for supporting conduit, tubing, wireways, switches, air piping and all instrument accessory items such as relay or terminal enclosures, transducers, pressure switches, valves and air relays. The main frame work shall be constructed of standard structural shapes. Special shapes such as "Unistrut" may be used for secondary supports. Framework must not interfere with instrument connections or access needed for maintenance or adjustments.
2. Steel framework shall extend 2 feet 8 inches back of the panel face unless otherwise required. Where indicated, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel shall be self-supporting.

Q. Finish:
1. Preparation: The front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all openings shall be prepared as follows:
a. All high spots, burrs, and rough spots shall be ground smooth.
b. The surfaces shall be sanded or sandblasted to a smooth, clean bright finish.
c. All traces of oil shall be removed with a solvent.
2. Finishing:
a. A 3 mils dry coat of Amercoat 185, or equal primer shall be applied over the entire panel surface immediately after solvent cleaning.
b. Wet sand, dry, then quick glaze spot putty on the front of the panel only. Dry, then wet sand again and dry.
c. Apply a second 3 mils dry coat of alkyd enamel primer to the front of the panel.
d. Wet sand to smooth clear finish, then dry.
e. At least two 3-mil dry coats of air-dry, satin finish, alkyd enamel shall be applied over the entire surface. Color to be as selected by City's representative.
f. The Contractor shall furnish two 1-pint containers of the enamel to the City's representative.

3. Instrument Finishing: The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black japan or "crinkle" finishes on instrument cases are not acceptable.

R. Mounting of Instruments:
1. The Contractor shall provide cut-outs, and shall mount all instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other manufacturers.
2. The Contractor shall also mount, behind the panels, other instrument accessory items as indicated.
3. Rear of panel mounted equipment shall be installed with due regard to commissioning adjustments, servicing requirements and cover removal.
4. Wiring shall be kept clear of spare space to give maximum space for future additions.
   a.

S. Electrical Requirements for Control Panels:
1. The Contractor shall provide all wiring, conduit, wireways, and switches required to make instruments and other panel electrical devices operational.
2. Conduit, wireways, junction boxes and fittings shall be installed for all signal wire, all thermocouple and resistance thermometer lead wire including those between temperature sensors and temperature indicators.
3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. All wiring shall be identified with stamped tubular wire markers.
4. Freestanding panels shall be provided with switched two 18 watt LED lights which are powered from a source independent from that which powers the panel devices. One light shall be provided for every 4 feet of panel width and shall be mounted inside in the top of the back-of-panel area.
5. Freestanding panels shall be provided with a 15 amp, 120 volt service outlet circuit within the back-of-panel area which are powered from a source independent from that which powers the panel devices. The circuit shall be provided with one three wire, 120 volt, 15 ampere, duplex receptacle for every 4 feet of panel width spaced evenly along the back-of-panel area. As a minimum, two duplex outlets shall be provided for each panel.
6. Smaller panels shall be sized to adequately dissipate heat generated by equipment mounted in or on the panel.
7. Where smaller panels are mounted outside or in unshaded areas, they shall be provided with thermostatically controlled heaters capable of maintaining inside temperatures above 40 degrees F.
8. Smaller panels shall be provided with a hand-switch controlled two 18 watt LED light and a breaker protected 120 volt, 15 amp duplex receptacle.

9. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose unless otherwise indicated. Opening wiring in close cabinet type panels is allowed when indicated.
10. Construction:
    a. Wire for 115 volt circuits shall be No. 14 AWG stranded with Type THWN or THHN insulation. All terminals for external wiring connections shall be suitable for No. 12 AWG wire.
    b. Flexible conduit is not acceptable.
    c. Conduit fittings shall be cast fittings.
    d. Soldered or pressure crimped wire splicing in conduits shall be acceptable.
    e. For case grounding, panels shall be provided with a 1/4 inch by 1 inch copper ground buss completed with solderless connector for one No. 4 AWG bare stranded copper cable. The Contractor shall connect the copper cable to a system ground loop.
    f. Single case annunciator units with no remote logic which are installed at the top of a panel may be considered as being a terminal box when top of panel wire entry is indicated. If bottom of panel entry is indicated, terminal box shall be provided at the bottom of the panel and wired to the annunciator. Terminals shall be identified with plastic marker strips.
    g. Terminal boxes for incoming and outgoing signal leads shall be located at the top or bottom of the panel as indicated or as otherwise required.
11. Power Supply Wiring:
    a. Unless otherwise indicated, all instruments, all alarm systems, and all motor controls shall operate on 24V dc circuits.
    b. The Contractor shall furnish terminal box connections for the main power supply entry as indicated.
    c. Power supply switches for alarm units shall be three pole type, arranged to open both the power and alarm circuits. Each annunciator shall be equipped with a separate switch.
    d. Instruments located on a single panel section which serve one process unit may be connected to a common branch power circuit. The number of branch circuits shall be such that no circuit load exceeds 10 amps. Different panel sections and instruments serving different process units shall not use common branch circuits. A 15 amp, two-pole circuit breaker shall be provided in each branch circuit. When instruments do not come equipped with integral fuses, the panel fabricator shall furnish and install fuses as required for the protection of individual instrument against fault currents. Fuses shall be mounted on the back of the panel, in a fuseholder, with each fuse identified by a service name tag.

e. Each potentiometer type instrument, electronic transducer, controller or analyzer shall have an individual disconnect switch. Disconnect switches shall have metal or plastic tags listing the associated instrument tag numbers. Individual plug and cord set power supply connections may be used without switches when indicated.

f. Where alarm units are single unit types, one switch may be used to disconnect not more than six alarm units located on the same or adjacent panels.

12. Alarm Wiring: The Contractor shall provide all alarms including light cabinets, audible signal units, test and acknowledge switches and remote logic units as indicated. Interconnecting wiring to panel mounted initiating devices shall also be provided. Wiring from external initiating devices shall be provided by the Contractor. Where plug and cord sets are provided for component interconnection, the Contractor shall harness and support the cables in a neat and orderly fashion. Where separate wire is required, the Contractor shall install 16 AWG with THWN or THHN insulation between all components.

13. Signal Wiring:

a. Computer and Noncomputer Use: Signal wire shall be twisted shielded pair or triads in conduit or troughs. Cable shall be constructed of No. 16 AWG copper signal wires with THWN or THHN insulation. Color code for instrument signal wiring shall be:

1) Positive: Black (+).
2) Signal Ground Negative: White (-).
3) Equipment Ground: Green.
4) Ungrounded: Red.
5) Energized by Voltage Source External to Panel: Yellow.
6) DC Circuit: Blue.

b. Multiconductor cables where indicated shall consist of No. 16 AWG copper signal wires twisted in pairs, with 600 volt fault insulation. A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.

c. Multi-conductor cables, wireways and conduit shall provide for 10 percent allocation of spare, unused signal wires in addition to the indicated requirements.

14. Thermocouple Wiring:

a. The Contractor shall provide metal wire troughs, pullboxes, and thin walled conduit for duplex thermocouple lead wire in a manner which will facilitate field installation of lead wire without splices or terminal connections. The Contractor shall also provide the lead wire connections between multipoint temperature sensors and temperature indicators when indicated. When a thermocouple

junction box is indicated, it shall be located with the approval of the City's representative. The panel manufacturer shall install conduit and troughs and lead wires between the junction box and the instruments. Terminal material shall be compatible with extension wire used.

b. Thermocouple lead wire shall be No. 16 AWG with high temperature PVC insulation on each wire and PVC jacket overall, and shall conform to the latest ISA Specification for standard grade.

c. Conduit for thermocouple lead wire shall be in accordance with the following:

CONDUIT SIZE	1/2"	3/4"	1"	1½"	2"
NO. OF DUPLEX	1	4	6	16	26

d. Where the number of duplex lead wires exceeds 26, the wires shall be installed in rectangular ducts filled to not more than 40 percent capacity.

e. All thermocouple wireways and main conduits shall be sized to allow for 10 percent spare thermocouple leads.

f. Each signal, control, alarm, and indicating circuit conductor shall be designated by a single unique number which shall be shown on shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be plastic-coated cloth, or shall be permanently marked heat-shrink plastic.

15. Terminal Blocks: Terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 15 amperes at 600 volts. White marking strips, fastened securely to the molded sections, shall be provided and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid.

T. Color Conventions: Lens covers for indicating lights on all panels will be colored as follows:

1. Red ON when:
   a. Motor not running (STOPPED).
   b. Valve CLOSED (not fully opened).
   c. Circuit breaker CLOSED.
2. Green ON when:
   a. Motor running in forward direction (fast speed for multi-speed motors).
   b. Valve OPEN (not fully closed).
   c. Circuit breaker OPENED.
3. White ON when:
   a. Power available.

b. System in AUTOMATIC mode.
c. Monitoring taking place.

4. Amber ON when:
   a. Malfunction trip.
   b. Equipment locked out.
   c. Alarm condition.

U. Nameplates: Nameplates shall be provided for instruments, function titles for each group of instruments, and other components mounted on the front panel(s) as indicated. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, and electronic trip mounted inside the panel(s). Nameplates shall be descriptive to define the function and system of such element. These nameplates shall be of the same material as those on the front of the panel(s). Adhesives shall be used for attaching nameplates. Nameplates shall be fabricated from black face white-center laminated engraving plastic. Painted surfaces shall be prepared to allow permanent bonding of adhesives. Colors, lettering, styles, abbreviations and sizes shall be in conformance with ISA-RP60.6 with an intended viewing distance of 3 feet to 6 feet.

V. Factory Inspection:
   1. Panels shall be inspected for compliance with requirements at the factory before shipment to the site. The Contractor shall notify the City's representative 2 weeks in advance of the testing date. A representative of the City's representative will visit the factory to make the inspection.
   2. Contractor shall perform the following tests prior to arrival of the City's representative:
      a. All air lines adequately tested for leaks.
      b. All alarm circuits rung out to determine their operability.
      c. Electrical circuits checked for continuity and where applicable, operability.
      d. Nameplates checked for correct spelling and correct size of letters.
      e. Other test required to place the panel in an operating condition.
   3. It shall be the responsibility of the Contractor to furnish all necessary testing devices and sufficient manpower to perform the tests required by the City's representative to determine conformance to the requirement of the Contract Documents.
   4. If the above tests have not been performed prior to the arrival of the City's representative, the Contractor shall reimburse the Owner for the cost of the extra time required for the inspector's services and travel expenses.

W. Shipment: Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. Instruments which are shipped with the panel shall have suitable shipping stops and cushioning material installed to protect instrument parts from mechanical shock damage during shipment. Each panel crate shall be provided with removable lifting lugs to facilitate handling.

2.2 PROCESS CONTROL MODULE (PCM) CABINETS

A. PCM Cabinets shall be provided to house the DCS PCM hardware which interfaces to the DCS network and RIO, PLC / or Termination Cabinets.

B. The Cabinet shall be as required by area classification, gasketed, floor standing (minimum 72"w x 96"h x 24"d), with double doors and access from the front, and rear where applicable, of the cabinet. Doors shall have a 3-point, key-locking, 1/4 turn latching mechanism. Doors shall be 36-inches wide and hung by continuous full height piano hinges at the outside edges. (Integral cabinet configuration dimensions shall not exceed 72" wide)). Cabinet shall be provided with cable entry from the top and bottom (where applicable) as needed for entry of cables from cable trays and/or conduits. Cabinet shall be able to incorporate:

1. One (1) set redundant PCM
2. Redundant power supplies.
3. Redundant Communications modules
4. Redundant RIO communications modules if applicable
5. I/O cards or modules and all required appurtenances to function as a stand- alone node within the DCS.
6. Any cabinet and raceway shall be sized to accommodate equipped, spare, and future growth requirements of I/O and wiring, as well as for cables from I/O cards to the Termination Cabinet if used.
7. Weatherproof, exterior mounted, RJ-45 Data Jack, which shall be wired back to the closest port on the data highway/LAN switch.
8. UPS to power DCS PCM and loop powered instruments.

C. CABINET LAYOUT

1. PCM and I/O rack and cards shall be accessible from the front of the cabinet. Access for card I/O cable connections shall be from the front or rear of the cabinet, based on area requirements. A Separate wire-way shall be used to carry 120VAC signals. 120VAC power shall be separately routed within the enclosure for shielding and isolation from low-voltage signal wiring**.** Power entry to the cabinet and UPS Power Supplies shall be grouped together in an area of the Cabinet that is separated from PCM processors and I/O wiring assemblies.
2. Cabinet Power Distribution: Provide circuit breakers in the number and capacity required to protect all internal power circuits from overload and damage due to abnormal power conditions and/or device failure. Follow requirements for power circuits contained elsewhere in the Specifications. Group the circuit breakers together in a part of the Cabinet adjacent to power supplies. Associated wiring shall be routed in wireway and/or conduit provided for 120VAC power only. A main

circuit breaker / disconnect shall also be provided for the Cabinet, which shall switch electrical power to all internal Cabinet equipment.

3. Wireway: Internal Cabinet wiring shall be contained in wireway, or where this is not possible, wiring shall be bundled and tied with nylon ties and secured to the nearby cabinet walls with approved affixed mounts.

2.3 REMOTE INPUT/OUTPUT (RIO) CABINETS

A. RIO Cabinets shall be provided to house the DCS RIO hardware which interfaces to the DCS PCM and Termination Cabinets (if provided).

B. The Cabinet shall be as required by area classification, gasketed, floor standing (minimum 36"w x 96"h x 24"d), with single or double doors as appropriate, and access from the front, and rear of the cabinet where applicable based on site conditions. Doors shall have a 3-point, key-locking, ¼ turn latching mechanism. Doors shall be 36-inches wide and hung by continuous full height piano hinges at the outside edges. (Integral cabinet configuration dimensions shall not exceed 72" wide)). Cabinet shall be provided with cable entry from the top and bottom as needed for entry of cables from cable trays and/or conduits. Cabinet shall be able to incorporate:

1. Redundant PCM communications modules
2. Redundant power supplies
3. A minimum of 32 I/O cards or modules and all required appurtenances to function as a RIO node within the DCS.
4. Any cabinet and raceway shall be sized to accommodate equipped, spare, and future growth requirements of I/O and wiring, as well as for cables from I/O cards to the Termination Cabinet.
5. Weatherproof, exterior mounted, RJ-45 Data Jack, which shall be wired back to the closest port on the data highway/LAN switch.
6. UPS to power DCS RIO and loop powered instruments
7. Cabinet shall be sized to accommodate expansion and growth of twenty (20) percent of the I/O.

C. CABINET LAYOUT

1. RIO PCM communications modules and I/O rack and cards shall be accessible from the front of the cabinet. Access for card I/O cable connections shall be from the front, rear of the cabinet where applicable based on site conditions. Separate wireways shall be used to carry 120VAC signals. 120VAC power shall be separately routed within the enclosure for shielding and isolation from low voltage signal wiring.
2. Power entry to the cabinet and UPS Power Supplies shall be grouped together in an area of the Cabinet that is separated from PCM processors and I/O racks assemblies.

3. Cabinet Power Distribution: Provide circuit breakers in the number and capacity required to protect power circuits from overload and damage due to abnormal power conditions and/or device failure. Follow requirements for power circuits contained elsewhere in the Specifications. Group the circuit breakers together in a part of the Cabinet adjacent to power supplies. Associated wiring shall be routed in wireway and/or conduit provided for 120VAC power. A main circuit breaker / disconnect shall also be provided for the Cabinet, which shall switch electrical power to all internal Cabinet equipment.
4. Wireway: Internal Cabinet wiring shall be contained in wireway, or where this is not possible, wiring shall be bundled and tied with nylon ties and secured to the nearby cabinet walls with adhesive mounts.

2.4 FIELD TERMINATION CABINETS

A. Field Termination Cabinets, if required, shall be provided to interface between the DCS PCM/RIO cabinets housing the DCS system hardware and the field mounted instruments and devices. In addition to providing terminal blocks for connection of wiring, the Cabinets may also provide electrical isolation between DCS discrete output signals and the equipment being controlled, and between the DCS and any field signal operating at a voltage level other than 24VDC. Where necessary to ensure analog signal compatibility and/or isolate ground loops, signal isolators shall be provided and installed in the Termination Cabinets.

B. Cabinet shall be front access only, and shall provide openings at the top, or bottom, as needed for entry of cables from cable trays and/or conduits. The cabinet shall be as required by area classification, gasketed, floor standing (minimum 72”w x 96”h x 24”d), with double doors and 3-point latching mechanism, and key locking 1/4- turn. Doors shall be 36-inches wide and hung by continuous full height piano hinges at the outside edges. Cabinet shall incorporate:
   1. Knife blade fused terminal blocks shall be provided on every wire connection for convenient isolation of circuits without de-terminating wiring.
   2. Interposing Relays - Slave / Pilot Relays shall be provided in the Termination Cabinet for the electrical isolation of discrete output signals. Where 120-volt wetting voltages are present, interposing relays shall be isolated from relays handing low voltage.
   3. Signal Isolators – Provide in the Termination Cabinet as mentioned above.
   4. Power supplies: Provide a redundant power system for the Cabinet consisting of individual power supplies and automatic failover with alarm light, located in the bottom of the Termination Cabinets. All electronics

power supplies and loop- powered instruments shall be powered by the UPS as specified elsewhere.

5. Provide 3 terminal blocks for each 2-wire signal (2 conductors & shield), and 4-terninals for each 3-wire signal for landing field wiring and DCS wiring entering/exiting the Termination Cabinets. Also, provide all terminal blocks required for internal cabinet wiring and connections such as power supply, interposing relays, signal isolators, grounding and similar requirements. Provide terminals for all other wiring entering / leaving the Termination Cabinets as needed for landing connections. No wire splicing shall be used for connections in the Termination Cabinets.
6. Every wire conductor shall be individually labeled with its unique ISA identifying wire number in accordance with the requirements of the Contract Documents. Similar labels shall be attached to every terminal block.
7. Each conductor will be terminated in one of the following manners:
    a. Conductor may be terminated in a safety-type forked, spade terminal of appropriate size for the screw on the termination block. All conductors shall be crimp-type spade terminal as manufactured by T&B. Substitution is not allowed.
    b. If Phoenix Contact compression-type terminal blocks are utilized, each wire shall be ferruled or soldered tinned prior to terminating under the compression pawl.
    c. Conductor may be terminated in a ferruled terminal type of appropriate size for the screw on the termination block. All conductors shall be crimp-type ferruled terminal.
8. Labels and nameplates shall be provided for identification of each active component contained within the Termination Cabinets (i.e., interposing relays, power supplies, terminal blocks, and similar items).
9. Grounding: provide an electrical Cabinet ground bus and ground wiring system.
10. Signal Grounding: provide an isolated signal ground path and buss within the cabinet. All shields from signal wiring shall be grounded in the Termination Cabinets. Grounding and Signal grounding shall be terminated to the ground buses and connected to the DCS ground grid by other under Division 26.

C. CABINET LAYOUT

1. Cabinets shall be arranged with vertical columns of terminal blocks bounded on both sides by wireways. Wherever possible, DCS wiring shall be separated from field wiring within the wireways. DCS wiring shall be routed to the left side of terminal blocks and field wiring to the right side of terminal blocks. Separate wireways shall be used to carry 120VAC signals. 120VAC power shall be separately routed in conduit within the enclosure for shielding and isolation from signal wiring.

2. Interposing relays shall be housed in an area of the Cabinet that is separate from terminal blocks. Within this area, relays shall be separated according to whether they carry 24VDC or 120VAC signals. Relays shall be arranged so that all 120VAC signal wiring is contained in separate wireways from24VDC signals.
3. Power Supplies shall be grouped together in an area of the Cabinet that is separated from terminal blocks and relays, but may be located in adjacent areas on the DIN rail in order to facility interconnecting wiring.
4. Cabinet Power Distribution: Provide DIN rail mounted circuit breakers in the number and capacity required to protect power circuits from overload and damage due to abnormal power conditions and/or device failure. Follow requirements for power circuits contained elsewhere in the Specifications. Group the circuit breakers together in a part of the Cabinet that is separated from terminal blocks and relays, but is adjacent to power supplies. Associated wiring shall be routed in wireway and/or conduit provided for 120VAC power. A main circuit breaker / disconnect shall also be provided for the Termination Cabinets, which shall switch electrical power to all internal Cabinet equipment.
5. Cabinet Power Supply: The cabinet power supplies shall be provided from two independent sources, UPS and utility power. These shall be distributed separately within the cabinet to provide the sources of power as described herein.

D. Wireway: Internal Cabinet wiring shall be contained in plastic wireway, or where this is not possible, wiring shall be bundled and tied with nylon ties and secured to the nearby cabinet walls with adhesive mounts. Wireways shall also be provided at the top and bottom of the Cabinets to collect the wiring from the vertical wireways and direct it to the proper location.

E. Separate areas shall be provided on the DIN rail terminal blocks for each type of input / output points (i.e., Analog Input – AI, Analog Output – AO, Discrete Input – DI, and Discrete Output – DO). Separate areas shall also be provided in the Cabinets for interposing relays.

F. Cabinet shall be sized to accommodate expansion and growth of twenty (20) percent of the I/O.

2.5 Uninterruptible Power Supply (UPS)

A. UPS supply systems shall be provided by the DCSP for each PCM, RIO, Termination Cabinet and any Local Cabinet containing electronics, in this contract. The UPS shall be installed and terminated under Division 26 by others.

B. UPS systems shall be sized to match area supply voltages and will provide, as a minimum, two (2) hour of standby power, at the full rated load of the Cabinet plus 20% spares.

C. UPS shall be provided with external bypass mechanism to allow removal of the UPS for service without interrupting the PCM, etc.

D. Each UPS shall be provided with its own electrical protective Load Center, provided and installed by others under Division 26. Load Center will contain adequate number and ampacity of circuit breakers to facilitate all loads fed from that UPS. Load Center will be of appropriate voltage and have a main protective breaker of appropriate ampacity to match the KVA rating of the UPS.

E. UPS's shall be floor mounted adjacent to the cabinet being served. They shall be mounted on a rack above a minimum of 6-inches above finished floor. If requirements dictate, UPS shall have additional, self-contained battery capacity to ensure minimum standby times.

F. The UPS shall be provided with a Network Communications Module capable of Modbus and SNMP that will transmit UPS environmental data to the DCS.

G. The UPS shall be Liebert GXT4 with IS-Unity communications card or approved equal.

2.6 SHOP PAINTING

A. Powdered epoxy resin coatings applied in the shop shall protect all ferrous metal surfaces. Surfaces that will be inaccessible after assembly shall be hot-dip galvanized and flood coated with 2-part epoxy paint. All surfaces shall be cleaned and prepared in the shop prior to painting / coating. All mill scale, rust, lubricants, and other coatings shall be removed. Exposed surfaces shall be finished smooth, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. All surfaces shall be treated with primer to resist rust and to form a bond between the metal and the paint.

B. As an alternative to powder coating, PCM and RIO enclosures shall be given one or more coats of rust-inhibiting primer and two coats of high-grade oil-resistant enamel, lacquer, epoxy or polyurethane finish both inside and out. Paint films that show sags, checks, blisters, teardrops, or fat edges will not be acceptable. Any such defects shall be repaired by the DCSP prior to shipping.

C. The DCSP shall include touch-up paint and primer with the equipment he is furnishing that shall be of the same type and color as the factory-applied finish paint and primer. One quart of finish color shall be furnished for future touch-up. Complete application instructions shall be furnished. The paint and instructions shall be boxed or crated to prevent damage and shall be clearly labeled.

D. The exterior finish colors of the enclosures shall be the DCSP's standard colors. Interior color shall be white. Where stainless steel enclosures are used, powder coating or painting is not required.

E. Where area classification dictates, or at the option of the DCSP all cabinets may be provided in 316 stainless steel as opposed to painting and epoxy coating.

2.7 WIRING REQUIREMENTS

A. General: The cabinets shall be provided with top or bottom terminal box connections for the main power supply entry. Each electronic component shall be equipped with a separate switch or disconnect means. Signal and low voltage wiring shall be run separately from power and 120-volt control wiring. Intrinsically safe wiring shall be run separately from non-intrinsically safe wiring.

B. Power Supplies: Low voltage DC power supplies shall be supplied. Low voltage direct-current power supplies for bulk instrumentation power shall be convection- cooled switching type. Line regulation shall be 0.4 percent for input line variations from 105 to 132 VAC, and load regulation shall be 0.4 percent for load variations from 0 to full load. Ripple and noise shall not exceed 100 mV peak-to-peak. Hold-up time at maximum load shall not be less than 16 milliseconds. Efficiency shall be better than 70 percent. Power supply shall be designed for continuous duty at full rated capacity operating in ambient temperatures from 0 to 50 degrees C. In addition, power supplies shall be sized so that they do not exceed 60 percent of their rated capacity, when operating under the full calculated electrical load of the connected control system equipment. Output shall be electronically current limited, and overvoltage shutdown shall be provided. Power supply output voltages shall be rated as required and adjustable plus or minus 5 percent.

C. Provide UPS power to all control cabinets to supply all DCS components and instrumentation, via Uninterruptible Power System provided by the DCSP and installed by others as part of Division 26.

D. Cabinet Power Supply: The cabinet power supplies shall be provided from two independent sources, UPS and utility power. These shall be distributed separately within the cabinet to provide the sources of power as described herein.

E. Interposing Relays: Interposing relays (IR) shall be 115-volt AC or 24-volt DC coils and have a minimum of 10-amp rated contacts and be suitable for the application. Mounting dimensions and drilling for AC and DC relays shall be identical. Relays shall be Phoenix Contact or equal.

F. Surge Protectors: Surge protectors shall be nominal 120 volts AC with a nominal clamping voltage of 200 volts. Surge protectors shall be non-faulting and un- interrupting design with a response time of not more than 5 nanoseconds. Surge protectors shall be as manufactured by Islatrol or L.E.A. Dynatech or equal.

G. Enclosure Lights and Receptacles: Enclosures shall be internally lighted by LED lamps, provided with guards and a door activated switch. One duplex GFCI, grounded twist lock type receptacle shall, also, be provided in each Cabinet enclosure section. The lights and receptacles shall be wired to outgoing terminal blocks for normal (utility, non-UPS) 120v -60Hz, single phase utility power supply. Power branch circuits will be installed by others under Division 26.

H. Limit Switches: Switches mounted on all Cabinet enclosure doors for intrusion detection and light activation, shall be proximity type and shall be self-contained, side or end sensitive as required. Output shall be a closed contact with no intrusion (supervised). Switches shall be Square D, Class 9007 Type C or Allen-Bradley 802T Series, or equal.

I. Terminal Blocks:
   1. Quantity:
      a. For external connections
      b. Wire spare or unused cabinet mounted elements to their cabinets' terminal blocks.
   2. General: Group to keep 120V ac circuits separate from 24V dc circuits.
      a. Connection Type: Screw connection clamp.
      b. Compression Clamp:
         1) Hardened steel clamp with transversal grooves penetrating wire strands providing a vibration-proof connection
         2) Guides strands of wire into terminal
      c. Screws: Hardened steel, captive and self-locking.
      d. Current Bar: Copper or treated brass.
      e. Insulation:
         1) Thermoplastic rated for minus 55 to plus 110 degrees C.
         2) Two funnel shaped inputs to facilitate wire entry.
      f. Mounting:
         1) Rail.
         2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
         3) End Stops: One at each end of rail, minimum.
      g. Wire Preparation: Stripping only.
      h. Jumpers: Allow jumper installation without loss of space on terminal or rail.

i. Marking System:
    1) Terminal number shown on both sides of terminal block
    2) Allow use of preprinted and field marked tags
    3) Terminal strip numbers shown on end stops
j. Mark terminal block and terminal strip numbers as required

3. Terminal Block, 120-Volt Power:
    a. Rated Voltage: 600V ac
    b. Rated Current: 30 amp
    c. Wire Size: 22-10 AWG
    d. Rated Wire Size: 10 AWG
    e. Color: Gray body
    f. Spacing: 0.25 inch, maximum
    g. Manufacturer and Product: Entrelec; Type M4/6 or approved equal.
4. Terminal Block, Ground:
    a. Wire Size: 22-12 AWG.
    b. Rated Wire Size: 12 AWG
    c. Color: Green and yellow body
    d. Spacing: 0.25 inch, maximum
    e. Grounding: Ground terminal blocks electrically grounded to the mounting rail
    f. Manufacturer and Product: Entrelec; Type M4/6.P or approved equal.
5. Terminal Block, Blade Disconnect Switch:
    a. Use: Provide one for each discrete input and output field interface wire.
    b. Rated Voltage: 600V ac
    c. Rated Current: 10 amp
    d. Wire Size: 22-12 AWG
    e. Rated Wire Size: 12 AWG
    f. Color: Gray body, orange switch
    g. Spacing: 0.25 inch, maximum
    h. Manufacturer and Product: Entrelec; Type M4/6.SN or approved equal by Allen Bradley or Phoenix Contact
6. Terminal Block, Fused, 24V dc:
    a. Rated Voltage: 600V dc
    b. Rated Current: 6.3 amp
    c. Wire Size: 22-12 AWG
    d. Rated Wire Size: 12 AWG
    e. Color: Gray body
    f. Fuse: 5 by 20 GMA fuses
    g. Fuse Marking: Fuse amperage rating shown on top of terminal block
    h. Indication: LED diode 24V dc
    i. Leakage Current: 5.2 mA, maximum

j. Spacing: 0.32 inch, maximum
k. Manufacturer and Product: Entrelec; Type M4/6.SFD
l. Terminal Block, Fused, 120V ac:
m. Rated Voltage: 600 V ac
n. Rated Current: 6.3 amp
o. Wire Size: 22-12 AWG
p. Rated Wire Size: 12 AWG
q. Color: Gray body
r. Fuse: 5 by 20 GMA fuses
s. Fuse Marking: Fuse amperage rating shown on top of terminal block
t. Indication: Neon lamp 110V ac
u. Leakage Current: 1.8 mA, maximum
v. Spacing: 0.32 inch, maximum
w. Manufacturer and Product: Entrelec; Type M4/6.SFL or approved equal by Allen Bradley of Phoenix Contact.

J. Grounding: Internal copper grounding bus for ground connections on cabinets, consoles, racks, and cabinets. Cabinet grounding shall be as required under Section 40 95 15 – DCS Equipment Grounding.

K. Intrinsic Safety Barriers:
1. Intrinsically Safe Relays:
a. Monitor discrete signals that originate in hazardous area and are used in a safe area.
b. Manufacturer and Product: MTL, Inc.; Series MTL 2000. Or approved equal.
2. Intrinsically Safe Barriers:
a. Interface analog signals as they pass from hazardous area to safe area.
b. Manufacturer and Product: MTL, Inc.; Series MTL 6000. Or approved equal.

2.8 NAMEPLATES

A. Nameplates shall be provided for all I/O, PCM, RIO and miscellaneous DCS racks, and shall include function titles for each group of components mounted within the enclosures. A nameplate with identifying tag numbers coded to City's DCS numbering system shall be provided for each signal isolator, electronic trip, and other components mounted inside the enclosure(s). The nameplates shall be descriptive to define the equipment number, function, and system of each element. All nameplates shall be engraved phenolic, black-on white labels. Adhesive labels are not acceptable. The DCSP shall be select lettering, style, and sizes for approval by City's representative. Unless otherwise noted, mount all labels with stainless steel

screws, nuts, bolts, etc. Before being produced the DCSP shall submit a list indicating the wording and tag numbers of all equipment identification name plates to City's representative for approval in accordance with Specification 01300, Submittals.

PART 3 -- EXECUTION

3.1 PACKAGING FOR SHIPMENT/STORAGE

A. Enclose copies of the cabinet layout, wiring diagrams and installation detail documentation within manila envelopes and secure inside of each cabinet in a door pocket made for this purpose.

B. During the construction period, periodically provide and replace cabinetry and air conditioning filters. Replace the filters just prior to City's representative's final acceptance of the equipment.

C. During the construction period, provide and replace blown cabinet fuses.

3.2 INSTALLATION

A. DCSP shall perform a complete Factory Acceptance Test (FAT) in accordance with these Specifications for all cabinet configurations in accordance with the Specifications. FAT shall be executed at the approved staging area and witnessed by the City Representative.

B. DCSP shall provide jobsite delivery of enclosures in accordance with the requirements of these Contract documents.

C. During the installation of DCS cabinets it shall be the responsibility of the DCSP to provide personnel to oversee proper installation of all DCS cabinetry, grounding, peripherals and systems components, in addition to termination of I/O wiring, all of which is executed by others under Division 26.

D. The DCSP shall furnish the services of factory trained engineer(s) to check the completed installation and to perform all Loop Testing jointly with others, functional testing and make all necessary adjustments for satisfactory operation of the DCS.

E. All work, including installation oversight, calibration, testing, adjustment, start-up and maintenance, shall be done by qualified experienced personnel who are technically skilled in their trade, are thoroughly instructed, and are competently supervised.

END SECTION

SECTION 40 95 15
DCS EQUIPMENT GROUNDING

PART 1 GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish all tools, equipment, materials, consumables and supplies and shall perform all labor required to complete the WORK to fulfill the intent of the requirements outlined in the Specifications and Drawings. The purpose of this section is to ensure proper grounding for all DCS equipment and peripherals, supplied under this contract, for integration into the City of San Diego Enterprise Distributed Control System (DCS), COMNET.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. The work of the following Divisions and Sections applies to the work of this Section. Other Division and Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this work.

1. Section 01 33 00, Submittal Procedures.
2. Division 26, Electrical, applicable sections.
3. Section 40 94 00, Distributed Control System General Requirements.

B. Materials, equipment and devices furnished and installed under this Contract including raceway and electrical conductors furnished, installed, and connected shall be a specified under Division 16, Electrical.

1.3 REFERENCED SPECIFICATIONS, CODES AND STANDARDS

A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

B. Comply with the current provisions of the following Codes and Standards.

1. Codes and Standards:
   a. All applicable City of San Diego Electrical Code, latest adopted edition.
   b. California Code of Regulations Title 8, Industrial Relations, Subchapter 5, Electrical Safety Orders.
   c. NECA.
   d. NFPA 70.
2. Commercial Standards:

a. ANSI/IEEE 80 Guide for Safety in AC Grounding.
b. ANSI/UL 467 Safety Standard for Grounding and Bonding Equipment.
c. IEEE 142 Grounding of Industrial and Commercial Power Systems.
d. ANSI/IEEE Standard 1100 (“Emerald Book”), IEEE Recommended Practices for Powering and Grounding Sensitive Electrical Equipment.
e. TIA J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
f. NEC and NFPA 70 (latest adopted versions).

C. All equipment furnished by the Contractor shall be listed by and shall bear the label of UL or of an independent testing laboratory acceptable to the City of San Diego.

D. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the CAL OSHA Safety orders. (Title 8 CCR, as applicable), State Building Standards, and applicable local codes and regulations.

1.4 CONTRACTOR SUBMITTALS

A. Submittals shall be made in accordance with Section 40 94 00, Distributed Control System General Requirements.

B. Submittals shall also conform to the requirements of Sections on ‘Electrical Tests’, ‘Conductors’ and additional requirements specified herein. Submittals shall be made for, but not be limited to, the following:

1. Catalog literature for all products.
2. Ground Testing Plan and Procedures.
3. Certified copies of Ground Test results.
4. Field test procedures including lists of test equipment to be used.
5. Calibration certifications for all field test equipment. Certification shall be current within 180 days of testing.

1.5 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the requirements of Section on ‘Electrical General Provisions’ and ‘Electrical Tests’.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. The grounding plan drawings are diagrammatic and may not show all required grounding connections. The Contractor shall ground all DCS Controller, Remote I/O and 'B' Cabinet enclosures, whether or not the required grounding connections are shown on drawings, to complete the grounding system.

B. Except where specifically indicated otherwise, ground all exposed noncurrent-carrying metallic parts of DCS equipment, DCS raceway systems, and the A/C neutral of all DCS wiring systems in strict accordance with the state, and other applicable laws and regulations.

C. Ground connection to equipment and ground buses shall be by exothermically welded copper ground lugs.

3.2 COMPUTER OR TELECOMMUNICATIONS RACK OR FRAME GROUNDING

A. Rack framework grounding conductor: Each DCS equipment cabinet and equipment rack framework requires its own grounding connection to the grounding infrastructure. A minimum of a No. 6 AWG copper conductor shall be used for this purpose. The recommended conductor types are:

1. Bare copper.
2. Insulated green, UL VW1 flame rated.

B. Rack grounding connection point: Each DCS cabinet or rack shall have a suitable connection point to which the rack framework grounding conductor can be bonded. A dedicated rack ground bus, a 1-inch by 1/4-inch by rack width, copper ground bar or copper strip, shall be attached to the rack. A bond between the ground bar or strip and the rack shall exist. The mounting screws shall be of the thread-forming type, self-tapping or sheet metal screws are prohibited.

C. Bonding to the Rack:

1. When bonding the rack framework grounding conductors to the busbars on the cabinet or rack, two-hole irreversible compression lugs listed by a nationally recognized testing laboratory (NRTL) shall be used to insure that the ground connection does not become loose due to excessive vibration or movement of the attaching cable. Paint or other surface contact inhibitors should be removed before bonding straps are directly attached to metal enclosures or cabinet surfaces. Subsequently,

the connections should be properly treated to inhibit rust, corrosion, and moisture.

2. The connection to the rack should have the following characteristics:
   a. Bare metal-to-metal contact.
   b. Antioxidant recommended.

D. Bonding to the Grounding Infrastructure: Attach the opposite end of the rack framework or equipment grounding conductor (EGC) to the grounding infrastructure (CBN). The connection should use a compression type, through-bolt lug which is UL listed. All DCS equipment, should be connected to the signal reference grid busbar with low-inductance bonding straps or jumpers. Grounding straps should be as short as practicable to minimize inductive reactance in the path.

E. Rack Continuity: Every structural member of the cabinet or rack shall be grounded. This is achieved by assembling the cabinet or rack in such a way that there is electrical continuity throughout its structural members, as described below:

1. For Welded Racks: The welded construction serves as the method of bonding the structural members of the rack together.
2. Bolt Together Racks: Special consideration should be taken while assembling bolted racks. Removing paint at the point of contact with assembly hardware is an acceptable method of bonding. An alternate method is the use of two internal-external tooth lock washers: One under the bolt head contacting and cutting paint and one under the nut.
3. Even in equipment lineups where the cabinets are bolted together, bond each enclosure to the signal reference grid with its own strap.
4. All enclosure doors shall have independent ground straps which bridge the hinge point, providing grounding of the door to the main enclosure frame, or ground buss bar.

F. Grounding Equipment Chassis: All rack-mounted equipment shall be bonded and grounded via the chassis, in accordance with the manufacturer's instructions. The equipment chassis should be bonded to the rack using one of the following methods:

1. To meet the chassis grounding requirements; the manufacturer may supply a separate grounding hole or stud. This should be used with a conductor of proper size to handle any fault currents up to the limit of the circuit protection device feeding power to the equipment unit. One end of this chassis grounding conductor will be bonded to the chassis hole or stud, and the other end will be properly bonded to the cabinet copper ground bar or strip.
2. If the equipment manufacturer suggests grounding via the chassis mounting flanges and the mounting flanges are not painted, the use of

thread-forming tri-lobular screws and normal washers will provide an acceptable bond to the rack.

3. If the equipment mounting flanges are painted, the paint can be removed, or the use of the same thread-forming screws and aggressive internal-external tooth lock washers, designed for this application, will supply an acceptable bond to safety ground through the rack.
4. Assuming adequate grounding, solely through the equipment AC (alternating current) power cables containing a ground wire, is not allowed.

G. Electrostatic Discharge Wrist Straps: The use of static discharge wrist straps when working on or installing network or computer hardware is specified in most manufacturers' installation guidelines. Wrist strap ports shall be provided at each DCS enclosure and shall be permanently attached to the rack grounding busbar by a means that ensures electrical continuity to ground.

3.3 FIELD TESTS

A. Perform all field tests in accordance with Section on 'Electrical Tests'.

B. DCS Grounding:

1. Ground resistance testing shall be performed by an independent testing laboratory.
2. Measurement of ground resistance shall be in accordance with IEEE Standard 81.
3. Measurements of all grounding electrodes shall not exceed 25 ohms per Section 250.56 of the NEC. Resistance testing shall take place after installation but before connecting the earth grounding electrode to the remaining grounding system, but at no other time. The ground resistance tests shall be conducted with a fall-of-potential method instrument.
4. Verify that the impedance level of the EGC (equipment grounding conductor) does not exceed the values per Table 1 below based on the amperage rating of the over-current device for the feeder or branch circuit.
5. An "open ground" indication reveals no EGC connection. A high-impedance measurement indicates poor-quality connections in the equipment grounding system or an improperly installed EGC and must be repaired and retested by the Contractor at no extra cost.

Table 1

Overcurrent Device Rating (A)	Circuit Voltage to Ground	
	120 V	220/240/277 V
10	1.6	-----

15	1.0	1.0
20	0.8	0.7
25	0.6	0.6
30	0.5	0.5
40	0.4	0.3
60	0.10	0.10
100	0.10	0.07
125	0.06	-----
150	0.05	-----
200	0.04	-----

6. The Contractor shall verify that the ground reading through the ground bond conductor from the rack or enclosure, to the independent tri-ground system, or alternately to the UFER ground grid, is 1 ohm or less. Testing shall be provided by an independent ground testing agency in accordance with a City approved Ground Testing Plan. Failure to achieve proper signal grounding, shall require the Contractor to add additional tri-ground systems and larger bonding conductors, and retest to acceptable levels.
    a. At the conclusion of Ground Testing the Contractor shall submit copies of the certified testing report in accordance with Section 01 33 00, Submittal Procedures.

END OF SECTION

SECTION 40 95 33
DISTRIBUTED CONTROL NETWORK

PART 1 – GENERAL

1.1 NAMED TYPES:

A. DCS Network consists of DCSLAN (Facility Information Network (FIN), Process Information Network (PIN)), and DCSWAN (District Information Network (DIN)).

B. Remote Network is a network other than a DCS Network. A DCS Network shall not be directly connected to a Remote Network.

C. DCSLAN: Consists of two elements, FIN and PIN.

1. FIN – Fiber network connecting root switches to fanout switches
2. PIN – Cat 6 cabling between fanout switches and DCS drops.

D. DCSWAN: Inter-plant Wide Area Network (provided by the City COMNET group (DIN)).

E. Business Network Ethernet TCP/IP Communication Network (provided by City), which is also a Remote Network.

F. City Intranet is a Remote Network.

G. Internet is a Remote Network.

H. Wireless Networks are defined as Remote Networks.

1.2 RELATED SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

1.3 REQUIREMENT

A. The DCSP shall interface all DCS components to the DCS LAN at Project plant, which is designed by the Design Engineer and installed by others, under Division 26.

B. The assumptions made for the WORK involved in the section includes:
   1. Each DCSLAN communications network shall be capable of 1 Gbit/sec Ethernet communication system linking all DCS stations.
   2. DCSP shall coordinate with City for IP address assignments.
   3. Cabling shall be provided, installed and tested as specified.
   4. All inter-facility interface cabling shall be fiber optic.

1.4 NAMED TYPES

A. DCS Network consists of DCSLAN and DCSWAN

B. Remote Network is a network other than a DCS Network. A DCS Network shall not be directly connected to a Remote Network.

C. DCSLAN: Intra-plant (facility) Local Area Network (LAN), one at each of the plant facilities.

D. DCSWAN: Inter-plant Wide Area Network (provided by the City COMNET group)

E. Business Network Ethernet TCP/IP Communication Network (provided by City), which is also a Remote Network.

F. City Intranet is a Remote Network.

G. Internet is a Remote Network.

H. Wireless Networks are defined as Remote Networks.

1.5 OTHER NETWORK RELATED SECTIONS

A. Other information regarding the requirements for communication networks can be found in Section 40 95 34 , Fiber Optics.

1.6 SUBMITTALS

A. The DCSP shall submit six (6) hard copies and one (1) soft copy (CD/DVD) of detailed proposed final LAN design diagrams detailing network components, hardware, interfaces, etc. in accordance with Section 01 33 00, Submittal Procedures

B. Based on the Design Engineers Network design, the DCSP shall develop and submit six (6) hard copies and one (1) soft copy (CD/DVD) of a Link Budget Evaluation that calculates the total loss suffered by a transmitted signal across the various components and fiber channels with reference to the minimum receiver power required to maintain normal operation. The purpose of this submittal is to verify adequacy of network design and memorialize the expected signal budgets. The link budget for all point-to-point transmissions shall include the following parameters:
   1. The minimum transmit power guaranteed (minTx), expressed in dBm.
   2. The minimum receive power required (minRx), expressed in dBm.
   3. The loss of optical connectors and adapters (L), expressed in dBm.
   4. The number of connectors and adapters (n).
   5. The normalized fiber loss (FL), expressed in dB/km.
   6. The reach or distance to be achieved (d), expressed in km.
   7. The link budget and loss shall be calculated as follows:
      a. Link Budget in dB (LB) = (minTx)-(minRx).
      b. The total loss (TL) suffered by the transmitted signal along the given link, in dB: (TL) = n*(L) +d*(FL).
      c. Any amplifier gain or dispersion unit loss shall be taken into account in the calculations.

1.7 CODES AND REGULATORY REQUIREMENTS

A. Each communication network has been designed around the International Standards Organization's Open System Interconnection (OSI) model, IEEE 802.3 industry standards and support a hierarchical communications network.

B. All Work shall comply with:
   1. ISO/IEC 11801:2000
   2. ISO/IEC 15802-3:1998
   3. ISO/IEC 17799:2005
   4. ANSI/EIA/TIA-568-B.

1.8 DEFINITIONS

A. Definitions of acronyms are identified in Section 40 90 05, Definitions.

PART 2 – PRODUCTS

2.1 NETWORK ELEMENTS

A. All network elements shall consist of routers and switches, provided by the DCSP from a single Vendor.

B. Network Elements shall be compliant with industrial standards for network managed network elements in harsh environments. This includes the following characteristics:

1. Tolerance to high EMI/RFI.
2. Tolerance to temperature ranges from 0 degrees to 50 degrees C.
3. Tolerance to 95 percent relative humidity, non-condensing.
4. Tolerance to electrical power voltage variations.
5. Tolerance to vibration and physical shock.
6. Supports DIN rail mounting or rack mounting.
7. Powered by 24 V DC.
8. Network Elements shall support security features such as Authentication, Authorization, and Auditing. Security shall include password protection and Access Control Lists. Network Elements shall be capable of port disabling.
9. Network Elements shall support a browser based administration. Network administrators shall be able to log in to the network elements and provision the network elements.

2.2 FIBER OPTIC PATCH PANELS

A. Fiber Optic Patch Panels shall be provided by the DCSP, wall or rack mountable and designed to provide termination facilities for 24 fibers, see Section 40 95 34 for details. Fiber optic patch panels used shall match the existing Enterprise wide DCS installations wherever possible. Existing patch panels are the products of AT&T and Corning or approved equal.

2.3 NETWORK SWITCHES AND ROUTERS

A. The DCSP shall use industrial network switches and routers from Cisco and the DCSP shall guarantee the performance based on its choice of switch or router model. If possible the switches and routers selected shall match that of the existing Enterprise DCS, or shall be of a family that is a successor to the switches originally used. Switches and routers shall be fully backwards compatible with the existing network and network hardware.

B. All switches and routers shall have an IP address on the network. IP addressing scheme will be provided by City COMNET Group to the DCSP, at time of network setup.

C. All switches and routers shall provide built-in support for SNMP

D. All fanout switches shall support fiber links to the root switches via SFP hardware.

E. Multicast traffic shall be allowed on all switches on the DCSLAN

F. Port status shall be visible on LEDs

G. External media converters shall not be used between root and fanout switches.

PART 3 – EXECUTION

3.1 DCSLAN

A. The Design Engineer has designed each DCSLAN for each plant process segment to support the performance requirements and operating characteristics of the DCS. However, it is the responsibility of the DCSP to verify functionality of the DCSLAN and shall immediately notify the Prime Contractor and the City's representative of all operational problems found on the DCSLAN.

B. The DCSLAN shall consist of a dual redundant communications network at each facility.

C. The DCSLAN shall facilitate communications between devices using fiber optic and CAT 6 cables.

D. Each networked DCS device shall be dual ported onto the DCSLAN.

E. The DCSLAN, in its installed configuration shall be fault tolerant.

F. The DCSLAN provides connectivity between the WSs, PCMs, RIOs and Facility Historian System (FHS) to enable the timely update and archiving of process information and timely control response.
   1. To provide support of FHS, the DCSP will provide exterior- mounted Data Jacks on each PCM and RIO cabinet, as a minimum, as specified elsewhere in these Documents. Based on process functionality, or safety considerations, the Design Engineer may have added additional Data Jacks to support FHS, which are shown on the Drawings.
   2. Each Data Jack will be wired back to the nearest port on the appropriate data highway/LAN network switch. Cat-6 LAN cabling shall be provided and installed by others, under Division 26.

G. The DCSLAN designs, and associated documentation, provide the configuration and equipment inventory requirements of a fully dual redundant Ethernet network for all process segments, which shall operate independently of the other plants LANs.

H. VLANs shall conform to standard IEEE 802.1Q.

I. VLAN designs segment traffic onto the appropriate VLAN. VLANs are independent from each other, in particular with regards to bandwidth control and

segmentation. Typical traffic segmentation strategies include defining VLANs and traffic priority schemes. Other VLANs and network traffic prioritization schemes can be defined for administration traffic and operational traffic. Operational traffic may be further subdivided into file transfer traffic (backups) and non-file transfer traffic. Non-FTP traffic shall include VLANS to support applications such as trouble ticket, work management, and other operational applications. Network Design shall provide traffic segmentation and prioritization capabilities to support work cells, where required by specifications.

J. Classic DMZ Network Design utilizes firewalls to isolate the DCS network from the Remote Networks.

K. Network Design shall use standard Cat 6 cables or fiber optic cables for links between Network Elements as specified in the TIA/EIA 568-B set of standards. Cat 6 and fiber optic link cables are provided and installed by others, under Division 26

L. All network devices shall be included in the sizing calculations of the UPS systems. All network devices shall be powered and backed up by DCSP supplied UPS systems provided under Division 40, and installed by others in Division 26.

M. Laminated plastic nameplates conforming to standard ASTM D 709 shall be provided for all network hardware. Nameplates shall include the function, network address, and identifier (ISA Tag) of the device.

N. PCM Data Highway Performance:
   1. Networks are designed with due consideration for quality of services (QoS), bandwidth, latency, and high performance within a plant automation application.
   2. LAN networks shall be robust, scalable, secure, and manageable; and must provide high availability (24x7x365) for single points of failure.
   3. Communication speed shall be capable of 1GB on all ports
   4. Operating Length: 6,000 feet, minimum.
   5. Stations Supported per Highway: 256, minimum.
   6. Time Synchronization interval shall be every 1 minute, minimum, using multicast messaging.

O. Redundancy and Reliability:
   1. The network design supports a network topology design that is fault tolerant. Fault tolerance shall be defined as 99.999 percent system uptime of critical network equipment consisting of the network backbone and associated servers.
   2. The design is to ensure continuing communications between servers and workstation (WSs) under any of the following conditions:
      a. A port on a network adapter fails
      b. A network cable fails

c. A port on a switch fails
d. A switch fails

3. Communications system are fully redundant; no single failure of communications component results in loss of communications to any DCS station.
4. Redundant Components: Including, but not limited to, communications controllers, modems, power supplies, data highway cables, and cable connectors.
5. The DCSLAN design shall incorporate automatic detection of communications system component failure.
6. The DCSLAN design shall incorporate automatic switchover from failed communications system component to backup component without any interruptions to normal operations.
7. The DCSLAN shall alarm switchover and identify the failed component in alarm message to the NMS.
8. Communication system shall not be affected by connection, disconnection, and failure of DCS distributed processing stations (PCMs).

P. Network Elements Performance Requirements:

1. Network Elements shall be able to monitor and alarm for network performance.
2. Excessive loss of packets and elevated network congestion issues shall be alarmed via standard network administration protocols such as SNMP. Network congestion, loss of packets, CRC errors, collisions, IGMP Snooping, defective frames, and the number of packets sent/received and other Quality of Service (QOS) levels shall be defined for various traffic types.

3.2 DCSWAN

A. The DCSWAN shall be provided by the City COMNET Group.

3.3 INDIVIDUAL FACILITIES

A. Treatment Plant Communications

1. The new design includes all process segments of the Plant on one physical LAN.
2. Fiber optic cables in support of the LANs are routed in separate new conduits, raceways or duct banks.
3. Redundant paths are provided in separate conduit so as to provide no single point of network failure in the event of a cable strike, or failure.

END OF SECTION

SECTION 40 95 34
FIBER OPTICS AND INSTALLATION

PART 1 GENERAL

1.1 WORK IN THIS SECTION

A. The Work of the following Divisions and Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Fiber optic cable shall consist of optical fibers, strength members, and jacketing. Associated components shall include optical fiber connectors, optical patch panels, terminal bay cabinets, and splice closures as indicated. Fiber optic cables shall be installed exclusively in inner duct. The Fiber Optic CONTRACTOR (FC) shall install the fiber optic cabling in new, or existing, raceways, concrete-encased duct-banks, conduits, manhole systems in strict accordance with drawings, notes and other specification sections where applicable. Where new raceway is required within structures to support fiber optic cables, those conduits shall be either EMT, GRC or PVC coated GRC, as appropriate for the process area and as specified in Division 26. Fiber optic Termination Panels and Patch panels shall be located in existing or new facility buildings in strict accordance with drawings, notes and other specification sections where applicable.

C. References in this section to 'cable' shall refer to fiber optic cable.

D. FC shall provide LC connectors unless otherwise specified.

1.2 SCOPE

A. The intent of this Specification is that the Fiber Optic CONTRACTOR (FC) will provide a complete and operational, turn-key Fiber Optic based Backbone network, capable of supporting GigaBit plus communications in support of the specified DCS systems at each facility, and locations as shown on drawings.

B. The FC shall furnish all materials, tools, equipment, consumables and supplies and shall perform all labor required to complete the work in this Specification.

C. The FC shall integrate the fiber optic backbone network, with each existing or new facility DCS LAN and WAN, Wide Area Network, Firewalls, Switches and Routers, as shown on drawings and as directed by City COMNET network support staff.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM INTERNATIONAL (ASTM)
1. ASTM C 338 (1993; R 2003), Standard Test Method Softening Point of Glass.
2. ASTM D 4976 (2004a) Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

B. Building Industry Consulting Service International (BISCI)
1. Telecommunications Distribution Methods Manual.
2. Cabling Installation Manual.

C. ELECTRONIC INDUSTRIES ALLIANCE (EIA)
1. EIA 455-168A (1992) FOTP-168 Chromatic Dispersion Measurement of Multimode Graded-Index and Single-Mode Optical Fibers by Spectral Group Delay Measurement in the Time Domain
2. EIA 455-169A (2001) FOTP-169 Chromatic Dispersion Measurement of Optical Fibers by the Phase-Shift Method
3. EIA 455-25C (1996) FOTP-25 Repeated Impact Testing of Single-Mode Fiber Optic Cables and Cable Assemblies
4. EIA 455-30B (1991) Frequency Domain Measurement of Multitude Optical Fiber Information Transmission Capacity
5. EIA 455-33A (1988) FOTP-33 Fiber Optic Cable Tensile Loading and Bending Test
6. EIA 455-41 (1993) FOTP-41 Compressive Loading Resistance of Fiber Optic Cables
7. EIA 455-46A (1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers
8. EIA 455-47B (1992) FOTP-47 Output For Field Radiation Pattern Measurement
9. EIA 455-51A (2001) FOTP-51 Pulse Distortion Measurement of Multi-mode Glass Optical Fiber Information Transmission Capacity
10. EIA 455-53A (2001) FOTP-53 Attenuation by Substitution Measurement for Multimode Graded-Index Optical Fibers or Fiber Assemblies Used in Long Length Communications Systems
11. EIA 455-80B (1996) FOTP-80 Cutoff Wavelength of Un-cabled Single-Mode Fiber by Transmitted Power
12. EIA 455-81B (2000) FOTP-81 Compound Flow (Drip) Test for Filled Fiber Optic Cable

13. EIA 455-82B (1991) FOTP-82 Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable

D. TELECOMMUNICATIONS INDUSTRIES ASSOCIATION (TIA)
1. EIA/TIA 455-165A (1993) Standard for Mode-Field Diameter Measurement by Near-Field Scanning Technique
2. TIA 455-104A (1993, R 2005) Standard for Fiber Optic Cable Cyclic Flexing Test
3. TIA 455-78B (2002) Optical Fibers - Part 1-40: Measurement Methods and Text Procedures – Attenuation
4. TIA/EIA 492 AAAA
5. TIA/EIA 492 CAAB
6. ANSI/TIA/EIA-526-7 Optical Power Loss Measurements of Installed Single-mode Fiber Cable Plant.
7. ANSI/TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
8. ANSI/TIA/EIA-568 Commercial Building Telecommunications Cabling Standard
9. TIA/EIA-568-B.2, Transmission performance specification for 4 pair 100 Ohm Category 6 cabling
10. ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces
11. ANSI/TIA 569-B Commercial Building Standard for Telecommunications Pathways and Spaces
12. ANSI/TIA/EIA-606 The Administration Standards for the Telecommunications Infrastructure of Commercial Building
13. ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications
14. ANSI/TIA/EIA-TSB-67 Telecommunications System Bulletin Technical Systems Bulletin, Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems.

E. ISO: ISO/IEC 11801 (2002) Information Technology – General Cabling for Customer Premises.

F. ITU: ITU-T G.652 Characteristics of single-mode optical fiber and cable

G. IEC: IEC 60793-2-50 Type B1.3.

H. NATIONAL FIRE PROTECTION ASSOCIATION: NFPA-70, National Electric Code.

I. UNDERWRITERS LABORATORY: All Fiber Optic Cable and equipment furnished by the FC in this Section shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, (UL) or of an independent testing laboratory acceptable to the City of San Diego (City).

1.4 SUBMITTALS

A. General
1. All submittals shall be provided in accordance with Specification 01 33 00 – Submittal Procedures, as a minimum, and in accordance with specialty submittal requirement below.
2. All submittal of this section shall be provided with six (6) hard copy and one (1) soft copy [USB storage device]

B. Informational Submittals:
1. Preconstruction Submittals: The following preconstruction submittals shall be submitted to the City's representative for approval and approved prior to installation of any fiber optic cable:
   a. Qualifications of personnel working with fiber optic cable
   b. Quality Assurance Plan
      1) Pre-Installation Test Plan, Fiber Optic Cabling
      2) Post-Installation Test Plan, Fiber Optic Cabling
      3) Primavera P6 Fiber Optic Cable Master Installation Schedule, inclusive of all work related to this Specification Section
2. Product Data: The following Product submittals shall be submitted to the City's representative for approval and approved prior to issuing any Purchase Orders for all applicable Fiber Optic Products. Data shall include a complete list (Bill of Material – BOM) of all material, parts, special tools, consumables and supplies, each with current unit prices, source of supply, and vendors contact information, including telephone numbers. Manufacturer's product data shall be submitted for the following items:
   a. Fiber Optic Cable
   b. Splice Organizers
   c. Pre-Connected Cable Assembly
   d. Fiber Optic Terminal Cabinets
   e. Optical Patch Panel Assemblies
   f. Fiber Optic Line/Patch Cables
   g. Inner Duct
   h. Cable Supports and Management Systems
   i. Cable Trays/Ladder Rack
   j. Fire stopping Material

C. Action Submittals:

1. Test Reports: FC shall submit test reports for approval, to the City's representative, not later than 14 calendar days after the completion of each test. Test Reports shall be submitted as follows:
    a. Factory Test Certificates.
    b. Fiber Optic Cable Bi-Directional, Optical Time Domain Reflectometer (OTDR) pre-installation tests, "on-reel" on site. No cable installation shall occur until the "on-reel" test report has been submitted and approved by City representative.
    c. Fiber Optic Cable Bi-Directional, Optical Time Domain Reflectometer (OTDR) post-installation tests, Installed and terminated.
    d. Unidirectional End-to-End Attenuation Tests.
    e. Unidirectional End-to-End Bandwidth Tests.
        1) The OTDR, Attenuation and Bandwidth 'tests' result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test, and immediately transferred to CD/DVD in the presence of the City representative, to provide non-volatile backup. The CD/DVC shall be transmitted to the City representative immediately upon completion of daily testing.
        2) The test result records saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.
        3) These results shall be transferred to the PC or laptop unaltered, i.e., "as saved by the tester" at the end of each test. The popular 'csv' format (comma separated value format) does not provide adequate protection and shall not be acceptable. The database for the completed job shall be stored and delivered to the City representative on CD/DVD; this CD/DVD shall include the software tools, complete with applicable licenses, required to view, inspect, and print any selection of test reports.
2. Pulling Plan: The FC shall submit a proposed Fiber Optic Cable Pulling Plan. The Pulling Plan shall be submitted for approval to the City's representative not later than 21 calendar days prior to the scheduled start of cable placement.
    a. The Pull Plan: Will identify all Fiber raceway segments to be pulled.
    b. Will identify the proposed methodology of placement for each segment.

c. Will show proposed ‘unique Reel Number Identifications’, ‘cable start and stop footage measurements’, Cable(s) ID number, as well as cable type and fiber count.
d. Will show calculated pulling tension for the segment and proposed methodology for measuring pulling tension in each segment.
e. State manufactures maximum allowed pulling tension for each segment.

1.5 QUALIFICATIONS

A. FC may place cable with his own forces or through a sub-contractor. However, all personnel installing inner-duct work, or cable shall be performed by personnel who have experience in placing fiber optic cabling in conduit, cable trays, and underground duct systems.

B. Fiber optic cable splices, terminations and testing shall be made by certified cable splicers who have had experience in fusion and in-line compression splicing and terminating fiber optic cables. Personnel working pursuant to this section, may, at the City representative option, be required to demonstrate technical competence by performing sample work and/or by displaying their state qualifications/certificates. FC personnel may be required, at no additional cost to the City, to provide sample work shall involving performing a minimum of 10 (ten) acceptable sample splices and 10 (ten) terminations, in the presence of the City representative.

1.6 QUALITY ASSURANCE PLAN

A. FC shall prepare a Quality Assurance Plan. The Plan shall include as a minimum:
1. Shall include a schedule of when tests will be performed relative to installation milestones, specific test procedure that will be used, a list of test equipment that will be used including manufacturer, model number, range, resolution accuracy and shall conform to the specified requirements.
2. List and show all test equipment Calibration certificates, valid within the last 180 calendar days.
3. Show detailed procedures defining methods to ensure compliance to contract drawings and specifications by drawing control, inspection and procurement records.
4. Show when and how each system will be tested, material testing procedures and certification records.
5. Shall address whether cladding modes have been stripped prior to testing, source wavelength (peak), spectral width full width/half maximum (FWHM), mode structure, fiber end preparation, and

bandwidth measurements of fiber links both greater and less than 1 kilometer.

B. Test plan shall be submitted and approved by the City representative in a timely fashion to the PMT, and 'Approved' at least 30 calendar days prior to the start of the Earliest Test Plan item.

1.7 STORAGE AND HANDLING

A. Care shall be exercised in handling materials during construction.

B. The FC shall be solely responsible for proper handling and storage of all fiber Optic cabling and Fiber Optic apparatus. The FC shall ensure that all Fiber Optic cable reels are ordered, received and stored with hard reel-shields in place. [Reels received without reel-shields may, at the sole discretion of the City, be required to be returned].

C. Fiber Optic cabling shall be stored in a clean, dry environment, approved by the City representative, until installation. Fiber Optic cable reels shall be stored with proper orientations such that large reels do not create a crush- weight on fiber.

D. Adequate care shall be exercised when handling and storing reels of cable to prevent damage to the cable. Cable with dents, flat spots, or other sheath distortions shall not be installed

E. Fiber Optic ancillary apparatus, such as connectors, splice cases, patch panels, terminal enclosures, etc. shall be stored indoors in a clean, dry environment at all times.

PART 2 PRODUCT

2.1 OPTICAL FIBERS

A. Named Types:

1. Single Mode Type: Single-Mode (SM) fiber must be the equivalent graded index optical glass. Core diameter of the fiber shall be approximately 8.7 (μm) micrometer. Cladding diameter shall be 125 (μm) plus or minus 3 micrometer (μm). Core cladding offset shall be less than 1 micrometer. Minimum tensile strength of the fiber after primary protective coating shall be greater than 350,000 kilopascal (50,000 psi). Softening point of the clad material of the optical fiber shall be 1630 degrees C plus or minus 50 degrees C in accordance with ASTM C 338, or the optical fiber shall meet the requirements in paragraph entitled,

"Splice Compatibility Test." Corning's SMF-28e+ Ultra Single-mode or equal.

2.

B. Fiber Primary Protective Coating: Optical fiber shall be coated with suitable material to preserve the intrinsic high tensile strength of the glass fiber. Outside diameter of the coated optical fiber shall be 250 plus or minus 15 micrometers. Coating material shall be readily removable, mechanically or chemically, without damaging the optical fibers when the removal is desired.

C. Optical Fiber Color-Code Coating: Primary protective coated SM and MM fibers shall be coated with a color-code coating for individual fiber identification. Maximum outside diameter of color-code coated fiber shall be less than 300 micrometers.

D. Colorants: Color concentrates or inks used to color code the optical fibers and the loose buffer tube shall not be susceptible to migration and chemical reaction with surrounding compounds.

2.2 FIBER OPTIC CABLE

A. Fiber Optic Cable specified under this section shall be provided and staged by the DCSP. However, the fiber optic cable shall be installed by the fiber optic subcontractor and that Work shall be performed under Division 26, inclusive of all fiber terminations, fiber optic pre-installation testing and fiber optic post installation testing. All testing to be witnessed by the City's representative and the DCSP.

B. Cable Length: Cable shall be manufactured continuous with no factory splices. FC, at his discretion, may use 'master-reels', or individual segment reels, as long as proper identification, handling and storage methods are utilized. All cable reels shall have factory-affixed reel identifiers.

C. Materials and Construction:
   1. Materials used within a given cable shall be compatible with all other materials used in the same cable when such materials come into intimate contact. All cable components used shall have no adverse effect on optical transmission or on the mechanical integrity characteristics of the fiber placed in the cable. All materials used shall be non-toxic, non- corrosive, and shall present no dermal hazard.
   2. Minimum required material components applied to fiber optic cable construction shall be central core member, color-coded optical fiber, color-coded loose tube design with:
      a. Gel-free water bloacking technology around loose tube, inner jacket, pulling strength members, and outer jacket.

b. In addition, variations in sequence and construction structural components will be considered when necessary.
c. The fiber shall be manufactured by the outside vapor deposition (OVD) process.

D. Central Core Member: A central core member shall be included to serve as a cable core foundation to reduce strain on the fibers but not to serve as a pulling strength member. Material of the central core member shall be non- metallic.

E. Named Types:
1. 24-fiber cable shall contain multi-mode (MM) or single mode (SM) fibers, as required and as shown on drawings, Type Corning ALTOS , or equal,.
2.

F. Loose Tube Buffering: Color-code coated fibers shall be surrounded with a loose tube buffering for protection from external mechanical and environmental influences. Loose tube buffering shall be color coded for the tube identification.

G. Inner Jacket: Buffer tubes shall be located concentrically around the cable central core member and covered with a polyethylene inner jacket. Polyethylene inner jacket shall be polyethylene in accordance with ASTM D 4976. Pulling Strength Member: Aramid type material shall be used as pulling strength members in the cable to provide pulling strength of at least 2700Newton (600 pounds) for the cable, during the installation process.

H. Cable Outer Jacket: Black, high-molecular weight, polyethylene materials in accordance with ASTM D 4976 shall be applied longitudinally over all the inner jacket and sheathing strength member to form the cable outer jacket. Outer jacket shall be smooth, concentric, non-nutrient to fungus, and free from holes, splits, blisters, or other imperfections.

I. Overall outside diameter of any cable type shall not exceed 0.75 inch.

2.3 CABLE IDENTIFICATION SYMBOL

A. General:
1. An ID shall be hot stamped on the outer jacket of the fiber optic cable at periodic intervals shall be at least every 5 feet.
2. Color shall be white.

B. Identification Approach:

1. Some Cable identification is easily stamped on the cabling at the factory, while other information is not so easily accomplished.
    a. Each cable shall have embossed on the outer jacket of the cable, in white lettering, the following; The Manufacturer's ID or Model Number of the cable. The Type of cable e.g. MM or SM. The number of fibers in the cable. The Footage Marker of the cable. All of the above shall be stamped on the cable at intervals of five (5) feet.
    b. At FC option, each cable shall have the ISA Cable Identification Number, as shown on the drawings, either: (1) embossed on the outer jacket of the cable, in white lettering, or (2) alternately place onto the cable a printed label, of the wrap-on self-laminating type, which contains the unique ISA Cable Identification Number. If option 1 is used, Cable Identification stamping shall be at intervals of five (5) feet. If option 2 is used, Cable Identification tags shall be placed at each end of the cable within five (5) feet of the terminus and at the entrance and exit points of all intermediate points as follows: Pull-boxes, handholes, manholes, cable-tray, splice cases, etc.

C. Cable Reel Identifier:
    1. Each cable reel shall be uniquely identified on the exterior of each fiber optic reel by the manufacturer. In addition, the beginning and ending cable reel footage identifiers shall be placed on the exterior of the reel by the manufacturer.
    2. When preparing the Pulling Plan, the FC shall use this unique cable identifier, as well as the proposed starting and ending footages, for each conduit segment to be pulled.

2.4 REPLACEMENT CABLE

A. In addition, a reel of each size (FO count), and type, of cable furnished by the FC, not less than .5 kilometers in length, shall be provided. This cable shall be turned over to the City representative immediately after on-reel, bi- directional, 'on-site OTDR testing is completed.

2.5 PRE-CONNECTED CABLE ASSEMBLY

A. FC shall supply factory assembled pre-connectorized cable assembly to interface FO cables with the patch panel bulkhead feed-through receptacle. FC shall terminate all fibers, used as well as spares. FC shall supply and install dust caps for all terminated fibers.

B. Single fiber optic cable assembly shall be housed in a cassette form single fiber connector terminated on the three (3) meter length of single fiber, single

mode cable. Single fiber cable shall contain a buffered optical fiber and shall be the same as that provided in the multi-fiber cable.

C. Connector/cable interface shall be able to withstand a tensile force of 110 Newton (25 pounds) without detrimental effects on the connector loss characteristics.

D. Each connectorized cable assembly shall have a loss of less than or equal to 0.5 dB

2.6 OPTICAL PATCH PANEL ASSEMBLIES

A. All cable terminations shall be made in optical patch panel assemblies. Patch panel assemblies shall be of the pre-assembled chassis type with associated rack-mounting hardware.

B. Splice attenuation shall not exceed 0.2 db. Splice shall be covered with a protective sleeve.

C. FO Patch Panels are to be located 'within' the Fiber Optic Terminal Cabinets (FOTC) enclosures as shown on drawings; typically located adjacent to the DCS PCM cabinet.

2.7 FIBER OPTIC TERMINAL CABINETS

A. FOTCs shall be front access only.

B. Cabinet's frame shall consist of vertical and horizontal tubular aluminum extrusions with a minimum wall thickness of .150. Front to rear aluminum extruded corners shall be at least .125 thick.

C. Rear door, top panel, and side panels shall be a minimum 316 Stainless Steel.

D. FOTC shall be NEMA 12 or NEMA 4X, based on Area Classification. Where Area Classifications dictate NEMA 4X, the cable entry shall be sealed with EYS type fittings and sealed only after final cable testing.

E. Ten (10) feet of fiber shall be coiled prior to termination to Patch Panel within the FOTC. This requires cable handling and dressing mechanisms within the FOTC that shall be subject to City representative approval as part of the enclosure submittal.

F. FOTC shall be wall mounted, and seismically rated and braced.

G. FOTCs shall provide for strain relief of incoming cables as well as providing connector panels and connector couplings adequate to accommodate the number of fibers to be terminated.

H. All FOTCs shall incorporate radius control mechanisms to limit bending of the fibers to the manufacturer's recommended minimums.

I. Couplers shall be mounted on a panel that, in turn, snaps into the housing assembly.

J. FOTCs shall have a common key lock that opens all FOTCs installed for this project, or a common City lockset as directed by City representative.

K. FOTCs shall be rack-mounted, unless specified otherwise in the drawings. Size should be 24-fiber.

2.8 SPLICE ORGANIZERS

A. Single mode fibers shall be fusion spliced with a protective sleeve covering and stored in an organizer with a minimum of 450 millimeters (18 inches) spare coiled buffer tubing.

2.9 FIBER OPTIC CONNECTORS

A. FOT fiber optic single mode connectors (LC/APC – angle polish) shall be suitable for optical circuits.
   1. Connectors: Attenuation per mated pair shall not exceed 0.75 dB (individual) and 0.5 dB (average). They shall sustain a minimum of 200 mating cycles per EIA/TIA – 455-21 without violating specifications. Connectors shall meet the following performance criteria:

Test	Procedure	Max. Attenuation Change (dB)
Cable Retention	FOTP-6	0.2 dB
Durability	FOTP-21	0.2 dB
Impact	FOTP-2	0.2 dB
Thermal Shock	FOTP-3	0.2 dB
Humidity	FOTP -5	0.2 dB

B. Manufacturer: Corning or equal

2.10 FIBER OPTIC LINE/PATCH CABLES

A. All fiber optic patch cords shall be duplex zip cords, factory terminated and 100 percent tested.

B. All fiber optic patch cords shall match fiber optic panel termination connector, i.e., green LC/APC to LC/APC for angle polish.

2.11 FIBER OPTIC INNER DUCT

A. This specification applies to the following:
   1. Flexible, Plenum and Riser-rated inner duct
   2. Flexible, Plenum and Riser-rated MaxCell Cells

B. Pull cord: Each inner duct shall come with pull cord. Pull cord shall be 1/4- inch polypropylene or equivalent with a minimum tensile strength of 1250 pounds. Pull cord shall be installed in the inner duct prior to delivery to the construction site. The pull cord shall extend 6 feet beyond the termination at each end.

C. Conduit and inner duct plugs: The Fiber Optic conduit plugs will be Jack Moon Duct Plug from TYCO or equal. Inner duct will be affixed to the interior of the Duct Plug by an approved means, in accordance with MaxCell or TYCO technical bulletins.

PART 3 EXECUTION

3.1 FACTORY TEST

A. Fiber optical cable shall comply with the optical and mechanical test requirements of this section.

B. The MANUFACTURER shall certify OTDR test, optical, and mechanical performance for each reel. Manufacturers' Certification shall be delivered with the fiber optic cable when it arrives.
   1. Factory testing documentation shall be submitted to the City representative upon receipt of cable, and before any on-site OTDR testing commences.

C. Optical Performance:
   1. Single-Mode Fibers in the Cable:
      a. Optical attenuation of each optical fiber in the cable (reeled) shall be no greater than 0.4 dB/Km at 1310 nm, plus or minus 50 nm, optical spectrum window and 0.3 dB/km at 1550 nm. Attenuation shall be measured on completed cable reel length, and normalized linearly to 1 Km. Measurement method shall be in accordance with TIA 455-78B, at central wavelength 850 nm nominal.
      b. Pulse dispersion of each optical fiber in the cable (reeled) shall be no greater than 3.5 picoseconds/nm-Km within the emissive

region of 1285-1330 nm. Measurement method shall be in accordance with EIA 455-168A and EIA 455-169A.

c. Mode field diameter at 850 nm optical spectrum window shall be within 10 plus or minus 1 micrometer. Measurement method shall be in accordance with EIA/TIA 455-165A at central wavelength 850 nm nominal. When this requirement is not met, the fusion splice compatibility test shall be applied.

d. Cut-off wavelength for 850 nm optical spectrum window shall be within 1200 plus or minus 70 nm. Measurement method shall be in accordance with EIA 455-80B.

D. Mechanical Performance:

1. Minimum Bend Radius: Cable shall be able to withstand bending to a minimum radius of 10 times the cable outer diameter without tensile load applied, and of 20 times the cable outer diameter with maximum tensile load applied (during installation), without damage to cable components or degradation of the optical fiber performance at room temperature.
2. Tensile Strength: Fiber optical cable shall withstand a pull force of at least 2700 Newtons (600 pounds force per square inch) to be applied to the pulling strength member during the installation, and a tensile load of at least 300 Newtons during operation without incurring any damage or detriment to fiber optical cable and optical performance. Tensile strength test shall be in accordance with EIA 455-33A.
3. Flexing or Bending Cycles: Fiber optical cable shall withstand at least 20 bending cycles at minimum bend radius without damage to the fiber optic cable components or degrading optical performance. Cyclic flexing test shall be in accordance with TIA 455-104A.
4. Crush Resistance: Minimum crush resistance of the fiber optical cable shall be greater than 650 Newton/centimeter (cm) without damage to cable components or degrading optical performance. Crush resistance test shall be in accordance with EIA 455-41.
5. Impact Resistance: Fiber optical cable shall be capable of withstanding 20 impacts, at five Newton-meters force, without damage to cable components, or degradation of optical performance. Impact resistance test shall be in accordance with EIA 455-25C.
6. Waterbloacking Compound Drip Test: Optical cable shall be tested for the ability of the waterblocking compound in the interior of the inner jacket and loose tube buffer to resist flow at the temperature range of minus 40 degrees C to 60 degrees C in accordance with EIA 455-81B.
7. Fluid Penetration: Optical cable shall be capable of preventing the entry and axial migration of pressurized water when subjected to fluid penetration testing in accordance with EIA 455-82B.

3.2 TEMPERATURE ENVIRONMENT

A. Fiber optical cable shall comply with the mechanical performance requirements herein while used in duct applications where the temperature varies from minus 8 degrees C to plus 38 degrees C. Optical performance degradation shall be less than five percent of the optical performance requirements in the temperature range of minus 20 degrees C to plus 60 degrees C. Fiber optical cable shall not be damaged in storage where the temperature may vary from minus 40 degrees C to plus 65 degrees C.

3.3 FIBER SPLICES

A. The use of fiber optic splicing is to be minimized. The FC shall perform all cable splicing with certified personnel approved by the City representative. Outside plant fiber splices shall be fusion type and made along the fiber route where shown on the design drawings, or when FC reel lengths and related cable 'budget' are not a concern. FC shall ensure that Splices shall exhibit an loss not greater than 0.2 dB. All splice measurements shall be made at appropriate frequencies for cable type. All splices shall be mounted in trays within splice enclosures.

B. Completed splice shall be covered with a protective sleeve heat shrink type to restore the protective properties of the fiber coating and buffering. Deviations to the splice, location and pulling plans, will be permitted upon approval by the City representative, and shall be provided at no additional cost to City.

C. All fiber colors shall be continuous from end to end. No switching or staggering of color scheme within the cable at splice points shall be allowed.

D. Cables shall be brought out of manhole, handhole or intermediate pull-box in a controlled environment to perform the fiber fusion splice operation. Splice shall be completed by returning the cable to the manhole, etc. such that the excess cable does not impede future entrance and utilization of the enclosure. Cable shall be secured within the enclosure at intervals not in excess of 3 ft. utilizing standard galvanize racking hardware, provided by the FC. Racking hardware shall maintain minimum bend radius requirements.

E. Field verification of all cable measurements end-to-end, before installation, is required to avoid any and all mid-span splices.

3.4 UNDERGROUND CABLE INSTALLATION

A. It is the responsibility of the FC to install all fiber optic cabling, in raceway, ductbanks, etc. provided and installed by others, under Division 26 of the specifications. It is the responsibility of the FC to inspect all raceway and

ensure that raceway has been installed in accordance with bend radius requirements and that all raceway is mandreled and clean, ready of cable installation. When placing Fiber Optic cabling the FC shall ensure that proper roller stands and sheaves are used to prevent strain or damage to the cabling during installation.

B. In the event that the FC's installation crews witness any anomaly to the fiber during installation they are to immediately stop installation and notify the City's representative.

C. Securing Cable:
   1. Immediately after cable placement, a permanent identification tag shall be attached to visible cable sections. Cables shall be checked to ensure that the markings are intact.
   2. Cables and equipment shall be supported and secured as indicated in the design drawings. Where the specific method of support is not shown, supports and fasteners shall be used to secure cables and equipment in position. Metallic supports and fasteners shall be Stainless Steel. All cables shall be routed along the interior sides of manholes and shall be secured such that no more than a 4" catenary is evident between fasteners.
   3. No fewer than four, and preferably eight (8), cable/racking hooks shall be required per manhole and shall be provided by the FC.
   4. Clamps and straps consisting of stainless steel clamps and black-nylon ty-wraps shall be used as necessary to properly secure the cable
   5. Sequential cable markings along the cable, prior to and after each end of splice point, shall be recorded on the sequential cable form and submitted for approval.

D. Bending:
   1. Caution shall be used by the FC when bending cable to avoid kinks or other damage to the sheath. Bend radius shall be as large as possible with a minimum of 10 times the cable diameter. Minimum radius shall be increased when necessary to meet cable manufacturer's recommendation. Cables shall not rest against any sharp edges.
   2. Minimum bending radii shall not be exceeded as specified by the cable manufacturer during placement.

E. Pulling:
   1. Pulling lines shall be attached to both cable ends when cable is destined for bi-directional pull, and fitted with factory-installed pulling eyes. Cables not equipped with a pulling eye shall have the pulling line attached to the cable end by means of a cable grip. Core hitches shall not be used.

2. Cable reels shall be located and aligned so that the cable is pulled out from the top of the reel into the duct or conduit in a long, smooth bend without twisting. Cable shall not be pulled from the bottom of the reel. A cable feeder guide of proper dimensions shall be used at the mouth to guide the cable into the duct or conduit.
3. Rigging shall be set up at the pulling end so that the pulling line and cable exit on a line parallel with the duct or conduit to prevent either from rubbing against the edge or mouth. Cable ends shall not be pulled around sheave wheels. When the sheave or pulley cannot be positioned to obtain sufficient cable end slack for proper racking and splicing with the pulling line attached to the end of the cable, a split cable grip may be used to obtain the necessary slack.
4. Unless direct burial cable, conductors shall be protected from earth, concrete or asphalt during a pull by plastic or canvas tarp covering the ground.
5. The FC shall perform all cable installation in conformance with the cable manufacturer's installation guidelines. Do not exceed cable manufacturer's recommendations for maximum pulling tensions. Where indicated in the Pulling Plan cable tension shall be monitored with a manometer.

F. Lubricant:
1. The FC shall use pulling lubricant to minimize pulling tension and prevent sheath damage when pulling cables into ducts and conduits. Lubricant shall be applied to the cable sheath with a lubricator. When pulling has been completed, the exposed cable ends shall be wiped clean of lubricant.
2. Lubricants shall be compatible with and intended for use with plastic-sheathed cables. Soap and grease type lubricants shall not be allowed.
3. All equipment and the pulling set shall be checked to minimize interruptions once pulling begins. Cable shall be pulled without stopping until the required amount of the cable has been placed. When the pulling operation is halted before the pull is completed, the tension of the pulling line shall not be released. When pulling is resumed, the inertia of the cable shall be overcome by increasing the tension in small steps a few seconds apart until the cable is in motion. Cable shall be paid from the top of the reel by rotating the reel in the feed direction at the rate of pull. Cable shall not be stripped off the reel by hand-pulling.

G. Damage and Defects:
1. FC shall use a tension monitoring device (Manometer) to ensure that the maximum pulling tension that may be applied to the cable to be pulled into a conduit section is not exceeded, unless cable is being pulled by

hand. Any damage to the cable due to exceeding the maximum tension will require a new cable furnished by the FC at his cost.

2. Cable shall be carefully inspected by the FC for sheath defects or other irregularities as it is paid out from the reel. When defects are detected, pulling shall stop immediately and the cable section shall be repaired or replaced at the sole discretion of the City representative. A system of communications shall be maintained between pulling and feed locations so that pulling can be stopped instantly, when required.
3. Cable shall be hand guided through intermediate manholes and into the next duct section when making pull-through. Proper rigging shall be used in the intermediate manhole to keep the pulling line and cable aligned with the exit duct to prevent the line or cable from rubbing against the edge of the duct. Cables in pull-through manholes shall be set up and racked before the cable ends in adjacent manholes are set up and racked.
4. Cable ends pulled into manholes, vaults, or terminal locations that are not to be racked or otherwise permanently positioned immediately shall be tied in fixed positions to prevent damage to the cables and provide adequate working space.

H. Seal:

1. Ducts or inner duct in which cable is placed shall be sealed with appropriate plugs or seals as specified elsewhere. This material shall be inserted between the cable and the duct and in all unused ducts, in order to prevent damage to the cable sheath and to prevent the entrance of dirt or water into the Ducts from the manhole or vault.
2. Cables shall be provided in continuous lengths as required to accomplish the required installation without splices from termination to termination, except where field splices are specifically shown on approved field installation design submittals.

3.5 CABLE INSTALLATION IN CABLE TRAYS

A. Except where shown by the design engineer, fiber optic cables shall not be installed in the same cable tray with ac power cables containing power in excess of 208 volts to ensure physical safety of FC installers, and subsequent safety of City personnel.

B. The cable tray pathways shall be as specified in Division 26, Electrical.

C. Cables placed in cable trays shall be installed in a neat and orderly manner.

D. Cables in vertical trays shall be individually retained with Velcro straps at a maximum of 6 ft. on center.

E. Provide and install cable management and support as required.

3.6 CABLE INSTALLATION IN CONDUIT

A. All conduits housing fiber optic cable shall be at least 3/4 inch in size. The conduit should be sized appropriately in accordance with the EIA/TIA 569A. Conduits are installed by others, under Division 26, Electrical.

B. Any conduits housing fiber optic cable shall have an inside bend radius of at least ten times the internal diameter of the conduit or the manufacturers specified bend radius of the fiber, whichever is greater.

C. All conduits housing fiber optic cable shall be terminated with an insulated bushing to prevent damage to the conductor during installation or shall be terminated with a Jack Moon (Tyco) sealing plug after cable installation.

D. All conduits, and inner duct, installed for fiber optic cable must be installed by others with a nylon pull cord.

E. All conduit and trays shall be supported to the structure, independent of other services. Refer to Division 26, Electrical, regarding conduit support.

F. All conduits that are larger than two inches and will house fiber optic cable must be filled with inner duct or MaxCell equivalent cells prior to the installation of the fiber optic cable. See the following table:

Conduit Size	**# of Inner ducts**
3" conduit	3-1" inner ducts
4" conduit	3-1" plus 1-1¼" inner ducts
5" conduit	3-1" plus 2-1¼" inner ducts

3.7 BACKBONE CABLE SERVICE COILS

A. Install backbone cable service coils with length of ten (10) feet and a coiled diameter as required by manufacturer at each end of all new fiber optic cables to control excess cable lengths before terminating fiber strands.

B. Install backbone cable service coils in 24' x 24' x 6' NEMA 1 enclosure within four feet of cable entrance inside of room. Use four adhesive holders and hook and loop fasteners to bind fiber service coil in four places with separation of 90 degrees and secure the slack fiber to the interior of the junction box. Tie wraps are not permitted.

3.8 FIRE STOPPING

A. Provide fireproof seals where required in accordance with the National Fire Protection Association (NFPA) and the National Electric Code (NEC), Article 200-221 and EIA/TIA 569 standards.
   1. Fireproofing around raceways or conduits shall be provided by others as called for on design drawings and Division 26, Electrical.

3.9 TESTING

A. Pre-Installation Testing, Fiber Optic Cables
   1. The FC is responsible for conducting full pre-installation testing of the Fiber Optic Cabling in accordance with this section and section 1.04.B
   2. Pre-Installation testing will be accomplished, bi-directionally, utilizing an Optical Time Domain Reflectometer (OTDR) and will be accomplished on each fiber, of each cable while still on the shipping reel. Pre-installation testing will be accomplished without any apparatus, connectors, etc., with the exception of the OTDR Launch cord/cable, affixed to the fiber under test.
   3. Prior to commencement of pre-installation testing, the FC will submit a Testing Plan which will address testing methodology for both Pre-and Post Installation testing. This plan should specify all parameters under which the FC will be testing the cables. All test equipment, test procedures, and testing techniques shall be specified in the Test Plan
      Note: no fiber optic cable may be placed until:
      a. The Test Plan is submitted and approved by City representative.
      b. The Pre-Installation OTDR testing is complete for all cables.
      c. The OTDR Test Report, CD/DVR, report software, etc. for Pre-Installation Testing has been submitted to the City representative.
      d. The FC receives written notice that the City's representative is ready and in place (Approval to Proceed)
   4. The City's representative will witness all pre-installation fiber optic testing. The City's representative will perform no less than 25 percent spot-witnessing of Pre-Testing and may, at his sole option, witness 100 percent of the testing.
   5. During testing the FC will log each cable, by real and/or cable identification number, and will provide a testing sign-off sheet for each reel tested. FC will continue to reference this same reel and/or Cable ID number in his pulling plan such that testing data can be tracked to each cable segment(s) for post-installation testing.
   6. During testing the City's representative may suspend testing at any time, if in his sole opinion, testing is not being conducted in accordance with this section, or the Testing Plan.
   7. During testing the City's representative may fail any reel of cable that has obvious flaws as determined by the OTDR. Should the cable flaw be within the first or last 10 percent of the reel length being tested, or if in

the sole opinion of the City's representative there is sufficient usable length on the reel, the FC may be allowed to re-spool the usable cable and re-test it at another time. If in the sole opinion of the City's representative a cable reel is 'rejected', the FC shall replace, and retest, that length of rejected cable at the FC's sole expense.

8. At the conclusion of Pre-Installation Testing the FC and the City representatives, will immediately sign each of the Reel Testing Sheets.
9. At the conclusion of Pre-Installation Testing the FC will immediately download the OTDR data, in the presence of the City representative, and burn that data to CD/DVD for record purposes. One Copy of the Disk will be turned over to the City representative.
10. The Hard Copy Report of the Pre-Installation OTDR Test will be provided in accordance with the Submittal Requirements in Section 1.03

B. Post-Installation Testing Fiber Optic Cables:

1. The FC is responsible for conducting full Post-Installation testing of the Fiber Optic Cabling in accordance with this section.
2. Post-Installation testing will be accomplished, bi-directionally, utilizing an Optical Time Domain Reflectometer (OTDR) and will be accomplished on each fiber, of each cable on the fully installed cable network. Post-Installation testing will be accomplished with each segment cable connectorized and attached to its respective bulkhead fitting at the Fiber Optic Patch Panel associated with each end of the cable. Additionally, the OTDR launch cord/cable will be affixed to the Patch Panel at one end of the fiber under test and a landing/cord cable at the other to make cable definition obvious.
3. Prior to commencement of Post-Installation testing, the FC will have submitted a Testing Plan which will address testing methodology for Post Installation testing. This plan should specify all parameters under which the FC will be testing the cables.
4. The FC shall provide written notice of his intent to perform Post-Installation Testing of Fiber Optic Cabling a minimum of thirty (30) calendar days prior. Note: Submission of the Testing Plan or test reports does not constitute written notice for this purpose.
5. The FC shall not proceed with Post-Installation testing until he receives written notice that the City representative is ready and in place (Approval to Proceed).
6. The City's representative will witness 100 percent of the Post- Installation testing.
7. During testing the FC will log each cable segment by cross-referencing to the Pre-Installation testing real and/or cable identification number, and will provide a testing sign-off sheet for each Cable Segment tested.

8. During testing the City's representative may suspend testing at any time, if in his sole opinion, testing is not being conducted in accordance with this section or the Testing Plan.
9. During testing the City's representative may fail any Cable Segment that has obvious flaws as determined by the OTDR. Should the cable flaw be associated with connectorization or faulty Patch Panel Bulkheads, the FC will be given the opportunity to repair and retest that segment at a later time. If in the sole opinion of the City's representative a Cable Segment is 'rejected', the FC shall remove the defective cable, replace it with a new Pre-Tested cable, and retest that Cable Segment at the FC's sole expense.
10. At the conclusion of Post-Installation Testing the FC, and the City representative, will immediately sign each of the Cable Segment Testing Sheets.
11. At the conclusion of Post-Installation Testing the FC, will immediately download the OTDR data, in the presence of the City representative, and burn that data to CD/DVD for record purposes. One Copy of the Disk will be turned over to the City representative.
12. The Hard Copy Report of the Post-Installation OTDR Test will be provided in accordance with the Submittal Requirements in Section 1.03

3.10 TEST REQUIREMENTS

A. Test equipment used for verifying installation testing shall be calibrated by a certified testing company within 30 days of use. Calibration certification shall be provided to the City's representative immediately prior to the start of testing.

B. Single and Multi-mode OTDR Test: The OTDR shall conform to the following minimum requirements:
   1. Operating wavelengths: single-mode at 1310nm and 1550nm plus or minus 20 nanometers in accordance with ANSI/TIA/EIA-526-7, Method A.1, Two Reference Jumper or the equivalent method. All single-mode links shall be certified with test tools using laser light sources at 1310 nm and 1550 nm. All multi-mode links shall be certified at 850 nm and 1300 nm.
   2. Attenuation Range (one way): minimum 5 dB at 1,300 nm
   3. Attenuation Resolution: 0.01 dB
   4. Accuracy: plus 0.5 dB.
   5. OTDRs shall have digital readout capability and shall have a means of providing a permanent record in the form of both electronic and hardcopy printout report displaying the OTDR tracegraph.
   6. Test results:
      a. Reflective events (connections) shall not exceed 0.5 dB.
      b. Non-reflective events (splices) shall not exceed 0.3 dB.

c. End-to-End Attenuation Tests: An attenuation measurement test set shall consist of an optical power meter and an optical power source. Attenuation measurement test set shall be in accordance with the applicable National Bureau of Standards (NBS) standards for a stable optical source. Meter may be analog or digital. End-to- end attenuation test reading shall be included on the test reference loss. The attenuation/insertion loss test shall be in single-direction only, in accordance with TIA/EIA-526-7, Method A-1.

C. Measurement test set shall conform to the following minimum requirements:
   1. Operating wavelengths: single-mode at 1310 and 1550 nanometers plus or minus 10 nanometers.
   2. Attenuation Range: at least 30 dB at 1,300 nm
   3. Attenuation Resolution: 0.01dB
   4. Accuracy: The accuracy of the attenuation measurement test set shall be plus or minus 5 percent.
   5. Optical source shall be capable of coupling sufficient power into the fiber so that the light received at the meter is within the meter delectability limits.

D. End-to-End Bandwidth Tests:
   1. Bandwidth test shall conform to the following minimum requirements:
      a. Operating wavelengths: single-mode at 1310 and 1550 plus or minus 10 nanometers
      b. Bandwidth range: minimum 1000 megahertz
      c. Bandwidth Resolution: 1 megahertz
      d. Accuracy: plus or minus 0.5 megahertz
      e. Measurement Method: Swept Frequency

E. Magnified Optical End Face inspection:
   1. Fiber end faces shall be inspected after connectorization but before termination at 250X or 400 X magnifications. 250X magnification are suitable for inspecting multimode and single mode fibers. 400X magnification may be used for detailed examination of single mode fibers.
   2. Scratched, pitted or dirty connectors shall be diagnosed and corrected.

END OF SECTION

SECTION 40 96 00
APPLICATIONS SOFTWARE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The DCSP shall design, develop, and start up the DCS Application process control software.

B. The work of this Section shall include:
   1. Project management and revision control
   2. Applications software workshop, if and when required by City's representative
   3. Applications software submittals
   4. Applications software development
   5. Software testing
   6. Software installation
   7. Startup

C. All Application Software developed for this Project shall fully conform with and be integrated into the existing Enterprise wide COMNET DCS. New Application Software development shall follow, as closely as possible, the control scheme Application Software of the existing system(s).

D. The DCSP shall provide all loop tuning and software modifications employed throughout the startup and testing period with actual process to provide operation exhibiting stable and controllable response to all process changes, steady state operation, and alteration of control parameters such as set point, with robust and fault tolerant functionality, all in accordance with the requirements of these specifications.

E. All Application Software developed for this project shall follow the Best Practices for Designing Control as defined in Emerson's "Control Builder User Guide for Ovation" documentation.

F. All Application Software developed by DCSP for the CoSD DCS becomes the property of CoSD and may be modified, deleted, copied and reused for other functions or in other drops or other plants. The CoSD will not retransmit any Application Software beyond the exclusive use in the CoSD (COMNET) DCS.

1.2 RELATED SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 - Submittals
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego

1.3 DIVISION OF WORK

A. The DCSP shall provide and implement the applications software required to complete the Work.

B. The DCSP shall have overall system responsibility and shall provide all work necessary to satisfy all requirements of this and related sections.

C. The software of this Section at a minimum shall include software, programming and configuration of: PCM control code, graphics code, trend groups and reports.

D. Definition of Software Types:
   1. Standard Software: Software packages that are independent of the project on which they are used. Standard software includes system software and process monitoring and control software.
      a. System Software: Application independent software developed by Microsoft. Includes, but is not limited to Microsoft operating systems, file management utilities, text editors, debugging aids, and diagnostics.
      b. DCS Software (DCSS): Software packages independent of the specific process control project on which they are used. Includes, but is not limited to, providing capability for, data acquisition, monitoring, alarming, man-machine interface (MMI), data collection, data retrieval, trending, report generation, control, and diagnostics.
   2. Application Software:
      a. Software to provide functions unique to this Work and that are not provided by standard software alone.
      b. Configuring databases, tables, displays, reports, parameter lists ladder logic, and control strategies required to implement functions unique to this Project.

1.4 WORK SEQUENCE AND SCHEDULE

A. DCSP shall integrate all elements of this section to their P6 fragnet schedule and integrate this schedule information into the Prime DCSPs Master Baseline Schedule.

1.5 CODES AND REGULATORY REQUIREMENTS

A. City of San Diego, COMNET Graphic Display Standards, 1995.

1.6 PREREQUISITES FOR SOFTWARE DEVELOPMENT

A. Process & Instrumentation Diagrams (P&IDs) – DCSP shall utilize P&ID drawings developed by the Design Engineer. Should the DCSP determine errors or omissions in the P&IDs that would affect software development schedules, he shall immediately notify the City's representative and the Prime DCSP. DCSP shall keep diligent red-line markups of all P&ID modifications, additions or clarifications.

B. Loop Diagrams & Specifications: DCSP shall utilize Loop Drawings developed by the Design Engineer. However, the DCSP is responsible for providing DCS-level details e.g. I/O termination identification, software level addresses, etc., to the Design Engineer to allow him to finalize the Project as-constructed Loop Drawings.

C. Fully attributed I/O Lists and attributed Control Narratives: DCSP shall annotate and attribute the Design Engineers I/O list, and shall annotate Design Engineer's Control Narratives with all assumptions, corrections and changes, for each process segment of the Project. The DCSP shall maintain red-line markups of all changes to facilitate final as-constructed documentation.

D. Control Strategies: The DCSP shall review Project Control Strategies for completeness. Should the DCSP find any errors or omissions, or have questions as to functionality, he shall immediately notify the City's representative.

E. The DCSP shall develop process graphics descriptions for all graphics programming, for all process segments, as part of the Software Submittal(s) for that process segment. The DCSP shall ensure that new graphics development conforms with existing COMNET DCS standards and will function with, and be integrated onto, the existing Enterprise wide DCS.
   1. At a minimum, the process graphics descriptions will include:
      a. Graphic hierarchy
      b. Navigation/Paging
      c. Operator inputs and control templates
      d. Action buttons and menus

e. Color coding, alarming, background fills, animation

1.7 SOFTWARE DESIGN WORKSHOPS

A. DCSP may request software design workshops for the work in this section on a process area by process area basis to clarify any questions or confirm compliance with City DCS standards. Should the DCSP require workshops, they shall submit the request through their Prime contractor to be processed through the City's representative.

1.8 DCS SOFTWARE SUBMITTALS

The DCS Software Submittal (DCSSS) shall be singular and all inclusive, submitted in accordance with Section 01 33 00, Submittal Procedures. The DCS Software Submittal shall include, but not be limited to:

A. The DCSP shall provide all Submittals in accordance with Section 01 33 00, Submittal Procedures. DCSP shall provide six (6) hard copies and one (1) soft copy (USB Storage Device) of all submittals.

B. Logic Diagrams: The DCSP shall develop and submit logic diagrams for all new PCM codes for City's representative approval. Diagrams shall be organized and bundled in a way that facilitates optimum review by the City's representative. All PCM codes shall be annotated with comments.

C. Graphic Diagrams: An English narrative of each data acquisition or control loop mission and anticipated action. Narratives shall enumerate the signal point name, signal descriptor, associated PCM number, associated system template displays, system functions activated by signal (i.e., interlocks, alarms, logs, etc.)

D. I/O Database: The DCSP shall develop and submit a fully attributed I/O database. The I/O database shall be organized and bundled in a way that facilitates optimum review by the City. The complete listing of the DCS database shall list each data point's relevant parameters such as range, contact orientation, limits, incremental limits, I/O card type, I/O hardware address and assignment as minimum.

E. Reports: The DCSP shall document and submit all reports being developed units this contract.

F. PCM Software Standards: The DCSP shall develop PCM software standards based on the Function Blocks listed in this Section.

G. DCS Standards: The DCSP shall utilize the existing City COMNET software standards to the greatest degree possible.

H. A complete set of PCM configuration sheets depicting each loop linkage. Each loop shall be on its own 11" x 17" sheet.

1.9 DCS GRAPHIC SUBMITTAL

The DCS Graphic Submittal (DCSGS) shall be singular and all inclusive, submitted in accordance with Section 01 33 00, Submittal Procedures. The DCS Graphics Submittal shall include, but not be limited to:

A. One complete set of all WS-accessible displays which are unique to this project (i.e., process global, system global, process regional, systems regional, process group, process loop, process component, integrated tutorials, integrated process tutorials, integrated documentation, user assistance.)

B. The DCSP shall ensure that all graphics development, and graphics submittal, conform to the existing graphics layouts, linkages and formats used throughout the COMNET Enterprise.

C. The Graphics Submittals shall contain displays in full size color graphic format and replicate the proposed screen contents. All background colors shall be identical to that of the screen content. All displays shall be arranged in a hierarchical order with references to associated WS's.

D. A system display linkage diagram which defines the hierarchical order and the linkages via page, down, left, right commands.

E. A definition of each display's data fields by tag numbers, utilizing City's standard.

F. A definition of each display's dynamic elements which shall blink, change color, rotate or change shape in response to process changes, and conforms to the City's standard.

G. A listing of all "help" text associated with each display screen, arranges in conformance to the City's standard.

PART 2 PRODUCTS

2.1 PCM APPLICATION SOFTWARE DESIGN CRITERIA

A. PCM Program Design:

1. DCSP shall develop and submit PCM Application software in strict accordance with these requirements and following existing City COMNET software standards.

2. The PCM shall be used to provide each process segment automatic control, alarm functions, and continuous loop control. Specific PCM functional requirements are described in the control narratives of source code for the current system provided as part of the Contract Document.
3. The DCSP shall organize the PCM application software into:
    a. Sections:
        1) Contains all logic for a specific unit operation.
        2) Each section consists of a general logic sub sections and, followed by unit operation sub sections.
    b. Subsections: Contains logic for specific equipment such as a pump, valve or loop.
    c. Functional Blocks:
        1) Building block for pumps, valves, loop control, analog processing, and alarm switches.
        2) Requirements for standard DCS/PCM function blocks to be provided are specified herein.
4. Program Documentation:
    a. Note and describe start of a new program section.
    b. Briefly describe control objectives.
    c. Identify subsections.
    d. Subsection documentation includes brief description of control objective followed by a description and tag of the equipment being controlled.
5. The DCSP shall provide an organizational index for PCM applications software that can be used to quickly search and locate a specific process section.

B. Program Flow Diagram:
1. Develop Program Flow Diagrams (PFDs) showing software Sections, subsections and functions blocks, subprograms, and their interrelationships. Provide written description of each section subsection and function block that will be used in the actual program.
2. PFD for each analog loop and PID loop configuration to include written descriptions of setpoint ramps, loop initialization, interface with DCS, etc.
3. PFD submittals shall follow SAMA Standards.

C. PCMs shall have redundant Ethernet Link Controllers (ELC) to communicate with PLCs at Packaged system (or OEM). Appropriate protocols shall be loaded in ELC to ensure successful communication between PCM and PLCs.

2.2 DCS APPLICATION SOFTWARE DESIGN REQUIREMENTS

A. General:
   1. DCSP shall develop and submit PCM Application software in strict accordance with these requirements, and conforming as closely as possible with existing City COMNET standards.
   2. The DCSP shall develop the DCS design to convey accurate information to the plant operations staff so they can make informed process control decisions and provide the platform to execute the control decisions.
   3. The following outlines key objectives in designing the DCS graphics displays: New graphics will be developed with the application of Graphic User Groups. Graphic User Groups will consist of representatives from the City Operations/Management Staff, COMNET engineers, design engineers (optional) and qualified graphic experts representing the DCSP. Additional members may be included as required. Established formats, look and feel will be followed unless re-designed by the Graphic User Group

B. General Display Organizational Philosophy:
   1. Graphic displays provide the vehicle for Operations to accomplish supervisory control over the entire treatment process. Organization of these graphics displays into a consistent homogeneous hierarchy that permits fast, easy and intuitive navigation between the displays is essential for plan operations. The DCSP shall use its standard graphic and library together with current City COMNET displays and standards to generate the new displays for the DCS.

2.3 DCS/PCM I/O DATABASE

A. DCS/PCM I/O Database: The DCSP shall provide a Database tool that has the following functions:
   1. Coordinate, manage and document all PCM points.
   2. Access to all database points and attributes (including live data) shall accessible and maintainable thru standard query language.
   3. A comprehensive database listing shall be provided that contains the following as minimum: Point Tag, English Description, Set/Reset Descriptions, Limits, Engineering Units, Wire Tag Designations to be used on Loop Diagrams and when landing I/O wires in PCM Cabinets, Alarm Priorities, Alarm Limits, Alarm Delays, Alarm Cutout Points, Hardware Addresses, Third-party I/O linkage details including protocols and addressing Packed Group Point usage and descriptions, Point Origination.

B. Configuring the DCS Controller:
   1. The DCS Controller shall be configured from an EWS using a standard Emerson Process Management (EPM) studio, DCS Controller

configuration shall conform to City COMNET standards and shall integrate into the existing Enterprise wide COMNET DCS.

2.4 TOTALIZATION REQUIREMENTS

A. DCSP shall provide diagnostic totalization for all field assets and DCS components, in accordance with existing COMNET DCS standards. This Totalization may include:
   1. All runtimes and start/stops for rotating equipment greater than 5hp including, but not limited to: Pumps, conveyers, augers, fans, blowers and rakes.
   2. All successful open/closes of all motor operated valves, gates and other mission critical valves.
   3. The runtime for each DCS components and UPS.
   4. Accumulated analog values of power monitoring for all UPS, switchgear and motor control centers where said devices are capable of interfacing to DCS.
   5. Totalization code shall be resident in the PCM in which the I/O is attached.
   6. A reset of the totalization shall only be initiated by authorized personnel.
   7. Each totalizer IO value shall be attributed with the Asset ID associated with the piece of equipment.
   8. Totalization accumulations shall be based on EWS input ranging between 1 minute and 1 year.

B. At a minimum, upon totalization reset, the previous total shall be recorded in the Historian

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 96 04
SECURITY

PART 1 - GENERAL

1.1 REQUIREMENT

A. The DCSP shall secure the DCS from all accidental and malicious attacks using best management practices and utilizing appropriate technologies and secure network designs.

B. The DCSP shall protect all entry points.

C. All facility DCSLANs (collectively DCS Network) shall be, at a minimum, logically separated from the City of San Diego, and the Plant, Business Network on physically separate network devices.

D. Network Management Software shall monitor all devices on the DCS Network.

E. Antivirus software shall be compatible with the City's present antivirus software and shall monitor the DCS Network and virus files shall be maintained to the current status to detect malicious code, prevent it from infecting the system, and remove malicious code that has infected the system. Antivirus update mechanism shall be coordinated with the City.

1.2 RELATED SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

1.3 SUBMITTALS

A. All Submittals shall be developed and submitted in accordance with Section 01 33 00, Submittal Procedures.

B. Submittals of this Section shall be included in hardware and software submittals, specified elsewhere.

C. DCSP shall submit manufacturer cut-sheets for all network security equipment.

D. Prior to configuration of the firewalls, DCSP shall submit a list of all firewall rules to be implemented, which shall, after ORT, become part of change management procedures.

E. DCSP shall submit their final design and drawings of the DMZ, including connections to the business network, and the DCSLAN, and DCSWAN.

1.4 CODES AND REGULATORY REQUIREMENTS & REFERENCE

A. IEC62443: Security for Industrial Process Measurement and Control

B. ISO IEC 17799: 2005

C. NIST SP 800

1.5 DEFINITIONS

A. Definitions of acronyms are identified in Section 40 90 05, Definitions.

PART 2 - PRODUCTS

2.1 REMOTE ACCESS SERVER(S)

A. When shown on Drawings, the DCSP shall provide a remote access server(s) with built in firewall for access to Remote Network(s).

PART 3 – EXECUTION

3.1 NOT USED.

END OF SECTION

SECTION 40 98 00
PROJECT MANAGEMENT SERVICES

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Work of the DCSP requires all project management services to complete the tasks specified in these RFP documents for the Project.

B. Notwithstanding the requirements in Division 1 and other requirements of the contracts documents the DCSP's Project Manager and representatives shall perform the Work of this section.

1.2 REFERENCES

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

1.3 SPECIFICATIONS:

A. Definitions:

1. Definitions of acronyms are identified in Division 40.
2. A DCSP Project Manager and the team shall be established and shall be comprised of personnel who are familiar with this type of DCS work and the existing City Enterprise wide DCS. The PM and the team shall oversee the design, implementation, construction, and support of the DCS Work.
3. Project Manager (PM) and the team shall perform the necessary DCSP project management services to ensure that the DCS provided under this contract is fully functional in accordance with Contract requirements, and works seamlessly integrating into the City's Enterprise wide COMNET DCS
4. Process segments: The implementation of this project may include multiple process segments comprising the overall Distributive Control System for this portion of the Project. Each process segment may require separate engineering design(s), design approvals, procurement, staging,

programming/configuration, readiness testing, and installation, and commissioning of the DCS at the Project site.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

A. The DCSP shall provide a Project Manager to perform the necessary project management services. The DCSP shall provide all project management services required to complete the DCS Work specified in these documents. DCSP Project Management and administrative services shall be performed at the approved staging site and Project site, as required. The required minimal project management services are defined in the following sections.

3.2 PROJECT COMMUNICATIONS

A. Communications Structure:
   1. A communication structure and escalation procedure will be developed between the DCSP, Prime Contractor and the City as part of the Prime Contract.
   2. The DCS Project Manager (PM) will coordinate and communicate project activities with the Contractor and City's representative.
   3. The PM shall coordinate n ew DCS upgrades, as well as existing DCS modifications (when specified) with the City's representative and Plant Staff.
   4. The PM shall have strong verbal and written communication skills and be fluent in English.

3.3 PROJECT SCHEDULE

A. The DCS Work of the process segments shall be initiated and completed in accordance with the Contractors Master Baseline Schedule, as required by Division 1
B. The DCSP shall develop within their P6 fragnet schedule, sufficient granularity, inclusive of goals, internal DCSP milestones and contractual milestones to demonstrate proper schedule coordination with the Contractors Master Schedule.

3.4 PM TASKS

A. The DCSP shall take full responsibility for DCS-related project management services required to meet the requirements of the RFP documents. At a minimum, the DCSP shall perform the tasks below as required by the Work:
   1. Regular coordination meetings with the Contractor and City's representative review progress, as scheduled by the Contractor

2. The DCSP shall provide weekly status reports to the Contractor, depicting DCS development and readiness, through the construction phase of the project.
3. Project Delivery Plan (PDP), which defines the overall delivery of each process segment of the project. The PDP shall include the following items:
    a. Delivery Philosophy
    b. Control System Architecture, Device Networks, Local Networks and Communications Interfaces
    c. Design Approach
    d. Software Development and Testing Criteria
    e. Procurement Plan
    f. Construction Coordination Plan
    g. Document Management and Revision Control Strategy
    h. Communication Network Plan
    i. FAT, Field Testing (including ORT), Start up and Commissioning Plan
    j. Operations and Maintenance Manual Criteria
    k. Training Requirements Criteria
    l. Health and Safety Plan
    m. QA/QC Plan Requirements
4. Scheduling, The DCSP shall be responsible for updating the DCS portion of the project schedule as necessary.
5. Schedule of Values / Detailed Cost Breakdown
6. Scheduling of training:
7. Invoicing to Contractor, on a monthly schedule
8. The DCSP shall execute periodic quality reviews of the delivery of the DCS, including management QA/QC and delivery of:
    a. Record Management and Document Control
    b. Testing Records
    c. Acceptance Records
    d. Inspection Records
    e. Maintenance Records
9. Prepare Outage requests Forms or Plant permits as required
10. Prepare and provide operation and maintenance manuals

3.5 PROJECT IMPLEMENTATION

A. General: Project Implementation is generally defined as the actual implementation of the work required under the Contract. During the implementation of each of the five segments, the DCSP is required to fulfill a number of project management requirements. The delivery of each Segment shall be based on four Phases, including the Engineering/ Design Phase, Procurement, Staging, Programming and Testing Phase, Field Construction/ Commissioning Phase, Maintenance Phase. It is expected that the Phases for

each Segment will be performed in order as identified below. The following project management services are required to be performed by the DCSP.

B. Engineering/Design Phase:
   1. In the Engineering/ Design Phase, the DCSP shall complete the detailed design of the DCS as specified in the contract documents. The DCSP is also responsible for the following project management services during the Engineering and Design Phase:
      a. The DCSP shall coordinate all activities related to the DCS design of the project.
      b. The DCSP shall review and confirm requirements as necessary with the Prime Contractor and the City's representative.

C. Procurement, Staging, Programming and Testing Phase
   1. In the Procurement, Staging, Programming and Testing Phase, the DCSP shall procure the equipment required in the final design documents and stage the system at the approved staging site. The project management services related to these activities include, but are not limited to:
      a. The DCSP shall coordinate and schedule the procurement, delivery and storage of all required equipment and materials on a timely basis.
      b. Procurement of hardware and software shall be based upon requirements defined within these Project specifications and refined during the Engineering/Design Phase.
      c. Procurement schedules shall be communicated to the Prime Contractor and the City's representative.
      d. The DCSP shall be responsible for the development of the approved staging area.
      e. The DCSP shall be responsible for all permitting activities related to the staging area construction, if any.
      f. The DCSP shall coordinate the moving and storage of all materials between manufacturing site and staging area and between the staging area and the Project site. DCSP shall be responsible for coordinating deliver of DCS components at site with the Prime Contractor.
      g. The City's representative and the Prime Contractor shall be provided the opportunity to inspect inventory and staging set-up.
      h. DCSP shall manage all licensed software and the development of all controls, graphics, and database programming and DCS configuration.
      i. The Factory Acceptance Testing shall be witnessed and signed- off by the City's representative prior to the installation of the system.

D. Field Construction/Commissioning Phase
   1. In the Field Construction/Commissioning Phase, the DCSP shall coordinate installation, construction and commissioning activities of all

DCS-related components in accordance with these Specifications. The project management services related to these activities include:

a. The DCSP shall coordinate the overall sequence and schedule of control systems construction and installation.
b. The DCSP shall coordinate and participate in Preconstruction Safety Conference, and shall adhere to the Prime Contractor's Safety Plan at all times.
c. The DCSP shall coordinate the F A T , O R T , system, software and performance testing.
d. The DCSP shall establish a Health and Safety plan for construction activities which adheres to the Prime Contractors Safety Plan as well as the City's safety standards.
e. The DCSP shall perform loop check and commissioning activities. The DCSP shall be responsible for manning all PCM locations, Main Control Room(s) and Workstation locating in performance of Loop Testing. The Prime Contractor shall be responsible for coordinating and manning at all field device, instruments and Foreign Device (Skid-mounted and package system) in support of Loop Testing.

E. Maintenance Phase

1. In the Maintenance Phase, the DCSP shall provide ongoing support services and warranty repair in accordance with Division 1 of the Contract.
   a. The DCSP shall establish warranty and maintenance procedures to meet operations and maintenance criteria of the Plant.
   b. The DCSP shall coordinate operations and maintenance activities with City's representative and plant Operations staff.
   c. The DCSP shall monitor system performance and perform corrective maintenance as required.
   d. The DCSP shall provide warranty service reports to the City's representative or City COMNET staff, within 48 hours of the completion of each service or warranty event.

END OF SECTION

SECTION 40 98 01
ENGINEERING AND DESIGN SERVICES

PART 1 - GENERAL

1.1 SUBMITTALS

A. The DCSP shall take full responsibility for developing an approved DCS design that meets the specifications set forth in these Contract Documents. The hardware and software design shall be developed by the DCSP and submitted using a submittal review process in accordance with Specification 01300, Submittals.

B. The DCSP shall group or arrange submittals in a methodical and logical fashion such that the City's Representative and Design Engineers have all the required information to perform its review. For example, grouping of all hardware including workstations, PCM, Field Cabinets, Networking and the like, for a process area, would be acceptable.

C. The DCSP shall develop a complete list of all submittals (technical and administrative) required by all Contract Documents for all process segments in accordance with the prime contractor schedule requirements of the Contract.

D. The DCSP shall plan for a pre-submittal conference to finalize the needs of the City's Representative and Design Engineers to eliminate as much rework as possible. DCSP shall present an outline and samples of the proposed submission to the City's Representative in this conference.

E. The DCSP shall provide adequate time in their schedule to accommodate the review of the City's Representative and any and all re-submittals.

F. Loop Diagram Submittals:
   1. Loop Diagrams: The preparation of the loop diagrams is the responsibility of the Contractor. However, the DCSP is responsible for providing to the Contractor all the DCS-level information, including termination designation, software addressing levels, I/O card assignments, etc. on a timely basis to facilitate development of these documents. DCSP portions of the Loop Diagrams shall be submitted in accordance with Specification 01 33 00, Submittal Procedures.
   2. In addition to other DCS-related construction level as-built drawings, DCSP shall be responsible for providing red-line mark-ups of the Loop Diagrams and P&IDs, as required. Red-line mark-ups shall be provided on a timely

basis to allow Engineers and Contractor time to finalize as-built documentation.

1.2 RELATED SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ENGINEERING AND DESIGN TASKS

A. The list below is intended to be used as a guide for DCSP and not intended to be all inclusive and complete. At a minimum, DCSP shall perform the tasks below as required by the Work:

1. Workshop Participation; as may be required for development of software, Operations training, special maintenance requirements, etc.
2. Submittals (Refer to Division 40 and Section 01 33 00, Submittal Procedures.)
3. Develop and submit DCS-PCM-related termination information
4. Develop and submit DCS-related portions of loop drawings
5. Develop and submit DCS-related portions of P&IDs
6. Develop and submit mounting details for all DCS equipment, including seismic calculations and certifications.
7. Civil Design, if and when required
8. Structural Design, if and when required
9. Electrical Design requirements for DCS-related equipment
10. Mechanical Design requirements for DCS-related equipment
11. Develop and submit Control System Block Design
12. DCS Design
13. Work Scopes for DCS-related Sub Contractors
14. Historian Format Designs, if and when specified
15. I/O Database Design including point attributes
16. Technical Calculations

17. Control Strategy Review and functional verification
18. Control Strategy programming
19. Graphic Design Workshops, and graphics development
20. System security design
21. Red-line markups of all As-Built Documents
22. As-Built Documentation updated Red-lines during Construction
23. Review and coordinate all submittals from DCSP subcontractor.
24. Coordinate information among DCSP and Prime Contractor subcontractors' submittals
25. Coordinate Panel Drawing design
26. Develop and submit Panel Drawings
27. Approved Staging Area design and build out
28. DCSP staging area equipment and furniture

3.2 DCSP QA/QC AND DESIGN ASSISTANCE REQUIREMENTS

A. As the DCSP is operating under and 'assigned subcontractor', 'sole-source provider' arrangement with the City, various items of Quality Control and of design assistance to the Project Design Engineers is required of the DCSP. Some, but not all, of the assistance items required of the DCSP are as follows:
   1. The DCSP shall be responsible for thorough review of the project design documents, annotating any DCS related errors, omissions, size conflicts, environmental difficulties, etc. and so notifying the Project Design Engineer on a timely basis.
   2. The DCSP may be called upon by the City, or the Design Engineers to participate in RFI responses to DCS—related orr I&C questions posed by other subcontractors. The DCSP shall provide immediate response to such RFIs.
   3. The DCSP may be called upon by the Design Engineers to provide technical detail, review and/or approval of designs being executed via change-order to the Project. DCSP shall promptly provide such services.
   4. During the course of construction, the DCSP shall have their field engineers verify various aspects of installation are being installed within the Project specification and DCS manufacturer's requirements. This is particularly true of I/O and fiber optic conduit, raceway or duct bank installation, conduit cabinet entrance locations, physical obstructions to the DCS and environmental requirements. Inspection and notification requirements are stated throughout Division 40 Specifications.
   5. The DCSP shall verify that special DCS grounding requirements and installation, as specified in Division 40, are performed correctly and in accordance with the specifications and DCs manufacturer's requirements.
   6. The DCSP shall verify that the UPS' provided under the DCS portion of the contract, but install by others under Division 26, is placed, wired,

installed and tested in accordance with Specifications and DCS manufacturer requirements.

7. The DCSP shall be responsible for oversight of I/O wiring installation to ensure subcontractor does not combine conduits, or route dissimilar I/O wiring in common conduits e.g. Analog I/O with Discrete I/O.
8. The DCSP shall be responsible for coordinating with Package System suppliers or other Foreign Device Manufacturer's equipment to ensure that data-links are installed correctly, communications protocols are coordinated, etc.
9. The DCSP shall be responsible for oversight of all I/O wiring termination, being provided by others under Division 26, to ensure that I/O wiring is tagged correctly, routed and dressed neatly and terminated on correct locations, at the DCS end I/O wiring only.
10. Integration of new configuration across all Multi-Networked DCS Installations.
11.

B. The costs for all QA/QC Engineering Service above shall be borne solely by the DCSP under his assigned subcontract.

END OF SECTION

SECTION 40 98 02
PROCUREMENT, STAGING, PROGRAMMING

PART 1 – GENERAL

1.1 DEFINITIONS

A. Equipment: Tools, products, items, devices, or machines needed for the correct functioning of the DCS and its supporting systems.

B. Materials: Materials are physical substances used as inputs to production or manufacturing of the DCS. The definition of materials also includes finished materials, which includes equipment.

C. Procurement: DCSP manufactures DCS equipment and procures third party equipment in accordance with contract documents.

D. Staging: Approved site that receives shipments of equipment and materials to be set up or staged, used for programming all equipment as a system and for Factory Acceptance Testing.

E. Programming: Programming of all software systems.

F. Testing: All testing required prior to shipping to each facility.

1.2 RELATED SECTIONS

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Equipment, Materials, etc. shall be certified as Underwriters Laboratories (UL) compliant.

1.3 PROCUREMENT

A. The DCSP is responsible for procuring all materials related to the delivery of the Work.

B. The DCSP shall coordinate procurement to meet the project schedule and the needs of the City Representative.

C. The manufacturer's standard equipment suitable for applicable service conditions shall be provided, unless otherwise specified in the individual Specifications.

D. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.

E. Interchangeable components of the same manufacturer shall be provided for similar components, unless otherwise specified.

F. Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

G. Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.

1.4 PREPARATION FOR SHIPMENT

A. Systems may be manufactured at remote facilities, but shall be assembled at the DCSP approved staging site. The DCSP shall:
   1. Mark or tag, using ISA tagging scheme, the separate parts and assemblies for field assembly.
   2. Cover machined and unpainted parts that may be damaged by elements with a strippable protective coating.
   3. Products shall be packaged or crated to provide protection from damage during shipping, handling, and storage.
   4. Packages and crates shall be marked or tagged to indicate its purchase order number, bill of lading number, contents by name, name of project and Seller, equipment number, and approximate weight.
   5. Spare Parts and Special Tools shall be delivered at same time as Products delivery.
   6. Accessories shall be delivered at same time as Products delivery.
   7. Accessories shall be furnished so that each item of equipment may be placed in full operation.
   8. Accessories include, but are not limited to, light bulbs/LEDs, fuses, enclosure keys, special tools, and other items as required for initial operation.

B. Delivery of Products:

1. Deliver products in accordance with accepted current Project Schedule and coordinate to avoid conflict with the Work and conditions at Site.
2. Deliver products in undamaged condition, in original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.
3. DCSP shall record receipt of Products at the approved Staging Site, and upon receipt of Products shall inspect for completeness and evidence of damage during shipment. Receipt and inventory of Products must be witnessed by the City representative.
4. Should there appear to be damage, DCSP shall inform the City's representative and the project Prime Contractor and shall immediately make necessary arrangements to repair or replace the item.
5. DCSP shall expedite replacement of damaged, incomplete, or lost items, so as not to delay progress of the Work.

1.5 MOVING AND STORAGE OF EQUIPMENT

A. General

1. The DCSP is responsible for the movement, as well as the safe storage, of all material from the factory, to the approved staging area and ultimately to its installed location. To adhere to this requirement, the DCSP must perform the following:
2. Unloading of Products: Unless otherwise specified, after acceptance by inspecting party products will be unloaded by DCSP in accordance with manufacturer's instructions.
3. Handling, Storage, and Protection:
    a. Products shall be handled and stored in accordance with manufacturer's written instructions and in a manner to prevent damage.
    b. Products shall be stored in an approved environment within the staging area and at each installation site.
    c. Storage shall be arranged in a manner to provide easy access for inspection.
    d. Periodic inspections of stored products shall be performed by the DCSP to assure that products are maintained under specified conditions, and free from damage or deterioration.
    e. A running account of products in storage shall be kept by the DCSP to facilitate inspection.
    f. Electrical, instrumentation, control products, and equipment containing bearings shall be stored in weather-tight structures maintained between 60-120 degrees F, with humidity control.
    g. Electrical, instrumentation, and control products, shall be protected and insulated against moisture, water, and dust damage.

h. Products that are ready for installation shall be stored in dry and well-ventilated areas that are not subject to extreme changes in temperature or humidity.

1.6 DCS APPROVED STAGING SITE

1. The proposed staging site shall be submitted to the City in accordance with Specification 01 33 00, Submittal Procedures. The City shall approve the staging site in writing. The DCSP shall also perform project management, engineering, programming, assembly, testing and support services at the approved staging site.
2. The DCSP shall be responsible for providing all utility power source, potable water (tap) and sanitary sewer services at the approved staging site. The DCSP shall bear the cost of power, water and sewer.
3. The DCSP shall provide necessary tenant improvement for the approved staging site space, power/ground and acceptable environmental conditions.
4. The DCSP shall be responsible for provide parking space for the DCSP staff City inspection staff. Where required, the DCSP shall pay for parking.
5. The DCSP shall provide the necessary equipment at the staging site to perform the required programming, DCS setup, testing and support activities, furnish and build-out the staging site, and disassemble after Final Completion.
6. FAT results shall be reviewed and accepted by the City's Representative before systems are transported to the various sites for installation.
7. The DCSP shall establish security measures, and pay all security costs, to protect the equipment at the approved staging. Prime Contractor shall be responsible for DCS security once transported to the project site.
8. The staging site shall meet the environmental requirements established in the 'Moving and Storage' portion of these specifications.
9. The staging site shall be accessible to the appropriate DCSP, DCSP subcontractor and City staff.
10. The staging site shall adequately accommodate DCSP staff, storage of equipment, and setup of system for testing purposes in accordance with building codes, ADA requirements and OSHA requirements.
11. The staging site shall meet the City's workplace safety requirements as well as the Prime Contractor's safety plan.
12. The DCSP shall provide a plan and schedule for the construction and setup of the approved staging site.
13. The DCSP shall provide lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.
14. The DCSP shall make the necessary provisions to maintain adequate environmental conditions to facilitate progress of the Work, to meet

specified conditions for installation of materials, and to protect materials, equipment, and finishes from damage due to impact, temperature or humidity.

15. The DCSP shall provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
16. The DCSP shall pay all costs of installation, maintenance, operation, removal, and fuel consumed at the approved staging area prior to transport and installation.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PROJECT DELIVERY SERVICES - PROCUREMENT AND STAGING

A. The DCSP shall take full responsibility for the procurement, delivery and staging of all equipment and materials required by these Contract Documents. The list below is intended to be used as a guide for DCSP and not intended to be all inclusive and complete. At a minimum, DCSP shall deliver the following to achieve a complete delivery, including procurement, staging, installation, testing, maintenance, upgrades and warranty, as required by the Work such as:

1. All COTS and DCSP software and firmware
2. All hardware for DCS
3. All DCS-related LAN and required network equipment
4. All UPS for all DCS and LAN equipment
5. All required cabinetry for DCS equipment
6. All furniture for all DCS Workstations
7. All DCS network connectivity
8. All DCS PCM-related cabling including copper, fiber optic, conduits, interducts, etc.
9. All Control System Databases
10. All Integration Equipment
11. All Security equipment
12. All specified Spare Parts and tools

3.2 PROGRAMMING

A. The DCSP shall take full responsibility for the configuration and programming of all software, and firmware required by these Contract Documents. The list below is intended to be used as a guide for DCSP and not intended to be all inclusive and complete. At a minimum, DCSP shall deliver the following to achieve a complete operating DCS:

1. All coordination of software development
2. All Control Strategy programming

3. All System software development and programming and configuration
4. All Control System Database programming
5. All Integration to "other," Foreign Device systems as required by these specifications
6. All local Historian Configuration and programming, when and where specified.
7. All Security configuration and access programming
8. All Graphics programming/configuration
9. All Trending and alarm configuration

B. All detailed programming requirements are specified in other sections.

END OF SECTION

SECTION 40 98 03
INSPECTION AND TESTING SERVICES

PART 1 GENERAL

1.1 GENERAL

A. The DCSP is responsible for all testing of all software and hardware and their operation together in project segments and the overall Enterprise-wide DCS, as a complete system.

B. The DCSP is responsible for supplying all testing tools, such as operating systems and test software, testing tools, simulation hardware and software, and equipment.

C. Inspections and tests shall be carried out to demonstrate that the Work complies with the requirements detailed in these specifications.

D. Test results shall be measurable; the performance of the test object shall be clearly specified in terms of conditions, inputs, and outputs. The specification of the whole system or relevant part shall be the starting point in all cases.

E. All testing must be accomplished in accordance with Division 1, General Requirements.

1.2 SUBMITTALS

A. The DCSP shall develop and submit to the City's representative, test procedures for all testing required by these Contract Documents in accordance with Specification 01 33 00, Submittal Procedures.

1.3 REFERENCES

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Division 1 – General Requirements
2. Specification 01 33 00 – Submittal Procedures
3. Division 26 – Electrical
4. Division 40 – Process Integration

B. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

PART 2 – PRODUCT

2.1 TYPES OF INSPECTION & TESTING

A. The DCSP shall provide the following types of tests:
   1. Factory Acceptance Testing (FAT)
   2. Operational Readiness Testing (ORT)
   3. Contractor Functional Testing and Commissioning support
   4. Thirty Day Performance Acceptance Testing
   5. Integration Period Testing Support

PART 3 – EXECUTION

3.1 EXECUTION SERVICES

A. For all types of inspections and testing the DCSP shall provide experienced personnel and management in field (Staging Site, and Plant Site) to coordinate and complete all aspects of the Work in this specification.

B. At the Staging Site:
   1. The DCSP shall maintain DCS hardware and standard software by completing the following:
      a. Preventive maintenance.
      b. Demand maintenance.
      c. Replacement of failed components and parts.
      d. Replenishment of spare parts, where applicable.
      e. Recordkeeping.

C. Startup and Testing Team: Provide a team, as required by project, of experienced DCS systems engineers, hardware maintenance, and software configuration staff at the Plant site during the total period required to:
   1. Check the installation, termination, and adjustment of all subsystems and their components.
   2. Perform complete onsite tests.
   3. Provide startup assistance to the prime contractor and City staff.

3.2 FACTORY ACCEPTANCE TEST (FAT)

A. General: The complete system, including all, DCS equipment, peripheral devices and interconnecting cables shall be assembled on the DCS manufacturer's test floor or City pre-approved Staging site, and all programs shall be completely tested under simulated operating conditions. Further tests shall be performed in the field at time of start up with external sensors and field wiring connected to determine final specification compliance.

B. Four certified copies of all test data and results shall be submitted to the City. All test documentation and results shall comply with ISA RP55.1 (R1983) Type 2 and Type 3 documentation standard.

C. The equipment shall be operationally tested for compliance with the conditions of these Specifications. FAT set up shall include simulated inputs. On line configuration of the monitoring and control loops using simulated inputs shall be demonstrated without error or malfunction. Logs and report generation capability shall be demonstrated by simulating process inputs and manually entering data.

D. The DCSP shall submit a detailed FAT specification to the City at least six (6) weeks in advance of commencement of the FAT. The City shall be notified at least 30 days in advance of the FAT and reserves the right to have representatives in attendance.

E. Each item of equipment shall be fully inspected, calibrated and tested for function, operation and continuity of circuits as applicable. Exceptions shall be approved in writing from the City.

F. System performance shall be tested using a complete integrated system including all peripheral devices and interconnecting cables assembled on the test floor, complete operational programs loaded, and simulated inputs applied. The DCSP shall carry out a 100-hour full system test during which the entire system shall operate continuously without failure, all in accordance with the requirements of the specifications and drawings. If a system component fails during the test, the 100-hour test period shall be restarted after its operation is restored.

G. After successful completion of the FAT, four (4) certified copies of all test results shall be furnished to the City together with a clear and unequivocal statement that all FAT requirements have been met. The City will give written notice of the acceptability of the FAT within 30 days of receipt of the FAT results.

H. City's Representatives shall witness the FAT and at least 30 days written notice shall be given prior to date of starting tests. One copy of each acceptance test procedure shall be submitted to the City 20 days prior to the start of the acceptance test.

I. In the event that the system does not function as specified, it shall be modified to meet the specification requirements, and shall be retested as specified herein. Costs for all such retesting and witnessing shall also be borne by the DCSP.

All of the City's' representatives travel and per diem costs associated with all FAT testing and retesting shall be borne by the DCSP.

J. Prior to installation, all PIN, FIN, and DIN cable shall be factory tested by the DCSP to verify that the attenuation does not exceed prescribed limits and to

ensure that concealed or internal discontinuities which could cause reflections do not exist. In conformance with the submittal requirements of these specifications, the DCSP shall submit certified test reports which contain the following data:

1. Dielectric constant
2. Outside diameter of inner conductor
3. Inside diameter of outer conductor
4. Attenuation constant
5. Plot of each cable attenuation frequency response per 100 feet of cable.
6. All data links, which shall be the final hardware, application software, and node addresses installed in the field shall be tested during the operational readiness test.

K. Factory Acceptance Testing of Contractor Provided Package Systems

1. The DCSP shall support the FAT for all major packaged systems that contain PLC's.
2. The DCSP shall attend the packaged system FAT and shall provide all temporary hardware and software to monitor the packaged system control and data transfer for compatibility with the DCS programming for the packaged system.
3. The DCSP shall pay for all costs associated with travel to the package system FAT.
4. The package system FAT's that require the DCSP attendance are:
   a. High Purity Oxygen System FAT

3.3 INSTALLATION

A. Physical installation of the DCS PCM assemblies may be accomplished by the DCSP or as required others, under the contract. The DCSP shall provide all labor required for oversight of the installation and to verify proper installation of all equipment.

B. Subsequent to the installation of all DCS equipment, the DCSP shall certify to the City's representative that the DCS has been properly installed.

C. The DCSP shall furnish the services of trained engineer(s) to check the completed installation and to make all necessary adjustments for satisfactory operation of the DCS.

D. There shall also be furnished complete installation drawings and instructions in accordance with these Specifications. Final as built drawings, and Loop Diagrams are the responsibility of the prime contractor and/or Design Engineer. The DCSP shall furnish all drawings and technical assistance to these parties to complete these drawings.

E. If any device (including network cables) has been installed by others in a faulty manner, the DCSP shall notify the City's representative immediately.

3.4 OPERATIONAL READINESS TESTING

A. The DCSP shall time the complete DCS system testing after installation.
   1. This shall ensure that those components provided under this Contract, having adjustable features are set carefully for the specific conditions and applications of this installation and that the components and systems are within the specified limits of accuracy.
   2. The DCSP, as part of this process, shall furnish qualified engineers to assist City Operations staff with the tuning of PID loops to ensure proper operation of process equipment.
   3. The DCSP shall notify the City's representative if any existing components, including field devices or instruments provided by others, are found to be defective.
   4. Defective DCS elements which were provided under this Contract, which cannot achieve proper calibration or accuracy, either individually or within the system, or subsystem, shall be replaced and the City's representative shall be notified.
   5. The DCSP shall be responsible for performing all DCSP related portions of loop checks and testing procedures. DCSP shall be responsible for manning all PCMs, Control Room, remote Workstation locations, etc. Prime Contractor shall be responsible for manning all field devices, instruments, etc. in order to ensure a complete end-to-end loop test.
   6. Analog input channels shall be verified at a minimum of five points: 0, 25 percent, 50 percent, 75 percent and 100 percent of span by applying simulated analog test signals (using a calibrated signal generator). Applied test data shall be processed by the associated PCM using programs assigned to the particular data channels being simulated with the resulting engineering unit data presented on a display.

B. A complete DCS test shall be performed by the DCSP, including interfaces with, foreign devices and networks. All modes of operation and HMI interactions shall be exercised. All data communication equipment shall be thoroughly tested for function and accuracy. DCSP shall be responsible for DCS related items during this test and the prime contractor shall be responsible for all field devices and instruments.

C. Upon the satisfactory completion of all DCS installation tests, six (6) hard copies and one (1) soft copy in a format acceptable to the City of a certified report, including all test documentation, shall be furnished to the City's representative together with a clear and unequivocal statement that the installed system has been successfully calibrated, tuned, inspected and tested. These documents shall be submitted in accordance with Specification 01 33 00, Submittal Procedures. The City's representative will give acceptance of the installation tests within 21 days of receipt of the test report if the results of the installation tests are acceptable.

D. The DCSP shall submit six (6) hard copies and one (1) soft copy of a procedure for field hardware and software tests. In addition, a full functional procedure that pertains to the control system logic and graphic displays shall be submitted for approval by the City's representative. The procedure shall include:
   1. The object to be tested
   2. The aspects of the object to be tested
   3. The kind of tests to be carried out
   4. The conditions under which the tests shall be performed
   5. The procedures to be followed
   6. The expected results and how the results will be evaluated
   7. When the tested aspect has passed the test

E. Systems shall be exercised through operational tests in the presence of the City's representative in order to demonstrate achievement of the specified performance.

F. The equipment shall be operationally tested for compliance with the conditions of these Specifications. Online configuration of the monitoring and control loops shall be demonstrated without error or malfunction. Logs and report generation capability shall be demonstrated by simulating process inputs if actual inputs are not available from process components with City approval.

G. The proper control of all final control elements and control panels shall be verified by tests conducted in accordance with the requirements specified herein. Where feasible, system commissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent practicable, normal final control element operating ranges and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using the DCS and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control modes.

H. All control stations incorporating proportional, integral and/or differential (PID) control circuits shall be initially tuned using mathematical methods such as Ziegler-Nichols or Tyreus-Luyben rules in order to establish the initial parameters for closed loop control. The tuning parameters shall be refined experimentally, by applying control signal disturbances and adjusting the gain, reset and/or rate setting(s) as required to achieve a proper response. Measured final control element variable position/speed set-point settings shall be compared to measured final control element position/speed values at 10 percent, 50 percent and 90 percent of span and the results checked against specified accuracy tolerances. Specified accuracy tolerances are defined as the root-mean-square-summation of individual component accuracy requirements. Individual component accuracy requirements shall be as specified in the contract or as specified by published

manufacturer accuracy specifications whenever contract accuracy requirements are not specified.

I. Completion of all system commissioning and test activities shall be documented by a certified report, including all test forms with tests data entered, delivered to the City's representative with a clear and unequivocal statement that all system commissioning and test requirements have been satisfied. The City's representative will give written acceptance of the system commissioning and test activities.

J. In the event that the system does not function as specified, it shall be modified to meet the specification requirements, and shall be retested as specified herein. Costs for all such retesting and witnessing shall be borne by the DCSP.

K. Six (6) hard copies and one (1) soft copy of certified test data and results shall be submitted to the City's representative in accordance with Specification 01 33 00, Submittal Procedures.

3.5 DCS PERFORMANCE TEST

A. DCS performance testing shall commence after ORT and inspections have been conducted and accepted in accordance with the following B, C, D, and E, and shall demonstrate that all components of the control system can meet all contract requirements with the equipment operating over full operating ranges under actual operating conditions.

B. All commissioning and test activities shall follow detailed test procedures, and check lists, previously submitted by Contractor and approved by the City. All tests data shall be acquired using equipment as specified and recorded on test forms, previously submitted by Contractor and approved by the City.

C. The proper control of all final control elements and control panels shall be verified by tests conducted in accordance with the requirements specified herein. Where feasible DCS performance testing activities shall include the use of water to establish service conditions that simulate, to the greatest extent practicable, normal final control element operating ranges and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start up and steady state operating conditions to verify that proper and stable control is achieved using the distributed control system and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control modes.

D. All control stations incorporating proportional, integral and/or differential control circuits shall be tuned experimentally, by applying control signal disturbances and

adjusting the gain, reset and/or rate setting(s) as required to achieve a proper response. Measured final control element variable position/speed set point settings shall be compared to measured final control element position/speed values at 25 percent, 50 percent and 75 percent of span and the results checked against specified accuracy tolerances.

1. Various tests required during testing may require the presence and control of a licensed wastewater operator. It is incumbent on Contractor to coordinate all tests are conducted within the regulations.
2. Contractor and its sub-contractors are responsible for the field-end testing and operation of all equipment, which may require manipulation by a licensed wastewater operator.
3. The DCSP shall be responsible for staffing at PCM cabinets, DCS peripheral equipment locations and the main control room, during commissioning phases.

E. During the commissioning phase, and possibly beyond, as may be required, the DCSP shall be responsible for coordinating, and working with Operations, in providing fine tuning of the PID controllers to ensure proper process operation. The DCSP shall also aid in setting alarm limits, top of scale setting etc., in concert with Operations.

F. Subsequent to the commissioning and performance testing of process equipment furnished by others, the DCSP shall conduct a successful 30-day performance acceptance test for the DCS furnished under this contract. In the test, the entire DCS shall be continuously operated and maintained (i.e., 7 days per week, 24 hours per day) during the test period with zero downtime resulting from DCS system failures. If a system failure occurs, the 30-day test shall be considered a failure and not acceptable. The DCSP shall reinitiate the 30-day test. The DCS shall be acceptable only after all equipment has satisfied the performance test requirements and demonstrated a system availability of 99.98 percent.

G. The system availability shall be calculated based on the following equation:

System Availability = (MTBF x 100%)/(MTBF + MTTR), where:

1. A= system availability in percent
2. MTBF = average time interval between consecutive system failures
3. MTTR = average time required to repair system failure

H. Thirty Day Acceptance Test: During this period, all System functions shall be exercised. Any System interruption and accompanying component, subsystem, or program failure shall be logged for cause of failure, as well as time of occurrence and duration of each failure. A failure may be categorized as "minor" so long as the fundamental monitoring and control functions of the system are not affected. For example, failure of a peripheral equipment, such as a printer, would fall in the minor failure category. A minor failure shall halt the 30-day acceptance

test. Upon correction of the failure, the test may continue for the remaining during. If a component failure causes disruption to proper operation of the system, it shall be considered a “major” failure. A major failure shall cause termination of the 30-day acceptance test. When the cause of a failure has been corrected, a new 30-day acceptance test shall start.

I. The DCSP shall submit a performance test completion report which shall state that all contract requirements have been met and which shall include (1) a listing of all DCS equipment maintenance/repair activities conducted during testing and (2) a listing of all components which were unable to operate successfully. The performance testing report shall be submitted in accordance with Section 01 91 14 – Testing, Integration, and Startup Submittals. Final acceptance, in writing, of the DCS will be provided by the City.

3.6 INTEGRATION PERIOD TESTING SUPPORT

A. The DCSP shall provide support during the integration period. The support shall be as described in Section 01 91 14 – Testing, Integration, and Startup

END OF SECTION

SECTION 40 98 04
FIELD CONSTRUCTION/COMMISSIONING SERVICES

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The DCSP shall be responsible for all DCS related Field Construction/Commissioning services for the facilities within this contract document.

B. The DCSP shall be responsible for monitoring Contractor Field Construction/Commissioning services, to ensure that no negative impact to DCS commissioning is occurring. In the event of such impacts, the DCSP shall immediately notify the City's representative of the impact.

1.2 REFERENCES

A. The Work described in the following sections also applies to the Work in this section. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this Work.
   1. Division 1 – General Requirements
   2. Specification 01 33 00 – Submittal Procedures
   3. Division 26 – Electrical
   4. Division 40 – Process Integration

B. Specifications: Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego.

1.3 SUBMITTALS

A. The list below is intended to be used as a guide for DCSP and not intended to be all inclusive and complete. At a minimum, DCSP shall be responsible for the submittals below as required by the Work:
   1. Technical, operational and administrative submittals.
   2. DCS Systems Construction and Installation Schedule to be included and incorporated into the Contractor's master baseline schedule.
   3. Installation details for new UPS systems, Load Centers and both utility and UPS power and grounding, for those portions provided by the DCSP.
   4. Details for installation of all DCSP provided systems, including:
      a. All network communications.
      b. I/O wiring and termination schemes.

c. Utility and UPS power and grounding for all DCS equipment.

5. The Design Engineer is responsible for generating a complete set of P&ID Drawings for the project. However, the DCSP is responsible for providing the Design Engineer with the DCS design, termination architecture, etc. required to complete the DCS redlines of the P&ID . The Contractor shall be responsible for producing the Loop Drawings with support from the DCSP.
6. Health and Safety Plan.
7. Results of all field verification of existing conditions and documentation, where applicable.
8.
9. All test results including, but not limited to, Network Communications, including fiber optic cable tests, DCS calibration, loop checks, ground tests, and system tests.
10. Verification that each training class/course has been successfully completed, in accordance with Section 40 98 05.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

A. Outage Forms: The DCSP shall ensure that all City required outage forms, or City/Plant work permits are completed prior to commencement of any construction.
   1. All outage request/permits shall be submitted with three hard copies and one soft copy to the City's representative.

B. General:
   1. The DCSP shall coordinate installation, construction and commissioning activities with the City's representative in accordance with the Contract Documents.
   2. The DCSP shall coordinate and participate in Preconstruction Safety Conference as specified in Division 1.
   3. The DCSP shall coordinate the overall sequence of control systems construction and installation, by the Contractor, with the City's representative.
   4. The DCSP shall establish a Health and Safety Plan for construction activities, for integration into the Contractor's H&S Plan.
   5. The DCSP shall perform all DCSP related loop checking, functional testing and commissioning in accordance with these Contract Documents.
   6. The DCSP shall coordinate system cutover and outage requests through the City's representative.

7. City's representative shall inspect all DCS and I&C system installation prior to cutover.
8. The DCSP shall coordinate the DCS system, software and performance testing with the City's representative.

C. The DCSP shall pay particular attention to both Contractor Construction sequencing and Commissioning scheduling.
   1. To ensure that the DCSP is closely monitoring and coordinating these efforts, he shall participate in weekly Commissioning and Start-Up Meetings with the City's representative and the Contractor, including attendance in the Joint Test Group meetings
   2. The DCSP shall provide a fragnet type P6 schedule, excerpted from the Contractor's master baseline status schedule, updated monthly, which shows progress and all planning activities for individual and overall Segment activities. The City's representative will review and approve/disapprove the FragNET Schedule and may require additional granularity in the schedule, if in the sole opinion of the City's representative there is not sufficient granularity in the schedule.

END OF SECTION

SECTION 40 98 05
QUALITY CONTROL

PART 1 - GENERAL

1.1 QUALITY PROGRAM

A. The DCSP shall institute a Quality Control Plan (QCP) which utilizes organized methodologies and industry standards. All manufacturing, design, development, production, installation, and field service resources of the DCSP shall be certified as conforming to all of the requirements of international quality management standard ISO 9001. The certification shall be submitted to the City's representative in accordance with Section 01 33 00, Submittal Procedures. This certification shall be a "Certification of Quality" from an internationally recognized certification agency. The plan shall include the following aspects at a minimum:

1. Quality assurance organization which complies with ISO 9001 guidelines.
2. System of traceability of manufactured unit and system software throughout development, production and testing.
3. System of "burn-in" for all components and available supportive documents.
4. Record of prompt shipments in accordance with contract obligations
5. Documented program of failure analysis.
6. Documented product safety policy relevant to all products intended to be furnished under this Contract.
7. Demonstrated record of prompt positive response to field failures.

B. Provide DCS of rugged construction design for the site conditions. Provide only new, standard, first-grade materials throughout, conforming to standards established by Underwriter's Laboratories (UL), Inc., and so marked or labeled, together with manufacturer's brand or trademark.

C. Provide material and equipment in accordance with applicable codes and standards, except as modified by the specifications.

D. Refer to Section 01 45 16, Contractor Quality Control.

1.1 SUBMITTALS

A. DCSP Project Specific Quality Control Plan (CQP): Submit, not later than 30 days after receipt of Notice to Proceed.

1.2 RISK MANAGEMENT PLAN

A. The DCSP shall assess and document all potential project risks. Risk assessment and mitigation shall include:

1. Risks shall be documented in a format to be communicated to the City's representative.
2. Each risk shall be classified in terms of probability, impact, and status.
3. High impact risks shall be discussed at project progress meetings.
4. Each risk shall have an associated mitigation plan.

1.3 DCSP QUALITY CONTROL PLAN (QCP)

A. General:

1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
2. DCS Construction will be permitted to begin only after acceptance of the Quality Control Plan (CQP).

B. Content:

1. Plan shall cover the intended quality control organization for the entire Contract and shall include the following, as a minimum:
   a. Organization: Description of the quality control organization, including a chart showing lines of authority.
   b. Quality Control Staff: The name, qualifications, duties, responsibilities, and authorities of each person assigned a QC function.
   c. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of sub DCSPs, offsite fabricators, suppliers and purchasing agents.
   d. Testing: Control, verification, and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests is required.
   e. Procedures for tracking preparatory, initial, and follow-up control steps and control verification, and acceptance tests, including documentation.
   f. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.
   g. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.

C. Acceptance of Plans: Acceptance of the DCSP's basic and addendum QC plans is required prior to the start of DCS construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The City reserves the right to require DCSP to make changes in the QC plan and operations including removal of personnel, as necessary, to obtain the quality specified.

D. Notification of Changes: After acceptance of the QC plan, DCSP shall notify City's representative, in writing, a minimum of 7 calendar days prior to any proposed change in the plan. Proposed changes are subject to acceptance by the City's representative.

1.4 SUBMITTAL QUALITY CONTROL

A. The QC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements. City's representative will furnish copies of test report forms upon request by DCSP, or DCSP may use other forms as approved by City representative.

1.5 TESTING QUALITY CONTROL

A. Testing Procedure:

1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Perform the following activities and record the following data:
   a. Verify testing procedures comply with contract requirements.
   b. Verify facilities and testing equipment are available and comply with testing standards.
   c. Check test instrument calibration data against certified standards and provide certification to City's representative.
   d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
   e. Documentation:
      1) Record results of all tests taken, both passing and failing, on the QC report for the date taken.
      2) Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.
      3) Actual test reports may be submitted later, if approved by City's representative, with a reference to the test number and date taken.
      4) Provide directly to City's representative an information copy of tests performed by an offsite, or commercial test facility,

if applicable. Test results shall be signed by an engineer registered in the state where the tests are performed.

1.6 COMPLETION INSPECTION

A. QC System Manager shall conduct an inspection of the DCS Work at the completion of all Work or any contract milestone established by a completion time stated in the Contract.

B. Punch list:

1. QC System Manager shall develop a punch list of DCS items which do not conform to the Contract requirements.
2. Include punch list in the QC report, indicating the estimated date by which the deficiencies will be corrected.
3. The QC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the City's representative.
4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 99 90
PACKAGE CONTROL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. The Institute of Electrical and Electronics Engineers, Inc. (IEEE): C62.41, IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
2. International Society of Automation (ISA): S50.1, Compatibility of Analog Signals for Electronic Process Instruments.
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. AB 1, Molded Case Circuit Breakers and Molded Case Switches.
   c. ICS 2, Industrial Control Devices, Controllers and Assemblies.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. Underwriters Laboratories Inc. (UL): 508A, Standards for Safety, Industrial Control Panels.

1.2 SYSTEM DESCRIPTION

A. Assemble panels and install instruments, plumbing, and wiring in equipment manufacturer's factories.

B. Test panels and panel assemblies for proper operation prior to shipment from equipment manufacturer's factory.

1.3 SUBMITTALS

A. Action Submittals:

1. Bill of material, catalog information, descriptive literature, wiring diagrams, and Shop Drawings for components of control system.
2. Catalog information on electrical devices furnished with system.
3. Shop Drawings, catalog material, and dimensional layout drawings for control panels and enclosures.
4. Panel elementary diagrams of prewired panels. Include in diagrams control devices and auxiliary devices, for example, relays, alarms, fuses, lights, fans, and heaters.
5. Plumbing diagrams of preplumbed panels and interconnecting plumbing diagrams.

6. Interconnection wiring diagrams that include numbered terminal designations showing external interfaces.
7. Seismic anchorage and bracing data sheets and drawings as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Programmable Controller Submittals:
   a. Complete set of user manuals.
   b. Fully documented ladder logic listings.
   c. Function listing for function blocks not fully documented by ladder logic listings.
   d. Cross-reference listing.
   e. Modbus Data Table
      1) All soft points passed between the DCS and PLC must be referenced with Modbus addressing and format.
      2) PLC will act as a slave to the DCS utilizing Modbus TCP/IP
   f. Communications hardware and configuration
2. Manufacturer's list of proposed spares, expendables, and test equipment.
3. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers and related equipment as recommended by capsule manufacturer.

1.5 EXTRA MATERIALS

A. Spares, Expendables, and Test Equipment:

1. Selector Switch, Pushbutton, and Indicating Light: 20 percent, one minimum, of each type used.
2. Light Bulb: 100 percent, 2 minimum, of each type used.
3. Fuse: 100 percent, 5 minimum, of each type used.
4. Surge Suppressors: 20 percent, one minimum, of each type used.

PART 2 PRODUCTS

2.1 GENERAL

A. Section 40 90 00, Instrumentation and Control

2.2 INSTRUMENT TAG NUMBERS

A. A shorthand tag number notation is used. For example:

12FIT345 [pH]

Notation	Explanation
12	Unit process number
FIT	ISA designator for Flow Indicating Transmitter
345	Loop number
[pH]	Same notation shown at 2 o'clock position on ISA circle symbol on Process and Instrument Diagram

2.3 SIGNAL CHARACTERISTICS

A. Analog Signals:

1. 4 to 20 mA dc, in accordance with compatibility requirements of ISA S50.1.
2. Unless otherwise specified or shown, use Type 2, two-wire circuits.
3. Transmitters: Load resistance capability conforming to Class L.
4. Fully isolate input and output signals of transmitters and receivers.

B. Discrete Signals:

1. Two-state logic signals.
2. Utilize 120V ac sources for control and alarm signals.
3. Alarm signals shall be normally open, close to alarm isolated contacts rated for 5-ampere at 120V ac and 2-ampere at 30V dc.

2.4 CORROSION PROTECTION

A. Corrosion-Inhibiting Vapor Capsule Manufacturers:

1. Northern Instruments; Model Zerust VC.
2. Hoffmann Engineering; Model A-HCI.

2.5 CONTROL PANEL

A. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), UL 508, state and local codes, and applicable sections of NEMA, ANSI, and ICECA.

B. Conform to NEMA ratings as specified in individual equipment sections.

C. Minimum Metal Thickness: 14 gauge.

D. NEMA 250, Type 4X Panels: Type 316 stainless steel construction unless otherwise specified.

E. Doors:

1. Three-point latching mechanisms in accordance with NEMA 250 Type 1 and 12 panels with doors higher than 18 inches.
2. For other doors, stainless steel quick release clamps.

F. Cutouts shall be cut, punched, or drilled and finished smoothly with rounded edges.

G. Access: Front, suitable for installation with back and sides adjacent to or in contact with other surfaces, unless otherwise specified.

H. Temperature Control:

1. Size panels to adequately dissipate heat generated by equipment mounted on or in the panel.
2. Furnish cooling fans with air filters if required to dissipate heat.
3. For panels outdoors or in unheated areas, furnish thermostatically controlled heaters to maintain temperature above 40 degrees F.

I. Push-to-Test Circuitry: For each push-to-test indicating light, provide a fused push-to-test circuit.

J. Lighting: Minimum of one hand switch controlled internal 100-watt incandescent light for panels 12 cubic feet and larger.

K. Minimum of one 120-volt GFCI duplex receptacle for panels 3 cubic feet and larger or any enclosure containing a processor that is capable of communicating with a laptop computer.

L. Finish:

1. Metallic External Surfaces (Excluding Aluminum and Stainless Steel): Manufacturer's standard gray unless otherwise specified.
2. Internal Surfaces: White enamel.

M. Panel Manufacturers:

1. Hoffman.
2. H.F. Cox.

N. Breather and Drains: Furnish with NEMA 250, Type 4 and 4X panels.

1. Manufacturer and Product: Cooper Crouse-Hinds; ECD Type 4X Drain and Breather; Drain Model ECD1-N4D, Breather Model ECD1-N4B.

2.6 PROGRAMMABLE CONTROLLERS/HMI HARDWARE

A. Programmable Controller (PLC) Hardware:

1. General:
   a. PLC system shall be Allen-Bradley ControlLogix series, as specified below. No substitutes allowed.
   b. Not all equipment listed below may not be used the package control system.
   c. Control processors shall be provided in a redundant configuration where noted on the individual equipment specifications.
   d. All products shall be the latest version of each module.
2. Control Processor: Units shall be Allen-Bradley; Model 1756-L71.
3. Power Supply Module: Units shall be Allen-Bradley; Model 1756-PAR for redundant configuration and Model 1756-PA75 for non-redundant configuration.
4. PLC I/O Chassis: 10-slot chassis shall be Allen-Bradley; Model 1756-A10, 17-slot chassis shall be Allen-Bradley; Model 1756-A17.
5. Redundancy Module: Units shall be Allen-Bradley; Model 1756-RM.
6. Ethernet Communications Module: Units shall be Allen-Bradley; Model 1756-EN2T.
7. Digital Input Module: Units shall be Allen-Bradley; Model 1756-IA16I, with Model 1756-TBCH I/O Module Terminal Interface.
8. Digital Output Module: Units shall be Allen-Bradley; Model 1756-OA16I, with Model 1756-TBCH I/O Module Terminal Interface.
9. Analog Input (HART) Module: Units shall be Allen-Bradley; Model 1756-IF16H, with Model 1756-TBCH I/O Module Terminal Interface.
10. Analog Output Module: Units shall be Allen-Bradley; Model 1756-OF8, with Model 1756-TBNH I/O Module Terminal Interface.

B. Human Machine Interface (HMI) Hardware:

1. General: Operator Interface System shall be Allen-Bradley, as specified below. No substitutions allowed.
2. Graphic Display Terminal: Units shall be Allen-Bradley PanelView Plus 1500.

2.7 CONTROL PANEL ELECTRICAL

A. UL Listing Mark for Enclosures: Mark stating "Listed Enclosed Industrial Control Panel" per UL 508A.

B. I&C and electrical components, terminals, wires, and enclosures UL recognized or UL listed.

C. Control Panels without Motor Starters:

1. Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.
2. Locate to provide clear view of and access to breakers when door is open. Group on single subpanel. Provide typed directory.
3. Circuit Breakers:
    a. Coordinate for fault in branch circuit trips, branch breaker, and not main breaker.
    b. Branch Circuit Breakers: 15 amps at 250V ac.
    c. Breaker Manufacturers and Products:
        1) Heineman Electric Co.; Series AM.
        2) Airpax/North American Philips Controls Corp.; Series 205.
        3) "Or-equal."

D. Control Panels with Three-Phase Power Supplies and Motor Starters:

1. Interlock main circuit breaker with panel door.
    a. Mount logic controls, branch circuit breakers, overload reset switches, and other control circuit devices.
    b. Mount operator controls and indications on front access door.
2. Circuit Breakers:
    a. In accordance with NEMA AB 1.
    b. 18,000-ampere RMS symmetrical rating, minimum at 480 volts, unless otherwise specified.
    c. Breakers, except Motor Branch Breakers: Molded case thermal magnetic.
    d. 14,000ampere RMS symmetrical rating, minimum at 480 volts, unless otherwise specified in package system equipment specification sections.
    e. Tripping: Indicate with operator handle position.
3. Magnetic Motor Starters:
    a. Full voltage, NEMA ICS 2, Class A, Size O minimum.

b. Include three-pole bimetallic or eutectic alloy thermal overload relays sized for each motor.
c. Manual reset type with reset button mounted on panel door.

4. Motor Control: 120V ac (except intrinsically safe circuits where applicable).
   a. Power Control Transformer:
      1) Sufficient capacity to serve connected load, including 200VA for duplex outlet plus 100VA (minimum).
      2) Limit voltage variation to 15 percent during contact pickup.
      3) Fuse one side of secondary winding and ground the other.
      4) Furnish primary winding fuses in ungrounded conductors.
5. Power Monitoring Relay:
   a. Protect three-phase equipment from single phasing, phase imbalance, or phase reversal.
   b. Separate, isolated contact outputs to stop motors and activate alarm light during abnormal conditions.
   c. Transient Voltage Protection: 10,000 volts.
   d. Manufacturer and Product:.
      1) Furnas; Class 47
      2) "Or-equal."
6. Power Distribution Blocks: Furnish to parallel feed tap on branch circuit protective devices. Do not "leap frog" power conductors.
7. Terminations for Power Conductors: Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

E. Wiring:

1. ac Circuits:
   a. Type: 600-volt, Type MTW stranded copper.
   b. Size: For current to be carried, but not less than 14 AWG.
2. Analog Signal Circuits:
   a. Type: 300-volt, Type 2 stranded copper, twisted shielded pairs.
   b. Size: 18 AWG, minimum.
3. Other dc Circuits.
   a. Type: 600-volt, Type MTW stranded copper.
   b. Size: 18 AWG, minimum.
4. Separate analog and other dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.
5. Enclose wiring in sheet metal raceways or plastic wiring ducts.
6. Wire Identification: Numbered and tagged at each termination.
   a. Wire Tags: Machine printed, heat shrink.
   b. Manufacturers:
      1) Brady PermaSleeve.
      2) Tyco Electronics.

3) "Or-equal."

F. Wiring Interface:

1. For analog and discrete signal, terminate at numbered terminal blocks.
2. For special signals, terminate power (240 volts or greater) at manufacturer's standard connectors.
3. For panel, terminate at equipment on/with which it is mounted.

G. Terminal Blocks:

1. Quantity:
   a. For external connections.
   b. Wire spare or unused panel mounted elements to their panels' terminal blocks.
   c. Spare Terminals: 20 percent of connected terminals, but not less than 10.
2. General: Group to keep 120V ac circuits separate from 24V dc circuits.
   a. Connection Type: Screw connection clamp.
   b. Compression Clamp:
      1) Hardened steel clamp with transversal grooves penetrating wire strands providing a vibration-proof connection.
      2) Guides strands of wire into terminal.
   c. Screws: Hardened steel, captive, and self-locking.
   d. Current Bar: Copper or treated brass.
   e. Insulation:
      1) Thermoplastic rated for minus 55 to plus 110 degrees C.
      2) Two funnel shaped inputs to facilitate wire entry.
   f. Mounting:
      1) Rail.
      2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
      3) End Stops: One at each end of rail, minimum.
   g. Wire Preparation: Stripping only.
   h. Jumpers: Allow jumper installation without loss of space on terminal or rail.
   i. Marking System:
      1) Terminal number shown on both sides of terminal block.
      2) Allow use of preprinted and field marked tags.
      3) Terminal strip numbers shown on end stops.
      4) Mark terminal block and terminal strip numbers as shown.
3. Manufacturer and Product: Phoenix Contact Entrelec or equal.

H. Grounding: Internal copper grounding bus for ground connections on panels, consoles, racks, and cabinets.

I. Relays:

1. General:
   a. Relay Mounting: Plug-in type socket.
   b. Relay Enclosure: Provide dust cover.
   c. Socket Type: Screw terminal interface with wiring.
   d. Socket Mounting: Rail.
   e. Furnish holddown clips.
2. Control Circuit Switching Relay, Nonlatching:
   a. Type: Compact general purpose plug-in.
   b. Contact Arrangement: 3 Form C contacts.
   c. Contact Rating: 10A at 28V dc or 240V ac.
   d. Contact Material: Silver cadmium oxide alloy.
   e. Coil Voltage: As noted or shown.
   f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
   g. Expected Mechanical Life: 10,000,000 operations.
   h. Expected Electrical Life at Rated Load: 100,000 operations.
   i. Indication Type: Neon or LED indicator lamp.
   j. Push-to-test button.
   k. Manufacturer and Product: Potter and Brumfield; Series KUP.
3. Control Circuit Switching Relay, Latching:
   a. Type: Dual coil mechanical latching relay.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 10A at 28V dc or 120V ac.
   d. Contact Material: Silver cadmium oxide alloy.
   e. Coil Voltage: As noted or shown.
   f. Coil Power: 2.7 watts (dc), 5.3VA (ac).
   g. Expected Mechanical Life: 500,000 operations.
   h. Expected Electrical Life at Rated Load: 50,000 operations.
   i. Manufacturer and Product: Potter and Brumfield; Series KB/KBP.
4. Control Circuit Switching Relay, Time Delay:
   a. Type: Adjustable time delay relay.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 10A at 240V ac.
   d. Contact Material: Silver cadmium oxide alloy.
   e. Coil Voltage: As specified or shown.
   f. Operating Temperature: Minus 10 to 55 degrees C.
   g. Repeatability: Plus or minus 2 percent.
   h. Delay Time Range: Select range such that time delay setpoint fall between 20 to 80 percent or range.
   i. Time Delay Setpoint: As specified or shown.
   j. Mode of Operation: As specified or shown.
   k. Adjustment Type: Integral potentiometer with knob external to dust cover.
   l. Manufacturer and Products: Potter and Brumfield.

1) Series CB for 0.1-second to 100-minute delay time ranges.
2) Series CK for 0.1- to 120-second delay time ranges.

J. Intrinsic Safety Barriers:

1. Intrinsically Safe Relays: Monitor discrete signals that originate in hazardous area and are used in a safe area.
   a. Manufacturer and Product: MTL, Inc.; Series MTL 5000.
2. Intrinsically Safe Barriers: Interface analog signals as they pass from hazardous area to safe area.
   a. Manufacturer and Product: MTL, Inc.; Series MTL 5000.

K. Front-of-Panel Devices in Conjunction with NEMA 250, Type 1 and 12 Panels:

1. Potentiometer Units:
   a. Three-terminal, oiltight construction, resolution of 1 percent and linearity of plus or minus 5 percent.
   b. Single-hole, panel mounting accommodating panel thicknesses between 1/8 and 1/4 inch.
   c. Include legend plates with service markings.
   d. Manufacturers and Products:
      1) Allen-Bradley; Model 800T.
      2) Eaton/Cutler-Hammer; Model 10250T.
      3) "Or-equal."

2. Indicating Lights:
   a. Heavy-duty, push-to-test type, oiltight, industrial type with integral transformer for 120V ac applications.
   b. Screwed on prismatic glass lenses in colors noted and factory engraved legend plates for service legend.
   c. Manufacturers and Products:
      1) Eaton/Cutler-Hammer; Type 10250T.
      2) General Electric; CR2940U.
      3) "Or-equal."

3. Pushbutton, Momentary:
   a. Heavy-duty, oiltight, industrial type with full guard and momentary contacts rated for 10 amperes continuous at 120V ac.
   b. Standard size legend plates with black field and white markings for service legend.
   c. Manufacturers and Products:
      1) Square D; Class 9001, Type K.
      2) Eaton/Cutler-Hammer; Type T.
      3) General Electric; Type CR-2940.
      4) "Or-equal."

4. Selector Switch:
    a. Heavy-duty, oiltight, industrial type with contacts rated for 120V ac service at 10 amperes continuous.
    b. Standard size, black field, legend plates with white markings, for service legend.
    c. Operators: Black knob type.
    d. Single-hole mounting, accommodating panel thicknesses from 1/16 inch to 1/4 inch.
    e. Manufacturers and Products for Units with up to Four Selection Positions:
        1) Eaton/Cutler-Hammer; Type T.
        2) Square D; Type K.
        3) "Or-equal."
    f. Manufacturers and Products for Units with up to 12 Selection Positions:
        1) Rundel-Idec; Standard Cam Switch.
        2) Electroswitch; 31.
        3) "Or-equal."

L. Front-of-Panel Devices Used in Conjunction with NEMA 250, Type 4X Panels:

1. Potentiometer, Watertight:
    a. Three-terminal, heavy-duty NEMA 250, Type 4X watertight construction, resolution of 1 percent and linearity of plus or minus 5 percent.
    b. Single-hole, panel mounting accommodating panel thicknesses between 1/8 and 1/4 inch.
    c. Include engraved legend plates with service markings.
    d. Manufacturer and Product: Allen-Bradley; Bulletin 800H.
2. Indicating Lights, Watertight:
    a. Heavy-duty, push-to-test type, NEMA 250, Type 4X watertight, industrial type with integral transformer for 120V ac applications and corrosion-resistant service.
    b. Screwed on prismatic lenses and factory engraved legend plates for service legend.
    c. Manufacturers and Products:
        1) Square D; Type SK.
        2) Allen-Bradley; Type 800H.
        3) "Or-equal."
3. Pushbutton, Momentary, Watertight:
    a. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with momentary contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.

b. Standard size, black field, legend plates with white markings for service legend.
c. Manufacturers and Products:
1) Square D; Type SK.
2) Allen-Bradley; Type 800H.
3) "Or-equal."

4. Selector Switch, Watertight:
a. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.
b. Standard size, black field, legend plates with white markings, for service legend.
c. Operators: Black knob type.
d. Single-hole mounting, accommodating panel thicknesses from 1/16 to 1/4 inch.
e. Manufacturer and Products:
1) Square D; Class 9001, Type SK.
2) Allen-Bradley; Type 800H.
3) "Or-equal."

2.8 NAMEPLATES, NAMETAGS, AND SERVICE LEGENDS

A. Nametags: Permanently mounted bearing entire ISA tag number.

1. Panel Mounted: Plastic, mounted to instrument behind panel face.
2. Field Mounted: Engraved Type 316 stainless steel, 22-gauge minimum thickness, attached with stainless steel.

B. Service Legends (Integrally Mounted with Instrument) and Nameplates:

1. Engraved, rigid, laminated plastic type with adhesive back. Furnish service legends and nameplates to adequately describe functions of panel face mounted instruments.
2. Color: White with black letters.
3. Letter Height: 3/16 inch.
4. For each panel, face mounted laminated nameplate inscribed with the panel name and tag number. Color shall be white with black letters 1/2 inch high.

C. Standard Light Colors and Inscriptions: Unless otherwise specified in individual equipment specifications, use the following color code and inscriptions:

Tag	Inscription(s)	Color
ON	ON	Green
OFF	OFF	Red

Tag	Inscription(s)	Color
OPEN	OPEN	Green
CLOSED	CLOSED	Red
LOW	LOW	Amber
FAIL	FAIL	Amber
HIGH	HIGH	Amber
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow
FORWARD	FORWARD	Red
REVERSE	REVERSE	Blue

1. Lettering: Black on white and amber lenses; white on red and green lenses.
2. Standard Pushbutton Colors and Inscriptions:
   a. Use following unless otherwisenoted:

Tag Function	Inscription(s)	Color
OO	ON OFF	Black Black
OC	OPEN CLOSE	Black Black
OCA	OPEN CLOSE AUTO	Black Black Black
OOA	ON OFF AUTO	Black Black Black
MA	MANUAL AUTO	Black Black
SS	START STOP	Black Black
RESET	RESET	Black

Tag Function	Inscription(s)	Color
EMERGENCY STOP	EMERGENCY STOP	Red

b. Lettering Color:
   1) Black on white and yellow buttons.
   2) White on black, red, and green buttons.

D. Grounding:

1. Coordinate surge suppressor grounding in field panels and field instrumentation as specified in Section 26 05 26, Grounding and Bonding for Electrical Systemsand suppressor manufacturer's requirements.
2. Provide control panels with an integral copper grounding bus for connection of suppressors and other required instrumentation.

PART 3 EXECUTION

3.1 ELECTRICAL POWER AND SIGNAL WIRING

A. Restrain control and signal wiring in control panels by plastic ties or ducts. Secure hinge wiring at each end so bending or twisting will occur around the longitudinal axis of wire. Protect bend area with a sleeve.

B. Arrange wiring neatly, cut to proper length, and remove surplus wire. Install abrasion protection for wire bundles passing through holes or across edges of sheet metal.

C. Use manufacturer's recommended tool with sized anvil for crimp terminations. No more than one wire may be terminated in a single crimp lug. No more than two lugs may be installed on a single screw terminal.

D. Do not splice or tap wiring except at device terminals or terminal blocks.

3.2 PROTECTION

A. Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.

B. During Work, periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules at Substantial Completion.

END OF SECTION

SECTION 41 22 13.13
OVERHEAD BRIDGE CRANE

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
   a. B30.2, Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist).
   b. B30.10, Hooks.
   c. B30.11, Monorails and Underhung Cranes.
   d. B30.17, Overhead and Gantry Cranes (Top Running, Single Girder).
   e. HST 1M, Performance Standard for Electric Chain Hoists.
   f. HST 2M, Performance Standard for Hand Chain Manually Operated Chain Hoists.
   g. HST 4M, Overhead Electric Wire Rope Hoists.
2. Crane Manufacturer's Association of America (CMAA):
   a. 70, Electric Overhead Traveling Cranes.
   b. 74, Top Running & Under Running Single Girder. Electric Overhead Traveling Cranes.
3. National Electrical Manufacturer's Association (NEMA):
   a. MG 1, Motors and Generators.
   b. 250, Enclosures for Electrical Equipment (1,000 volts maximum).
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. Occupational Safety and Health Act (OSHA).
6. Underwriters Laboratory (UL): 674, Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

1.2 DESIGN REQUIREMENTS

A. Top-Running Multiple-Girder Overhead Traveling Crane: CMAA No. 70 and ASME B30.2 and B30.17.

B. Top-Running and Underhung Single-Girder Overhead Traveling Cranes: CMAA No. 74, and ASME B30.11.

C. Crane Service Class: CMAA No. 74.

D. Trolley Service Class: CMAA No. 70.

E. Wire Rope Hoist Service Class: ASME HST 4M and CMAA No. 70 or No. 74.

F. Chain Hoist Service Class: ASME HST 1M and CMAA No. 70 or No. 74.

G. Hook: ASME 30.10.

H. Building Clearances: CMAA No. 70 and No. 74. Where bridge span exceeds 40 feet, increase clearance to 6 inches.

I. Stress and Safety Factors: CMAA No. 70 and No. 74. Properly select materials of construction for stresses to which subjected.

J. Safety of Operation, Accessibility, Interchangeability, and Durability of Parts: ASME B30.2.0 and OSHA requirements. Design equipment for environment operated.

K. Provide system, equipment, and components, including supports and anchorages, designed in accordance with Section 01 61 00, Common Product Requirements**.**

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Make, model, weight, and horsepower of each equipment assembly.
   b. Complete catalog information, descriptive literature, materials of construction, and specifications on bridge drive system, end trucks, runway stops, foot walks and platforms, wheels, shafting, drive motor, gears and bearing, steel framing, trolley drive system, hoist motor and assemblies, hook, brakes, starting system, variable speed drive system, conductors (bus bar, festoon, cable reel), controls, remote control system, and accessories.
   c. Structural design calculations for runway beams and support system, and calculations of loads on support structure stamped by a California registered professional civil or structural engineer**.**
   d. Detail Shop Drawings of crane runways, brackets, hangers, and their attachments to building structural steel.
   e. Power and control wiring diagrams, including terminals and numbers.
   f. Motor nameplate data in accordance with NEMA MG 1 and include any motor modifications.
   g. Factory finish system.

B. Informational Submittals:

1. Special shipping, storage and protection, and handling instructions.
2. Manufacturer's printed installation instructions.
3. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified herein.
4. Factory Functional Test Report
5. Suggested spare parts list to maintain the equipment in service for a period of 3 years**.** Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
6. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
7. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
8. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services**.**

1.4 ENVIRONMENTAL REQUIREMENTS

A. Temperature: Maximum 100 degrees; minimum 60 degrees F.

B. Humidity: 70 percent.

C. Atmosphere: Moderately corrosive.

1.5 EXTRA MATERIALS

A. Furnish for each remote control crane:

1. One transmitter.
2. One battery.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide overhead bridge crane with top-running bridge beam and under-running trolley as shown on the Drawings, with rated weight capacity as shown on the Drawings.

B. Crane manufacturer to coordinate equipment requirements with steel structures, panels, drive motor, control panel, trolley and hoist, hoisting cable or chain, hook, crane mounted conductors, rails, stops, and electrical equipment controls.

C. Where adjustable speed drives or remote control systems are required, crane manufacturer to furnish a coordinated operating system.

2.2 CRANE DATA TABLE

Parameter	Quantity or Description
Bridge Beam Span	51'-6"
Bridge Depth	2'-0"
Number of Bridge Girders	2
Hook Height-Retracted	19'-11"
Heights of Bottom Flange of Bridge Beam AFF	21'-0"
Bridge Beam Type	Top Running
Trolley Type	Under Running
Bridge Crane Rated Capacity	10 Tons
Minimum Horizontal Distance from Hook to Centerline of Rail Beams at Full Range of Trolley Travel	75"
Pendant	2 remote wireless pendants to be provided
Speed of Travel	
High Hook Requirements	
Low Hook Requirements	

A. See supplements to this section for additional requirements.

2.3 RUNWAY

A. Runway beams, brackets, and associated framework furnished under Section 05 12 00, Structural Steel Framing. Furnish runway beams, brackets, and associated framework in accordance with Section 05 12 00, Structural Steel Framing.

B. Runway rails shall conform to cross-sections and weights per yard as specified in CMAA No. 70 or No. 74. Furnish rails, rail connections, crane stops, and conductors by crane manufacturer.

2.4 BRIDGE

A. Furnish girders from structural shapes proportioned to resist vertical, lateral, and torsional forces.

B. Construct bridge end trucks in accordance with CMAA No. 70 or No. 74. Furnish end trucks with rail sweeps and impact-absorbing bumpers.

C. Furnish runway stops attached to resist force applied when contacted and locate at limit of travel of bridge. Runway stops shall not engage the wheels.

D. Provide bridge travel limit switches, located approximately 5 feet from each end of bridge runway, or as required such that bridge travel speed is reduced to low speed prior to bridge engaging runway end-stops. Bridge drive speed past the limit switch locations shall be limited to low speed.

E. Wheels: Rolled or forged steel with treads and flanges heat treated, or cast iron wheels with chilled tread. Minimum tread hardness 200 Brinell. Clearances, wheel loads, and tolerances in accordance with CMAA No. 70 or No. 74. Wheel axles of alloy steel, machined and ground to receive inner bearing races. Use rotating axles and wheels mounted by press fit and keys. For top-running cranes provide rotating axles and wheels mounted by press fit and keys. For under-running trolley provide fixed axles with wheels accurately machined and ground to receive inner bearing races.

F. Bridge driving machinery consisting of a cross shaft driven by an electrical motor through a gear speed reducer unit. Cross shaft, high-grade steel, turned, ground, polished, and adequately supported with self-aligning bearings. Shaft diameter to resist torsional strains when bridge is traveling under full load, or when stopped suddenly. Furnish oil-tight speed reducer gear case and support on common base with bridge brake. Bridge motors shall be provided with VFDs capable of adjusting the speed between 52 FPM and 105 FPM.

G. Drive Gears: Helical, spur or herringbone type, rolled or cast steel, with machine cut teeth.

H. Bearings: Combination radial and thrust type, double row, spherical ball, either prelubricated and sealed or fitted for pressure lubrication. Pressure lubrication fittings for maintenance accessibility.

I. Brakes: Electrically operated, adjustable, suitable for the service class indicated, with rated torque capacities as specified in CMAA No. 70 or CMAA No. 74.

2.5 TROLLEY

A. Frame: Ductile iron construction. Design to control deflection of trolley assembly while transmitting the carrying load to bridge rails. Provide under-running trolley type.

B. Drive shall consist of trolley drive shaft, driven by an electric motor through a gear reduction unit.

C. Drive shall consist of chain sprocket mounted on shaft. Furnish chain to within 5 feet of operating floor level. Drive shaft shall drive the trolley wheels through a gear and pinion or spur gear arrangement.

D. Furnish roller assembly stabilizers on single-girder trolley units to prevent tipping during load pickup.

E. Wheels: 4-inch diameter rolled C-1040 steel, accurately machined and ground to receive inner bearing races. Furnish alloy steel axles. Rotating axles with wheels mounted press fit and keys, or with keys alone. Minimum tread hardness 210 Brinell.

F. Drive Gears: Helical, spur or herringbone type, rolled or cast steel, with machine cut teeth.

G. Bearings: Combination radial and thrust type, double row, angular contact ball bearings or single-row tapered roller bearings. Bearings prelubricated and sealed, or fitted for pressure lubrication. Locate pressure lubrication fittings for accessibility during maintenance.

H. Brakes: Suitable for service class and rated torque capacities as specified in ASME B30.11. Furnish stops on trolley rails or beams.

I. Provide trolley travel limit switches, located approximately 6 feet to 8 feet from each end of trolley rails/beams, or as required such that trolley travel speed is reduced to low speed prior to trolley engaging the trolley end-stops. Trolley drive speed past the limit switch locations shall be limited to low speed.

J. Trolley Motors: 2 motors at maximum 1.0 Hp each. Provide 2-speed VFD with speed settings of 75 feet per minute and 19 feet per minute. Provide

TEFC, NFMA design B, squirrel cage induction type, inverter duty rated motors.

2.6 HOIST

A. Wire Rope Hoisting Machinery: Rope drum driven through gear reductions, load blocks, hook, hoisting rope, sheaves, and hoist braking. Drum size and length sufficient for minimum two turns of cable remaining on drum when hook is at lowest position. Furnish reeving as specified on supplement located at end of section. Provide right and left-hand grooved drum when two-part double reeving is specified.

B. Rope drum and surrounding members constructed to minimize abrasion, crushing or jamming of hoist rope. Load blocks enclosed type. Hoisting rope extra flexible, improved plow steel wire rope, made especially for hoist service.

C. Hook: Construct with sufficient ductility to open noticeably before hook failure, equipped with safety latch, free to rotate 360 degrees with rated load and positively held in place with locknuts, collars or other devices.

D. Brakes: Mechanical and electric load brake and controls, designed in accordance with ASME 4M, and adjustable to compensate for wear. Provide gear brake and inverter duty motor brake.

E. Chain Hoisting Machinery: Load chain wheel driven through gear reductions, an electric motor, a hand chain wheel**,** load blocks, sheaves, chain, hook, and hoist braking.

F. Chain: Nonjamming alloy type**.** Chain hoists shall have chain storage adequate for storing the full lift length of chain and shall be designed and located to avoid interference while hoisting. Provide 30 feet of available lift.

G. Hook: Construct with sufficient ductility to open noticeably before hook failure, equipped with safety latch, free to rotate 360 degrees with rated load, and positively held in place with locknuts, collars or other devices.

H. Brakes: In accordance with ASME HST 1M and HST 2M, adjustable to compensate for wear, positive action, Weston type mechanical load brake, with uniform composition lining and forged steel alloy latch pawl.

I. Hoist Motor: Nominal motor horsepower between 5 Hp and 7.5 Hp. Provide 2-speed VFD with speed settings of 17 FPM and 4 FPM.

2.7 ELECTRICAL

A. Furnish electrical equipment including motors, motor starters, pendant control, control systems, wire, and conduit. Bridge conductors may be removed for shipment. Crane wiring by crane supplier.

B. Electrical: In accordance with NFPA 70, NEC Article 610.

C. Furnish motors compatible with adjustable frequency, variable speed, drive system suitable for hoist, trolley, and bridge drive applications. Controls with 120-volt ac, microprocessor based, pulsed width modulation design, withstand 45 degree C temperatures, housed in NEMA 250, Type 4 enclosure, and supplied with 200 percent overcurrent protection.

D. Bridge and trolley conductor voltage drops from runway supply taps shall permit the crane motors to operate within voltage tolerances of plus or minus 10 percent, when building supply voltage is at plus or minus 5 percent of design voltage.

E. Enclosed Bus Bar Conductors: Stainless steel clad hard copper enclosed in insulation. Collector mechanism components: aluminum, stainless steel, plastic, or other noncorrosive materials.

F. Grounding: External in accordance with NFPA 70, NEC Article 250.

2.8 CONTROLS

A. Furnish electric cranes with pendant control having momentary contact pushbuttons with a device which will disconnect motors from line on failure of power. Device shall not permit any motor to be restarted until controller handle is brought to the OFF position, or a reset switch or button is operated. Furnish with undervoltage protection as a function of each motor controller, or by magnetic main line contactor.

B. Controls: Fully magnetic, plain reversing type, housed in NEMA 250, Type 12 enclosure, with contactors of sufficient size and quantity for starting, accelerating, reversing, and stopping duty for specified crane service class.

C. Bridge and Trolley Drives: Soft start controls, 460/230-volt ac series device, installed in between drive motor and motor starter with torque and acceleration rate adjustable, suitable for crane service, and work in conjunction with crane controls.

D. Backup Pushbutton Control Stations: Heavy-duty, oil tight, suspended from trolley, with control transformers to supply 120-volt ac power to pushbutton control station. Pushbutton enclosure supported with chain or wire rope. Control wire cable attached to support chain or wire rope at not more than 6-foot intervals. Furnish control station buttons for control of bridge, trolley, and hoist, ON/OFF main line contactor power switch which removes all power from crane and controls.

E. Remote Control System: Infrared, line-of-sight system, handheld and capable of operating all crane functions.

F. Control motions indicate direction of resultant crane motion. Furnish spring-loaded switch motions, with return to OFF position when switch is released and designed to prevent runaway crane situations.

G. Crane motions shall stop automatically when crane can no longer receive remote signals and designed to stop when control signal for any motion becomes ineffective.

H. Remote Control Crane Motions: Hook raise and lower, trolley movement, bridge movement, and crane power up and power. Furnish an EMERGENCY OFF pushbutton station which will disconnect main line power via a remote switch, and manual reset function to activate all motions after an EMERGENCY OFF event.

2.9 ACCESSORIES

A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location. Mounted on separate components of each crane assembly, to facilitate assembly in the field.

B. Lifting Lugs: Equipment weighing over 100 pounds.

2.10 FACTORY FINISHING

A. Prepare and prime coat in accordance with Section 09 90 00, Painting and Coating.

2.11 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels and equipment for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments**:** No-load run test all equipment furnished.

C. Factory test report shall include Test Data Sheets.

2.12 MANUFACTURER

A. CraneVeyor Corporation, El Monte, CA

B. TC American

C. Spanco

D. Or equal

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Provide lubrication and lubrication fittings.

3.2 FIELD FINISHING

A. Equipment as specified in Section 09 90 00, Painting and Coating.

3.3 FIELD QUALITY CONTROL

A. Functional Test: Conduct on each crane.

1. Alignment: Test complete assemblies for proper alignment and connection, and quiet operation.

B. Performance Test:

1. Conduct on each crane.
2. Load tests in compliance with OSHA, ASME B30.11, and ASME B30.16.

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner for minimum person-days listed below, travel time excluded:

1. One person-days for installation assistance and inspection.
2. One person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. One person-days for prestartup classroom or Site training.

4. One person-days for facility startup.

B. See Section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Testing, Integration, and Startup.

END OF SECTION

SECTION 41 22 23.19
MONORAIL HOISTS AND JIB CRANES

PART 1 GENERAL

1.1 GENERAL

A. Provide monorail hoists and jib cranes as shown on structural and mechanical drawings. Rated weight capacity shall be shown on the Drawings.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI): MH27.1, Underhung Cranes and Monorail Systems.
2. American Society of Mechanical Engineers (ASME):
   a. B30.10, Hooks.
   b. B30.11, Monorails and Underhung Cranes.
   c. HST 1M, Performance Standard for Electric Chain Hoists.
   d. HST 2M, Performance Standard for Hand Chain Manually Operated Chain Hoists.
   e. HST 4M, Performance Standard for Overhead Electric Wire Rope Hoists.
3. National Electrical Manufacturer's Association (NEMA):
   a. MG 1, Motors and Generators.
   b. 250, Enclosures for Electrical Equipment (1,000 volts maximum).
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. Occupational Safety and Health Act (OSHA).
6. Underwriters Laboratory (UL): 674, Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

1.3 DESIGN REQUIREMENTS

A. Monorail System: Specifications for Underhung Cranes and Monorail Systems, ANSI MH27.1 and ASME B30.11.

B. Hoist: ASME B30.11, Hoist Manufacturers' Institute.

C. Trolley: ANSI MH27.1.

D. Wire Rope Hoist Service Class: ASME HST 4M.

E. Chain Hoist Service Class: ASME HST 1M.

F. Hook: ASME 30.10.

G. Stress and Safety Factors: ANSI MH27.1 and ASME B30.11. Properly select materials of construction for stresses to which subjected.

H. Safety of Operation, Accessibility, Interchangeability, and Durability of Parts: ASME B30.11 and OSHA requirements.

I. Provide system, equipment, and components, including supports and anchorages, designed in accordance with Section 01 88 15, Anchorage, Thrust Restrain and Bracing.

1.4 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Make, model, weight, and horsepower of each equipment assembly.
   b. Complete catalog information, descriptive literature, materials of construction, and specifications on hoist, wheels, gears and bearing, trolley drive system, hoist motor and assemblies, hook, brakes, starting system, variable speed drive system, conductors (bus bar, festoon, cable reel), controls, remote control system, and accessories.
   c. Structural design calculations for monorail track and support system and calculations of deflection and loads on building steel stamped by a California registered professional civil or structural engineer**.**
   d. Detail Shop Drawings of monorail track, brackets, hangers, and their attachments to building structural steel.
   e. Power and control wiring diagrams, including terminals and numbers.
   f. Motor nameplate data in accordance with NEMA MG 1, and include any motor modifications.
   g. Factory finish system.
   h. Design calculations and connection details for the wall-mounted bracket connections, by a licensed California civil or structural engineer in the employ of the Contractor.

B. Informational Submittals:

1. Special shipping, storage and protection, and handling instructions.
2. Manufacturer's printed installation instructions.
3. Manufacturer's Certification of Compliance that factory finish system is identical to requirements specified herein.
4. Factory Functional Test Report.

5. Suggested spare parts list to maintain the equipment in service for a period of 3 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
6. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
7. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
8. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services**.**

1.5 ENVIRONMENTAL REQUIREMENTS

A. Temperature: Maximum 100 degrees; minimum 60 degrees F.

B. Humidity: 70 percent.

C. Atmosphere: Moderately corrosive.

1.6 EXTRA MATERIALS

A. Furnish for each remote control crane:

1. One transmitter.
2. One battery.

PART 2 PRODUCTS

2.1 GENERAL

A. No "or-equal" or substitute products will be considered.

B. Hoist and trolley manufacturer to coordinate equipment requirements with steel structures, drive motor, hoisting cable or chain, hook, track, stops, and electrical equipment controls.

C. Where adjustable speed drives or remote control systems are required, crane manufacturer to furnish a coordinated operating system.

2.2 SUPPLEMENTS

A. See supplements to this section for additional requirements.

2.3 TRACK OR CANTILEVER JIB BOOM

A. Monorail: Furnish monorail track or cantilever jib boom in accordance with Section 05 12 00, Structural Steel Framing. Provide steel I-beam reinforced

with ccp channels and stiffeners. Provide A36 steel and 316 stainless steel bolts and hardware.

B. Track Design Criteria:

1. Cross-Section: Design for stresses not exceeding 60 percent of material's yield strength and deflection not to exceed 1/800 of span.
2. Span: As shown on Drawings. Ratio of span to top flange width shall not exceed 60 to 1 for spans over 16 feet. Lower load-carrying flange minimum of 3-1/4-inch width and have raised running or wear tread.
3. Couplings: Web type at track joints with maximum gap at track ends of load-carrying flange of 1/16 inch and 3/16 inch at turntable, switch, or free ends.
4. Stops: Furnish stops and impact-absorbing bumpers at both boom or track ends.
5. Design for vertical force increased by 25 percent for impact.
6. Design for longitudinal force of 10 percent of vertical force.
7. Design for torsional forces caused by eccentric loading, lateral forces, or offset connections.
8. Consider fatigue and stress on bottom flange due to wheel loading.

C. Track Suspension:

1. Furnish clamps, hanger rods, and fittings to support live and dead load of hoist, trolley, controls, motors, and track.
2. Hanger Rods: High carbon, cold-rolled alloy steel with unified national fine, Class 2 screw thread ends.
3. Vertical Adjustment: 1 inch adjustable.
4. Lubricant: Permanent factory prelubricated joints.

2.4 WALL MOUNTING BRACKETS FOR JIB CRANE

A. Provide A36 steel wall mounting brackets supplied by job crane manufacturer, with 316 stainless steel bolts and mounting hardware.

2.5 TROLLEY

A. Frame: Welded steel, cast steel, or ductile iron construction, or a combination thereof. Construct to control deflection of trolley assembly while transmitting the carrying load to running surface.

B. Drive shall consist of trolley drive shaft, driven by an electric motor through a gear reduction unit.

C. Drive shall consist of chain sprocket mounted on shaft. Furnish chain to within 5 feet of operating floor level. Drive shaft shall drive the trolley wheels through a gear and pinion or spur gear arrangement.

D. Furnish roller assembly stabilizers on single-girder trolley units to prevent tipping during load pickup.

E. Wheels: Rolled or forged steel, accurately machined and ground to receive inner bearing races. Furnish alloy steel axles. Rotating axles with wheels mounted press fit and keys, or with keys alone. Minimum tread hardness 210 Brinell.

F. Drive Gears: Helical, spur or herringbone type, rolled or cast steel, with machine cut teeth.

G. Bearings: Combination radial and thrust type, double row, angular contact ball bearings or single-row tapered roller bearings. Bearings prelubricated and sealed, or fitted for pressure lubrication. Locate pressure lubrication fittings for accessibility during maintenance.

H. Brakes: Suitable for service class and rated torque capacities as specified in ASME B30.11.

2.6 HOIST

A. Wire Rope Hoisting Machinery: Rope drum driven through gear reductions, load blocks, hook, hoisting rope, sheaves, and hoist braking. Drum size and length sufficient for minimum two turns of cable remaining on drum when hook is at lowest position. Furnish reeving as specified on Supplements at end of section. Provide right and left-hand grooved drum when two-part double reeving is specified.

B. Rope drum and surrounding members constructed to minimize abrasion, crushing or jamming of hoist rope. Load blocks enclosed type. Hoisting rope extra flexible, improved plow steel wire rope, made especially for hoist service.

C. Hook: Construct with sufficient ductility to open noticeably before hook failure, equipped with safety latch, free to rotate 360 degrees with rated load and positively held in place with locknuts, collars or other devices.

D. Brakes: Mechanical and electric load brake and controls, designed in accordance with ASME 4M, and adjustable to compensate for wear.

E. Chain Hoisting Machinery: Load chain wheel driven through gear reductions, an electric motor load blocks, sheaves, chain, hook, and hoist braking.

F. Chain: Nonjamming alloy type. Hand wheel shall have a guard that prevents chain slipping or jumping. Chain hoists shall have chain storage adequate for storing full lift length of chain and shall be designed and located to avoid interference while hoisting.

G. Hook: Construct with sufficient ductility to open noticeably before hook failure, equipped with safety latch, free to rotate 360 degrees with rated load, and positively held in place with locknuts, collars or other devices.

H. Brakes: In accordance with ASME HST 1M and ASME HST 2M, adjustable to compensate for wear, positive action, Weston type mechanical load brake, with uniform composition lining and forged steel alloy latch pawl.

2.7 ELECTRICAL

A. Furnish electrical equipment including motors, motor starters, pendant control, control systems, wire, and conduit.

B. Electrical: In accordance with NFPA 70, NEC Article 610.

C. Furnish motors compatible with adjustable frequency, variable speed, drive system, 40 to 1 speed range, suitable for hoist, trolley, and bridge drive applications. Controls with 120V ac, microprocessor based, pulsed width modulation design, withstand 45 degree C temperatures, housed in NEMA 250, Type 4 enclosure, and supplied with 200 percent overcurrent protection.

D. Monorail conductor voltage drops from monorail track supply taps shall permit the hoist and trolley motors to operate within voltage tolerances of plus or minus 10 percent, when building supply voltage is at plus or minus 5 percent of design voltage.

E. Enclosed Bus Bar Conductors for monorails: Stainless steel clad. Collector mechanism components aluminum, stainless steel, plastic, or other noncorrosive materials.

F. Festooned Flat Cable Conductors for jib cranes: Flexible cable, carried by heavy-duty roller, permanently lubricated roller bearings, with monorail support system that will dispense and retrieve flexible cable without twisting or tangling, and 20 percent spare conductor in each cable assembly.

G. Grounding: External in accordance with NFPA 70, NEC Article 250.

2.8 CONTROLS

A. Hoist and Trolley: Pendant control having Momentary contact pushbuttons with a device which will disconnect motors from line on failure of power.

Device shall not permit any motor to be restarted until controller handle is brought to the OFF position, or a reset switch or button is operated. Furnish with under voltage protection as a function of each motor controller, or by magnetic main line contactor.

B. Pushbuttons: Fully magnetic, plain reversing type, housed in NEMA 250, Type 12 enclosure, with contactors of sufficient size and quantity for starting, accelerating, reversing, and stopping duty for specified hoist service class.

C. Trolley Drives: Soft start controls, 460/230V ac series device, installed between drive motor and motor starter with torque and acceleration rate adjustable, suitable for trolley drive service, and work in conjunction with crane control and pendant system.

D. Remote Control System: Infrared, line-of-sight system, handheld and capable of operating all monorail functions.

E. Backup Pendant Pushbutton Control Station: Heavy-duty, oil tight, suspended from hoist with control transformers to supply 120V ac power to pushbutton control station. Pushbutton enclosure supported with chain or wire rope. Control wire cable attached to support chain or wire rope at not more than 6-foot intervals. Furnish control station buttons for control of hoist and trolley ON/OFF main line contactor power switch which removes all power from control station.

F. Control motions indicate direction of resultant monorail motion. Furnish spring-loaded switch motions, with return to OFF position when switch is released and designed to prevent runaway monorail situations.

G. Monorail and jib crane motions shall stop automatically when monorail and jib crane can no longer receive remote signals and designed to stop when control signal for any motion becomes ineffective.

H. Remote Control Monorail and Jib Crane Motions: Hook raise and lower, trolley movement, and monorail power up and power down. Furnish an EMERGENCY OFF pushbutton station which will disconnect main line power via a remote switch, and manual reset function to activate all motions after an EMERGENCY OFF event.

2.9 ACCESSORIES

A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.

B. Lifting Lugs: Equipment weighing over 100 pounds.

2.10 FACTORY FINISHING

A. Prepare and prime coat in accordance with Section 09 90 00, Painting and Coating.

2.11 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels and equipment for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments**:** No-load run test all equipment furnished.

C. Factory test report shall include Test Data Sheets.

2.12 MANUFACTURER

A. CraneVeyor Corporation.

B. TC American.

C. Spanco.

D. Or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Provide lubrication and lubrication fittings.

3.2 FIELD FINISHING

A. Equipment as specified in Section 09 90 00, Painting and Coating.

3.3 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each hoist and monorail system.

1. Alignment: Test complete assemblies for proper alignment and connection, and quiet operation.

B. Performance Test:

1. Conduct on each hoist and monorail system.
2. Load tests in compliance with OSHA, ASME B30.11, and ANSI MH27.1

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. One person-days for installation assistance and inspection.
2. One person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. One person-days for prestartup classroom or Site training.
4. One person-days for facility startup.

B. See Section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Testing, Integration, and Startup.

3.5 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification.

1. Hoist/Monorails Data Sheet (Screening Building Lower Level)
2. Hoist/Monorail Dimension Sheet (Screening Building Upper Level)
3. Induction Motor Data Sheet.

END OF SECTION

HOIST/MONORAIL DATA SHEET (Screening Lower Level)

Project:_____ Manufacturer.:_____

Owner:_____ Model No.:_____

Service:_____ Number of Units:_____

Equip. Tag Number(s):_____ Rev/Date/By:_____/_____/_____

GENERAL REQUIREMENTS

Equipment Capacity:_____tons Factory Testing: Power Supply:_____

Method of Control:_____ ☐Required ☐Not Required Voltage_____

Location of Control:_____ Field Testing: ☒Not required Phase_____

Equipment Location: ☐Required, functional and Frequency_____

☐Indoors ☐Outdoors performance

HOIST	TROLLEY
Type:	Type:
☐Electric, Wire Rope ☐Hand Operated, Chain	☐Top Running ☐Underhung
Service Class (ANSI):	Service Class (ANSI):
☐H1 (standby) ☐H2 (light) ☐H3 (standard)	☐A1 (standby) ☐A2 (infrequent) ☐B (light)
☐H4 (heavy) ☐H5 (severe)	☐C (moderate) ☐D (heavy)
Speed (fpm):_____to _____	Speed (fpm):_____to _____
☐Constant Speed ☐Two Speed ☐Variable Speed	☐Constant Speed ☐Variable Speed ☐Hand Operated
Motor hp:_____	Motor hp:_____
Hook: See Hoist/Monorail Dimension Sheet	Electric Conductors:
Hook Manufacturer: _____	☐Bus Bar ☐Festoon ☐_____
Reeving:_____	☐Cable Reel

SPECIAL REQUIREMENTS

Accessories:

☐Central Lubrication System

☐OSHA operating and safety devices

Remote Controls:

☐Infrared, line-of-sight

☐Frequency modulated (FM)

Manufacturer:_____

☐Extended Grease Fittings

Special Electrical Requirements:

_____

See Hoist/Monorail Dimension Sheet for clearances, lift distances, and details.

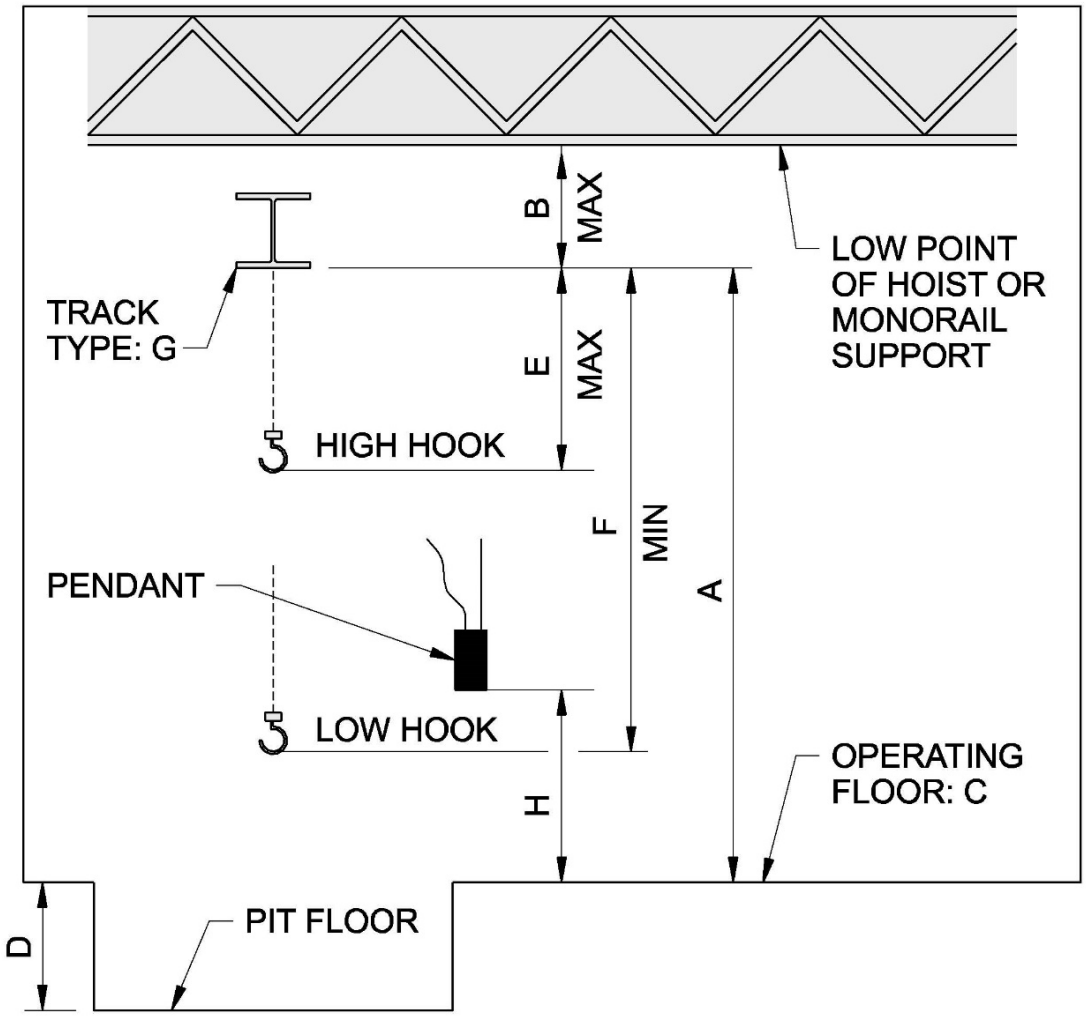
HOIST/MONORAIL DIMENSION SHEET [(Screening Lower Level)

Building Clearances for Monorail Cranes

Project:_____

Owner:_____

Equipment Tag Number(s): _____



A:_____ D:_____ G: See Drawings

B:_____ E:_____ H:_____

C:_____ F: _____

Notes:

1. Monorail Track Length: _____

INDUCTION MOTOR DATA SHEET

Project:_____

Owner:_____

Equipment Name:_____

Equipment Tag Number(s):_____

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer.

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Horsepower:_____

Voltage:_____

Phase:_____

Frequency:_____

Synchronous Speed:_____rpm

☐ Thermal Protection:_____

☐ Space Heater: volts, single-phase

Guaranteed Minimum Efficiency at Full Load:_____percent

Guaranteed Minimum Power Factor at Full Load:_____percent

Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☐ 1.15

Enclosure Type:_____

☐ Multispeed, Two-Speed:_____/_____rpm

Winding: ☐ One ☐ Two

Mounting Type: ☐ Horizontal ☐ Vertical

☐□ Vertical Shaft: ☐ Solid ☐ Hollow

☐□ Vertical Thrust Capacity (lb): Up_____Down _____

☐ Adjustable Speed Drive: See Section 26 29 23, Low-Voltage Adjustable Frequency Drive System.

Operating Speed Range:_____to_____% of Rated Speed

☐ Variable Torque

☐ Constant Torque

Additional Motor Requirements: ☐ See Section 26 20 00, Low Voltage AC Induction Motors.

Special Features:

_____

_____

_____

HOIST/MONORAIL DATA SHEET (Screening Upper Level)

Project:_____ Manufacturer.:_____

Owner:_____ Model No.:_____

Service:_____ Number of Units:_____

Equip. Tag Number(s):_____ Rev/Date/By:_____/_____/_____

GENERAL REQUIREMENTS

Equipment Capacity:_____tons Factory Testing: Power Supply:_____

Method of Control:_____ ☐Required ☐Not Required Voltage_____

Location of Control:_____ Field Testing: ☒Not required Phase_____

Equipment Location: ☐Required, functional and Frequency_____

☐Indoors ☐Outdoors performance

HOIST	TROLLEY
Type:	Type:
☐Electric, Wire Rope ☐Hand Operated, Chain	☐Top Running ☐Underhung
Service Class (ANSI):	Service Class (ANSI):
☐H1 (standby) ☐H2 (light) ☐H3 (standard)	☐A1 (standby) ☐A2 (infrequent) ☐B (light)
☐H4 (heavy) ☐H5 (severe)	☐C (moderate) ☐D (heavy)
Speed (fpm):_____to _____	Speed (fpm):_____to _____
☐Constant Speed ☐Two Speed ☐Variable Speed	☐Constant Speed ☐Variable Speed ☐Hand Operated
Motor hp:_____	Motor hp:_____
Hook: See Hoist/Monorail Dimension Sheet	Electric Conductors:
Hook Manufacturer: _____	☐Bus Bar ☐Festoon ☐_____
Reeving:_____	☐Cable Reel

SPECIAL REQUIREMENTS

Accessories:

☐Central Lubrication System

☐OSHA operating and safety devices

Remote Controls:

☐Infrared, line-of-sight

☐Frequency modulated (FM)

Manufacturer:_____

☐Extended Grease Fittings

Special Electrical Requirements:

_____

See Hoist/Monorail Dimension Sheet for clearances, lift distances, and details.

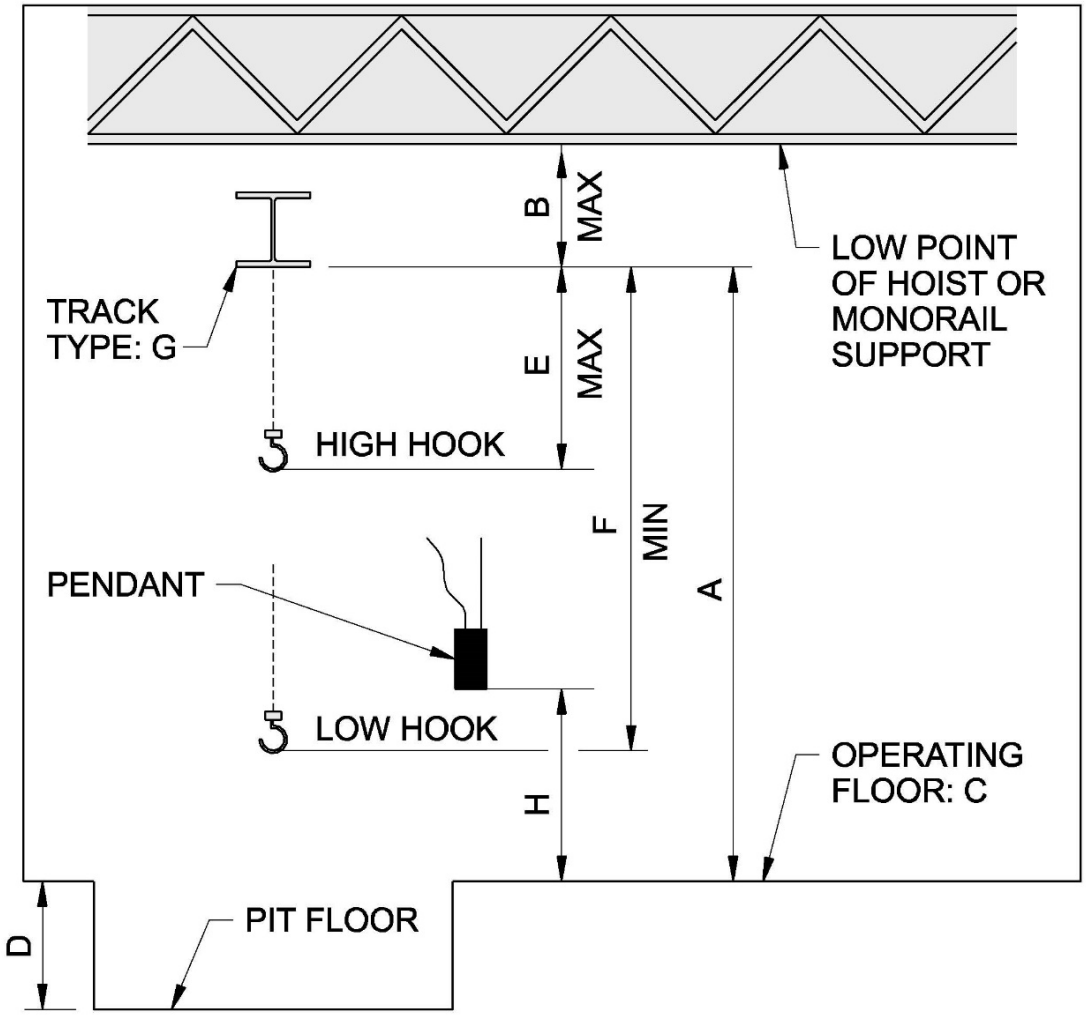
HOIST/MONORAIL DIMENSION SHEET [(Screening Upper Level)

Building Clearances for Monorail Cranes

Project:_____

Owner:_____

Equipment Tag Number(s): _____



A:_____ D:_____ G: See Drawings

B:_____ E:_____ H:_____

C:_____ F: _____

Notes:

1. Monorail Track Length: _____

INDUCTION MOTOR DATA SHEET

Project:_____

Owner:_____

Equipment Name:_____

Equipment Tag Number(s):_____

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer.

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Horsepower:_____

Voltage:_____

Phase:_____

Frequency:_____

Synchronous Speed:_____rpm

☐ Thermal Protection:_____

☐ Space Heater: volts, single-phase

Guaranteed Minimum Efficiency at Full Load:_____percent

Guaranteed Minimum Power Factor at Full Load:_____percent

Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☐ 1.15

Enclosure Type:_____

☐ Multispeed, Two-Speed:_____/_____rpm

Winding: ☐ One ☐ Two

Mounting Type: ☐ Horizontal ☐ Vertical

☐□ Vertical Shaft: ☐ Solid ☐ Hollow

☐□ Vertical Thrust Capacity (lb): Up_____Down _____

☐ Adjustable Speed Drive: See Section 26 29 23, Low-Voltage Adjustable Frequency Drive System.

Operating Speed Range:_____to_____% of Rated Speed

☐ Variable Torque

☐ Constant Torque

Additional Motor Requirements: ☐ See Section 26 20 00, Low Voltage AC Induction Motors.

Special Features:

_____

_____

_____

SECTION 43 05 11
GENERAL REQUIREMENTS FOR EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section specifies general requirements which are applicable to all motorized equipment. The Contractor is responsible for ensuring that all motorized equipment meets the requirements of this section in addition to the specific requirements of each individual equipment specification section.

B. Equipment Lists:

1. Equipment lists, presented in these specifications and as specified on the drawings, are included for the convenience of the Project Representative and Contractor and are not complete listings of all equipment, devices and material required to be provided under this contract. The Contractor shall prepare his own material and equipment takeoff lists as necessary to meet the requirements of this project.

1.2 QUALITY ASSURANCE

A. Arrangement:

1. The arrangement of equipment shown on the drawings is based upon information available to the Owner at the time of design and is not intended to show exact dimensions conforming to a specific manufacturer. The drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual submitted equipment installation requirements; these may vary significantly from manufacturer to manufacturer. The Contractor shall, in determining the cost of installation, include these differences as part of his bid proposal. Structural supports, foundations, connected piping, valves, and electrical conduit specified may have to be altered to accommodate the equipment actually provided. No additional payment shall be made for such revisions and alterations.

B. References:

1. This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, has been discontinued or has been replaced.

Reference	Title
ABMA Std 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA Std 11	Load Ratings and Fatigue Life for Roller Bearings
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings, (Classes 25, 125, and 250)
ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI S2.19	Mechanical Vibration – Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Unbalance, Including Marine Applications

C. Unit Responsibility:

1. The Contractor shall cause equipment assemblies made up of two or more components to be provided as a working unit by the unit responsibility manufacturer, where specified. The unit responsibility manufacturer shall coordinate selection, coordinate design, and shall provide all mechanical equipment assembly components such that all equipment components furnished under the specification for the equipment assembly, and all equipment components specified elsewhere but referenced in the equipment assembly specification, is compatible and operates reliably and properly to achieve the specified performance requirements. Unless otherwise specified, the unit responsibility manufacturer shall be the manufacturer of the driven component equipment in the equipment assembly. The unit responsibility manufacturer is designated in the individual equipment specifications found elsewhere in this project manual. Agents, representatives or other entities that are not a direct division of the driven equipment manufacturing corporation shall not be accepted as a substitute for the driven equipment manufacturer in meeting this requirement. The requirement for unit responsibility shall in no way relieve the Contractor of

his responsibility to the Owner for performance of all systems as provided in the General Conditions of the Contract Documents.

2. The Contractor shall ensure that all equipment assemblies provided for the project are products for which unit responsibility has been accepted by the unit responsibility manufacturer(s), where specified. Unit responsibility for related components in a mechanical equipment assembly does not require or obligate the unit responsibility manufacturer to warranty the workmanship or quality of component products not manufactured by them. Where an individual specification requires the Contractor to furnish a certificate from a unit responsibility manufacturer, such certificate shall be submitted prior to shop drawing final approval. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory. Failure to provide acceptable proof that the unit responsibility requirement has been satisfied will result in withholding approval of progress payments for the subject equipment even though the equipment may have been installed in the work.

D. Balance:

1. Unless specified otherwise, for all machines 10 HP and greater, all rotating elements in motors, pumps, blowers and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. All rotating elements shall be balanced to the following criteria:

   a. $$U_{per} = 6.015\frac{GW}{N}$$

   b. Where:
      1) U_{per} = permissible imbalance, ounce-inches, maximum
      2) G = Balance quality grade, millimeters per second
      3) W = Weight of the balanced assembly, pounds mass
      4) N = Maximum operational speed, rpm

2. Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data. Equipment balance quality grade shall be *G* 2.5 ($G = 2.5$ mm/sec) or better in accordance with ANSI S2.19.

3. Pumps with overhung impellers only require the impeller to be dynamically balanced. The rotating element shall be fully machined to ensure that it is inherently balanced.

1.4 SEISMIC AND ANCHOR BOLT REQUIREMENTS

A. Anchor and brace equipment to resist seismic loads specified in Section 01 88 15. Seismic design and engineering calculations in accordance with Section 01 88 15. Anchor bolt design and material accordance with Division 5 Specifications.

PART 2 PRODUCTS

2.1 FLANGES AND PIPE THREADS

A. Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.

B. Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.

C. Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

2.2 BEARINGS

A. Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of ABMA Methods of Evaluating Load Ratings of Ball and Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum L-10 rating life of 50,000 hours. The rating life shall be determined using the maximum equipment operating speed.

B. Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic alemite type.

C. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 degrees C and shall be equipped with a filler pipe and an external level indicator gage.

D. All bearings accessible to touch, and located within 7 feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps, fixed ladders or other access structures, shall either incorporate bearing housings with sufficient cooling to maintain surface temperature at 65 degrees C or less for continuous operation at bearing rated load and a 50 degrees C ambient temperature or shall be provided with appropriate shielding shall be provided that will prevent inadvertent human contact.

2.3 V-BELT ASSEMBLIES

A. Unless otherwise specified, V-belt assemblies shall be Dodge Dyna-V belts with matching Dyna-V sheaves and Dodge Taper-lock bushings, Wood's Ultra V-belts with matching Ultra-V sheaves and Wood's Sure-Grip bushings, or equal.

B. Sheaves and bushings shall be statically balanced. Additionally, sheaves and bushings which operate at a peripheral speed of more than 5500 feet per minute shall be dynamically balanced. Sheaves shall be separately mounted on their bushings by means of three pull-up grub or cap tightening screws. Bushings shall be key seated to the drive shaft.

C. Belts shall be selected for not less than 150 percent of rated driver horsepower and, where two sheaves sizes are specified, shall be capable of operating with either set of sheaves. Belts shall be of the antistatic type where explosion proof equipment is specified.

2.4 PUMP SHAFT SEALS

A. General:

1. Seals for water and wastewater pump shafts shall be either stuffing box or mechanical seals. For industrial wastewater service, or for fluids other than water or municipal wastewater, the recommendations of the seal manufacturer shall be followed for selection of appropriate seals. Unless specified otherwise, stuffing boxes and mechanical seals shall conform to the requirements set forth in this paragraph.

B. Mechanical Seals shall meet the following requirements, unless otherwise specified in the individual equipment sections:

1. Unless otherwise specified in the detailed pump specifications, mechanical seals shall be split mechanical seals requiring no field assembly, other than assembly around the shaft and insertion into the pump. They shall be self-aligning, and self-centering, single seals. They shall be of a nondestructive (nonfretting) type requiring no wearing sleeve for the shaft. Shafts for pumps specified with mechanical seals shall be furnished with no reduction in size through the seal area (no shaft sleeve). Where the detailed specifications call for cartridge instead of split seals, all other requirements of this paragraph apply.
2. Metal parts shall be Type 316 or 316L stainless steel. Springs shall be Hastelloy C, Elgiloy, or other Duplex SS selected for resistance to chloride attack. Rotary faces shall be silicon carbide or chrome oxide. Stationary faces shall be silicon carbide for solids bearing fluid service and carbon for clean water service. Elastomers shall be ethylene propylene or fluorocarbon. Mechanical seals shall be suitable for operation between full vacuum (0 psia) up to 200 percent of the maximum specified operating pressure, but in any event not less than 200 psig.

3. Seal chambers shall be provided with vented solids removal restriction bushings except for enclosed line shaft pumps where the seal barrier fluid is used for line shaft bearing lubrication. The bushing shall both control the amount of flushing water flow and restrict solids and gas accumulation from the seal face area.
4. Candidate seals include:
    a. Chesterton 442 seals provided with Chesterton/SpiralTrac solids removal restriction bushings Version N or D, as recommended by EnviroSeal Engineering Products, Ltd, Nova Scotia, Canada.
    b. AESSEAL RDS seals with Cyclops bushing.
    c. John Crane 3710 seals with Type 24SL bushing.
    d. Or equal.
5. Seals on pumps for contaminated water service (sludge, grit, wastewater, scum, reclaimed water, etc.) shall be drilled and tapped for connection of a clean water flushing supply.
6. Seals for all vertical pumps (whether column or volute type) shall be provided with a second flush connection. Vertical pumps shall have a vent valve attached to the mechanical seal to eliminate air from the seal chamber prior to pump start; start-up procedures shall include venting instructions; and for remotely started pumps, the vent system shall be automated. Where specified in the detailed specifications, permissive confirmation automatic vent systems shall be provided.

C. Shaft Packing:

1. Where shaft packing is specified, stuffing boxes shall be tapped to permit introduction of seal liquid and shall hold a minimum of five rows of packing. Stuffing boxes shall be face attached. Stuffing box and shaft shall be suitable for field installation, without machining or other modifications, of the mechanical seal.
2. Unless otherwise specified, lantern rings shall be bronze or Teflon, packing shall be die-molded packing rings of non-asbestos material suitable for the intended service and as recommended by the manufacturer, and glands shall be bronze, two piece split construction. Lantern rings shall be of two-piece construction and shall be provided with tapped holes to facilitate removal. Lantern rings shall be drilled and tapped 1/4 NC-20. The impeller end of the packing on all but line shaft pumps with external source water lubricated bearings shall be fitted with a SpiralTrac, Version P packing protection system as manufactured by EnviroSeal Engineering Products, Ltd, Nova Scotia, Canada.
3. The section of each shaft or impeller hub that extends through or into the stuffing box shall be fitted with a replaceable stainless steel sleeve with a Brinell hardness of not less than 500. The sleeve shall be held to the shaft to prevent rotation and shall be gasketed to prevent leakage between the shaft and the sleeve. Minimum shaft sleeve thickness shall be 3/8 inch.

2.5 COUPLINGS

A. When the couplings specified in this Section are not suitable for the intended service, specify the required coupling in the respective equipment section.

B. Unless otherwise specified in the particular equipment sections, equipment with a driver greater than 1/2 HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taper lock bushings which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.

C. Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas-Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions. Custom-designed, fabricated couplings for the 750 Hp two-stage variable speed centrifugal sewage pumps are shown on the Mechanical Drawings.

2.6 GUARDS

A. Exposed moving parts shall be provided with guards which meet all applicable OSHA requirements. Guards shall be fabricated of 14-gage steel, 1/2-13-15 expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided. Lube fittings shall be extended through guards.

2.7 CAUTION SIGNS

A. Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "Caution - Automatic Equipment May Start At Any Time". Signs shall be constructed of fiberglass material, minimum 1/8 inch thick, rigid, suitable for post mounting. Letters shall be white on a red background. The sign size and pattern shall be as shown on the drawings. Signs shall be installed near guarded moving parts.

2.8 GAGE TAPS, TEST PLUGS AND GAGES

A. Gage taps shall be provided on the suction and discharge sides of pumps, blowers and compressors. Pressure and vacuum gages shall be provided where specified. Gage taps, test plugs, and gages shall be as specified in Division 40.

2.9 NAMEPLATES

A. Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped stainless steel and fastened to the equipment in an accessible and visible location with stainless steel screws or drive pins.

2.10 LUBRICANTS

A. The Contractor shall provide for each item of mechanical equipment a supply of the required lubricant adequate to last through the specified commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the Owner's current lubricant supplier. The Contractor shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment, the Contractor shall provide the Owner with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

2.11 ANCHOR BOLTS

A. Anchor bolts shall be designed for lateral forces for both pullout and shear in accordance with the provisions of the structural plans and specifications. Unless otherwise stated in the individual equipment specifications, anchor bolt materials shall conform to the provisions of the structural plans and specifications.

2.12 SPARE PARTS

A. Spare parts, wherever required by detailed specification sections, shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by project equipment number and identified by part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration, such as ferrous metal items and electrical components, shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with a hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment,

equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.

PART 3 EXECUTION

3.1 GENERAL

A. Installation of equipment accessories included in this section shall be as recommended by the equipment manufacturer unless otherwise specified in the individual equipment specification section.

END OF SECTION

SECTION 43 05 13
RIGID EQUIPMENT MOUNTS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section specifies minimum requirements for rigid equipment mounts (baseplates, soleplates, and mounting blocks) and their installation on equipment pads. Completed equipment supports shall consist of equipment pads, equipment anchors, and rigid equipment mounts (baseplates, soleplates, or mounting blocks) set in grout.

2. Unless alternate requirements for equipment mounts are specified in the applicable equipment specification, the requirements of this section shall be applied to rigid mounts for all rotating or reciprocating equipment that is used to mix, convey, or pressurize fluids (gases and liquids). The requirements of this section shall also apply whenever referenced in specifications for other types of equipment. If conflict exists between this section and requirements of individual equipment manufacturers, the more restrictive requirements shall prevail.

B. Definitions:

1. Specific equipment mounting terminology used in this section conforms to the following definitions:
   a. Baseplate:
      1) Fabricated (welded structural steel elements), cast, or plate steel base providing a common mounting element on which the legs, feet, or mounting surfaces of equipment are mounted by means of bolted connections.
   b. Soleplate:
      1) A machined plate, spanning an opening in the floor or equipment pad, providing a common mounting element on which the legs, feet, or mounting surfaces of equipment are mounted by means of bolted connections.
   c. Mounting Blocks:
      1) Multiple smaller baseplates on which individual legs, feet or equipment supports are mounted when equipment or drivers are not fastened to a common baseplate or sole plate.
   d. Equipment Pad:
      1) Concrete foundation (block or slab) supporting and elevating equipment mounts above the supporting structural floor slab or local grade.
   e. Mounting Pads:

1) Thickened or raised areas of baseplates and soleplates where the feet or mounting surfaces of mounted equipment and drivers are bolted and/or doweled to the baseplate or soleplate.

f. Leveling Blocks:
   1) Temporary steel blocks placed under baseplates, soleplates, or a mounting block at leveling positions (at equipment anchors) for the purpose of leveling baseplates, soleplates, or mounting blocks prior to grouting.
g. Shims:
   1) Thin stainless steel plates of a uniform thickness installed on top of Leveling Blocks for fine adjustment of level. Shims may also be used between equipment or drivers and baseplates, soleplates, or mounting blocks for equipment alignment purposes specified in Section 43 05 14.
h. Wedges:
   1) Pairs of uniformly tapered metal blocks that are stacked with the tapered surfaces reversed (relative to the other wedge) so that the top and bottom surfaces of the wedges are parallel. Wedges are used between equipment pads and baseplates, soleplates, or mounting blocks for the purpose of leveling baseplates, soleplates, or mounting blocks.
i. Mounting Stud:
   1) Threaded rod or bolts anchored to baseplates, soleplates, or mounting blocks for the purpose of mounting equipment or ancillary devices onto baseplates, soleplates, or mounting blocks.
j. Reinforcement Dowels:
   1) Steel reinforcement rods embedded in concrete, across a cold joint, for the purpose of transferring loads or force across the joint.
k. Machine Alignment Dowels:
   1) Tapered diameter rods inserted in tapered diameter holes for the purpose of aligning machinery. The practice of drilling tapered diameter holes through machinery and baseplates so that Machine Alignment Dowels may be inserted to facilitate alignment of machinery is known as Doweling.
l. Leveling Position:
   1) A location on the top of a concrete equipment pad where leveling tools and equipment will be temporarily installed or used for the purpose of leveling baseplates, soleplates, and mounting blocks prior to grouting.
m. Grout Manufacturer:
   1) Refers to the manufacturer of the epoxy grout system used for installation of rigid equipment mounts.
n. Grout Manufacturer's Technical Representative(s):
   1) Refers to the technical representative(s) of the Grout Manufacturer.

C. Equipment Mounting Requirements:

1. Unless otherwise specified, equipment and drivers shall be rigidly mounted on a common cast iron or fabricated steel baseplate or soleplate grouted into place on a concrete equipment pad. Under no circumstances shall baseplates, soleplates, or

mounting blocks be grouted directly to concrete slabs or floors. Equipment that uses an interdependent equipment and driver mounting configuration (equipment that is bolted onto the driver frame and equipment that supports the driver entirely from the equipment frame) may be bolted directly on concrete or grout surfaces of equipment pads if the driver is less than five horsepower. Bolting equipment directly on concrete or grout surfaces of equipment pads is not acceptable for equipment and drivers that do not have an interdependent equipment and driver mounting configuration.

1.2 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. It is a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed document, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/HI 1.4	Centrifugal Pumps – Installation, Operation and Maintenance
ANSI/HI 2.4	Vertical Pumps – Installation, Operation and Maintenance
API RECOMMENDED PRACTICE 686	Recommended Practices for Machinery Installation and Installation Design
ASTM E329	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
MIL-PRF-907E	Anti-Seize Thread Compound, High Temperature
SSPC	Society for Protective Coatings Specifications, Vol. 2
IBC	2001 International Building Code (including local amendments)

B. Quality Control By Contractor:

1. To demonstrate conformance with the specified requirements for rigid equipment mounts, the Contractor shall provide the services of an independent testing

laboratory that complies with the requirements of ASTM E329. The testing laboratory shall sample and test equipment mount related materials as indicated in this section. Costs of testing laboratory services shall be borne by the Contractor.

2. For equipment with drivers 20 horsepower and greater, the Contractor shall furnish the services of a grout manufacturer's technical representative that has been factory trained by the grout manufacturer. The grout manufacturer's technical representative shall perform training and quality control of epoxy grout installation for rigid equipment mounts as indicated in this section.

1.3 SUBMITTALS

A. The following information shall be provided in accordance with the submittal requirements specified in Section 01 33 00.

1. A copy of this specification section, with addendum updates included, (referenced sections need not be included for Section 43 05 13) with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (□) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. Copies of this specification section shall be numbered and marked (specification number and eqiuipment number) for inclusion (filing) with the associated equipment submittal requirements.
2. Schedule of rigid equipment mount installations specified in paragraph 2.01.
3. Name, employer and certificates or other information documenting compliance with the journeyman qualifications requirements for millwrights who will install rigid equipment mounts, as specified in paragraph 3.03 Leveling.
4. Certificates or other documentation issued by the epoxy grout manufacturer that demonstrates that the grout manufacturer's technical representative has been factory trained on installation of epoxy grout for equipment mounts, as specified in paragraph 1.02 Quality Control by Contractor.
5. Shop drawings for all equipment pads, equipment anchors, and baseplate, soleplate or mounting block details. Shop drawings shall depict size and location of equipment pads and reinforcement; equipment drains; equipment anchor, size, location, and projection; expansion joint locations; elevation of top of grout and grout thickness; elevation of top of baseplate; soleplate; or mounting block; size

and location of electrical conduits; and any other equipment mounting features embedded in equipment pads. Shop drawings for equipment pads, equipment anchors, and baseplate, soleplate, or mounting blocks shall be numbered and marked (specification number and equipment number) for inclusion (filing) with the associated equipment submittal requirements.

6. Equipment anchor calculations specified in paragraph 2.02.
7. Results of grout strength tests, as specified in paragraph 3.03 Grouting.
8. Completed Rigid Equipment Mount Installation Inspection Checklist Forms (Form A), as specified in paragraph 3.02 Epoxy Grout Quality Control.
9. List of Contractor's equipment installation staff that has completed epoxy grout manufacturer's grout installation training specified in paragraph 3.02 Epoxy Grout Training.

PART 2 PRODUCTS

2.1 GENERAL

A. Prior to initiating any installation efforts, the Contractor shall produce a rigid equipment mount installation schedule containing the expected dates for installing equipment anchors and preparation of equipment pads for leveling, grouting, and final equipment anchor clamping for each item of equipment. The schedule shall list the equipment, by equipment tag number, and shall list applicable equipment specification section, motor horsepower, and name of the Contractor's representative responsible for quality control during installation of rigid equipment mounts. The schedule shall be accompanied by written verification of equipment anchor clamping torque from the manufacturer of each item of equipment to be installed with rigid equipment mounts.

2.2 CONCRETE EQUIPMENT PADS

A. Concrete equipment pads shall be as shown in the structural details for equipment pads and equipment anchors for rigid mounted equipment.

B. The Contractor shall submit equipment anchor calculations for all equipment with drivers 20 horsepower and greater. Equipment anchor calculations shall demonstrate that equipment anchor size, embedment, and edge distance comply with the CBC and ACI 318-14, and are sufficient to resist the maximum lateral and vertical forces specified in Section 43 05 11-2.11. Equipment anchor calculations shall be sealed by a registered structural or civil engineer licensed in the State of California.

2.3 BASEPLATES, SOLEPLATES, AND MOUNTING BLOCKS

A. General:

1. Unless otherwise specified, Type I baseplates, soleplates, and mounting blocks shall be a minimum of 1 inch thick for equipment with drivers 20 horsepower and

larger. All Type I baseplates, soleplates, and mounting blocks shall have edges of surfaces bearing on grout rounded to a radius of not less than 0.25 inch. Horizontal corners of Type I baseplates, soleplates, or mounting blocks shall be rounded to a radius of not less than two inches to avoid producing stress risers on the grouted foundation. Grout pouring holes (minimum 4 inches in diameter for epoxy grout, minimum 2 ½ inches in diameter for cementitious nonshrink grout) shall be provided in all baseplates and soleplates and all baseplates and soleplates shall have grout release holes. Mounting blocks may be grouted without grout pouring holes provided that no dimension of the mounting block (width or length) exceeds 18 inches. Grout relief or vent holes (minimum 1 inch in diameter) shall be provided in all baseplates, soleplates, and mounting blocks. Internal stiffeners shall be provided on all cast and fabricated baseplates and shall be designed to allow free flow of grout from one section of the baseplate to another. The minimum acceptable opening in cross bracing and stiffeners shall be 2-inches high by 6-inches in width. All welds shall be continuous and free from skips, blowholes, laps and pockets.

2. Mounting holes for equipment anchors shall be drilled through baseplates, soleplates, and mounting blocks. Mounting holes for equipment anchors shall not be burned out and they shall not be open slots. All mounting studs shall be Type 316 stainless steel. An anti-seize or anti-galling compound, as specified in paragraph 2.06, shall be applied to all mounting stud threads prior to installing nuts on mounting studs. Terminations requiring connections to baseplates, soleplates, or mounting blocks shall be acorn nuts welded to the under side of the baseplate or nuts welded to the underside of the baseplate and plugged with cork, plastic plugs or grease. In no case shall the fastener terminate only into the metal base. Where baseplates, soleplates, or mounting blocks are leveled using jackscrews, jackscrew threads shall be tapped in thickened pads or otherwise in sufficient metal to provide ease in adjusting level.
3. Mounting pads for equipment shall be machined after all welding and stress relieving and shall be coplanar within 0.002 inch per foot in all directions. Mounting pads shall extend not less than 0.5 inch beyond the perimeter of the foot or mounting surface of the mounted equipment, in any direction.
4. Equipment baseplates shall provide common support for the equipment and driver (and flywheel, if one is specified). Baseplates for equipment with drivers 20 horsepower and greater shall be furnished with eight transverse alignment (horizontal) positioning jackscrews for alignment of equipment drivers on horizontal surfaces of baseplates. Two of the eight transverse alignment/positioning jackscrews shall be installed in perpendicular directions in a horizontal plane at the mounting position for each corner or foot of the equipment driver. (Eight additional jackscrews shall be provided for transverse alignment of the flywheel, if flywheels are specified.)

B. Type I Baseplates:

1. Type I baseplates shall be plate or fabricated structural steel baseplates with thickened steel mounting pads for doweling and bolting equipment to the baseplate. The baseplates shall be rectangular in shape for equipment other than centrifugal refrigeration machines and pump baseplates, which may be "T" or "L" shaped to accommodate the equipment drive and accessories. Baseplates for split case pumps shall include supports for suction and discharge elbows, if required by the specified configuration. Perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the baseplate. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.

C. Type II/III Baseplates:

1. Type II and Type III Baseplates, which are applicable for vibration isolation mounting, are specified in Section 43 05 18.

D. Type IV Baseplates:

1. Type IV Baseplates shall be cast iron with thickened mounting pads for doweling and bolting equipment to the baseplate. Cast iron baseplates shall be sealed in accordance with the requirements for bleeding surfaces specified in Section 09 90 00 prior to grouting.

E. Soleplates:

1. Where soleplates are provided, the underside shall be scribed with the words “This Side Down” using welding rod material prior to milling the mounting pad for each equipment foot or mounting surface. Mounting surfaces and mounting pads on soleplates shall be milled flat to a tolerance of not less than 0.002 inch per foot in all directions. Soleplates shall be machined for an indexed fit to the mounted equipment or driver.

F. Mounting Blocks:

1. Where equipment is fabricated or cast with feet or mounting surfaces that are not fastened to a common baseplate or soleplate, as in dry-pit bottom suction pumps, the equipment may be supported on individual concrete piers or equipment pads in lieu of a common baseplate or soleplate and equipment pad. In such instances, the equipment shall be supported at the feet or mounting surfaces on individual mounting blocks, which shall be leveled and grouted into place on the individual piers or equipment pads as specified in this section. Vertical volute-type pumps weighing more than 2000 pounds shall be mounted on mounting blocks under each foot or mounting surface for the pump. All mounting blocks shall be furnished with jackscrew threads (three locations, minimum) tapped in the mounting block for the purpose of leveling mounting blocks with jackscrews.

2.4 GROUT FOR EQUIPMENT PADS

A. Epoxy Grout for Equipment Mounting:

1. Unless otherwise specified, grout for setting bearing surfaces of baseplates, soleplates, and mounting blocks on equipment pads shall be Epoxy Grout for Equipment Mounting as specified in Section 03 62 00. Where the term epoxy grout is used in the context of details and specifications for equipment mounting it shall mean Epoxy Grout for Equipment Mounting.

B. Cementitious Nonshrink Grout:

1. Cementitious Nonshrink Grout, specified in Section 03 62 00, may be used for setting bearing surfaces of baseplates, soleplates, or mounting blocks on equipment pads where equipment drivers are 20 horsepower and smaller and the combined weight of equipment and driver is less than 1000 pounds. Where the term nonshrink grout or cementitious grout is used in the context of details and specifications for equipment mounting it shall mean Cementitious Nonshrink Grout. Training and quality control by the grout manufacturer's technical representative is not required for rigid equipment mounts installed with cementitious non-shrink grout.

2.5 EPOXY PRIMER

A. Epoxy primer shall be a lead free, chrome free, rust inhibitive, two-component epoxy primer specifically designed for use on metal substrates and in conjunction with epoxy grout. The epoxy primer shall be a product of the epoxy grout manufacturer.

2.6 ANTI-SEIZE/ANTI-GALLING COMPOUND

A. Anti-seize or anti-galling compound shall be a molybdenum disulfide and graphite combination in an aluminum complex base grease conforming to MIL-PRF-907E. Acceptable products include Jet Lube 550 by Jet Lube, Inc., E-Z Break by LA-CO, or equal.

PART 3 EXECUTION

3.1 GENERAL

A. Grouting for installation of equipment on equipment pads shall take place prior to connecting any field piping or electrical and instrumentation systems. Unless the Construction Manager accepts an alternate installation procedure in writing, baseplates, soleplates, and mounting blocks shall be leveled and grouted with the equipment removed. Pumps shall be installed in accordance with this section and ANSI/HI 1.4 or ANSI/HI 2.4, as appropriate for the type of pumping equipment installed.

B. Connecting piping with flexible connections and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system without imposing strain on the equipment connections.

C. Where an equipment manufacturer's installation requirements include a rigid connection between the machine and connecting piping systems, the Contractor shall delete any flexible coupling (including equipment connection fittings) shown on the drawings and install the equipment in the following manner, in lieu of installing the flexible coupling:

1. The equipment pad shall be prepared as shown on the details for rigid equipment mounts.
2. The baseplate, soleplate, or mounting blocks supporting the equipment shall be installed, leveled, and grouted in place as specified in this section.
3. The equipment shall be installed, aligned and doweled in place as shown and specified.
4. The piping shall be installed and aligned to the equipment connections and the field piping connections without welding one of the joints for one section of pipe between the equipment connection and the field piping and all valving. All flanged joints shall be bolted up and pressure tested.
5. All piping shall be fully supported by supports designed to accept their full weight and thrust forces.
6. The final sections of piping shall be aligned with the equipment and field connections without the use of jacks, chain falls or other devices to force it into alignment.
7. The final piping joints shall be welded only after the previous steps have been completed and accepted by the Construction Manager.

3.2 EPOXY GROUT TRAINING AND QUALITY CONTROL

A. Epoxy Grout Training:

1. Prior to commencing rigid equipment mount installation work on equipment pads, the Contractor shall furnish the services of a grout manufacturer's technical representative to conduct a training school for the workers that will be using the epoxy grout for rigid equipment mount installations. The school shall be not less than 4 hours in length and shall cover all aspects of using the products, from mixing to application. This requirement, however, shall not be construed as relieving the Contractor of overall responsibility for this portion of the work. The epoxy grout manufacturer shall furnish a list of school attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

B. Epoxy Grout Quality Control:

1. For equipment with drivers 20 horsepower and greater, the epoxy grout manufacturer's technical representative shall provide quality control services for epoxy grout installation in rigid equipment mounts. The epoxy grout manufacturer's technical representative shall be on site to inspect and verify that the application personnel have successfully performed surface preparation, epoxy grout application, and Quality Control Inspection in accordance with these specifications for a representative portion of the epoxy grout installation work.
    a. Specifically, the epoxy grout manufacturer's technical representative shall perform the following services for at least one rigid equipment mount installation for each equipment type and size:
        1) Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.
        2) Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria, including but not limited to substrate profile, degree of cleanliness, and moisture.
        3) Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.
        4) Inspect the epoxy-primed metallic substrate for coverage and adhesion.
        5) Inspect preparation and application of epoxy grout form work for conformance to the specifications.
        6) Inspect and record that the "pot life" of epoxy grout materials is not exceeded during installation.
        7) Inspect epoxy grout for cure.
        8) Inspect and record that localized repairs made to grout voids are in conformance with the specification requirements.
        9) Conduct a final review of completed epoxy grout installation for conformance to these specifications.

3.3 INSTALLATION

A. Concrete Equipment Pad Preparation:

1. After the concrete is fully cured, the top of the equipment pad shall be roughened by chipping the surface. Chipping shall remove all laitance and defective or weak concrete and result in a rough surface profile with a 0.25 inch minimum amplitude. Chipping shall expose broken aggregate without dislodging unbroken aggregate from the cement matrix and shall not cause fractures below the concrete surface. Leveling surfaces of the concrete that have been finished smooth and level for baseplate, soleplate, or mounting block leveling at equipment anchors shall be protected from damage during chipping. A light duty, hand held

pneumatic chipper with a chisel type tool shall be used for chipping the equipment pad concrete surface. Abrasive blast, bush-hammer, jack hammers with sharp chisels, heavy chipping tools, or needle gun preparation of concrete surfaces to be grouted is not acceptable.

2. Prior to leveling activities, satisfactory removal of defective or weak concrete shall be demonstrated in the presence of the Construction Manager by operating the chipper on the chipped concrete surface at locations identified by the Construction Manager. The chipped surface of the concrete shall be such that the final baseplate, soleplate, or mounting block elevation results in the grout manufacturer's recommended grout thickness of a minimum of 4-inches between the surface of the equipment pad and the lower baseplate flange, underside of the soleplate or underside of mounting block.
3. All dust, dirt, chips, oil, water, and any other contaminants shall be removed and the surface protected with plastic sheeting until grout is installed.
4. Concrete equipment pad surfaces that have been finished smooth and level for use as leveling positions shall be protected from damage during chipping activities. Alternatively, leveling positions may be restored on chipped surfaces. Leveling positions shall be restored by installing leveling blocks or leveling plates for jackscrews on a high compressive strength epoxy putty (Philadelphia Resins, Phillybond Blue 6A, or equal). Leveling blocks and leveling plates shall be installed level on the epoxy putty.

B. Baseplates, Soleplates, and Mounting Blocks:

1. All surfaces of baseplates, soleplates, and mounting blocks to be in contact with epoxy grout shall be cleaned to SSPC SP-6 and shall be primed with epoxy primer within 8 hours of cleaning.

C. Leveling:

1. All machinery shall be mounted and leveled by journeyman millwrights. Precision surveying equipment shall be used for leveling. Machinists' spirit levels will not be permitted for leveling purposes for any baseplate, soleplate, or mounting block with a plan dimension greater than 4 feet. Baseplates and mounting blocks shall be leveled to a maximum tolerance of 0.002 inch per foot or as otherwise required by the equipment manufacturer, if more stringent. Soleplates shall be leveled to 0.0005 inch per foot or as otherwise required by the equipment manufacturer, if more stringent. An anti-seize or anti-galling compound specified in paragraph 2.06 shall be applied to all equipment anchor threads prior to beginning baseplate, soleplate, or mounting block leveling.
2. All baseplates, soleplates, and mounting blocks shall be leveled against steel surfaces (jackscrew plates, leveling blocks, leveling nuts, support plates, or other steel surfaces). Use of other materials for leveling purposes is strictly and specifically prohibited. Unless otherwise specified, baseplates, mounting blocks, and soleplates shall be leveled as indicated in the leveling details. Leveling equipment and tools shall be stainless steel leveling blocks and shims, steel

wedges, or jackscrews bearing on leveling plates. Leveling nuts may be used for leveling baseplates and soleplates weighing less than 200 pounds. The use of leveling nuts for leveling mounting blocks is not permitted.

3. After baseplates, soleplates, or mounting blocks have been leveled on the leveling equipment, the Contractor shall clamp the baseplates, soleplates, or mounting blocks in position by installing the equipment anchor nuts and washers. Clamping torque shall be less than the final clamping torque specified in paragraph 2.01, but sufficient to hold the baseplate, soleplate, or mounting block in position. The Contractor shall verify that the correct level and position of the baseplate, soleplate, or mounting block has been maintained after clamping on the leveling equipment.
4. Leveling blocks shall be stainless steel, four inches square and 1-1/2 inches thick with an open-ended slot terminating in the center for the equipment anchor. Leveling blocks shall be machined flat on all horizontal surfaces and placed under the baseplate or soleplate at each equipment anchor. Shims shall be pre-cut stainless steel, slotted for removal after grouting, and shall extend not less than three inches beyond the baseplate, soleplate or mounting block. Leveling blocks and shims shall be coated with a light oil just prior to beginning the leveling and grouting work. Shims shall be placed so the tabs on the shims are easily accessible.

D. Grouting:

1. Grout forms shall be built of minimum 0.75 inch thick waterproof plywood and shall be securely braced (minimum brace size shall be two-by-four lumber). Forms shall be designed for a minimum of 6 inches hydrostatic head above the final elevation of the grout, to assist in flow during installation. Equipment mounting grout shall be furnished with expansion joints installed at four to six foot intervals, perpendicular to the centerline of baseplates.
2. Forms shall be coated with three coats of paste wax on all areas that will come in contact with the grout to prevent the grout from bonding to the forms. Forms shall be waxed before assembly to prevent accidental application of wax to surfaces where the grout is to bond. Before any forms are installed, all concrete surfaces that will contact epoxy grout shall be free from any foreign material, such as oil, sand, water, wax, grease, etc. Forms shall be liquid-tight. Any open spaces or cracks in forms, or at the joint between forms and the foundation, shall be sealed off, using sealant, putty, or caulking compound. All outside vertical and horizontal edges of the grout shall have 45-degree chamfers as indicated in the equipment anchor details for rigid equipment mounts. Match chamfers in concrete portions of the equipment pad. Block outs shall be provided at all shimming and leveling positions to allow removal of leveling equipment and tools after the grout has cured. Jackscrews shall be coated with a light oil or other acceptable bond-breaking compound prior to grouting in order to facilitate removal after the grout has cured.

3. The 45-degree perimeter chamfer strip shall be located at the final elevation of the grout. The final elevation of the grout on baseplates with exposed I-beam or C-channel supports shall be at the top of the lower support flange. The top of the grout, on all other baseplates soleplates, and mounting blocks, shall be at least 1.0 inch above the bottom or underside of the baseplate, soleplate, or mounting block and shall not be higher than the top of the baseplate, soleplate, or mounting block. The grout's final elevation shall not be so high as to bond the equipment anchor nut and washer.
4. The resin and hardener for epoxy grout for equipment mounting shall be mixed in accordance with the epoxy grout manufacturer's recommendations. Epoxy grout shall be placed at the center of one end of the baseplate or soleplate and worked toward the ends in such a manner as to force the air out from beneath the baseplate or soleplate and out the vent holes, to eliminate voids. Epoxy grout shall be placed in a manner that avoids air entrapment, using a head box to pour grout into the grout holes. When the head box is moved to the next grout hole, a 6-inch high standpipe shall be placed over the grout hole and filled with grout. Use of vibrating tools and/or jarring (rapping or tapping) forms to facilitate grout flow is not permitted during placement of epoxy grout.
5. The Contractor shall exercise care to never allow the grout to fall below the baseplate level once the grout has made contact with the baseplate. Grout placement shall be continuous until all portions of the space beneath the baseplate, soleplate, or mounting block have been filled. Subsequent batches of grout shall be prepared so as to be ready when the preceding batch has been placed. Under no circumstances shall the grouting operation be halted because of lack of grout mix. After the entire baseplate is full, 6-inch high standpipes shall be maintained over each grout hole, to continue purging of air. When the grout has started to take an initial set (typically this is determined by a noticeable increase in temperature and no flow of grout at the vent holes) the standpipes shall be removed and excess grout cleaned from all surfaces.
6. Where the cavity under a baseplate or mounting block extends above the elevation of the top of the bolting flange for the baseplate or mounting block, grouting may be completed in two pours. Under these circumstances, the first grout pour shall be continuous until the lower face of the bolting flange for the baseplate or mounting block is submerged in grout a minimum of one inch. The second grout pour shall be completed with standpipes and air purges as specified in the previous paragraph.
7. Grout forms shall be checked for leaks throughout grout pours. Leaks shall be repaired immediately to prevent formation of voids. A final check of baseplate, soleplate, or mounting block level and elevation shall be performed before the grout sets.
8. A grout sample shall be taken for each equipment pad that has a baseplate, soleplate, or mounting block set in grout. The sample shall be placed in a cylinder of sufficient size to yield three two-inch cubes as test samples. The samples shall be tagged with project name, date, time, the equipment number and ambient temperature at the time of placement. Once the epoxy grout cylinder has been

completely filled, it shall be placed next to the foundation of the equipment being grouted and allowed to cure for 48 hours. After 48 hours, the test cylinder shall be tested in accordance with the grout manufacturer's recommendations by the independent testing laboratory specified in paragraph 1.02 Quality Control by Contractor. The results shall be reported directly to the Construction Manager. Forms shall be removed only after the grout has cured sufficiently and upon specific permission from the Construction Manager.

E. Completion:

1. Upon acceptance by the Construction Manager and the equipment manufacturer's representative and after the grout has reached sufficient strength, grout forms and block outs at leveling positions shall be removed. Leveling blocks and shims or wedges and support plates shall be removed, leveling nuts and jack screws shall be backed off to allow the grout to fully support the baseplate, mounting block, or soleplate. Take care not to damage the grout during removal of extended shimming material or leveling equipment and tools.
2. The equipment anchor nuts shall be tightened sequenchly, using calibrated indicating torque wrenches, to develop the full clamping force required by the equipment manufacturer.
3. Equipment anchor nuts shall be tightened in increments of not more than 25 percent of the final torque value in an alternating pattern to avoid stress concentration on the grout surface. After tightening equipment anchor nuts to final values, apply additional wax, grease, or mastic to all exposed portions of the equipment anchor beneath the baseplate, soleplate, or mounting block.
4. After applying additional wax or mastic to exposed portions of equipment anchors, block outs (pockets) for access to leveling nuts, leveling blocks and shims, or wedges shall be filled with the grout material installed under baseplates, soleplates, or mounting blocks and pointed after the equipment anchor nuts have been tightened to final values. Jackscrews shall be removed and holes in the baseplate, soleplate, or mounting blocks filled with a flexible sealant (silicone rubber) or a short cap screw.
5. Check for baseplate, soleplate, or mounting block movement (soft foot) by individually loosening and re-tightening each equipment anchor. Vertical movement at each equipment anchor shall be measured and recorded during loosening and retightening and shall not exceed 20 micrometers (0.001 inch). Vertical movement shall be measured using a magnetic-based dial indicator on the baseplate, soleplate, or mounting block referenced to the epoxy grout surface of the equipment pad or other approved method. Soft foot conditions shall be sufficient cause for removal and reinstallation of grout and baseplates, soleplates, or mounting blocks.
6. Check for grout voids by tapping along the upper surfaces of the baseplate, soleplate, or mounting block. Grout voids shall be sufficient cause for removal and reinstallation of grout and baseplates, soleplates, or mounting blocks. Grout

voids shall be marked. At the discretion of the Construction Manager, grout voids may be repaired as specified in Chapter 5, Section 3.16 of API 686.

3.4 FINAL INSPECTION

A. The Construction Manager will conduct a final inspection with the Contractor for conformance to requirements of the contract documents.

END OF SECTION

SECTION 43 20 05
MACHINE ALIGNMENT

PART 1 GENERAL

1.1 DESCRIPTION

This section specifies requirements for alignment of directly coupled mechanical equipment weighing 1000 pounds or more and/or greater than 100 horsepower furnished or modified under this contract. Equipment direct coupled to the motor with drivers 100 horsepower and less and belt or chain driven machinery are specifically exempted from the requirements of this section. This section also includes requirements for alignment software and equipment to be furnished to the Owner on commissioning of the project.

1.2 QUALITY ASSURANCE

A. GENERAL:

1. All equipment shall be aligned using laser alignment equipment to the tolerances specified by the subject equipment manufacturer or the criteria specified in this section, whichever is more stringent.

B. ALIGNMENT CRITERIA:

1. Unless otherwise specified by more stringent manufacturers' requirements, all mechanical equipment affected by this section shall be aligned to the following criteria:

Maximum Tolerable Misalignment

Speed, rpm, maximum	Short Couplings (Distance between flex planes ≤ 4")		Spacer Shafts angle at each flex plane in mils/inch or projected offset in mils/inch of spacer length
	Offset (mils)	Angularity (mils/inch)	
600 and less	5.0	1.0	1.8
900	3.0	0.7	1.2
1200	2.5	0.5	0.9
1800	2.0	0.3	0.6
3600	1.0	0.2	0.3
7200	0.5	0.1	0.15

Notes: (1) Soft foot (machine frame distortion) shall be not more than 2.0 mils for any speed.

(2) Separately mounted equipment connected by offset universal joints are exempted from the offset and angularity requirements, but all units must be installed and leveled as specified in this section.

C. ALIGNMENT EQUIPMENT:

1. Alignment equipment used to perform the work required under this section shall employ laser alignment techniques to achieve the required tolerances. The equipment shall be computer based and its software shall be compatible with current Windows® based spreadsheets and databases. The equipment shall employ a hand-held field computer using a graphic interface to determine actual alignment and necessary corrective action to bring equipment into required tolerance. The link between field measurement components and the computer shall be through cable, infrared, or wireless transmission.

1.3 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
Shaft Alignment Handbook	Shaft Alignment Handbook, Third edition, John Piotrowski, Marcel Dekker Inc.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Laser alignment equipment shall be [Rotalign® Ultra] as distributed by Ludeca, Inc., of Doral, Florida, or equal.

2.2 ITEMS TO BE FURNISHED TO OWNER:

A. The following shall be furnished to the Owner upon completion of all alignment work for the project or appropriate portion thereof and prior to substantial completion of the project or portion thereof:

1. All alignment records, in both hard copy and in computer memory. The hard copy shall be signed and dated by the technician performing the alignment work and shall be witnessed by the Construction Manager.
2. One complete [Rotalign® Ultra] equipment system, or approved equal, including plastic carrying case, transducer, receiver, equipment mounting brackets, connecting cable, hand-held computer and computer software for use in records computer, or the equivalent complete setup as accepted for the project.

PART 3 EXECUTION

3.1 GENERAL

A. After machine base grouting, all machines mounted on baseplates or soleplates specified above shall be aligned as specified under this section.

B. Alignment work shall be performed by journeyman millwrights skilled in this type of work under the supervision of a technician trained in the use of the laser alignment by the manufacturer or vendor of the alignment equipment. The use of untrained laborers, carpenters or apprentices for this work will not be acceptable.

3.2 PROCEDURE

A. SEQUENCE:

1. Machines supported on integral feet or support pads shall be leveled, grouted and aligned in the following order: driven machine; intermediate bearings or machines; and driver. Under certain circumstances, such as a diesel engine driving a generator, it may be preferable to reverse this order and set the driver first. The Contractor shall submit a written request for a reversal of the alignment order to the Construction Manager and the Construction Manager must approve any change in alignment order in writing before it will be allowed.

B. ALIGNMENT:

1. All machines shall be rough aligned without any connections to piping, electrical and instrumentation systems. Upon completion of all field connections, alignment shall be rechecked to demonstrate no change. If change has occurred, the Contractor shall eliminate any external forces affecting machine alignment.
2. Next, soft foot (machine frame distortion) shall be measured and brought to within the permissible tolerances (see Paragraph 1.02 B, Note 1). Thereafter, the alignment shall be rechecked and the alignment process repeated if necessary to bring all machinery to final alignment tolerances.

3.3 VERIFICATION

A. FACTORY PERSONNEL:

1. Where required by other sections in this project manual, factory authorized installation technicians representing the equipment manufacturer shall witness final alignment work. After completion of all alignment work, acceptance of the work shall be documented in writing by factory installation technicians.

B. VERIFICATION:

1. All alignment work shall be independently checked using the shaft and coupling spool method described in the Shaft Alignment Handbook. All final results of the alignment work shall be subject to inspection and verification by the Construction Manager.

END OF SECTION

SECTION 43 23 03
GENERAL REQUIREMENTS FOR CENTRIFUGAL FLOW PUMPING EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section, when referenced in the detailed specification section, provides minimum requirements applicable to centrifugal flow pumping equipment furnished under this contract. More restrictive requirements, where found in individual pump specifications, shall supersede requirements of this section.
2. "Detailed pump specification", "detailed specification", "individual pump specification", "referencing section", or words of similar import in this section, shall mean the specification section where the requirements for specific pump performance are presented. "Pumping unit", whenever and wherever used, shall mean the complete pumping assembly, including driver (whether engine, turbine, or motor) and shall include all accessories such as variable speed drives required for motor operation, gear reducers, intermediate shafting and bearings, flywheels, and all supports for all equipment furnished with the pump.
3. A number of provisions of this section shall be required for a subset of pumps. These requirements (refer to Paragraphs 1.05 and 1.07 of this Section) are in addition to requirements applicable to all pumps. The subset of pumps is defined as pumping equipment meeting any of the following criteria:
   a. All pumping unit specifications where the words "Custom Engineered" appear in the title of the specification section.
   b. Where a particular Section 43 23 03 provision is specifically cited in the detailed sectionfor a particular pump.

B. Definitions:

1. The following definitions apply for classifying pumps specified in this and referencing sections:
   a. General: Terminology and definitions in this Section follow those established in ANSI/HI 9.1 - 9.5, unless otherwise noted.
   b. Solids Bearing Liquids: Liquids to be pumped containing, or assumed to contain, solids that require appropriate pump design considerations and/or materials of construction. Solids Bearing Liquids are liquids with settleable and/or floatable solids exceeding 50 mg/L and shall include wastewater, stormwater, primary effluent, return sludge, return activated sludge (RAS), trickling filter circulation, and similar services.

c. Clear Liquids: Liquids to be pumped generally free of deleterious solids. Clear Liquids shall include potable water, heat reservoir, raw water, secondary effluent pumping, and similar services.

d. Efficiency: For the purposes of this section and sections referencing this section, efficiency, as related to pumps, shall be the ratio of the pump output power (water horsepower) divided by the pump input power (brake horsepower) required to deliver the total head, with meanings as defined in ANSI/HI 1.2.3.8 and ANSI/HI 2.2.3.8.

e. Net Positive Suction Head – 3 Percent Reduction (NPSH3): For the purposes of this section and sections referencing this section, NPSH3 shall mean the value of net positive suction head resulting in a reduction of 3 percent in the developed pump discharge head when the pump is tested in accordance with procedures established by the Hydraulic Institute. NPSH3 is the successor designation to NPSHR (net positive suction head required). Where NPSHR is used in the Contract Documents it shall be taken to mean NPSH3.

f. NPSH Margin: For the purposes of this section and sections referencing this section, "NPSH Margin" wherever used shall mean Net Positive Suction Head Available (NPSHA) divided by the candidate pump's Net Positive Suction Head-3 Percent Reduction (NPSH3) for the specific operating condition in question.

1.2 TYPE

A. Provisions and requirements contained in this section apply specifically to centrifugal flow pumps, both vertical and horizontal, commonly falling into the generic types covered by ANSI/HI 1.1 through 1.4 and 2.1 through 2.4. This section does not apply, except by specific reference, to positive displacement pumps of any type.

1.3 REFERENCES

A. This section (Section 43 23 03) contains references to the following documents. They are a part of this section and any referencing section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section or any referencing section and those of the listed documents, the following order of precedence shall prevail (in the order of primacy):

1. The referencing section.
2. This section.
3. The referenced document.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean

the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
AISC	American Institute of Steel Construction –Manual of Practice
ANSI/API 610	Standard for Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
ANSI/ASME B46.1	Surface Texture, Surface Roughness, Waviness and Lay
ANSI/HI 1.1 – 1.4	Rotodynamic (Centrifugal) Pumps
ANSI/HI 2.1 – 2.4	Rotodynamic (Vertical) Pumps
ANSI/HI 9.1 – 9.5	Pumps – General Guidelines
ANSI/HI 9.6.1	Rotodynamic Pumps – Guideline for NPSH Margin
ANSI/HI 9.6.2	Centrifugal and Vertical Pumps for Allowable Nozzle Loads
ANSI/HI 9.6.4	Centrifugal and Vertical Pumps. Vibration Measurements and Allowable Values
ANSI/HI 9.6.6	Rotodynamic Pumps for Pump Piping
ANSI/HI 9.8	Pump Intake Design
ANSI/HI 11.6	Submersible Pump Tests
ANSI/HI 14.6	Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
API 686/PIP RElE 686	Recommended Practices for Machinery Installation and Installation Design
ASME B18.8.2	Taper Pins, Dowel Pins, Straight Pins, Grooved Pins, and Spring Pins (Inch Series)
ASME Code	ASME Boiler and Pressure Vessel Code
ASTM A27	Steel Castings, Carbon, for General Application
ASTM A36	Carbon Structural Steel
ASTM A148	Steel Castings, High Strength, for Structural Purposes
ASTM A322	Steel Bars, Alloy, Standard Grades
ASTM A564	Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A571	Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service

Reference	Title
ASTM A995	Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts, Grades 2A, 3A, or 6A
ASTM B148	Aluminum-Bronze Sand Castings
AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
AWWA C550	Protective Epoxy Coatings for Valves and Hydrants
NSF/ANSI 61	Drinking Water System Components – Health Effects
IEC 61298-2	Process Measurement and Control Devices. General Methods and Procedures for Evaluating Performance Tests Under Reference Conditions
ISO 9001	Quality Management Systems – Requirements, 3rd Ed. (2000)
ISO 10816-1	Mechanical Vibration—Evaluation of Machine Vibration by Measurement on Non-rotating Parts—Part 1: General Guidelines, Annex B, Table B.1. Zone A, Class I, II or II, as applicable. For the purposes of this specification, Annex B of ISO 10816, Part 1 shall form a part of this specification and ISO 10816, Part 1.
ISO 10816-7	Mechanical Vibration—Evaluation of Machine Vibration by Measurement on Non-rotating Parts—Part 7: Rotordynamic Pumps for Industrial Applications, Including Measurements on Rotating Shafts, Annex A, Tables A-1 and A-2 as applicable. For the purposes of this specification, Annex A of ISO 10816, Part 7 shall form a part of this specification and ISO 10816, Part 7.
MIL STD 167-2	Mechanical Vibrations of Shipboard Equipment (Reciprocating Machinery and Propulsion System and Shafting)
Corbo and Malanoski, 1996	Practical Design Against Torsional Vibration, 25th Turbomachinery Symposium, Turbomachinery Laboratory, Texas A & M University, p. 186 – 222
Corbo and Malanoski, 1998	Pump Rotordynamics Made Simple, Pumping Technology, June 1998, p. 202 – 236

1.4 DESIGN REQUIREMENTS – ALL PUMPS:

A. General:

1. Equipment furnished under all sections referencing this section shall conform to the requirements and objectives of paragraph 6.1, ANSI/API 610, unless specifically stated in this and the detailed specification section. All components associated with the rotating elements in the drive train, including equipment supports and supports for rotating elements, shall be selected and designed to function without damage or disassembly at reverse rotational speeds up to 150 percent of maximum operational speed during flow reversals through the

pump. The complete pumping unit shall operate without overload on any component at any point along the pump's entire full-speed operating curve. Pumps required by virtue of the specified operating conditions to operate against a closed valve or throttled for any period of time exceeding five seconds shall be furnished with drivers sized to operate continuously at the power requirement for that condition even though the power requirements at the rated condition may be less.

2. With the exception of submersible pumps and the inlet connection for pumps designed to operate in open forebays or wet wells, pump connection nozzles shall be designed for the loads and moments stipulated in ANSI/HI 9.6.2. Where ANSI/HI 9.6.2 does not cover a specific pump type or category, or where that document is silent on allowable nozzle loads or a particular type of nozzle load (e.g. thermal pipe strain), the Contractor shall furnish documentation from the manufacturer attesting to the limitations on loads and moment forces that can be tolerated on each connection and recommended connection details to be used.

B. Pump Selection:

1. Proven Designs:
   a. Pumps furnished under all sections referencing this section shall be proven designs that shall have been in service under similar conditions of service with no objectionable performance characteristics. The Contractor shall furnish a detailed list, duly signed by an officer of the pump manufacturer's corporation and notarized, of installations with contact information supporting qualification under this requirement with the information required under paragraph 1.08. In order to satisfy this requirement, the listed pump shall be of the same size volute or bowl, discharge case and nozzle size, impeller design (including number of vanes) and shall be operating under similar conditions of pumped fluid, head, capacity, speed, rotation, and Net Positive Suction Head Available (NPSHA).
   b. The Contractor may propose equipment that cannot meet this requirement only under the following conditions:
      1) The proposed design has been in successful operation under similar conditions of volute or bowl, discharge case and nozzle size, impeller design (including number of vanes), pumped fluid, head, capacity, rotation and NPSHA, or
      2) The proposed design has been in operation in designs where both larger and smaller inlet nozzle size pumps have been in service for a period of not less than five years, and impeller design (including number of vanes), pumped fluid, head, capacity, speed and NPSHA are similar to that for the proposed installation. Under no circumstances will an existing pump design operating at a higher speed than those currently in service in similar applications be considered.
   c. If the proposed pump qualifies under either exception [(b.1) or b.2)], the Contractor shall demonstrate, by operation of a test pump in a fully equipped hydraulic test facility, that the proposed pump in the size and at the speed

proposed, with the proposed impeller design will have acceptable operating characteristics (vibration, case noise, no indication of suction or discharge recirculation) under the conditions specified for the proposed installation. The test pump shall be set up and a witnessed demonstration shall be performed prior to designing, fabrication and testing any of the equipment proposed for the specific installation.

2. General Performance Criteria:
    a. Pumps furnished under this section and any referencing section shall operate without loss of head due to cavitation or vibration over the entire specified range of flow and head conditions and shall be specifically selected for NPSH margin requirements specified for the pump conditions of service. Pump selections which do not provide the specified margin will be rejected.
3. General Design Criteria:
    a. All pumps furnished under sections referencing this section shall be designed in accordance with applicable portions of ANSI/HI 1.1 – 1.4, 2.1 – 2.4, ANSI/HI 9.6.2 and ANSI/HI 9.6.6 and the requirements of this section. The pumps shall be specifically designed to pump the fluid described in the detailed specification and shall operate without clogging or fouling caused by material in the pumped fluid at any operating condition within the range of service specified.
    b. Unless otherwise noted or specified, pump head capacity curves shall slope in one continuous curve within the specified operating conditions. No points of reverse slope inflection capable of causing unstable operation will be permitted within the specified zone of continuous duty operation. Pumps with head/capacity curves with a reverse inflection are specifically prohibited if these characteristics will cause unstable operation within the specified range of operating conditions and where startup/shutdown conditions entail operation against a slow opening/closing valve.
    c. Pumps specified to operate at constant speed shall function without loss of head or capacity due to cavitation or excessive vibration over the entire specified range of flow and head conditions defined by the region bounded by Condition Points A, B, C, D, and E and any other continuous duty operating condition specified in the detailed specification referencing this section and shall be selected to place Condition Point C in the detailed specification within the PACL region determined by suction specific speed for the proposed pump and the limits from the table below.
    d. Pumps specified to operate at variable speed shall function without loss of head or capacity due to cavitation or excessive vibration over the entire specified range of flow and head conditions defined by the region bounded by Condition Points A, B, C, D, and E and any other continuous duty operating condition specified in the detailed specification referencing this section in the Allowable Operating Region as defined in ANSI/HI 9.6.3 and as indicated on the test curve developed for the specific pump model. Unless

otherwise specified in the section referencing this section, acceptance criteria shall include the following:

1) Operating Condition Points B and C and any other continuous duty operating point specifically required in the detailed specification shall reside within the region defined by ANSI/HI.9.6.3
2) Unless otherwise noted in the detailed specification referencing this section, Operating Condition Point A may reside in the area outside the POR as defined in ANSI/HI 9.6.3. Condition Point C shall be located within the POR;and Condition B shall be located within the POR, or within 5 BEPQ percentage points (in terms of flow) outside the POR so long as Condition Point C resides in the POR.

e. Pumps shall be specifically selected for NPSH margin requirements specified for the pump conditions of service. Pump selections which do not provide the specified margin will be rejected.
f. ANSI/HI 1.3, paragraph 1.3.2.2.
g. Exceptions to the foregoing will be considered by the Construction Manager only when the Contractor can provide certified test data demonstrating conclusively a wider region of stable pump performance. The test data shall include suction pressure pulse information as well as actual service information for the same impeller design and trim, operating at the same speed, capacities and head for the same size pump as required for the specified application.

C. Critical Speeds and Natural Frequencies:

1. General:
   a. The criteria of this paragraph apply to all pumps. Pumps exhibiting adverse behavior after installation from resonance, vibration or fatigue shall be repaired or replaced at no cost to the Owner. The criteria shall apply to the equipment in like new condition as well as the as worn condition (i.e., when all parts, individually and as a composite, reach the manufacturers' maximum tolerances). Critical speed and natural frequency data submittal requirements depend upon the pump:
      1) For the more critical pumps that are covered under paragraph 1.05 the Contractor is required to submit analytical reports confirming requirements on critical speeds and natural frequencies prior to pump fabrication as specified in that paragraph.
      2) Unless otherwise specified, for constant speed pumps and variable speed pumps with suction size less than 6-inch diameter – no critical speed submittal is required.
2. Lateral Rotor Dynamics:
   a. The complete pumping unit, including all related frames, supports, enclosures, and casings, shall be free from dangerous critical speeds from 20 percent below to 30 percent above the operating speeds required to

achieve the specified performance characteristics. The logarithmic decrement for each damped natural frequency (forward or backward) shall be greater than +0.3, and the amplitude magnification factor shall not exceed 3, for any natural frequency within this range.

b. Process sensitivities are such that operation at infinitely variable speed within the specified operational conditions is an absolute requirement. Any remedy imposing a locked-out speed interval or intervals will not be considered an acceptable remedy for identified critical speeds. Acceptable remedies include combinations of adjustments in rotor geometry or materials, and the substitution of energy absorbing couplings. Other remedies may be considered so long as they are justified in writing and the proposal sealed and signed by the design professional retained by the manufacturer to perform the system mass elastic system analyses.

3. Torsional and Combined Shaft Stress:

a. For constant torque applications, the pump rotor shall be free from torsional response which produces combined (steady plus alternating torque induced) stresses exceeding 30 percent of the material's elastic limit (but no more than 18 percent of the material's ultimate tensile strength) at any speed from 10 percent below to 20 percent above that required by the specified operating conditions, or during startup, shutdown or motor control transients.

4. For variable torque applications (including variable speed pumps, vertical pumps and pumps with large overhung loads) the pump rotor and any intermediate shafting shall be free from torsional responses which, in accordance with MIL STD 167-2, produce combined (torsional steady and alternating) peak shear stresses at points of stress concentration (calculated in accordance with the requirements of this section) that exceed 4 percent of the material's ultimate tensile strength, nor more than 50 percent of the material's fatigue limit, whichever is less.

D. Component Design Criteria:

1. General:

a. Unless otherwise specified, combined stresses in steel frames and supports shall not exceed those permitted by the AISC Manual of Practice. Combined stresses in cast, forged, rolled, or fabricated pressure retaining components, frames and supports shall not exceed that allowed for the given material in Section VIII, Division 1 of the ASME Code. Design pressures for pressure-retaining parts shall be not less than twice the pump's shutoff head at the manufacturer's listed maximum operating speed. Pump casing strain at any head on the full speed operating curve (including allowances for increases caused by specified multi-stage applications) shall not result in distortions at the bearing housings greater than the maximum allowable by the bearing manufacturer to provide the specified bearing life.

b. The term "combined stresses" in this section shall mean the sum of all operating stresses, including stresses induced by dynamic and static forces as developed via the analysis procedures stipulated in this section. Static forces (x, y, z, and moments in all planes) shall include the relevant maximum nozzle

loads specified in ANSI/HI 9.6.2 or as stipulated by the pump manufacturer. Dynamic forces shall include both steady state and transient stresses induced by operating conditions within the zone of operation established by the specified operating conditions.

2. Anchorage and Equipment Mounts:
   a. The Contractor shall cause the pump manufacturer to be responsible for the design of the anchor bolting system and equipment supports for each separately mounted component furnished under the detailed specification. Anchorage and equipment support requirements for pumps shall conform to the requirements of Section 43 05 13 and the standards of the Hydraulic Institute.
   b. Anchor bolts and connecting bolts for all pumps and assemblies supported by other assemblies furnished under this section, or sections referencing this section, shall be designed in accordance with the structural plans and specifications. All operation and maintenance manuals for all pumps and assemblies shall contain criteria for anchor and baseplate bolt torque values.
   c. Unless otherwise recommended by the equipment manufacturer, all pump discharge nozzles shall be restrained using the equipment connection fitting specified.
   d. Equipment mounts for vertical volute type pumps weighing more than 1000 pounds, with discharge nozzles 6 inches in diameter and greater, shall employ soleplates conforming to the requirements of Section 43 05 13.
      Soleplate mounting conforming to Section 43 05 13 shall also be provided for all separately supported components in the pump drive system. Fabricated steel supports regardless of design and the nature of the structural shapes used for such proposed supports, will not be accepted.
   e. Soleplates shall be designed to span openings for equipment connections and provide access to maintenance points. Soleplates shall be of sufficient section to key, not less than 1 inch, into the supporting grout provided for bonding the soleplate to the structure. Soleplates shall be of sufficient size to bolt the pump base to the soleplate and allow dowelling the pump base to the soleplate without encumbering the anchor bolts required for clamping the soleplate to the structure. Soleplates shall have the words" THIS SIDE DOWN" engraved in the underside (grout side) of each plate.
   f. Equipment mounts for horizontal pumps shall be designed in accordance with Section 43 05 13 and paragraph 7.3, ANSI/API 610 and shall provide common support for the pump and motor (and flywheel, if one is specified). Baseplate bolting shall conform to assumptions contained in ANSI/HI 9.6.2. Pump base shall be drilled and dowel pinned to the base plate in addition to bolting.
   g. Tapered dowel pins shall be used to record the final position of all machine bases on soleplates or pump baseplates. Dowel pins shall be hardened and machine-ground conforming to the requirements of ANSI/ASME B18.8.2. Holes for tapered dowels shall conform to the requirements set forth in Appendix A of ANSI/HI B18.8.2.

3. Torsional and Combined Shaft Stresses:
    a. Shaft stresses shall be calculated using the following equation and the stress concentration factors in the table below.

$$S = S_{cf} \times \frac{G \times D \times \Delta_{\Theta}}{2 \times L}$$

where:

S = stress, psi

S_{cf} = stress concentration factor, dimensionless

D = minimum shaft diameter at point of concentration, inches

Δ_{Θ} = twist in shaft between adjacent masses, radians

L = effective length between masses, inches

G = shear modulus of shaft material, lb/in2

The S_{cf}, to be applied at all the roots of all keyways and changes in shaft diameter shall be as follows:

S_{cf}	Ratio of fillet radius to shaft diameter
4.3	0.0025
3.7	0.01
3.05	0.02
2.75	0.03
2.6	0.04
2.55	0.05 and greater

Values of S_{cf} between data points in the table above shall be based upon a straight line interpolation.

4. Shaft Deflection:
    a. Pump shafts on volute type pumps shall be designed to provide sufficient stiffness to operate without distortion or damaging vibration throughout the range of service specified. Shaft deflection at the face (impeller side) of the shaft seal shall be limited to no more than 1.5 mils at any operating condition within the zone described by the specified continuous duty operating

conditions. Deflection at the shaft seal shall be calculated as required by provisions set forth in Paragraph 1.05 Shaft Radial Load and Deflection.

5. Bearings:
    a. Unless otherwise specified, anti-friction bearings for pumps shall be selected for a minimum L–10 life of 50,000 hours in accordance with ABMA 9 or 11. Anti-friction bearings for Custom Engineered pumps shall have bearings selected for an L–10 life of 100,000 hours in accordance with ABMA 9 or 11. Bearings for other elements in the rotating system such as motors, intermediate shaft bearings, and flywheel bearings shall be selected using the same criteria as specified for the pump. Bearing selection shall be based upon the worst combination of continuous duty operating conditions specified and shall include both steady state and transient loads. Calculations supporting the selection of bearing sizes shall be provided as Product Data.
6. Bearing Isolators:
    a. Unless otherwise specified, all pump and motor bearings shall be fitted with bearing isolators, specifically selected for the size and type bearing. Bearing isolators shall be labyrinth, non-fretting type designed to expel contaminants by centrifugal force and prevent escape of lubricants. Vapor block capability shall be provided. Bearing seals shall be Inpro/Seal, model AM or approved equal.
7. Pump Shaft Seals:
    a. Unless otherwise specified in the detailed specification, pump shaft seals shall be packing as specified in Section 43 05 11.

E. Net Positive Suction Head Margin Limitations:

1. General:
    a. Pumps furnished under this section and sections referencing this section shall be selected for NPSH (Net Positive Suction Head) margin limitations using the criteria set forth in this section. Net Positive Suction Head Required - 3 Percent Reduction (NPSH3) characteristics for the candidate pump shall be based upon documented test, performed on a pump not more than two nominal pump diameters larger or smaller than the proposed pump with an impeller of the same geometry as that proposed for the pump to be used for the subject application, and operating at the same speed as the pump for the proposed application. The Contractor shall document the basis for pump selection based upon NPSH margin limitations as set forth in this paragraph. The detailed specification sections provide NPSHA (Net Positive Suction Head Available) information for anticipated operating conditions for each application. This information is generally referenced to a specific elevation, stated in terms of project datum. It shall be the Contractor's responsibility to cause the pump manufacturer to adjust the NPSHA information in the specification section to the elevation of the pump impeller eye for the specific pump model and size proposed for the application. NPSH3, as used in the

following paragraphs, shall mean the NPSH3 at the impeller eye, determined in accordance with ANSI/HI 11.6 or 14.6, as applicable for the proposed pump. The Contractor shall cause the pump manufacturer to document the method used to determine NPSH3 for the proposed pump and justifying compliance with the NPSH margin limitations established under this paragraph for each specified operating condition in material submitted under paragraph 1.08. The documentation shall include justification of the NPSH3 tests used to develop NPSH3 characteristics, including the following:

1) Date, test procedure, and test logs of original NPSH3 information used to project requirements for pump selected for the application.
2) Test pump size, impeller diameter, impeller model, eye diameter, and speed.
3) Calculations projecting NPSH3 test information to NPSH3 curve information for the pump proposed for the application.
4) Calculations demonstrating compliance with the NPSH margin requirements established in this paragraph.

b. The Contractor shall submit the manufacturer's margin calculations justifying the proposed pump selection with the material required under Paragraph 1.08. The NPSH margin ratios specified in this paragraph shall be the minimum acceptable margin ratios. If the proposed pump requires greater margin ratios to operate within the specified operating conditions without loss of head due to cavitation, then it shall be the responsibility of the Contractor to bear all costs associated with achieving the required margin ratio by lowering the elevation of the pump setting, lowering the elevation of the structure or other means. Any such adjustments shall be subject to review and acceptance by the Construction Manager.

c. Individual restrictions that apply to NPSH margin shall be as set forth below, depending upon the type of pumping equipment and the fluid to be pumped.

2. Centrifugal Pumps – Wastewater Service:

a. The following restrictions shall apply to pumps for wastewater and all solids bearing liquids applications including storm water.

1) Pumps classified as centrifugal pumps under ANSI/HI 1.1 – 1.2 with suction specific speeds less than 8500 with cast duplex stainless steel impellers and specific speeds less than 5000, a minimum NPSHA/NPSH3 margin ratio of 1.1 shall apply to pumps at any operating condition within 85 percent and 115 percent of best efficiency capacity. The minimum acceptable NPSH margin ratio at any other location on the pump's head/capacity curve shall be 1.2.
2) Pumps with suction specific speeds greater than the above limitations shall have NPSH margins of 1.5 and 2 applicable to the capacity envelope limitations defined previously. Under no circumstances shall the absolute value of the margin above NPSH3 be less than 3.5 feet.

3) Pumps with suction specific speeds greater than the above limitations, and pumps with impeller materials that do not meet the requirement for duplex cast stainless steel set forth in this section, and all pumps with suction specific speeds greater than 10,000 shall have NPSH margins not less than 2.5 at operating conditions within ±15 percent of best efficiency capacity and not less than 3.5 for all operating conditions falling outside the ±15 percent of best efficiency capacity envelope. Under no circumstances shall the absolute value of the margin for pumps qualifying with the foregoing restrictions, be less than 3.5 feet greater than NPSH3.

3. Centrifugal Pumps - Clear Liquid Service:
   a. The minimum NPSH margin requirements set forth in the table below shall apply to water and all non-solids bearing liquid pumps classified as centrifugal pumps under ANSI/HI 1.1 – 1.2 with specific speeds less than 7000 fitted with cast duplex stainless steel or aluminum bronze impellers and to pumps with cast duplex stainless steel impellers or aluminum bronze impellers and specific speeds less than 4000. Under no circumstances shall the absolute value of the margin above NPSH3 be less than 3.5 feet.

Power per stage, Kw	Operating Condition Within POR	Operating Conditions Outside POR
< 75	1.1	1.2
≥ 75 but ≤ 225	1.05	1.1
>225	1.2	1.3

   b. Pumps with specific speeds greater than the above limitations, pumps with impeller materials that do not meet the requirement for duplex cast stainless steel set forth in this section, and all pumps with suction specific speeds greater than 10,000 shall have NPSHA margins not less than 3.0 at operating conditions within ±15 percent of the best efficiency capacity and not less than 4.0 for all operating conditions falling outside the ±15 percent of best efficiency envelope. Under no circumstances shall the absolute value of the margin above NPSH3 be less than 3.5 feet.

F. Electric Motors:

1. General:
   a. Unless otherwise specified, pumps shall be electric motor driven. All motors shall be selected to be non-overloading at any operating point along the pump's full speed operating curve, including all points located beyond specified operating conditions. All vertical motors shall be solid shaft construction. Hollow shaft motors will not be accepted. Motors furnished with pumps specified for operation at variable speed shall be inverter duty types

conforming to the requirements of Section 43 05 11 and shall be compatible with the variable speed equipment furnished with the pump.

b. Motor bearings shall be protected with bearing isolators as specified in Paragraph 1.04 Component Design Criteria.

2. Motors for Custom Engineered Pumps:

a. In addition to the information submitted under the requirements of Section 43 05 11, the Contractor shall provide certified reed frequency calculations for both the motor rotor and frame for vertical motors driving custom engineered pumps with the data to be submitted under Paragraph 1.08. Upon completion of construction of motors for custom engineered pumps, each rotor and frame and the completed assembly shall be given a bump test to confirm reed frequency calculations in the dynamic analysis modeling work performed under Paragraph 1.05 Rotor Critical Speed Analysis and System Design. The results of the bump test, certified by an officer of the manufacturing corporation and notarized, shall be submitted as Product Data under Paragraph 2.09.

b. All vertical motors shall meet motor face dimension tolerances as follows:

Motor face bolt circle diameter, inches	Motor face runout, inches
12	0.002
16.5 through 24.5	0.002
30 through 42	0.003
42 and larger	0.005

c. Motor face register concentricity, referenced to the shaft centerline, shall be not greater than 0.002 inches, if the motor is furnished without jack screws. Motor shaft total indicated runout (TIR) shall not exceed 0.002 inches.

3. Balance:

a. Motors rated 50 horsepower and greater, all motors driving custom engineered pumps and all motors operating at less than 1200 rpm shall be precision balanced motors conforming to the requirement set forth in the table below.

Speed, rpm	Mils displacement (peak to peak)
3000 and above	0.5
1500 - 2999	1.0
1000 - 1499	1.0
<1000	1.5

b. The Contractor shall provide certified balance logs attesting to achieving these requirements, as Product Data under Paragraph 2.09. Displacement readings shall be taken at the shaft with an FFT analyzer at 1X speed. Balance logs shall be notarized and signed by an officer of the manufacturing corporation.

4. Custom Electric Motors:
   a. Custom motors shall be provided in accordance with Section 43 05 11. Custom motors shall be provided for pumps to be supplied under the following Sections:
      1) Section 43 23 15.
      2) Section 43 42 56.04.

1.5 ADDITIONAL DESIGN REQUIREMENTS

A. Scope:

The following paragraphs present requirements that apply to only some pumps on the project. In each of the paragraphs, the first sub-paragraph titled "General" explains when the paragraph applies.

B. Rotor Critical Speed Analysis and System Design:

1. General:
   a. The requirements of this paragraph shall apply to all pumping equipment in detailed specifications where the words "Custom Engineered" appear in the title of the specification section, and elsewhere when the referencing specification section stipulates. The analyses shall be applied to the equipment in like new condition as well as the as worn condition (i.e., when all parts, individually and as a composite, reach the manufacturers' maximum tolerances).
2. Requirements:
   a. The complete pumping unit, including rotating elements, frames, supports, and all related structural elements, including pump, motor and bearing supports, shall be subjected to a lateral rotordynamic analysis, including a rotordynamic critical speed analysis, to identify and eliminate harmful resonant conditions.
   b. The complete pumping unit rotating element including pump, motor, intermediate shafting and flywheel rotors (if specified), and all other elements in the power train (or powered via the power train) shall be designed and manufactured to limit torsional stresses.
   c. Overhung shaft pumps and between bearings pumps operating in single volute casings shall be subject to analysis for shaft deflection in accordance with the terms of this section.

d. The torsional and rotordynamic analyses shall together be termed the pumping equipment's "mass elastic design". No fabrication work on any component for the equipment specified under this section and any referencing section shall be started until the mass elastic design has been completed and has been reviewed by the Construction Manager.

e. If the Contractor proposes the use of alternative methods for the required analyses, documentation shall be submitted justifying the substitution. The documentation shall include justification that product results will be equivalent to that specified and with an equivalent level of accuracy. The location and description of projects of an equivalent size where the procedure has been employed and the length of time these projects have been in actual service shall also be included.

3. Professional Qualifications:

a. The Contractor shall cause the manufacturer of the pumping equipment to retain the services of an independent professional engineering firm, employing a qualified design professional, which has been engaged in performance of the required, mass elastic design analyses on equipment of similar size and complexity. The design professional shall have experience working with a pump manaufacturer. The design professional's firm shall submit a notarized certification attesting to having no contractual arrangements with the proposed pump manufacturer. The pump manufacturer's internal engineering organizations, regardless of qualifications, are specifically prohibited from doing this work. This provision, however, shall not be construed as relieving the Contractor of overall responsibility for this portion of the work.

b. The mass elastic design shall be the product of a design professional, registered to practice mechanical engineering in at least one of the States comprising the United States, who has been responsible for the design of not less than five systems similar to that specified in the detailed specification section. The design professional shall have been engaged in this type of analysis and shall directly supervise the performance of the work and be responsible for analysis of results and recommendations for any corrections to the specific rotating system and the associated frames and supports. The Contractor shall submit the design professional's qualifications as a part of the initial submittal information required under this section.

c. The Owner and Construction Manager believe the following firms are capable of providing services which will satisfy the requirements of this paragraph. This statement, however, shall not be construed as an endorsement of a particular firm, nor shall it be construed that a named firm's standard service will comply with the requirements of this Section. Candidate firms performing these analyses satisfactorily in the past include:

1) DynaTech , Roseville, California
2) Engineering Dynamics Incorporated, Houston, Texas
3) No Bull Engineering (Corbo, Malanoski & Associates), Brandon, Vermont

4) Or equal.

d. The Contractor may propose a firm other than those listed. However, before a substitute firm can perform the analyses, the proposed firm's qualifications, the qualifications of personnel proposed for assignment to this project, along with examples of analyses performed on similar pumping equipment using the Corbo and Malanoski procedures specified in this section shall be submitted for review by the Construction Manager. Examples shall include the types of graphical displays required under this section as well as a complete report describing the analyses performed and the recommendations arising out of the analysis results. Construction Manager retains the right to reject any proposed firm with justification.

4. Reports, Calculations and Recommendations:
   a. All reports, calculations and recommendations resulting from the required analyses shall bear the design professional's original signature and professional registration seal. All reports, recommendations and calculations produced under this paragraph shall be submitted under the requirements of this section, as follows:
      1) Following completion of the pumping equipment's mass elastic design, Contractor shall cause the design professional to prepare a plain-English "Executive Summary" report with a narrative including: a description and assumptions about proposed operating system; detailed description of the analysis process; results of analyses and findings; detailed recommendations for modification of the Pumping Unit (defined in Paragraph 1.01 Scope), if any; and sufficient graphical depictions to describe the information to a lay reader. Detailed calculations and extensive data reports are not to be submitted at this time and will cause the entire report to be rejected, if included. This Executive Summary shall be submitted for review and acceptance prior to pump or component fabrication. The Executive Summary report shall state that analysis procedures have complied fully with the requirements of this section and that the proposed system will meet all of the requirements set forth herein for limitations in stresses, deflection and fatigue limits. The design professional shall affirm in writing that all requirements of this section have been achieved or shall specifically state where exceptions have been taken, with justification citing recognized authorities for taking such exceptions. The reports shall be signed and sealed by the design professional, as specified, and shall be notarized.
      2) Following review and approval of the Executive Summary, the Contractor shall cause the design professional to review and address any comments from the Construction Manager and incorporate all changes that may be required. Subsequently, Contractor shall direct the design professional to issue a complete, "Final Report" with a revised Executive Summary, recommendations binding on the manufacturer, calculations, data and

other supporting information. The format and documentation for this report shall follow the requirements of ANSI/HI 9.6.4. The Contractor shall submit this report as Product Data.

3) Upon completion and receipt of certified results of the bump tests required for the motor rotor, frame and assembly, the design professional shall review the data and submit a "Supplemental Report", as Product Data, either accepting the test results or recommending alterations to assembly structures to adjust for differences between calculated values used for the original analyses and actual values determined subsequent to motor fabrication.

4) Upon completion of installation and as a part of the initial test procedures, the design professional responsible for the mass elastic design shall visit the site and inspect the installed equipment. Prior to the initiation of any field tests, the design professional shall issue a report attesting that the equipment, as installed, conforms to the recommendations contained in the report setting forth the results of the mass elastic system design or recommendations for remedies should the supplied equipment contain features or characteristics deviating from the original recommendations and calculations.

5) During initial testing of the equipment, the design professional shall be prepared with all necessary monitors, instruments and recorders, and shall conduct an in-situ torsional vibration test on one of the installed pumping units, to be selected by the Construction Manager, to confirm the torsional natural frequency results of the original mass elastic system design. The torsional vibration test shall be conducted with transducers suitable for narrow band spectrum analysis, including strain gauges, magnetic or optical pulse demodulation, or shaft position encoders. If the torsional vibration test should reveal any anomalies that cause the equipment to be out of compliance with the requirements of this section, the design professional shall conduct torsional vibration tests on all other like pumping units and submit a comprehensive report, sealed and signed as specified above, detailing the reasons for failure to comply with these specifications and recommendations for attaining compliance. The design professional shall consider all feasible options for compliance and shall provide detailed descriptions of the modifications required to achieve the required performance. Those recommendations accepted by the Construction Manager shall be implemented by the Contractor at no cost to the Owner.

5. Methodology:
   a. Lateral Rotor Dynamic Analysis:
      1) The rotor dynamic analysis shall follow the procedure prescribed in Corbo and Malanoski, 1998, and shall include the following features:

a) The procedure shall consider all speeds required to operate the equipment within the envelope of specified continuous operating conditions specified.

b) The procedure shall produce Campbell diagrams for the proposed operating conditions depicting all potential sources of excitation to check interference with all relevant frequencies up to, and including, not less than 6 times (6X) operating speed.

c) For all pumps, the analysis shall also consider vane pass excitation at rev/2.

   (1) Unless specifically accepted by the Construction Manager, the range in variation of component characteristics shall comply with the ranges recommended in Corbo and Malanoski, 1998.

d) The mathematical modeling tools to be employed for the analyses and the procedure to be used shall be as described in the references specified in Paragraph 1.05 Rotor Critical Speed Analysis and System Design with the following modifications:

   (1) The mathematical model of the rotating element shall be built on a rotordynamics code such as FEATURE or DYROBES. Use of a finite element modeling program for this purpose will be unacceptable. The model shall specifically be constructed to contain axisymmetrical models of the rotor and casing. This model shall be used to determine the natural frequencies of the rotating elements.

   (2) A finite element code such as NASTRAN or ANSYS shall be used to construct three dimensional models of the casing and support structures for the equipment furnished under this contract. This model shall be used to determine the natural frequencies of the support structures and casing as well as the pump bearing frames.

   (3) The axisymmetrical model shall then be adjusted, preferably by changing component materials or sizes, or by changing component type, until its output frequencies agree with the models constructed under b).

e) Physical adjustments to provide the required characteristics shall be preferably by changes in component dimensions and secondarily by providing torsionally resilient dampening devices such as fluid-damped couplings or all metallic couplings such as manufactured by Bibby and Holset. Couplings or dampeners using rubber or similar elastic materials shall not be used.

f) The final report shall include three-dimensional graphic presentation of frame and shaft distortion and rotor element performance at identified critical speeds within the pump's operating range.

b. Torsional Dynamic Analysis:

1) The methodology used for evaluation of the mass elastic system and shaft combined stresses shall follow the approach prescribed in Corbo and Malanoski, 1996, using either the Matrix-Eigenvalue or Holzer methods for determining natural frequencies. The computer analysis results shall be verified by hand calculations for the fundamental frequency and for mode shapes. Exciting frequencies to be considered during the analysis shall be 0.5, 1, and 2 times running speed, vane passing frequencies and twice vane passing frequencies for the pump impeller/cutwater-diffuser vane combinations, line and twice line frequency, motor pole frequency and motor starting transients. Forcing function magnitudes used for the analysis shall be not less than 10 percent of the maximum transmitted torque. The analysis shall also include evaluation of control pulse frequencies induced by variable frequency drives or engine power stroke frequencies, if provided as part of the specified system. The analysis report shall include a statement produced by the variable frequency drive manufacturer detailing all control pulse frequencies generated by the equipment between 1/4 and 18 times motor running speed.
2) Unless otherwise justified by documentation supported by independent studies, the analysis procedure shall use the range of factors recommended in Corbo and Malanoski, 1996. The Contractor shall produce a Campbell-type interference diagram showing the relationship between operating range, natural frequencies and exciting frequencies with all relevant frequencies up to, and including, not less than 6 times (6X) operating speed. The stress analysis procedure shall be based upon a finite element analysis technique using a digital computer program that has been field calibrated with not less than five similar installations.
3) The analysis shall include a time-integration study showing transient peak stresses resulting from startup, shutdown and motor control transients if synchronous drives are specified. The diagrams shall include calculated stresses throughout the range of frequencies considered in the analysis. Tomographic diagrams, displaying colorimetrically stresses at all positions in the pump shaft and all frames, including roots at changes in section and keyways or other stress concentrating locations, shall be provided with the analysis report. The diagram shall indicate operating speeds identified that produce the peak stresses and shall be specific for speeds inducing identified peak stresses at keyways, changes in section and at connections to other components. The reported stresses shall be combined stresses incorporating all identified loads from torsional, lateral and hydraulic sources.

c. Shaft Radial Load and Deflection:
1) Calculation of radial thrust loads shall be performed in accordance with the methodology set forth in ANSI/HI 1.3, paragraph 1.3.5.1. Shaft deflection calculations shall be performed in accordance with ANSI/HI 1.3.5.4. Shaft deflection criteria and limits shall be as required by API 610 (ISO 13709). Calculations justifying the shaft and bearing sizes (selected

in accordance with the requirements of this Section, performed at 0%, 20%, 40% 60%, 80% 100% and 120% of BEP Flow and head shall be submitted with the information specified under Paragraph 1.08.

1.6 QUALITY ASSURANCE – ALL PUMPS

A. Quality Certification:

1. All manufacturers and manufacturing sites proposed by the Contractor for supply of equipment furnished under this section and sections referencing this section shall hold current certification under ISO 9001. Application for certification under ISO 9001 shall not be deemed as an acceptable substitute for current certification. Documentation attesting to current certification shall be signed by an officer of the manufacturer's corporation and shall be notarized. The documentation shall also include the manufacturer's written Quality Assurance/Quality Confirmation (QA/QC) program and the documentation plan necessary for ISO 9001 certification.

B. Unit Responsibility:

1. The Contractor shall assign Unit Responsibility to the pump manufacturer in conformance with the requirements of Section 43 05 11.

C. Performance Confirmation:

1. Hydrostatic Tests:
   a. All pressure sustaining parts shall be subjected to factory hydrostatic tests. Hydrostatic tests shall conform to the requirements of paragraph 8.3.2 of ANSI/ ANSI/API 610. Castings shall be held at the test pressure for 30 minutes for all pumps with discharge nozzles 14 inches in diameter and less and for 60 minutes for pumps with discharge nozzles 16 inches in diameter and greater. Test results shall be certified correct by an officer of the pump manufacturer's corporation, and shall be notarized.
2. Performance Guarantee:
   a. Unless specified otherwise in the detailed specification, pump performance (flow and head, efficiency and NPSH3) shall be guaranteed by the pump manufacturer to the criteria specified under this paragraph.
   b. Equipment performance documentation, including test data, where tests are specified, shall include sufficient test points (not less than 8) to document hydraulic performance along the complete head/capacity curve from shutoff to maximum capacity and shall cover all full speed operating points specified in the detailed specification section referencing this Section. Tests conducted at specified operating conditions shall be the inlet throttled to produce the NPSHA indicated for that specific condition in the detailed specification. NPSH3 tests shall be performed for not less than four full speed operating

conditions, but not less than all specified operating conditions and at Best Efficiency.

c. Test procedures shall conform to those set forth in ANSI/HI 14.6 acceptance grade 1U, and as specifically detailed in these specifications. However, any increase in flow or head permitted under acceptance grade 1U shall not result in overload (nameplate basis, S. F. = 1.0) of the specified motor power rating at any location on the pump's head/capacity curve. Performance tests shall be conducted at the specified maximum speed. Affinity relationship-predicted test results will not be accepted.

d. Acceptance criteria for head and capacity test results, based upon the rated condition specified in the detailed specification shall be as required in ANSI/HI 11.6 and 14.6, acceptance grade 1U, with the above stated limitation with respect to motor power overload.

e. Acceptance criteria for NPSH3 at any specified operating condition shall be the values proposed by the Contractor in the submittal curves submitted under Paragraph 1.08 and duly accepted by the Construction Manager, with a tolerance of plus 0, minus unlimited, with the exception that suction specific speed, as calculated for the specific pump, shall not exceed the limitation established under Paragraph 1.04 Pump Selection.

f. The guarantee shall include a statement to the effect that the pump will operate within the operating regions specified in the detailed specification. The guarantee shall be in writing, shall be signed by an officer of the manufacturing corporation, and shall be notarized. Under no circumstances shall deviations from specified operating conditions result in overload of the driver furnished with the equipment, nor shall such deviations result in power requirements greater than the driver's nameplate (1.0 service factor) rating.

3. Non-Witnessed Tests:

a. Unless specified otherwise, all pumps shall be performance tested in accordance with ANSI/HI 14.6, Acceptance Grade 1U, with the above restrictions on motor power overload. The factory tests shall include test data for each full speed performance requirement (Condition Points A and B specified in the detailed specification) and any other points stipulated for this test procedure in the detailed specification. These tests shall be conducted with the pump inlet throttled to provide the specified NPSHA. If specified in the detailed specification, test data at the full speed operating conditions shall include shaft vibration and case noise.

b. The test setup in the manufacturer's test facility shall duplicate as closely as possible the inlet conditions in the proposed installation, using temporary baffles and other means. Where submersible pumps are to be furnished with inlet nozzles and/or discharge elbows or adapters, the pumps shall be tested with these components fitted to the pumps. The specified performance requirements shall apply to the complete pumping assembly including any inlet nozzles, and discharge elbows or adapters. Certified test data shall include separate readings for inlet and discharge head for each data point.

c. Not less than eight test points shall be taken, including not less than three within ± eight percent (in terms of rated flow) of the rated condition (Condition Point A) and not less than two test points within ±4 percent of the pump's best efficiency point at the test speed. In addition, one test point shall be sufficient to define head and power requirements at shutoff head.

d. NPSH3 tests shall be performed in accordance with ANSI/HI 14.6, paragraph 14.6.8.5.2.1, Type 1 Test except that not less than 4 tests shall be performed at the test motor speed to completely cover the range of operating conditions specified in the detailed specification. One of the test points shall be at Best Efficiency (BEP) flow to confirm the test pump's suction specific speed. Translation of test results to specified operating conditions shall be in accordance with ANSI/HI 14.6, paragraph 14.6.6.1.1 so long as the exponent used can be supported by certified test data performed on a pump of the same type, size, speed and specific speed as that of the proposed pump. Test data justifying the exponent shall include NPSH3 tests at both the proposed and test speeds and shall include test points at BEP and at least three other points on the test pump head/capacity curve at least 15 percentage points removed from the BEP. The results of the NPSH3 tests shall be used to confirm the NPSH margins for each specified operating condition. NPSH3 tests for submersible wastewater pumps shall be performed using the method described in Figure 11.6.8 in ANSI/HI 11.6. All NPSH3 tests shall extend from 50 percent to 140 percent of Best Efficiency Flow at full speed, or to not less than 10 percent (in terms of flow) past the flow at Operating Condition B, whichever is greater. Failure to achieve specified performance or performance proposed in accepted submittal documents (capacity and head, efficiency or NPSH3), whichever is more restrictive, shall be cause for rejection. Acceptance tolerances shall be as set forth in Paragraph 1.06 Performance Guarantee.

e. All test procedures shall be in strict conformance with the referenced standards, except prediction of performance of a trimmed impeller from test data of the larger impeller will not be permitted. If trimming is required, the pump shall be retested. Under no circumstances shall deviations from specified operating conditions, though allowed by the referenced standards, result in overload of the driver furnished with the equipment, nor shall such deviations result in power requirements greater than the driver's nameplate (1.0 service factor) rating.

f. The Contractor shall furnish the Construction Manager with not less than four weeks' advance written notice of the date and place of the non-witnessed tests.

g. All test results, including test logs and generated curves, shall be certified correct by an officer of the pump manufacturer's corporation and shall be notarized. Contractor shall submit test results as Product Data.

1.7 QUALITY ASSURANCE – ADDITIONAL REQUIREMENTS

A. Scope:

1. In addition to the requirements under Paragraph 1.06 applicable to all pumps, the following are required for the subset of larger and custom engineered pumps defined in Paragraph 1.01 Scope Failure to meet these requirements will likely require remanufacture of the pumps or rework of one or more of the pump components to achieve the required and necessary pump stability characteristics. All costs associated with such remanufacture or rework and retesting shall be borne by the Contractor.
   a. All custom engineered pumps, and other pumps where required by the detailed specification, shall be subject to a witnessed factory performance, NPSH3 and pressure pulse tests in accordance with the provisions of this portion of the Specifications.
   b. The Contractor shall furnish the Construction Manager with not less than two weeks' advance written notice of the date and place of the witnessed tests.

B. Performance Testing:

1. Witnessed Tests:
   a. The Contractor shall furnish the Construction Manager with not less than four weeks' advance written notice of the date and place of the witnessed tests.
2. Performance Tests:
   a. Factory performance tests shall conform to the requirements of ANSI/HI 14.6, Acceptance Grade 1U. The factory tests shall include test data for each full speed performance requirement (Condition Points A and B specified in the detailed specification) and any other points stipulated for this test procedure in the detailed specification. These tests shall be conducted with the pump inlet throttled to provide the specified NPSHA or as otherwise detailed in the accepted test plan. Test data shall also include suction and discharge pressure pulse, shaft vibration and case noise at the full speed.
   b. The test setup in the manufacturer's test facility shall duplicate as closely as possible the inlet conditions in the proposed installation, using temporary baffles and other means. Where centrifugal pumps are furnished with inlet elbows, inlet adapters or inlet reducers, the pumps shall be tested with the elbow, adapter or reducer fitted to the pump and specified performance criteria shall apply to the complete pump assembly, including losses through any elbow, adapter or reducer. Where submersible pumps are to be furnished with inlet nozzles and/or discharge elbows or adapters, the pumps shall be tested with the inlet nozzles or adapters and the specified performance

requirements shall apply to the complete pumping assembly including any inlet nozzles, and discharge elbows or adapters. Under no circumstances shall NPSHA exceed that specified in the detailed specification during any performance test. Certified test data shall include separate readings for inlet and discharge head for each data point.

c. Not less than eight test points shall be taken, including not less than four within ±8 percent (on the basis of rated flow) of the rated condition (Condition Point A) and not less than two test points within ±4 percent of the pump's best efficiency point at the test speed. In addition, one test point shall be sufficient to define head and power requirements at shutoff head and one test point to define flow at Condition Point B.

3. NPSH3 Tests:

   a. NPSH3 tests shall also be performed to confirm the data used to establish NPSHA margin for each specified operating condition. NPSH3 tests for submersible wastewater pumps shall be performed using the method described in Figure 11.6.8 in ANSI/HI 11.6. All NPSH3 tests shall extend from 30 percent to 140 percent of Best Efficiency Flow at full speed, or to not less than 10 percent (in terms of flow) past the flow at Operating Condition B, whichever is greater. Failure to achieve guaranteed performance or performance proposed in accepted submittal documents, whichever is the more restrictive (capacity and head, efficiency or NPSH3) shall be cause for rejection. Tolerances and restrictions shall be as set forth in Paragraph 1.06 Non-Witnessed Tests, above, for non-witnessed tests.

4. Pressure Pulse Tests:

   a. Pressure pulse testing shall be performed on all dry pit centrifugal pumps provided under specifications containing the term 'Custom Engineered' in the specification section title or where specified in individual pump specification sections. Pressure pulse testing equipment shall include sufficient calibrated transducers to measure both static and dynamic pressures simultaneously at the pump discharge and suction; the latter if a centrifugal dry pit pump. The transducers shall be suitable for narrow band spectrum analysis and shall be mounted less than one pipe diameter away from the pipe wall, with suction and discharge gauge taps at acceptable mounting locations. Operating pressure capability of the sensors shall selected on the basis that the peak rating shall be less than four times the expected maximum pressure at the measurement location, with total accuracy (combined non-linearity, non-repeatability, and hysteresis as defined by IEC 61298-2) less than one percent of full scale. Sensors at pump inlets shall be capable of compound pressure output. Output from the sensors shall be recorded by vibration data acquisition equipment, with manual notation of either static or dynamic pressure being unacceptable. A frequency range from DC to 20 times the maximum operating speed of the pump shall be used for dynamic pressure measurements. A lower frequency range for static measurements may be used if desired. Pressure data shall be obtained from steady operating conditions

during testing, and for presentation purposes shall be the result of 16 full averages at the maximum frequency range. Static pressures must be corrected for elevation and velocity head.

b. Pressure pulse test procedures shall consist of operating the pump at full speed and manipulating the position of the discharge valve to record simultaneous flow, head, vibration and pressure pulse data beginning with the discharge valve positioned to achieve flow and head at Condition Point B and increasing head by 5 percent increments until the magnitude of the pressure pulses at the pump inlet and discharge increase by not less than 30 percent at which time the test run shall be terminated.

c. Reporting shall consist of description of the measurement system and must include both frequency and pressure range of the sensors. A National Institute of Standards of Technology-traceable calibration curve for each sensor, obtained in the last calendar year, shall be provided as part of the report appendix. Dynamic pressures shall be displayed in a spectral format, with any discrete peaks identified with harmonic order relative to pump speed and flow. Any significant non-integer dynamic pressure peak, defined as a peak with amplitude equal to or greater than 25% of the largest discrete peak, shall be marked in the spectrum and a source of the peak described and explained in the test report.

5. Model Tests:

a. Where allowed in the detailed specification or upon specific application with adequate justification by the manufacturer, confirmation of performance of large pumps may be demonstrated by testing the prototype at reduced speed or by testing a model of the prototype pump. NPSH3 tests shall also be performed to confirm the data used to establish NPSHA margin for each specified operating condition. Failure to achieve guaranteed performance (capacity and head, efficiency or NPSH3) shall be cause for rejection. Physical model testing shall be performed at qualified, commercial facilities, with at least 10 years of continuous operation. All tests shall be conducted in accordance with ANSI/HI 1.6 or 2.6. with the following restrictions:

1) If the prototype is tested at reduced speed the ratio of test speed to prototype speed shall not be less than 0.66:1.

2) Model test ratios shall not be less than 0.33:1, model to prototype.

3) Impellers for model tests shall be not less than 12 inches in diameter.

4) Impellers for prototype pumps shall be subject to a model-to-prototype profile comparison using templates ratioed from the impeller used for the completed and accepted model test. Impeller profiles shall be compared for the x, y and z planes. If model testing is proposed for any or all of the specified tests, the Contractor shall include the proposed methodology for profile confirmation as a part of the submittal material required under Paragraph 1.08. Impeller profile comparison shall be performed with a representative of the Construction Manager present. All costs associated

with travel and subsistence of the Construction Manager's representative shall be borne by the Contractor.

5) Acceptance criteria, based upon projected prototype performance from model test results using Hydraulic Institute approved affinity relationships, shall be as set forth above under Paragraph 1.06 Non-Witnessed Tests.
6) Restrictions set forth above for witnessed tests shall apply.

b. The Contractor shall furnish the Construction Manager with not less than two weeks' advance written notice of the date and place of the model tests.

6. Test Certification and Reporting:
   a. All test results, including test logs and generated curves, shall be certified correct by an officer of the pump manufacturer's corporation and shall be notarized. Contractor shall submit test results as Product Data.

7. and runs shall be repeated with different monitoring points to assure proper convergence.

1.8 SUBMITTALS

A. In addition to the material listed in the detailed specification, the following submittals shall be provided in accordance with Section 01 33 00:

1. Documentation of successful pump designs as specified under Paragraph 1.04 Proven Designs.
2. Certificate of Unit Responsibility attesting that the Contractor has assigned unit responsibility in accordance with the requirements of this section and Section 43 05 11-1.02 Unit Responsibility. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.
3. A copy of this specification section and the referencing section and all other applicable specification sections governing the pump, drive and driver, supports and specified appurtenances. The specification copies shall be complete with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check-marks (□) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

4. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
5. Documentation of certification in accordance with ISO 9001 as specified under Paragraph 1.06 Quality Certification.
6. Predicted pump performance curves for each condition point specified showing head, power, efficiency, and NPSH3 on the ordinate plotted against capacity (in mgd) on the abscissa. Curves for variable speed pumps shall be provided to demonstrate operation at all speeds required to achieve the specified reduced speed operating conditions. All curves shall clearly display the specified operating conditions and conformance with PACL limits, as specified in Paragraph 1.04 Pump Selection.
7. NPSH margin calculations performed for each specified operating condition.
8. Motor submittal information as specified in Sections 26 19 00 and 26 20 00. In addition, this information shall include certified calculations for motor rotor and frame reed frequencies, as specified under Paragraph 1.04 Electric Motors.
9. Complete description and sketch of proposed test setup for factory test if a factory test has been required under the detailed specification section or as required by the provisions of this Section. Submittal material shall include sample calculations and proposed test log format.
10. Drawings showing general dimensions and confirming the size of pumps, motors, drives and specified appurtenances; piping connections; construction details of equipment (including bearings and bearing isolators); wiring diagrams; and weight of equipment.
11. Variable-speed drive information as required under Section 26 19 23 if the equipment specified includes variable speed capability.
12. Driver unit support calculations and data if the driver is separately supported and if the analysis under the requirements of Paragraph 1.05 Rotor Critical Speed Analysis and System Design has been required by the terms of these specifications.
13. Shaft deflection calculations for volute type pumps: provide calculations to demonstrate compliance with Paragraph 1.04 Component Design Criteria, per the methodology set forth as required by Paragraph 1.05 Rotor Critical Speed Analysis and System Design.
14. Detail drawings of the pump and driver unit foundation demonstrating conformance to this Section and Section 43 05 13. Submittal shall include drawings depicting type, size, number, projection, and arrangement of anchor bolts, dimensional drawings of the sole and baseplates, dimensional drawings for the concrete supports for both the pump and motor, if applicable. Drawings shall

also depict all other pertinent information, including: location of equipment pads and reinforcement; equipment drains; expansion joint locations; elevation of top of grout and grout thickness; elevation of top of baseplate; soleplate; or mounting block; size and location of electrical conduits; and any other equipment mounting features embedded in equipment pads.

15. Limiting nozzle loading criteria, if different from that established by ANSI/HI 9.6.2.
16. The qualifications of the independent testing laboratory and individual personnel proposed by the Contractor to perform field vibration testing, analysis and reporting in accordance with the requirements of Paragraph 3.06.
17. The qualifications of the personnel proposed by the Contractor to perform field alignment procedures in accordance with the requirements of Paragraph 3.04.

B. The following are applicable for pumps meeting specified applicability criteria:

1. Qualifications of the design professional, and firm name, proposed to perform the mass elastic design analyses specified under Paragraph 1.05 Rotor Critical Speed Analysis and System Design if the subject analyses are required by the terms of these specifications.
2. Notarized certification attesting that the firm proposed to perform the mass elastic design analyses specified under Paragraph 1.05 Rotor Critical Speed Analysis and System Design has no contractual arrangements with the proposed pump manufacturer.
3. Descriptive material outlining the methodology and software to be used in the analyses required under Paragraph 1.05 Rotor Critical Speed Analysis and System Design.
4. "Executive Summary" report of the mass elastic design analyses for pumps as specified in Paragraph 1.05 Rotor Critical Speed Analysis and System Design.
5. The proposed instrumentation setup for the in-situ torsional vibration test specified under Paragraph 1.05 Rotor Critical Speed Analysis and System Design.
6. Model graphic outputs specified in Paragraph 1.07 Confirmation of Passage Geometry.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:

1. Where this section and sections referencing this section are silent with respect to materials of construction on any component, material selection shall follow the requirements of Table H.1, ANSI/API 610, Materials Class I-1, with the exception that shafts for all pumps shall be 12 percent chromium stainless steel. Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may

propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

B. Pumps:

1. Finish for Surfaces in Contact with Pumped Fluid:
   a. All pump components in contact with the pumped fluid shall conform to the following requirements.
   b. Surfaces to be machine-finished shall be indicated on the shop drawings by symbols which conform to ANSI B46.1, Surface Texture, Surface Roughness, Waviness and Lay. Machine surfaces shall be finished to at least the following tolerances (SI units):
      1) Nominal Roughness:

Surface	Grade, Ref: ANSI B46.1 (SI units)
General Machine Work	3.2 or better
Flange Faces	3.2
Journal Surfaces at Sleeve Bearings	0.4
Hydraulic Surfaces	
Impeller	4.5 or better
Impeller Bowl and Diffuser	3.2 or better
All other wetted surfaces	6.3 or better

   c. Flaws such as scratches, ridges, holes, peaks, cracks or checks which will make the part unsuitable will be cause for rejection. Machine finished surfaces shall be thoroughly cleaned and coated with protective layer of rust preventive. Small pieces, unassembled pipe or finished bolts, shall be oiled and wrapped with moisture resistant paper.
2. Materials:
   a. Unless otherwise specified, wetted cast iron parts for pumps for solids bearing liquid services shall have 2 to 3 percent nickel added to the cast iron.
   b. Stainless steel impellers shall be provided for the first stage of all custom engineered pumps, pumps intended for pumping screened or unscreened wastewater and elsewhere when specified. Stainless steel impellers shall be cast duplex stainless steel conforming to ASTM A995, Grades 2A, 3A, or 6A, with Charpy impact energies greater than 40 ft-lbs at -40°C per ASTM A923 method B.

c. Materials for all shaft sleeves for packed boxes, fretting seals and interstage seals shall conform to ANSI/API 610, Annex H; 12 percent chromium hardened; or hard-faced 316 austenitic stainless steel. Materials for seal glands for packed boxes and shaft sleeves shall be AISI 316 stainless steel. Fastener parts of all types in wetted areas shall conform to ANSI/API 610, Materials Class S-5 requirements. Regardless of the seal construction, all seal chambers shall be adequately sized to accommodate specified mechanical seals.

C. Flywheels:

1. Where flywheel assemblies are to be provided with the pumping equipment, pump pressure containing parts shall be of ductile iron conforming to ASTM A571. Materials of construction for the flywheels shall be as follows:

Frame:	Steel, ASTM A-36, welded and stress relieved.
Shaft:	Alloy Steel, ASTM A322, Grade 4142 HT, ST, BHN 375-388 for shafts 3.5 inches in diameter and less; Stainless steel, ASTM A564, Type 630 HT, Condition H1150 for shafts larger than 3.5 inches in diameter.
Rotor :	Steel, ASTM A36, or cast steel, ASTM A27 for flywheels 3 feet in diameter or less; Cast steel, ASTM A148 for flywheels greater in diameter than 3 feet. All stress relieved after machining.

2.2 GENERAL QUALITY

A. Details of manufacture and assembly of equipment furnished under this section and referencing sections shall follow the requirements of ANSI/API 610 with respect to the following features (paragraph references, ANSI/API 610):

1. Alignment aids (Paragraph 6.1.24).
2. Removal of rotating element (Paragraph 6.1.25).
3. Jackscrews for assistance in alignment on all baseplates and equipment supports (Paragraph 9.3.8.3.2).
4. Castings (Paragraph 6.12.2).

B. All components or subassemblies weighing 50 pounds or more shall have at least one lifting eye or a provision for threading in a lifting eye. Components 250 pounds or greater shall have lifting eyes or provisions for at least two lifting eyes. Components 1000 pounds or greater shall have at least 3 lifting eyes or provisions for inserting lifting eyes.

2.3 BASEPLATES AND SOLE PLATES

A. Unless otherwise noted in the detailed specification, all pumps shall be furnished by the pump manufacturer with baseplates or soleplates conforming to the requirements

of Section 43 05 13. Baseplates and sole plates shall be designed to be installed in the housekeeping curb shown and shall be machined flat and co-planar to within 0.002 inch per foot in all directions on the face mating with the pump and motor or driver support. Sole plates shall have the words "THIS SIDE DOWN" permanently affixed to the underside using welding rod material or stamped prior to milling. Alternative marking methods, using heavy scribing or machining, are acceptable provided that they may be observed following blasting in preparation for coating.

2.4 WEARING RINGS

A. Where specified, pumps shall be fitted with both stationary and rotating wearing rings. Except for the difference in hardness between stationary and rotating rings, wearing rings shall be of stainless steel and shall conform to the requirements of ANSI/API 610, paragraph 6.7 and material class S-8 (Table H.1, Annex H). Maximum wearing ring clearances shall not exceed 150 percent of the values stated in Table 6, ANSI/API 610. Minimum wearing ring hardness on the rotating ring shall be 350 Brinnel Hardness Number (BHN), with the stationary ring not less than 100 hardness points greater.

B. L-form wearing rings are not acceptable for wastewater, sewage, stormwater, thickener overflow, mixed sludge, digester circulation, digested sludge, waste activated sludge, return activated sludge or primary effluent pumping service.

2.5 BALANCE

A. Balancing for pumps with suction nozzle sizes 6 inches in diameter and greater and all associated components shall conform to the requirements set forth in ANSI/API 610, paragraph 6.9.4.1 (equivalent to ISO 1940 or ANSI 2.19 Grade 2.5), unless other portions of this project manual impose more restrictive requirements.

B. For separately balanced components, perform a residual unbalance inspection after rotor assembly per ANSI/API 610 requirements, as described in Annex J of that document. Provide copies of worksheets and demonstrate that tolerances are in compliance (i.e. rotor has passed) in addition to other reporting requirements of this paragraph.

C. All balance logs, certified correct and signed by an officer of the manufacturing corporation and notarized, shall be furnished as Product Data in accordance with Paragraph 2.10.

2.6 DRIVE UNIT SUPPORTS FOR SEPARATELY SUPPORTED MACHINES AND INTERMEDIATE SHAFT SUPPORTS

A. Supports for separately mounted vertical pump drivers and intermediate shaft bearings shall be composite structures of fabricated steel, ASTM A36. Unless otherwise specified, the supports shall be designed to span an opening in the floor sufficient to allow removal for the complete pump. Rolled steel beams shall be

provided to stiffen the support and a fabricated steel driver unit support pedestal shall be mounted on the support plate. The support pedestal top plate and all portions of the support plate assembly intended to join with surfaces in the installation structure shall be milled flat and parallel to 0.002 inches per foot. Pedestals shall be provided with access provisions to adjust or assemble/disassemble couplings. The support shall be designed to be supported on a sole plate or sole plates embedded in a house keeping pad at the edges of the floor opening or as indicated. Other details for the driver unit support shall be as indicated.

2.7 FLYWHEEL ASSEMBLIES

A. When a flywheel assembly is specified, the moment of inertia (WR^2) of the rotating element for each complete motor/pump set, including entrained water, pump rotor, shafting, couplings, and motor rotor shall be adjusted to provide the value specified in the detailed specification by providing a flywheel.

B. The flywheel shall consist of cast or fabricated steel weight in the form of a torus with supporting struts, keyed and locked on a shaft supported by bearings at each end of the shaft. Flywheels with diameters greater than three feet shall be double keyed to the shafts. If cast construction is used, the struts and weight shall be cast as a unit. The flywheel shall be designed and fabricated for a coefficient of fluctuation no larger than 0.05. A factor of safety of 5 shall be used for the ratio of operating speed to maximum safe operating speed. The lateral critical frequency of the flywheel assembly shall be shall be higher than the maximum safe operating speed by a factor of 1.5.

C. If the weight is to be fabricated steel, it shall be machined from a single billet to the diameter and shape required. All flywheels (cast and fabricated alike) shall be stress relieved before balancing. The size of the weight and the distance of the torus centroid from the center of the shaft shall be sufficient to achieve the overall rotating moment of inertia (WK^2) specified for the pump rotating system. Cantilevered designs employing only one set of bearings will not be permitted in stand-alone flywheel assemblies. Flywheels mounted on the motor shaft and using the bearings of a custom designed drive motor may be of the cantilever type. The flywheel assembly shall be included in the lateral, torsional and rotordynamic analyses specified under Paragraph 1.05 Rotor Critical Speed Analysis and System Design.

D. Bearings shall be selected in accordance with ABMA 9 or 11 for an L-10 life of not less than 100,000 hours. Input and output bearings shall be held in place by rigid fabricated steel struts. The entire rotating assembly shall be balanced in accordance with Paragraph 2.05. Bearing seals as specified in Paragraph 1.04 shall be provided for all flywheel assembly bearings.

E. The flywheel assembly shall be furnished with a fabricated steel enclosure designed to provide protection against accidental entry of tools or other objects and to provide enclosure protection in accordance with OSHA requirements. The flywheel enclosure

shall have an outside width of at least that of the motor, but not greater than 110 percent of the motor's width. The housing shall match the quality of the motor enclosure and shall be equipped with at least two lifting eyes. A mounting pad shall be located on the upper portion of the flywheel housing to permit installation of the vibration detector specified in Division 40 or the referencing section. The flywheel bearing housings shall be supported independently by a rigid frame to maintain alignment.

F. Where horizontal flywheels are required, the flywheel assembly shall be mounted on a baseplate common with the pump and motor. Frames for horizontally mounted flywheel assemblies shall be fitted with mounting pads for bolting to the pumping unit baseplate. Sufficient space shall be provided on each pad to permit dowelling to the baseplate after final alignment. End plates shall be similar to those provided for the motor and shall provide complete closure to prevent incidental access to the flywheel. The flywheel input shaft shall be direct connected to the motor output shaft by means of a flexible coupling, and the output shaft shall be designed to accommodate the shaft spacer coupling specified.

G. Where vertical flywheel assemblies are shown supporting the electric motor, the frame shall be designed to support the weight of the motor in accordance with the design requirements of this section. The flywheel assembly frame shall be extended to carry a support plate which shall be rabbeted to provide self-aligning features with the motor base. The frame extension shall have access openings to permit assembly/disassembly of the motor output shaft coupling. The lower flywheel assembly end plate shall be finished flat for mating with the support pedestal on the driver unit support, if so mounted..

H. Where vertical flywheel assemblies are mounted separately from the pump and motor, the lower end plate shall be finished flat. The input shaft shall be keyed for the specified flexible coupling and shaft guards shall be provided. Access opening shall be provided as specified herein for coupling assembly/disassembly.

2.8 MACHINING

A. All machined surfaces shall have a 90 micro inch Ra finish without any grooves, surface imperfections or machining marks of any sort. Mating surfaces shall be coplanar within a maximum of 0.001 inches. Surfaces that are in contact with a gasket such as flanges and casing joints shall have the customary concentric grooves pattern to increase leak path. Bearing housings and seals shall all have collinear centerlines within less than 0.001 inch total difference. Shafts shall have a 64 micro inch Ra finish.

2.9 PRODUCT DATA

A. The following information shall be provided in accordance with Section 01 33 00.

1. Performance guarantee as specified in Paragraph 1.06 Performance Confirmation.

2. Equipment anchor calculations specified in Paragraph 1.04 Component Design Criteria.
3. Operation and maintenance information specified in Section 01 78 23.
4. Motor Product Data as specified in Sections 26 19 00 and 26 20 00.
5. Bearing L-10 life calculations.
6. Critical speed calculations demonstrating compliance with Paragraph 1.05 Rotor Critical Speed Analysis and System Design shall be provided if a lateral rotordynamic analysis is required. Otherwise, critical speed calculations demonstrating compliance with Paragraph 1.04 Critical Speeds and Natural Frequencies shall be provided.
7. Nozzle loading information required under Paragraph 3.01.
8. Motor balance logs, certified and notarized as specified in Paragraph 1.04 Electric Motors.
9. Certified balance logs and worksheets, as specified in Paragraph 2.05.
10. Installation Certification Section 43 05 11-Form A as specified in Paragraph 3.01.
11. Training Certification Section 43 05 11-Form B as specified in Paragraph 3.08.
12. If factory tests are specified in the detail specification section, certification of satisfactory testing of each unit as specified. The certified material shall include copies of test logs and resulting performance curves. The results of pressure pulse tests shall also be included.
13. Documentation of field alignment data.

B. The following are applicable for pumps meeting specified applicability criteria:

1. "Final Report" of mass elastic systems analyses for pumps as specified in Paragraph 1.05 Rotor Critical Speed Analysis and System Design.
2. Results of motor rotor, frame and assembly bump tests, certified as specified under Paragraph 1.04 Electric Motors, along with the design professional's "Supplemental Report" as specified under Paragraph 1.05 Rotor Critical Speed Analysis and System Design.
3. Pump inlet well installation acceptance certification, as specified in Paragraph 3.03, if applicable.
4. Results of field vibration and pressure pulse tests as specified under Paragraph 3.06.

PART 3 EXECUTION

3.1 GENERAL

A. With the exception of submersible pumps, all pump inlet and discharge nozzles shall be connected to field piping using equipment connection fittings as shown and specified. Restraining rods on equipment connection fittings shall be designed specifically to restrain the unbalanced hydraulic thrust developed by the pump when

operating at full speed against a closed valve. All restraining rod nuts shall be torqued to assure that any moment or shear transmitted to the pump nozzles is within the values permitted under ANSI/HI 9.6.2 or that permitted by the equipment manufacturer, whichever is greatest. Where ANSI/HI 9.6.2 is silent with respect to any particular aspect of allowable nozzle loads, the Contractor shall follow the written requirements provided by the equipment manufacturer. All pumps furnished under specification sections containing the words 'Custom Engineered' in the title shall be installed under the presence of a factory authorized installation specialist or specialists. Under no circumstances shall any installation procedures take place without the installation specialists present. Equipment installation procedures shall conform to the requirements of Section 43 05 13. Upon completion of installation work, the Contractor shall submit a complete, properly signed certification Form 43 05 11-A.

3.2 SOLE PLATES

A. Sole plates, if provided pursuant to this section, or any section referencing this section, or where required by the equipment manufacturer's recommendation, shall be leveled in the presence of a factory authorized installation specialist to a maximum tolerance of 0.002 inches/foot in all directions. Where the equipment manufacturer requires more stringent tolerances, those tolerances shall prevail.

3.3 ALIGNMENT

A. Journeymen millwrights shall perform alignment of equipment furnished under this section and any referencing section. Carpenters, laborers or any other trades are specifically excluded from performing this work. In locations where such trades are not available, the Contractor shall retain the services of a firm specializing in this type of work to perform the setting and alignment work. The Contractor shall submit the qualifications of the proposed firm to the Construction Manager for acceptance prior to performing the work. The Construction Manager shall personally witness final alignment procedures for each item of equipment as a condition precedent to beginning any field testing work. Alignment techniques shall conform to the requirements of Section 43 20 05.

3.4 FIELD TESTING

A. Field testing shall conform to the requirements of Section 01 91 14. For all pumps furnished under specification sections containing the words 'Custom Engineered' in the title , the testing procedure shall be a plan developed jointly by the Contractor and the equipment manufacturer to demonstrate performance of each item of equipment at all specified operating conditions.

B. Field testing may include vibration and torsional vibration testing, as applicable.

3.5 FIELD VIBRATION AND PRESSURE PULSE TESTS

A. Qualifications:

1. The Contractor shall retain the services of an independent testing laboratory to conduct the testing work specified under this paragraph. The work shall be directed by a professional mechanical engineer, registered to practice in any one of the 50 states making up the United States of America. The engineer (hereinafter termed "professional vibration analysis specialist") shall be a graduate of a college holding ABET accreditation in mechanical engineering and shall have been engaged in the practice of providing the type of monitoring services required under this paragraph for rotating machinery. The professional vibration analyst's qualifications and references, certified and notarized, shall be submitted for review and acceptance by the Construction Manager not less than 6 weeks prior to the date scheduled for the field vibration test work specified herein. The Construction Manager shall review the required documentation and references and indicate acceptance or rejection of the proposed analyst's qualifications within 14 days of submission. If the analyst proposed by the Contractor is rejected, the Contractor shall propose an alternative choice with appropriate documentation.
2. The independent testing laboratory's testing team (comprised of the professional vibration analysis specialist and any technicians required to complete the specified tasks) shall be fully equipped to provide continuous pressure, velocity and displacement values for all rotating equipment installed under the requirements of this section. Vibration testing equipment shall include sufficient calibrated pressure and flow monitoring devices to determine pump operating conditions as well as vibration levels. Pressure pulse tests shall be conducted on all pumps where the words "Custom Engineered" appear in the specification title or where specified in the individual pump specification sections.

B. Vibration Tests:

1. RMS vibration velocity on any component when the pump is operating at any specified continuous duty operating condition shall not exceed the limits established for the appropriate machine by HI 9.6.4. Field vibration for custom engineered vertical pumps and motors shall not exceed 2.5 mils peak to peak RMS when the pump is operated at any capacity condition within 85 percent and 115 percent of the pump's Best Efficiency Point capacity at full speed, when measured at the top of the pump motor. When operating at any combination of conditions outside the PACL for any pump, regardless of type, limiting values shall be 25 percent greater than the above limits.

2. Vibration test reports shall be submitted as Product Data, directly to the Construction Manager, and shall bear the signature of the responsible professional vibration analysis specialist. Vibration spectra shall be of sufficient resolution for legibility of magnitude and frequency data to be properly reviewed by the Construction Manager. Cascade diagrams are not sufficient for variable speed drive application unless supported by the required data in a format suitable for more detailed analyses. Separate spectra shall be provided at the maximum and minimum operating speeds and any potential resonant frequencies.

C. Pressure Pulse Tests:

1. Pressure pulse testing shall be performed on all dry pit centrifugal pumps provided under specifications containing the term 'Custom Engineered' in the specification section title or where specified in individual pump specification sections. Pressure pulse testing equipment shall include sufficient calibrated transducers to measure both static and dynamic pressures simultaneously at the pump discharge and suction; the latter if a centrifugal pump. The transducers shall be suitable for narrow band spectrum analysis and shall be mounted less than one pipe diameter away from the pipe wall, with suction and discharge gauge taps at acceptable mounting locations. Operating pressure capability of the sensors shall selected on the basis that the peak rating shall be less than four times the expected maximum pressure at the measurement location, with total accuracy (combined non-linearity, non-repeatability, and hysteresis as defined by IEC 61298-2) less than one percent of full scale. Sensors at pump inlets shall be capable of compound pressure output. Output from the sensors shall be recorded by vibration data acquisition equipment, with manual notation of either static or dynamic pressure unacceptable. A frequency range from DC to 20 times the maximum operating speed of the pump shall be used for dynamic pressure measurements. A lower frequency range for static measurements may be used if desired. Pressure data shall be obtained from steady operating conditions during testing, and for presentation purposes shall be the result of 16 full averages at the maximum frequency range. Static pressures must be corrected for elevation and velocity head.
2. Pressure pulse test procedures shall consist of operating the pump at the speed required to meet each individual specified operating condition and manipulating the position of the discharge valve to record simultaneous flow, head, vibration and pressure pulse data beginning with a wide open discharge valve at full speed and increasing head by 5 percent increments until the magnitude of the pressure pulses at the pump inlet and discharge increase by not less than 30 percent at which time the test run for that speed shall be terminated. This procedure shall be repeated for each of the operating speeds required for each specified operating condition.
3. Reporting shall consist of description of the measurement system and must include both frequency and pressure range of the sensors. A National Institute of Standards of Technology-traceable calibration curve for each sensor, obtained in

the last calendar year, shall be provided as part of the report appendix. Dynamic pressures shall be displayed in a spectral format, with any discrete peaks identified with harmonic order relative to pump speed and flow. Any significant non-integer dynamic pressure peak, defined as a peak with amplitude equal to or greater than 25% of the largest discrete peak, shall be marked in the spectrum and a source postulated in the discussion of the data.

3.6 FIELD TORSIONAL VIBRATION TESTING

A. Where required by these specifications, field torsional vibration tests shall be performed under the direct supervision of the design professional responsible for the mass elastic system design on an installed pumping unit. The Contractor shall submit the qualifications and experience of this design professional to the engineer for review and approval.

3.7 TRAINING

A. Training shall conform to the requirements of Section 01 79 00 and shall include separate training sessions for each operator shift maintained by the Owner and a separate session for maintenance personnel. The training session for maintenance personnel shall include a comprehensive presentation, employing cut-away models or comparable graphics, and documentation on the step-by-step disassembly and subsequent reassembly of a pumping unit. Upon completion of all training requirements, the Contractor shall submit certified Form 43 05 11-B.

END OF SECTION

SECTION 43 23 15
CUSTOM ENGINEERED TWO-STAGE VERTICAL NON-CLOG, VARIABLE SPEED PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section specifies vertical two stage, motor driven variable-speed non-clog centrifugal Pumping Units for pumping fluids containing screened municipal and industrial wastewater solids. Each Pumping Unit shall consist of paired identical pumps, with each pump motor and flywheel driven by a common variable frequency drive. The first stage pump shall be comprised of an inlet elbow, pump, intermediate shafting and couplings, electric motor and flywheel, motor support frame, all furnished by the pump manufacturer. The first stage pump motor and flywheel shall be mounted on a removable steel frame which, in turn, will be supported on concrete housekeeping bases cast in the floor above in the pump room. The pumps and motor and flywheel support frames shall be grouted in place and anchored in accordance with the requirements of these specifications and details. The motor and flywheel assembly shall be aligned and dowelled in place on the motor and flywheel support frame in accordance with the requirements of these specifications.

   The second stage pump will be fitted with a concentric reducer, a fabricated steel motor and flywheel support which shall straddle the second stage pump and be supported by the pump room floor. The second stage pump motor and flywheel shall be direct connected to the pump through intermediate couplings, all furnished by the pump manufacturer. The motor and flywheel assembly shall be aligned and dowelled in place on the motor and flywheel support frame in accordance with the requirements of these specifications.

   The pump manufacturer shall also furnish the variable speed drive controller, and all specified appurtenances and spare parts.

   The pump manufacturer shall be responsible for providing the Turbo Free elbow on the suction of the first stage pump and inter stage piping from the discharge of the first stage pump to the suction of the second stage pump. Since the turbo free elbow may be proprietary to a pump manufacturer, other pump manufacturers that meet the qualifications and requirements of the project specifications can submit alternate design for engineer's review and approval. However, all costs associated for any redesign, and any additional

cost impacts on the project as a result of this alternate design shall be fully paid for by the pump manufacturer submitting the alternate design.

The first stage pump shall include a shaft removal system to remove the intermediate shaft without removing the pump, flywheel, or motor to allow for pump maintenance.

Due to size and the difficulty for removing the motor, the second stage pump shall include a pump removal system to allow for maintenance on the pump without removing the motor pedestal, flywheel, or motor. The pump manufacturer will submit to the engineer for review and approval of this pump removal system.

Equipment furnished under this section shall conform to the requirements of this section and to the requirements set forth in Section 43 23 03. All components specified herein shall be furnished as complete compatible assemblies by the pump manufacturer.

In operation, both pumps consisting of a functional pair as a Pumping Unit will start, operate at variable speed, responding to commands from the station wet well control system and shut down simultaneously. Under no circumstances will the individual pumps making up each functional pair be required to operate independently of the other.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers' Association (ABMA):
   a. 9, Load Ratings and Fatigue Life for Ball Bearings.
   b. 11, Load Rating and Fatigue Life for Roller Bearings.
2. American Society of Mechanical Engineers (ASME):
   a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   b. B106.1, Design of Transmission Shafting.
3. ASTM International (ASTM): A48/A48M, Standard Specification for Gray Iron Castings.
4. Hydraulic Institute Standards (HIS):
   a. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
   b. 11.6, Rotodynamic Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests.

5. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
6. Occupational Safety and Health Administration (OSHA).
7. ISO 1940 Balance Quality Requirements of Rigid Rotors.
8. See additional references in Section 43 23 03.

1.3 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.4 QUALITY ASSURANCE

A. Unit Responsibility:

1. The Contractor shall assign unit responsibility, as specified in Section 43 05 11-1.02 Unit Responsibility, to the manufacturer of the Custom Engineered Vertical Variable Speed Non-clog Variable Speed Centrifugal Pumps Paired as Two Stage Pumping Units provided under this section. This manufacturer is the unit responsibility manufacturer and has unit responsibility, as specified in Section 43 05 11-1.02 Unit Responsibility, for both the equipment assembly specified in this section and for the Adjustable Frequency Drive specified in Section 26 19 23, and all other equipment assembly components specified elsewhere but referenced in this section. A completed, signed, and notarized Certificate of Unit Responsibility shall be provided.
2. The equipment shall be protected during shipment and storage as specified in Section 01 61 00.

1.5 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Make, model, weight, and horsepower of each pump assembly.
    b. Complete pump and motor catalog information, descriptive literature, specifications, and identification of materials of construction.
    c. Plan and section dimensional outline drawings of the pumps and motors identifying all components, anchor bolts, external connections, and appurtenances.
        1) Include all components identified with quantity, part name and corresponding materials of construction complete with ASTM designation on sectional drawings.

d. Performance data curves showing head, capacity, horsepower demand, net positive suction head required (NPSH3), and pump efficiency over entire operating range of pump, from shutoff to maximum capacity.
   1) Include the pump's preferred operating range (POR) and the manufacturer's defined maximum allowable operating range (AOR) for continuous steady state service on performance curves.
   2) Indicate separately head, capacity, horsepower demand, NPSH3, and overall efficiency required at the AOR's minimum and maximum continuous stable flow conditions and at the Rated Conditions and at Secondary Conditions (if applicable).
e. For variable speed motors, provide performance data curves for 50, 60, 70, 80, and 90 percent of nominal speed.
f. Certified detail structural, mechanical, electrical drawings showing equipment dimensions, arrangement, assembly, including locations and type of connections and weights of major equipment and components.
g. Lateral and torsional critical speed analysis.
h. Structural response frequency analysis.
i. Detail extension shaft drawings with dimensional information, materials of construction, and complete certified torsional analyses and lateral critical calculations of the complete drive train assembly.
j. Power and control wiring diagrams, including terminals and numbers.
k. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
l. Factory finish system.
m. Bearing life calculation confirming compliance with L10 bearing life requirement.
n. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's design analyst qualifications.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's printed installation instructions.

5. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements that factory finish system is identical to requirements specified herein.
6. Factory Functional, Performance Test Reports, and Log.
7. Field, Vibration, Performance Test Reports, and Log.
8. Extension shaft alignment report.
9. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
10. Suggested spare parts list to maintain equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
11. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
12. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
13. Submittals shall conform to the requirements of Section 43 23 03. Sections to be marked-up and submitted in accordance with Section 43 23 03 requirements include:
    a. This Section.
    b. Section 43 05 11 – General Requirements for Equipment.
    c. Section 43 05 13 – Rigid Equipment Mounts.
    d. Section 43 20 05 – Machine Alignment.
    e. Section 43 23 03 – General Requirements for Centrifugal and Axial Flow Pumping Equipment.
    f. Section 26 19 23 – Medium Voltage Adjustable Frequency Drive System.

1.6 EXTRA MATERIALS

A. Furnish for each of the five (5) sets of pumps:

1. Complete set(s) bearings, for 5 pumps.
2. Complete set(s) gaskets and O-ring seals, for 5 pumps.
3. Complete set(s) of shaft sleeves, for 5 pumps.
4. Complete set(s) keys, dowels, pins, etc., for 5 pumps.
5. Complete mechanical seal(s), for 5 pumps.
6. Impeller and lock screw kit, for 5 pumps.
7. Impeller shaft, for 5 pumps.
8. Casing wear rings, for 5 pumps.
9. One complete set of any special tools required to dismantle pump.
10. Spare parts for the variable-speed, adjustable frequency drive shall be as specified in Section 26 19 23. Spare parts shall be tagged and stored as specified in Section 43 05 11-2.12.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide a complete, coordinated, and fully functional operating system.

B. Coordinate pump requirements with motor manufacturer and be responsible for pump and motor requirements, including pump base, elbow, flywheel, intermediate shaft, motor and drive (VFD).

C. Where adjustable speed drives are required, furnish a coordinated operating system complete with pump, motor, and adjustable speed controller. See Section 26 19 23, Medium Voltage Adjustable Frequency Drive System.

D. Pumps supplied under this section shall be a standard product of manufacturer and to have proven reliability.

E. Provide a complete lateral and torsional critical speed analysis of each pump-coupling-motor rotating assembly including extension shaft assembly, and structural analysis of complete pump and motor assembly performed by a qualified third party; Dynatech, Mechanical Solutions and Engineering Dynamics, NBE or approved equal.

1. Analyst Qualifications: Experienced in performing analyses for pump and motor units of comparable size and complexity.
2. Prepare a written report for each completed analysis documenting analysis and calculation procedures.
3. Submit results of each analysis for review and acceptance prior to pump and motor fabrication.
4. Critical speed analysis shall meet the requirements of Section 43 23 03.

F. Rotor Lateral Analysis:

1. Identify lateral critical speeds for both pump and motor shafts and extension shaft assembly.
2. Include both dry and wet impeller cases.
3. Provide a Campbell Diagram demonstrating that a critical speed does not occur below 1.25 times the maximum rated speed of the pump and motor and does not occur between 0.75 times the blade pass frequency associated with the minimum operating speed of the pump and 1.25 times the blade pass frequency associated with the maximum specified speed of the pump.
4. Calculate the damped vibration response to unbalance for the shafts and compare to applicable specified requirements to verify acceptable vibration amplitudes.

G. Torsional Analysis:

1. Calculate system torsional natural frequencies, corresponding mode shapes, and steady-state and transient torsional response.
2. Include extension shaft assembly in analysis.
3. Provide an interference diagram demonstrating compliance with API 610.
4. Forced Response Analysis:
    a. Perform a forced response analysis for all critical speeds determined to occur below 1.20 times the maximum rated operating speed.
    b. Expected excitation frequencies for steady-state operation include as a minimum, but not limited to, electrical line frequency, two times electrical line frequency, current modulating frequencies produced by the variable frequency drive, mechanical running speed (one times shaft speed), two times mechanical running speed (two times shaft speed), and blade pass frequency.
    c. Confirm that calculated steady-state and transient dynamic torsional shaft stresses and coupling torques are below allowable levels, such that the motor shaft, pump shaft, and associated drive train components are capable of an unlimited number of startup and shutdown cycles associated with 0 rpm up to the maximum rated speed.
    d. Determine allowable stresses (endurance limits) for the pump and motor shafts in accordance with ASME B106.1 (Design of Transmission Shafting) or MIL STD 167, whichever is lower.
    e. Include a factor of safety of at least two in the allowable stress levels and demonstrate stresses on a Modified Goodman Diagram.
    f. Confirm that dynamic torque in the couplings is in accordance with coupling manufacturer's requirements.

H. Structural Response Frequency Analysis:

1. Perform a structural response frequency analysis for the pump and motor assembly.
2. At a minimum, model the motor, pump, and fabricated support, including any other critical components based upon mounting details shown on Drawings.
3. Confirm that the minimum structural natural frequency of the complete pump and motor assembly is a minimum of 1.25 times the maximum rated pump and motor speed, and does not occur between 0.75 times the blade pass frequency associated with the minimum speed of the pump and 1.25 times the blade pass frequency associated with the maximum specified speed of the pump.

4. Verification of calculated natural frequencies of the pump and motor assembly shall be performed by pump manufacturer's selected third party analyst under 2.01E above, when unit is fully installed at the Project Site.

2.2 PERFORMANCE

A. The pumping equipment shall be suitable for pumping raw sewage and passing a 4.0" diameter sphere.

B. Pumps shall be vertical centrifugal, non-clog sewage pumps, complete with variable frequency driven motors, specifically designed, constructed, and installed for pumping raw sewage. Pumps shall comply with all conditions listed in the following table:

Design Conditions Location/I.D.	**Pumps P-01 through P-10**
Drive Type	Variable Speed
No. Required	5 pumping units with 2 pumps per unit
Design Point (full speed) [1,6] Condition A	
Capacity for One Pumping Unit (gpm)	6,549
Total Head (ft)	494
Min Bowl Eff (%)	79
Design Point (full speed)[2,6] Condition B	
Capacity for One Pumping Unit (gpm)	7300
Total Head (ft)	475
Min Bowl Eff (%)	80%
Third Design Point (full speed)[3,6] Condition C	
Capacity for One Pumping Unit (gpm)	9600
Total Head (ft)	409
Min Bowl Eff (%)	78
NPSH3 @ Cond C, 1190 rpm (ft)	30
Reduced Speed Design Point[4,6] Condition D	
Capacity for One Pumping Unit (gpm)	8000
Total Head (ft)	400

Design Conditions Location/I.D.	**Pumps P-01 through P-10**
Speed (rpm) (approximate)	1130
Reduced Speed Design Point (6) Condition E	
Capacity for One Pumping Unit (gpm)	5500
Total Head (ft)	390
Speed (rpm)	1047
Max Shutoff head – full speed (ft)	610
Min Shutoff head – full speed (ft)	580
Maximum Brake Horsepower (each motor)	750
Number of Motors per Pumping Unit	2
Max Oper. Speed (rpm)	1190
Min Discharge Nozzle Size/Class	14"/250-lb
Min Suction Nozzle Size/Class	16"/250-lb
Motor Voltage	4160 V
Nominal Motor Horsepower	750 Hp
Winding Temperature Device(5)	2 RTDs per winding phase
Bearing Temperature Device	1 RTD for pump bearing/1RTD for motor bearing
Vibration Switch	Yes

(1) Condition A shall be taken as the rated, continuous-duty operating condition for each pumping unit ("pumping unit" consists of two pumps connected in series, operating as a single unit). Performance at the rated condition shall be guaranteed in accordance with Section 43 23 03. Condition A has been selected to obtain the rated pumping capacity for the installation with 4 pumping units operating in parallel, discharging to the pumping station's discharge system against expected maximum system head. It is not intended that the pumps be selected for maximum efficiency at Condition A. Pumping units furnished under this section shall be selected to achieve Condition A performance, and shall operate continuously without objectionable vibration or cavitation at the head specified under Condition A. Condition A shall reside within the pumps' POR.

(2) Condition B head is presented to indicate operating conditions when four pumping units are operating in parallel operating at maximum speed against minimum anticipated system head, assuming a hypothetical head-capacity curve. Condition B shall not be used for pump selection. Pumping units with head-capacity curves steeper than that assumed for the purposes of identifying Condition B will produce somewhat less flow at somewhat lower head and vice versa for pumps with flatter

pump head-capacity curves. Condition B represents the minimum anticipated total head with 4 pumping units operating at full speed and delivering to the discharge system. Condition B shall reside in the selected pumps' POR. Proposed pump selections meeting this discharge head requirement by operating the equipment at less than full speed will be rejected.

(3) Condition C is the anticipated continuous duty maximum speed condition when one pumping unit is in service. Pumps furnished under this specification shall be capable of sustained (24 hours per day) operation at this condition within the requirements set forth in Section 43 23 03. Condition C shall reside in the selected pump's AOR.

(4) Condition D represents the expected momentary (startup/shutdown) condition. Pumps furnished under this specification will operate for no more than 5 seconds at this condition when initiating or terminating a service cycle. The maximum anticipated number of service cycles is 12 per day.

(5) See Electrical Drawings and Specifications

(6) Total head in the above tabulation is the algebraic difference between the discharge head and suction head as defined in ANSI/HI 1.1 through 1.6. Net positive suction head available (NPSHA) in the above tabulation is referred to the pump discharge piping at centerline elevation (project datum) as shown and is calculated in accordance with ANSI/HI 1.3 for average barometric pressure and maximum temperature conditions. NPSHA at the pump impeller eye can be determined by adjusting the given value by proposed pump dimensions and the indicated requirements for pump installation details. An allowance of five feet has been included for the presence of volatile constituents in the pumped fluid. Required NPSHA margin shall be as specified in Section 43 23 03. Total head is the head developed by the 2-stage pumping unit.

(7) Maximum expected surge pressure is 300 psig.

C. Pumping system vibration shall not exceed the acceptable field vibration limits given in the standards of the Hydraulic Institute.

D. The pump head capacity curve shall be sloped in one continuous curve with no points of reverse slope inflection capable of causing hunting at the pump operational speed.

E. All pump components shall be designed to safely withstand forces resulting from flow reversals, up to 125 percent of maximum speed, during shutdowns caused by power failures and/or motor or drive failures.

F. All pumps shall have a motor with sufficient horsepower to run the pump over the entire pump curve at full speed without overloading the motor and without use of the motor service factor.

G. The pumps will be started and stopped with a closed discharge valve. Upon starting, the pumping unit will be required to accelerate approximately 2,000 tons of liquid in the force main system.

H. Owing to the nature of this application, the wet well conforms to the Hydraulic Institute definition of a confined trench type wet well. Since physical constraints prevent the use of a self-cleaning trench type wet well and the presence of a screening facility will limit the size of solid material entering the wet well for the Morena Pumping Station, the station wet well level control system will automatically rotate the sequence of lead/follow, 2nd follow and 3rd follow units on a daily basis to limit the accumulation of solids in the wet well trench.

2.3 EQUIPMENT

A. Pump:

1. Each pump shall be of the vertical dry pit, bottom suction volute casing, enclosed impeller non-clog or non-clog mixed-flow volute type. The pumps shall be designed so that the impeller, back head, frame, and pump shaft can be removed as a complete unit without disturbing the connecting piping or casing, the first stage pump and motor/flywheel assembly shall be each be supported on separate bases mounted on separate floors. The second stage pump and motor/flywheel assembly shall be supported on separate bases mounted on the same floor.
2. Heavy-duty, solids handling, non-clog, dry pit design.
3. Configuration: See Supplements.
4. See Drawings for pump orientation and rotation.
5. Continuously rising head-capacity curve from runout to shutoff.
6. Designed to operate continuously at any point on specified operating range of performance curve without cavitation, overheating, or excessive vibration.
7. Motor nameplate horsepower rating not to be exceeded by pump brake horsepower required at any point on nominal pump performance curve.
8. Each pump should be capable of passing a minimum solids sphere of 4-inches.

9. Equipment List:

Item	Equipment No.
First Stage, Pumping Unit 1	P-01
Second Stage, Pumping Unit 1	P-02
First Stage, Pumping Unit 2	P-03
Second Stage, Pumping Unit 2	P-04
First Stage, Pumping Unit 3	P-05
Second Stage, Pumping Unit 3	P-06
First Stage, Pumping Unit 4	P-07
Second stage, Pumping Unit 4	P-08
First Stage, Pumping Unit 5	P-09
Second Stage, Pumping Unit 5	P-10

B. Casing:

1. Back pullout design allowing for removal of rotating element without disturbing piping connections.
2. Heavy wall, ductile iron, A-395, Gr. 65-42-12, one-piece volute construction with integral flanged discharge flange and smooth fluid passages. Casing shall have a nominal thickness of 7/8 of an inch. Provide drilled and tapped volute priming and drain connections.
3. Provide handhole for cleanout purposes at volute centerline located to provide access to interior of pump.
4. Flanges:
   a. Conform to ASME B16.1, Class 250-pound, flat face standard.
   b. Provide 1/2-inch gauge connection drilled and tapped in discharge flange.
5. Diffusion vanes or stationary guides are not allowed.
6. Each volute casing shall be of one-piece construction and shall be designed to permit the removal of all rotating internal parts without disturbing the suction and discharge piping connections. The discharge nozzle shall have a 1-inch minimum drain with a valve, and a minimum 1/2-inch tap for gage connection. The casing shall be designed for support on individual concrete piers extending from the floor elevation indicated to the underside of the casing. The casing shall include 4 cast

in feet that will mount to a fabricated pump base. Sole plates or adjusting blocks conforming to the requirements of Section 43 05 13 shall be provided to mate with pump base. The design of the support system shall provide convenient access to the inlet elbow gage taps, drain valve, and hand hole cover. A hand hole (6-inch minimum) with cover shall be provided on the discharge nozzle. The inner contours of the hand hole cover shall match the contours of the waterway. The hand hole cover shall be fitted with a lifting eye. Casing shall be provided with 1/2-inch minimum vent with a valve fitted to the top of the discharge nozzle.

C. Suction Cover (Front Head):

1. Single-piece construction designed to provide even flow to impeller eye.
2. Flanged connection conforming to ASME B16.1, Class 250-pound, flat face standard.
3. Material: ductile iron A 395, Gr.65-45-12.
4. Machine register fitted to casing.

D. Suction Elbow – First Stage Pump:

1. The first stage pump shall have a turbo free suction elbow.
2. ASME B16.1, Class 250-pound flat face standard, flanged suction elbow with contoured handhole cleanout and cover.
3. Suction flange shall be 24-inches and discharge flange shall be 16-inches.
4. Provide 1/2-inch gauge connection.
5. Material: ductile iron, A 395, Gr. 65-45-12.
6. General: The pump shall be furnished with suction cover and a turbo free elbow cast separately from each other. The arrangement provided shall be sufficient to characterize the incoming flow to provide uniform approach velocities in the entering flow at the leading edges of the impeller vanes.

   A handhole (minimum 6-inch diameter) with a bolted cover shall be provided in the inlet piece or elbow. Handhole inner contours shall match the contours of the inlet piece. The handhole cover shall be fitted with a lifting eye. A 1-inch-diameter drain with a valve shall be provided in the inlet piece.

E. Stuffing Box Cover (Back Head):

1. Single-piece construction designed with integral stuffing box suitable for use of mechanical seal.

2. Machine register fitted to casing.
3. Material: ductile iron, A395, Gr. 65-45-12cast iron conforming to ASTM A48 CL30
4. The back head shall be drilled and tapped for the installation of 3/8-inch seal flushing water connections and a 3/4-inch flushing water drain. Drain location and back-head design shall assure the continuous and complete removal of excess flushing water. The design of the back head shall be such that there shall be no standing pools of water so that shaft seal leakage drains readily to the back Head drain.

F. Bearing Frame and Bearings:

1. Removable, single-piece construction.
2. Machined for accurate bearing alignment and completely enclosing shaft between bearings.
3. Provide with retainer covers on inboard and outboard ends of frame equipped with lip-type grease seals to prevent entrance of contaminants.
4. Single or double row bearings at inboard and outboard ends designed to take radial, weight, and thrust loads of pump and associated shafting loads. Bearings to be designed for an L10 life per ABMA with minimum of 100,000 hours at any point in the POR.
5. Provide jacking screws for adjustment of impeller.
6. Grease packed at factory and provided with grease fittings for bearing lubrication.
7. The bearing support frame shall be rigidly bolted to the pump casing. Each frame shall be provided with three struts to distribute loads from the radial and thrust bearings into the casing. Cantilevered bearing frame designs will not be acceptable. The frame shall be designed to carry both radial and thrust bearings. Large openings shall be provided adjacent to the shaft seal area. The frame shall be designed for captured bearing positioning and shall not require any field axial adjustment. The frame shall be capable of running submerged.

G. Impeller:

1. Single-piece construction.
2. Wear ring securely fastened to impeller with recessed stainless steel screws. Impeller wear ring to be a minimum of 50 Brinell softer than suction head wear ring.
3. Impeller back vanes not allowed.
4. Wear rings shall meet requirements of Section 43 23 03.
5. Impellers shall be duplex cast stainless steel (refer to Section 43 23 03) single-stage, single-suction, three vanes, enclosed non-clog or non-clog

mixed-flow type, designed to pass solids sizes as specified and stringy material. The impeller shall be keyed to the shaft and held firmly in place by a stainless steel threaded nut. The method of attaching the impeller to the shaft shall be such that the impeller cannot unscrew or loosen by torque from either forward or reverse direction. The finished impeller with its wearing ring attached shall be statically and dynamically balanced.

6. To reduce deflection for the shaft, the impeller hub shall extend through the stuffing box. The shaft sleeve shall be provided on the exterior or the hub.

H. Pump Shaft:

1. 17-4-PH stainless steel, accurately machined over entire length and precision ground at bearing locations.
2. Designed to transmit full motor horsepower with a liberal safety factor to carry maximum loads imposed and to meet pump vibration requirements.
3. Provide keyways at both ends.
4. Provide renewable, hooked shaft sleeve positively secured to shaft to prevent leakage.
5. Minimum shaft diameters shall be as follows:
   a. At impeller: 4.175 in.
   b. Between Bearings: 6.75 in.
   c. At coupling: 2.785 in.

I. Mechanical Seal

1. Pumps shall be furnished with mechanical seals. Mechanical seals shall not require a wearing sleeve for the shaft, and shall be as specified in Section 43 05 11-2.04. There shall be no reduction in shaft size through the seal area. Provide silicon carbide seal, Type CURC manufactured by AES, or approved equal. Meet requirements of Section 43 05 11.

J. Pump Base:

1. Fabricated carbon steel, rugged, heavy duty, with ample strength for support of entire pump and imposed static and operational loads.

K. Coupling – Second Stage Pump:

1. Designed to provide flexible connection between pump and motor.
2. Flexible coupling to be designed to carry maximum horsepower of motor, including service factor, and additional forces imposed by rotating assembly.

3. Flexible coupling selection to take into account torsional analysis of complete pump and motor drive system.
4. Coupling shall be spacer type to allow for removal of the second stage pump without removing the motor support.
5. Provide fabricated coupling guard to comply with OSHA safety standards.

L. Flywheel and Motor Support:

1. Scope: The pump manufacturer shall engage the professional services of a registered structural engineer licensed to practice structural engineering s in the State of California to design and supervise the construction and installation of the components needed to provide rigid support frames for the first and second stage flywheel assemblies. The frames shall be designed to support the weight of the motor/flywheel assembly and sustain the lateral loads imposed by Seismic Zone 4 without sustaining any distortion or any detectable damage.
2. Materials and General Requirements: Motor and flywheel supports shall be fabricated from welded steel shapes steel and shall be designed to mount on cast concrete housekeeping pads in accordance with the requirements for Rigid Machine Mounts, Section 43 05 13 and the requirements set forth in paragraph 43 23 03-2.06. All support structure surfaces except those intended for mating with soleplate surfaces shall be finished with powder fused epoxy coating, finished color black.
   The first stage motor and flywheel support shall be designed to span the opening shown and shall be mounted on a sole plate cast into the housekeeping pad in accordance with Section 43 05 13, Rigid Machine Mounts. The support shall be comprised of a steel cover late stiffened with rolled steel shapes welded to the underside to provide no detectable deflection when a load equal to 150 percent of the weight of the motor and flywheel is applied to the mounting pads for the support frame. Access opening shall provide convenient and safe entrée to all intermediate coupling maintenance and disassembly points. As well as any flywheel bearing maintenance points.

   Second Stage Motor and Flywheel Support: The motor and flywheel support for the second stage pumps shall be a fabricated steel shroud designed to straddle the second stage pump and to transfer the weight, operational-related and seismic-related forces to the pump room floor.
3. A fabricated steel support/pedestal as shown on the drawings shall be of adequate height to allow service access to the couplings between the motor shaft and the flywheel shaft, and between the flywheel shaft and the pump shaft, and designed to carry weight of motor without undue

vibration to pump assembly. The flywheel/motor pedestal shall be included in mass elastic design analysis.

4. Provide with shaft guard to comply with OSHA safety standards.
5. Flywheel: Moment of Inertia shall be 2000 lb-ft^2 for the rotating element for each complete motor/pump set, including entrained water, pump rotor, shafting, couplings, and motor rotor shall be adjusted to provide this value.
   (1) Materials of construction as follows:
   Frame: Steel ASTM A-36, welded and stress relieved.
   Shaft: Alloy Steel, ASTM A322, Grade 4142 HT, Stainless, 375-388 BHN for sahfts 3.5 inches in diameter and less. Stainless ASTM A564 Type 630 HT Condition H1150 for shafts larger than 3.5 inches in diameter.
   Rotor: Steel ASTM A36, or cast steel, ASTM A27 for flywheels 3 feet in diameter or less.; Cast steel ASTM A148 for flywheels greater larger the 3 feet in diameter. All stress relieved after machining.

M. Extension Shaft Assembly (1st Stage Pumps Only):

1. Each pump shall be provided with intermediate shafting which consists of one full or semi floating disc pack composite shafting assembly. Disc pack intermediate shaft shall be constructed of composite tubing of graphite and/or B glass fibers in an epoxy matrix. The resin shall be corrosion-resistant epoxy thermoset plastic. The shaft shall be selected with a factor of safety of not less than 2 based upon ultimate stress.
2. The intermediate shaft assembly shall be designed to operate below its critical speed.
3. Shaft Deflection is not applicable for intermediate shafting.
4. Constructed of sufficient diameter and properties to transmit 1.25 times full motor horsepower including service factor.
5. Provide shaft guard over the entire length of the shaft and conform to OSHA safety requirements; complete with banded openings to allow access to shaft lubrication fittings.

N. Motor

1. Premium efficiency, vertical solid shaft motor
2. Inverter duty rated per NEMA MG1 Part 31 with 1.00 Service Factor
3. 4160-Volt/3-Phase/60 Hz
4. Class F insulation
5. 80˚C temperature rise at 1.0 Service Factor
6. Variable torque
7. Enclosure type: Weather Protected Type 2

8. 7 installed RTDs per motor (2 per phase plus 1 for the motor thrust bearing)
9. Nominal horsepower: 750 Hp
10. Max Weight: 10,700 lbs.
11. Nominal Motor Speed: 1200 rpm
12. Meet all requirements of Sections 43 23 03 and 43 05 21, including motor cooling requirements.
13. Maximum motor height: 84 inches (including shaft extension).
14. Manufacturer: TECO-Westinghouse, General Electric, WEG, or approved equal.
15. Motor shall have the following minimum NEMA nominal efficiencies:
    a. 100% load: 95.1 eff.
    b. 75% load: 95.36 eff.
    c. 50% load: 94.9 eff.

16. Motors shall have stator moisture protection by means of vacuum impregnation of epoxy. Windings shall be copper.
17. Space heater, 120 volt, single phase, shall be placed in each end-turn of the windings.
18. Bearings shall be selected to have ABMA rated (minimum) life of ten years when operated continuously at rated speed of motor and at total load consisting of the weight of the motor rotor plus any intermediate shaft weight. Thrust bearings shall be of the angular contact ball or spherical roller type.
19. Motors shall be supplied with a lifting hook and suitable base.
20. Motor conduit boxes shall be of cast-iron or fabricated steel, neoprene gasketed and bolted, and oversized to provide adequate space for connections. The motor leads shall be permanently marked in agreement with connection diagrams.
    a. Power conductor termination box shall not exceed 18” depth and 24” width.
    b. Low voltage termination boxes shall not exceed 9” depth and 12” width.
21. Each RTD detector shall have its leads wired to a terminal block located in a motor auxiliary terminal box.

2.4 ACCESSORIES

A. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.

B. Equipment Identification Plates: Provide 16-gauge stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear 3/8-inch

high engraved die-stamped block type black enamel filled equipment identification number and letters indicated in this Specification and as shown.

C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, 1/2-inch minimum diameter, and as specified in Section 05 50 00, Metal Fabrications. Coat in accordance with Section 09 90 00, Painting and Coating.

D. 1st Stage Pump Intermediate Shaft Removal System: The intermediate shaft dimensions and weights require that the system to remove and handle the intermediate shafts be custom designed. The shafts shall be movable without moving or disassembling the motors to which they are connected. The shaft removal system shall be designed to handle the intermediate shafts provided with the pumping unit.

1. The shaft removal system shall include the following components
   a. A trolley installed within the floor slot below each of the motors that are supplied with this project. To accommodate the trolley, the floor slot width may be modified within the limits established on the drawings. The trolley shall be sized to suspend the full weight of the intermediate shaft and slide to an area where the shaft can be removed with the overhead crane.
   b. For each trolley/slot, provide deck plates to cover the slot to provide a walking surface and personnel fall protection. The deck plates shall be designed to support maintenance personnel while decoupling the shaft. The deck plate shall have lifting lugs or similar attachments to allow removal from the floor slot so that the shaft can be moved within the slot.
   c. Provide a removable railing and safety chain for personnel protection when removing the deck plates.

E. 2nd Stage Pump Removal System: The second stage pump removal system shall be designed to allow removal of the pump from its installed location without removing the motor base, flywheel, or motor. The pump manufacturer shall design a system to raise and lower the pump on a track with wheels. Once the pump is raised on the track, it shall be easily moved to where the bridge crane can access the pump. The entire system shall allow removal and reinstallation of the pump.

2.5 FACTORY FINISHING

A. Manufacturer shall furnish the pump complete assembly with prime and finish coat in accordance with Section 09 90 00, Painting and Coating.

2.6 SOURCE QUALITY CONTROL

A. Factory Tests and Adjustments:

1. Factory testing shall be in accordance with the standards of the Hydraulic Institute, latest edition.
   a. Pump Test Acceptance Grade: 1U
2. Test all pumps identical to that furnished. Use actual motor to be provided for factory tests. One project motor may be used for all factory performance testing.
3. Factory tests shall include the following:
   a. Hydrostatic testing of pump pressure containing components, to include as a minimum, pump volute, suction cover, and stuffing box cover. Test pressure to be the greater of 150 percent of rated condition or 125 percent of pressure at rated speed with discharge valve closed. Test for 10 minutes**.**
   b. Performance testing of fully assembled pump, per Hydraulic Institute Standard 14.6. Performance testing to be at rated speed**.**
   c. Dynamically balance impeller to ISO 1940 Grade G2.5 or better prior to final assembly.
   d. Vibration testing of fully assembled pump with the Project motor at full rated speed.
      1) Due to the temporary setup in the factory, vibration readings taken during the factory performance test are for reference only. Vibration readings in the field will be guaranteed to HI standards.
   e. Include **c**omplete test records, performance curves, certified correct by an authorized representative of the pump manufacturer of each test performed.
   f. Motor Test: See Section 26 19 00, Medium-Voltage AC Induction Motors.
   g. Make necessary adjustments, realignments, and retest to bring pumps into compliance.
   h. Witnessing of factory testing shall meet the requirements of Spec Section 43 23 03.
   i. The Owner and Engineer believe the following manufacturers are capable of producing equipment and/or products, which will satisfy the requirements of this section. This statement, however, shall not be construed as an endorsement of a manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this section.
      1) Candidate manufacturers include Fairbanks Nijhuis, or approved equal.

2) Intermediate shaft manufacturers include Johnson Power, or or approved equal.

j. The current design is based on the Fairbanks Nijhuis pumps. Alternate qualified pump manufacturers that can meet the requirements of these specifications and can demonstrate that they have similar pumps proposed for this project within 10% of the flow and TDH requirements can be considered for this project. However, any redesign costs and additional project costs shall be the responsibility of the or equal pump manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 1/4 inch per foot. Use double wedges to provide level bearing surface for pump and driver base. Accomplish wedging so there is no change of level or springing of baseplate when anchor bolts are tightened.

C. Adjust pump assemblies such that driving units are properly aligned, plumb, and level with driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.

D. Connect suction and discharge piping without imposing strain to pump flanges.

E. Conform to requirements of Section 43 23 03.

3.2 FIELD FINISHING

A. Equipment as specified in Section 09 90 00, Painting and Coating**.**

3.3 FIELD QUALITY CONTROL

A. Functional Tests:

1. Conduct on each pump, system, and subsystem as specified in Section 01 91 14, Testing, Integration, and Startup.
2. Alignment:
   a. Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.

b. Shafting manufacturer's authorized representative shall verify installation alignment and prepare and submit a report confirming compliance**.**

3. Flow Output: Measure using plant instrumentation and storage volumes**.**
4. Operating Temperatures and Vibration: Monitor bearing areas on pump and motor and on extension shafting for abnormally high temperatures or vibrations**.**
5. Vibration Test:
   a. Test with units installed and in normal operation, and discharging to connected piping systems at rates at 20 percent speed increments over the anticipated operating speed range of the pump and with actual building structures and foundations provided.
      1) Confirm vibration is below 90 percent of limits specified in HIS 9.6.4.
   b. If units exhibit vibration in excess of the limits specified, adjust or modify as necessary to bring units into compliance. Units that cannot be adjusted or modified to conform as specified shall be replaced**.**
   c. Provide instrumentation in current calibration to measure pump vibration at locations outlined in the Hydraulic Standards.
   d. Prepare test report, including test records for each pump.
6. Performance Test: Conduct on each pump as specified in Section 01 91 14, Testing, Integration, and Startup.
7. Test in accordance with Hydraulic Institute Standard 1.6, Centrifugal Pump Test.
8. Perform under simulated operating conditions at full rated speed and at a reduced speed as approved by Engineer**.**
9. Test for a continuous 3-hour period without malfunction**.**
10. Test Records and Report: Prepare and submit a complete test report along with the test records in accordance with Hydraulic Institute Standard 14.6**.**
11. Use of plant instrumentation is allowed for tests. Provide additional instrumentation required to obtain required test data for conformance of factory test results**.**

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. Ten (10) person-days for installation assistance and inspection.
2. Ten (10) person-days for functional performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. Two (2) person-days for pre-startup classroom or Site training.

4. Two (2) person-days for facility startup.
5. Two (2) person-days for post-startup training of Owner's personnel**.** Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Owner.

B. See Section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Testing, Integration, and Startup.

END OF SECTION

SECTION 43 42 00
OXYGEN TANK AND VAPORIZERS

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section covers the work necessary by the Supplier to design and furnish, complete, the liquid oxygen (LOX) system including the tank and vaporizers to convert LOX to gaseous oxygen (OX).

B. The Supplier shall be responsible for furnishing a complete system and for coordination, proper sizing, and performance of all specified components. The system shall include, but not be limited to, the following:

1. One liquid oxygen storage tank.
2. Two ambient vaporizers.
3. Related valving, piping, and appurtenances as described herein.
4. All proper labels and signs, including those for safety.
5. Process instrumentation and control as described in these Specifications and as shown on the P&ID in the Contract Documents.

C. The Supplier shall provide all equipment; tank mounted valves, piping, and fittings; non-tank mounted piping and valves; and accessories required as shown on the P&ID and specified herein.

1.2 GENERAL

A. The equipment specified herein shall be fabricated, shop tested, fully assembled units requiring a minimum of field installation labor.

B. Like items of equipment provided hereunder shall be the end products of one Supplier to achieve standardization for appearance, operation, maintenance, spare parts, and Supplier’s services.

1.3 SUBMITTALS

A. Complete submittals in accordance with the requirements of Section 01 33 00, Submittal Procedures. B. Action submittals:

1. Submit materials of construction, complete Supplier's specifications, including dimensions and weight of equipment, and paint system data.

2. Submit proposed layout of equipment and piping.
3. Submit electrical requirements and power and control wiring diagrams.
4. Submit shop drawings, cut sheets, and catalog information, as required by Section 01 88 15, Anchorage and Bracing.
5. Submit dimensions of area required for servicing equipment and clearance requirements.
6. Submit list of special tools and materials for maintenance.
7. Submit O&M Manual, including LOX tank purging procedures, per Section 01 78 23, Operation, Maintenance, and Asset Data.
8. Submit Factory Testing plans, Factory Testing certification, Functional Testing plan, and Functional Testing report. C. Informational submittals:

1. Submit support and anchorage calculations as required by this specification and Section 01 88 15, Anchorage and Bracing. D. Quality Control Submittals:

1. Provide Supplier's Certification of Proper Installation.
2. Special shipping, storage, protection, and handling instructions.
3. Supplier's printed installation instructions.

1.4 QUALITY ASSURANCE

A. The oxygen system shall be designed and installed in accordance with NFPA 53 and NFPA 55 and industry standards as set forth by the Compressed Gas Association.

B. All equipment, piping, valves, instrumentation, and accessories in oxygen service shall be cleaned in compliance with the Compressed Gas Association (CGA) Pamphlet G4.1, "Cleaning Equipment for Oxygen Service," latest edition. For items cleaned prior to shipment, they shall be properly packaged for protection from contamination. Provide directions for storage at the site prior to installation. Precleaned items shall not require further cleaning after installation only if they meet the requirements of the CGA.

1.5 PROJECT CONDITIONS

A. Environmental Requirements:

1. Exposure: Outdoors, no shading.
2. Temperature: Maximum 104 degrees F; minimum minus 3 degrees F.

3. Elevation 16 feet above sea level.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage, and handling shall be in accordance with the LOX tank Supplier's written instructions.

B. All equipment shall be protected against any damage during transportation and handling.

C. Finished iron or steel surfaces not painted, before delivery to the job site, shall be properly protected to prevent rust and corrosion.

D. The finished surfaces of all exposed flanges shall be protected by blank flanges, strongly built and securely bolted thereto.

E. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing.

1.7 SYSTEM DESCRIPTION

A. General: The oxygen system described herein shall consist of one liquid oxygen storage tank, two ambient vaporizers, and related piping, valving, and appurtenances.

B. The LOX storage tank shall have a nominal storage capacity of 13,000 gallons. The oxygen system shall be designed to continuously provide oxygen at a rate of approximately 20,000 pounds per day.

C. System components shall be designed for oxygen service and shall be in accordance with the Compressed Gas Association and NFPA 53 and 55 requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. Piping, tank, and equipment shall be protected with suitable pressure relief valves as required to prevent excessive pressure buildup due to trapped liquid oxygen or vapor. Pressure relief valves shall be provided in every location in which gas could be trapped between two isolating devices. As a minimum, pressure relief valves shall be provided at all locations indicated on the P&IDs. All pressure relief valve exhausts shall be piped downward, terminating at an elevation no closer than 18 inches above the concrete pad.

B. All materials, where applicable, shall be suitable for oxygen gas and cryogenic liquid use.

2.2 COMPONENTS

A. Liquid Oxygen Storage Tank:

1. Design Criteria: The design of the liquid oxygen storage tank shall be based on the following conditions: a. Number of Tanks: One.
   b. Tank Style: Horizontal.
   c. Gross Capacity of Each Tank: 13,000 gallons.
   d. Normal Operating Pressure: 250 to 300 psig.
   e. Maximum Allowable Working Pressure: 275 psig.
   f. Design Temperature: Plus 110 degrees F to minus 320 degrees F.
2. The LOX storage tanks shall be products of:
   a. Chart Industries.
   b. Or equal.
3. Tank shall be horizontal, double walled construction with a minimum capacity as described above.
4. Inner vessel shall be 9 percent nickel steel SA-353/553 or SA240 Type 04 stainless steel cold stretched with vacuum perlite insulation and shall be built and stamped in accordance with ASME Pressure Vessel Code, Section VIII, Division I for maximum allowable working pressure.
5. Outer vessel shall be carbon steel. Factory prepare, prime, and finish coat per System 5 of Section 09 90 00.01, Painting and Coating for Equipment. Color as selected by Owner.
6. Tank piping shall be copper or Type 316 welded stainless steel in accordance with Section 40 27 00, Process Piping – General. The following piping, with labels, systems shall be provided as a minimum:
   a. Top and bottom fill lines.
   b. Safety relief line for inner vessel.
   c. Top and bottom gauge lines for pressure and level indication.
   d. Full trycock line.
   e. Liquid product withdrawal line.
   f. Economizer return line.
   g. Auxiliary vapor line.
   h. Pressure building coil line.
   i. Insulation space evacuation and gauge line.
7. Tank fill system shall include a standard Compressed Gas Association oxygen hose connector, check valve, pressure relief valve, and drain valve. Fill system shall be for connections to commercial highway transport.

8. Inner and outer vessels and the piping systems shall include safety valves and rupture discs to protect the equipment from excessive pressure.
9. Pressure Safety Devices: Piping, tank, and equipment shall be protected with suitable pressure safety valves (PSVs), for the intended fluid service, as required to prevent excessive pressure buildup due to trapped liquid oxygen or vapor. Provide dual automatic primary relief devices by pressure safety valves. Pressure safety valves shall be Herose GMBH, or equal. Provide secondary relief systems by rupture discs and a manual vent valve. Rupture discs shall be BS & B Safety Systems, or equal. Internal vessel pressure relief shall consist of both automatic primary and secondary relief devices and manual tank vent valves. External vessel pressure relief shall consist of an automatic relief device. Thermal relief valves shall be as manufactured by Engineered Controls International, Series B-9400, or equal.
10. Backpressure Valve: Provide backpressure valve, as recommended by supplier, within pressure relief circuit to limit loss of oxygen to atmosphere during extended periods between tank fill cycles.
11. Pressure Building System: The tank shall be equipped with a pressure building system, including a pressure building regulator and isolation valve, to automatically maintain a minimum set pressure required for the Supersaturated Oxygen System. The setting on the pressure building system shall be accessible at the tank to the Operator for setting adjustment as required.
12. Internal Economizer Circuit and OX Recovery System: Each tank shall be equipped with an internal economizer system that allows excess OX which accumulates in the head space of the tank during periods of low product use to be consumed prior to automatic blow-off. A special pressure regulator and internal tank piping and valves shall be provided to allow excess OX to flow into the LOX use pipeline prior to the LOX pipeline exiting the actual tank. The system shall be provided with a pressure regulator located in between the dual tank walls and designed to automatically set the economizer circuit to regulate at 5 to 10 psig higher than that of the pressure building circuit.
13. Insulation and Vacuum Requirements: The insulation shall be perlite packing, Super-Fiber, or composite insulation in the annular ring, and a high vacuum, such that the tank boil-off rate shall not exceed 0.35 percent of the tank capacity by weight per day for summer ambient temperature conditions of 104 degrees F.
14. Anchoring: The liquid oxygen storage tank shall be provided with all required support framing and lugs for fastening the tank to a concrete pad. Mounting base, legs, and support framing for the storage tank shall

be welded to the tank. The tank and anchors shall be designed in accordance with Section 01 88 15, Anchorage and Bracing.

15. NFPA Label: Each tank shall be provided with hazardous material signal arrangements painted on both ends and both sides following field painting. Each signal arrangement shall be 5-inch by 5-inch diamond shaped background painted white. The health signal shall be painted blue, the flammability signal shall be painted red, and the reactivity signal shall be painted yellow. All signals shall be 2 inches high. In the diamond shaped signal arrangement, the health signal shall be identified at the top, the reactivity signal shall be identified at the right, and the bottom shall be used to identify special hazards. The following numerical gradings shall be given to the signals: Health – "3," Flammability – "0," Reactivity – "0," and "OXY" shall be identified as a special hazard. B. Ambient Vaporizers:

1. Design Criteria: The design of the ambient vaporizers shall be based on the following conditions:
   a. Number of Vaporizers: Two.
   b. Maximum Hourly Gas Flow Requirement for Each Vaporizer:
      1) Summer Conditions: 11,700 scfh continuous at minimum ambient temperature of 70 degrees F.
   c. Minimum Period of Operation for Continuous Vaporization Cycle: 8 hours.
   d. Maximum Working Pressure (Approximate): 150 psig.
2. Ambient vaporizers shall be rated for a capacity as described above, 600 psi working pressure. Internal tubing shall be aluminum with wide gap aluminum fins to reduce ice bridging.
3. The vaporizers shall be the products of:
   a. Thermax.
   b. Or equal.
4. The vaporizers shall be capable of receiving liquid oxygen from the storage vessel and continuously converting it to gaseous form of supply to the ozone system at the required system pressure. Further oxygen compression shall not be provided.
5. Vaporizers shall be equipped with both external and internal fins. The linear gap between outside finned elements shall be no less than 5 inches in order to allow for maximum ice build-up. All critical pressure joints shall be manufactured with full penetration welds. No weld surface cracks due to thermal expansion and contraction of vaporizer elements will be allowed. The materials of construction shall be suitable for outside installation for the design conditions, LOX and

OX compatible, and shall be factory cleaned for oxygen service and sealed.

6. Flanged Connections: All inlet and outlet connections shall be ANSI flanges with minimum 300 psig rating. All flange connections where aluminum and stainless steel flanges are mated together shall be equipped with a suitable dielectric corrosion inhibiting flange kit. This flange kit shall be constructed of material suitable for the intended service (either LOX or OX) and shall not allow direct contact of aluminum metal to stainless steel metal on any part of the flange and bolt kit.
7. Ambient vaporizers shall be complete with piping connections and support legs suitable for anchor bolt attachment to an equipment pad. The vaporizers and anchors shall be designed in accordance with Section 01 88 15, Anchorage and Bracing.

C. Piping: As shown on the P&ID and as specified below:

1. The Supplier shall design and furnish all LOX and OX piping from the tank fill connection to the flanged OX connection near the edge of the concrete equipment pad.
2. Piping shall be copper or Type 316 welded stainless steel and shall conform to the requirements of Section 40 27 00, Process Piping – General.
3. A general layout of the LOX piping has been provided on the Drawings to ensure sufficient space is available on the tank pad. Supplier may revise layout currently shown. All piping shall be run in the vertical and horizontal planes. Piping shall be arranged and supported to ensure that undue stresses from thermal expansion are not transmitted to equipment components.

D. Valves: Valves shall be supplied as shown on the P&ID and described in this Section. Valves shall be Supplier's standard, appropriate for pure oxygen service. Valves shall be installed in accordance with Supplier's written instructions. Valves shall be firmly supported to avoid undue stresses on the pipe.

1. Isolation Valves for Liquid Oxygen Service: Valves shall be globe or ball style valves. Ball valves shall have appropriate upstream vent-tap on ball to prevent trapping of LOX or OX fluid. Valve bodies, bonnets, and plugs shall be brass or bronze or stainless steel, with stainless steel stems and PTFE or other approved packing for the intended fluid application. Valves in use in LOX piping and on LOX service shall be suitable for cryogenic use and shall have extended stems. All valves shall be cleaned for oxygen service. Valves shall be as manufactured by The Wm. Powell Company, Goddard Valve Corporation, or approved equal.

E. Instrumentation: As shown on the P&ID and as specified below.

1. General:
   a. Field instruments shall use Profibus digital field technology.
   b. Field instruments shall be FDT/DTM certified.
   c. HART 4 to 20 mA dc instruments with certified FDT/DTM are an acceptable substitution where Profibus fieldbus technology is not available.
2. Furnish and install the following field instrumentation on the tank for monitoring and control of the LOX tank. Instrumentation shall be suitable for cryogenic operation and shall be Endress+Hauser, or equal. a. Liquid Oxygen Storage Tank Level.
   b. Liquid Oxygen Storage Tank Inner Pressure.
   c. Liquid Oxygen Storage Tank Evacuated Space Vacuum.
   d. Vaporizer 1&2 Discharge Temperature.
   e. Gaseous Oxygen Temperature.
   f. Gaseous Oxygen Pressure. F. Accessories:

1. Identification Plates: Mount 16-gauge stainless steel plates in readily visible locations on each separate component of equipment.
2. Lifting Lugs: Provide on equipment and equipment components over 100 pounds.
3. All required safety and material identification signage for the tank, equipment, and piping. Signage shall be of appropriate size and materials for installed location.

2.3 FACTORY TESTS

A. The complete cost of all factory tests and factory cleaning procedures shall be the responsibility of the Supplier.

B. Hydrostatic Factory Test Prior to Shipment: A factory hydrostatic test shall be conducted at a minimum of 175 psig and held for not less than 1 hour. Any leaks discovered during the test shall be repaired and the unit retested until there is no leakage. The test may be witnessed, so the Supplier shall provide minimum 3 weeks notice of testing.

C. Functional Test: Each item of equipment supplied shall be factory tested by the Supplier prior to shipment, utilizing liquid nitrogen or liquid oxygen, to demonstrate that the unit and all subsystems function as specified and intended. All deficiencies discovered during the factory tests shall be corrected and retested prior to shipment.

D. Certification: The Supplier shall provide a certified test report stating that the equipment has been subject to a hydrostatic and/or functional factory tests and were appropriately cleaned and sealed for oxygen service and each unit complies with the specification requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. The oxygen system equipment shall be installed in accordance with Supplier's recommendations.

3.2 OXYGEN SERVICE

A. All skid-mounted piping, valves, instruments, controls, equipment, and associated appurtenances to be used with oxygen shall be cleaned for use in oxygen service in accordance with the Compressed Gas Association and marked and certified “Cleaned for Oxygen Service” before shipping to the job site.

B. Greases and lubricants shall be oxidation resistant, DuPont “Krytox,” or equal.

3.3 INSPECTION AND TESTING

A. Perform functional testing for all supplied equipment including checking for proper rotation, alignment, speed, excessive vibration, and noisy operation. Check instruments for proper installation, calibration, and adjustment. This activity shall

also include any necessary tuning of equipment to ensure that it is ready for reliable and safe operation. Once ready for operation, test under

actual startup conditions to determine that the operation is satisfactory, that the pressure building system and economizer system are operating properly, and that the liquid oxygen boil-off rate is satisfactory.

B. The initial tank fill will be supplied by the OWNER to test the liquid oxygen system and complete all startup services.

C. The liquid oxygen storage tanks and vaporizers shall be tested under actual startup and operating conditions.

D. Field touch-up per manufacturer's instructions and per System No. 4 of Section 09 90 00.01, Painting and Coating for Equipment.

3.4 TRAINING

A. After successful completion of required Functional Testing, Supplier shall provide field and classroom training to Owner's operations and maintenance staff.

1. Pre-Startup Training: Two person-day.
2. Post-Startup Training: Two person-day.

3.5 SUPPLIER'S SERVICES

A. A Supplier's representative for the equipment specified herein shall be present as required at the jobsite and/or classroom for installation assistance, inspection, certification of the installation, functional testing, performance testing, and post-startup training.

END OF SECTION

SECTION 43 42 56.04
SUBMERSIBLE SUMP AND SCUM PUMPS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Bearing Manufacturers Association (ABMA):
   a. 9, Load Ratings and Fatigue Life for Ball Bearings.
   b. 11, Load Rating and Fatigue Life for Roller Bearings.
2. American Society of Mechanical Engineers (ASME): B16.1, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 150.
3. ASTM International (ASTM):
   a. A48, Standard Specification for Gray Iron Castings.
   b. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
4. Hydraulic Institute Standards (HIS):
   a. 11.6, Submersible Pump Test.
   b. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
5. National Electrical Manufacturers Association (NEMA).
6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code.
   b. 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.
7. Underwriters Laboratories Inc. (UL).

1.2 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to ratings and nomenclature of Hydraulic Institute Standards.

1.3 SUBMITTALS

A. Action Submittals:

1. Make, model, weight, and horsepower of each equipment assembly.
2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction, including cable seal details.
3. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over entire operating range of pump, from shutoff to maximum capacity. Indicate separately head, capacity, horsepower

demand, overall efficiency, and minimum submergence required at guarantee point.

4. For variable speed motors, provide variable speed curves for every 50 rpm over the operational range.
5. Power and control wiring diagrams, including terminals and numbers.
6. Motor data, in accordance with the requirements of Section 26 20 00, Low-Voltage AC Induction Motors.
7. Adjustable frequency drive data, in accordance with the requirements of Section 26 19 23, Low-Voltage Adjustable Frequency Drive System.
8. Factory-finish system.
9. L-10 bearing life calculations per ABMA.
10. If required, wiring for motor protection module.
11. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Seismic Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Seismic Anchorage and Bracing.
2. Special shipping, storage and protection, and handling instructions.
3. Manufacturer's printed installation instructions.
4. Factory and Field Performance Test Reports and Manufacturer's Certificate of Compliance, in accordance with Section D: 01 61 00, Common Product Requirements.
5. Suggested spare parts list to maintain equipment in service for period of one (1) year. Include list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
6. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
7. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
8. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services**.**

1.4 EXTRA MATERIALS

A. Furnish for each pump:

1. One set mechanical seals.
2. One complete set of special tools required to dismantle pump.

PART 2 PRODUCTS

2.1 GENERAL

A. Submersible, vertical shaft, centrifugal non-clog type, for pumping wastewater and runoff (Pumps P-11, P-12, P-13, and P-14).

B. Designed for continuous operation under submerged or partially submerged conditions, and intermittent operation when totally dry without damage to pump or motor.

C. Pump and Electrical Driver: Meet requirements for class, group, and division location in accordance with NFPA 70.

D. Where adjustable speed drives are required, furnish a coordinated operating system complete with pump, drive, and speed controller.

E. Pumps furnished under this section to be provided by a single manufacturer.

2.2 COMPONENTS

A. Equipment consists of pump complete with motor, control system, guide rail, anchoring brackets, base elbow, power cable, and pump lifting cable and control panel and level switches.

B. Characteristics:

1. Motor and rotating parts shall be removable from motor end of pump.
2. Mating surfaces to be watertight and fitted with nitrile O-rings.
3. Pumps fitted with dynamically balanced nonclog impellers designed to pass course solids and stringy materials.

C. Lifting Arrangement:

1. Stainless steel chain, 2 feet minimum, and one "grip-eye."
2. Attach chain permanently to pump and access platform with stainless steel wire rope.
3. "Grip-eye" capable of being threaded over and engaging links of stainless steel chain so pump and motor may be lifted with "grip-eye" and independent hoist.

D. Sliding Guide Bracket:

1. Integral part of pump unit.

2. Pump unit to be guided by no less than two guide bars, or equivalent cable system, and pressed tightly against discharge connection elbow with metal-to-metal contact or through use of profile-type gasket, provided gasket is attached to pump's flange and can be easily accessed for inspection when pump is lifted out of wetwell.
3. Pump metal parts that come into contact with guide rail or cable system shall be made of nonsparking materials.

2.3 MOTOR

A. Oil chamber between seals shall be equipped with drain and inspection plug. Plug shall have positive antileak seal and shall be easily accessible from outside.

B. Motor nameplate horsepower not to be exceeded at head-capacity point on pump curve.

C. Pump motor and sensor cables shall be suitable for submersible pump application and cable sizing shall conform to NFPA 70 specifications for pump motors. Cables shall be of sufficient length to reach junction boxes without strain or splicing.

D. Motor Protection Module: If required, provide pump with a motor protection module for remote mounting. Contract Drawings are based on first named submersible pump manufacturer and motor protection module. If pump and motor protection module other than first named manufacturer is provided, provide revised wiring for the motor protection module.

E. Cable Entry System:

1. Junction chamber and motor separated by stator lead sealing gland or terminal board that prevents foreign material entering through pump top.
2. Utilize cable with factory-installed sealing gland with nonshrink epoxy seal system.
3. O-ring compression seal between sealing gland and cable entry point shall also be acceptable

2.4 CONTROL PANEL

A. NEMA 4X enclosure.

B. Free standing, post mounted.

C. Features:

1. Main circuit breaker disconnect interlocked with panel door.
2. Combination circuit breaker type, NEMA rated motor starters.
3. Fused control power transformer, 120V ac.
4. Alternator and pump lead-lag controls.
5. ON/OFF/AUTO switches.
6. Running lights.
7. High level indication.
8. Normally closed, dry, 5 amps at 120V ac contacts for remote indication of:
    a. High level alarm.
    b. Pump failure (temperature or moisture alarm).
9. Terminal strip for interfacing with external wiring.
10. High temperature indication.
11. Moisture alarm indication.
12. Alarm (high temperature, moisture, or high level) beacon located on top of panel.
13. Lightning protection.
14. Intrinsically safe relays as required for UL validation.
15. Alarm silence button.
16. Document pocket located inside panel with pump and panel operation and maintenance manual, and separate laminated pump curve.
17. 110-volt, duplex GFI outlet, weather-protected, and accessible from outside of panel.
18. Run hour meter.
19. 100 watts minimum, condensation heater with thermostat.
20. UL listing mark.

D. Prewired and factory tested.

E. Mount control switches, indicating lights, and switches on hinged front panel.

F. Single Feed: 480 volts, three-phase.

2.5 ACCESSORIES

A. Level Switches:

1. Low Low Level: Pumps off.
2. Low Level: First pump on.
3. High Level: Second pump on.
4. High High Level: Alarm.

B. Equipment Identification Plate: 316 stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in readily visible location.

C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications. Coat in accordance with Section 09 90 00, Painting and Coating.

D. Sidewalk Door: Size as shown on Drawing or if not shown, sized by equipment manufacturer. As specified in Section 05 50 00, Metal Fabrications, with the following additional requirements:

1. Gasketed and odor tight.
2. Channel drain is not required.

2.6 FACTORY FINISHING

A. Prepare, and finish coat in accordance with Section 09 90 00, Painting and Coating.

B. Manufacturer's standard epoxy system for continuous submergence in corrosive water.

2.7 SOURCE QUALITY CONTROL

A. Control Panel:

1. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.
2. Factory Tests and Adjustments: Test all control panels actually furnished.

B. Pump:

1. Factory Performance Test:
   a. In accordance with HIS 11.6, for submersible pump tests.
   b. Include test data sheets, curve test results, and performance test logs**.**
2. Conduct on each pump.
3. Perform under actual or approved simulated operating conditions.
   a. Throttle discharge valve to obtain pump data points on curve at 2/3, 1/3, and shutoff conditions.

C. Submersible Motor Functional Test: In accordance with HIS 11.6.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Mount the discharge elbow to the floor of the wetwell floor with stainless steel bolts.

C. Connect piping without imposing strain to flanges.

D. No portion of pump shall bear directly on floor of sump.

3.2 FIELD FINISHING

A. Equipment as specified in Section 09 90 00, Painting and Coating.

3.3 FIELD QUALITY CONTROL

A. Functional Test: Conduct on each pump.

1. Alignment: Test complete assemblies for correct rotation**,** proper alignment and connection, and quiet operation.
2. Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.
3. Test for continuous 3-hour period.
4. Test Report Requirements: In accordance with Hydraulic Institute Standards for submersible pump tests HIS 14.6 and 11.6.

B. Vibration Test:

1. Test with units installed and in normal operation, and discharging to connected piping systems at rates between low discharge head and high discharge head conditions specified**,** shall not develop vibration exceeding limits specified in HIS 11.6.
2. If units exhibit vibration in excess of limits specified, adjust as necessary. Units that cannot be adjusted or modified to conform as specified shall be replaced.

C. Pump Test:

1. General:
   a. Conduct on each pump provided.
   b. Conduct in accordance with HIS 11.6.
2. Routine Production Tests:
   a. Check impeller, motor rating and electrical connections for compliance to specification.
   b. Test motor and cable insulation for moisture content and insulation defects.

c. Prior to submergence, run pump dry to establish correct rotation and mechanical integrity.
d. Conduct abbreviated three-point operational performance test.
e. After operational performance test, perform insulation test again.

3. Factory Seven-Point Plotted, Performance Test:
   a. Level A for submersible pump tests.
   b. Include test data sheets, curve test results, and performance test logs**.**
   c. Perform under actual or approved simulated operating conditions.
4. Vibration test.
5. Hydrostatic test.

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. Two person-days for installation assistance and: inspection**.**
2. Two person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. Two person-days for prestartup classroom or Site training.
4. Two person-days for facility startup.
5. Two person-days for post-startup training of Owner's personnel. Training shall not commence until accepted detailed lesson plan for each training activity has been reviewed by Owner.

B. See Section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Testing, Integration, and Startup.

3.5 PUMP SCHEDULE

PUMP NO.	CAPACITY (GPM)	TDH (FEET)	MAX. SPEED (RPM)	VOLATGE & PHASE	MAX. HP	MAX. SPHERE SIZE (INCHES)
P-11	300	28	1800	480 / 3	7.5	3
P-12	300	28	1800	480 / 3	7.5	3
P-13	315	48	1800	480 / 3	10	3
P-14	315	48	1800	480 / 3	10	3

END OF SECTION

SECTION 44 47 00
HIGH PURITY OXYGEN SYSTEM

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Division 26 – Electrical

B. Division 40 – Process Integration

C. Division 43 – Process Gas and Liquid handling, Purification, and Storage Equipment

1.2 REFERENCE STANDARDS

A. The following is a list of standards which may be referenced in this section:

1. Occupational Safety and Health Administration (OSHA)
2. National Fire Protection Association (NFPA) 53
3. Compressed Gas Association (CGA) G-4.1
4. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section VIII, Div. 1
5. ASME B16.1/B16.5 Pipe Flanges and Flanged Fittings.

1.3 SYSTEM DESCRIPTION

A. The Super Oxygenation System (System) shall be designed to elevate dissolved oxygen (D.O.) levels at the Morena force main to reduce dissolved sulfides and subsequent vapor phase hydrogen sulfide (H_2S) levels in the sewer collection system. The System will be designed to achieve a minimum oxygen transfer efficiency of greater than 90 percent. To achieve this goal, the System shall provide a large oxygen/water interface generated by an intense bubble swarm to achieve dissolution such that the gaseous oxygen is completely dissolved into the wastewater before being blended back into the force main flow.

B. The System shall contain no internal nozzles, mixers, or inner baffles that are prone to clogging and all openings shall be a minimum of 4 inches in diameter to pass raw wastewater. The SuperOxygenation System shall not be pressurized

above the operating discharge pressure of the force main being treated. No pure oxygen headspace shall be developed inside of the dissolution vessel. No devices may be placed within the force main to aid dissolution as said devices may become fouled and/or otherwise adversely affect force main flow characteristics.

C. The Supplier shall provide all labor, materials, equipment and incidentals as specified and indicated herein and as required to meet the specified performance requirements to furnish:

1. One complete SuperOxygenation System and appurtenances complete and operational. Components are to include:
   a. SuperOxygenation Cone (Speece Cone).
   b. PLC based Process Control Panel.
   c. Oxygen Control Panel.
   d. Two 40 HP Side stream pump.
2. All mechanical components shall be designed and constructed in accordance with the latest edition and revision of all applicable codes and regulations, including the following:
   a. ASTM
   b. ANSI
   c. ASME
3. Equipment Materials:
   a. All components of the System shall be compatible with the conditions and chemicals to which they will be subjected to during normal operation.
   b. Compounds with which the materials of construction must be compatible include, but are not limited to:
      1) Hydrogen sulfide.
      2) Sulfuric acid.

D. Unit Responsibility and Scope of Supply:

1. The products shall be the end product of one responsible System manufacturer or responsible System supplier.
2. The System manufacturer shall provide components suitable for the service conditions listed herein.
3. The Contractor shall be responsible for coordinating with System manufacturer for Contractor's Scope of Supply.

4. The Contractor shall be responsible to provide and install, but not limited to, the following:
    a. Interconnecting raw sewage piping including valves and accessories.
    b. Oxygen feed piping to the System, and accessories.
    c. Installation and assembly of all equipment and instrumentation components for a complete system including labor.
    d. Site preparation
    e. Utility requirements, including main electrical service and field wiring.

1.4 SYSTEM SUPPLIER

A. The Super Oxygenation system shall be furnished by a single System Supplier. The System Supplier shall have experience in similar installations with permanently installed and operating systems adding a similar amount of oxygen to what are required per these specifications.

B. The System Supplier shall be ECO Oxygen Technologies, LLC of Indianapolis, IN.

1.5 SUBMITTALS

A. Action Submittals:

1. Detailed mechanical and electrical drawings showing equipment dimensions, system fabrication, arrangement, assembly, including locations and type of connections and weights of major equipment and components.
2. Power and control wiring diagrams, including terminals and numbers.
3. Factory finish system.
4. External utility requirements such as air, water, power, drains, etc., for each component.
5. Control panel elevation drawings showing panel face layout, construction, and placement of operator interface devices and other elements.
6. Complete set of engineered drawings for system I/O and Process control.
7. Make, model, weight, and horsepower of each pump assembly.
8. Complete pump and motor catalog information, descriptive literature, specifications, and identification of materials of construction.
9. Performance data curves at nominal pump speed showing head, capacity, horsepower demand, NPSH required, and pump efficiency over entire operating range of pump, from shutoff to maximum capacity.

10. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
11. Installation Manual.
12. Manufacturer shall have experience in the installation of HPO facilities in similar applications under similar circumstances and of similar size.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance.
2. Warranty Certificate
3. Operation and Maintenance Manuals (3 hard copies, 1 electronic copy).
4. Manufacturer's Certificate of Proper Installation.
5. Equipment Testing and Field Startup Report.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. The manufacturer must be able to provide the Owner with training as specified herein.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed in such a manner as to not degrade quality, serviceability or appearance.

B. All exposed equipment openings shall be properly protected.

C. Appropriate measures shall be taken to prevent the entrance of moisture or water to equipment during shipment and storage onsite.

1. Control panels should be stored in an enclosed place, safe from the weather until installed.

1.8 PATENTS

A. The manufacturer shall warrant that the use of their system and its equipment, in the process for which the system has been expressly designed, will not infringe on

any U.S. or foreign patents or patents pending. In the event of any claim of infringement, the manufacturer shall defend and indemnify the Owner free from any liabilities associated with the use of the patented equipment or process.

B. The manufacturer hereby grants to the City, in perpetuity, a paid-up license to use any inventions covered by patent or patents pending owned, or controlled by the manufacturer in the operation of the facility being constructed in conjunction with the equipment supplied under this Contract, but without the right to grant sublicenses.

1.9 WARRANTY

A. The manufacturer shall guarantee that the SuperOxygenation system will perform in accordance with the specifications when operated within the specified design conditions.

B. The manufacturer shall guarantee all materials and equipment to be free from all defects due to faulty materials or workmanship for a period of one (1) year from the date of startup and shall be limited to the repair or replacement of the SuperOxygenation system.

1.10 PERFORMANCE GUARANTEE

A. SuperOxygenation System Supplier shall guarantee that the System shall provide a minimum oxygen transfer efficiency of 90% or greater.

1. One-time performance testing as described in the FIELD TESTING section shall be means of proving performance criteria is met.

1.11 PAYMENT

A. Payment for equipment shall be in accordance with System Supplier's payment terms.

PART 2 PRODUCTS

2.1 SERVICE CONDITIONS

A. The SuperOxygenation System shall be designed to operate under the following operating conditions:

Process Parameter	Value
Diameter of Force Main (inches)	48
Length of Force Main to be Treated (ft)	56,760
Total Dynamic Head at Maximum Flow Conditions (ft)	494
Static Head	389
Force Main Pump Operation	Continuous
Daily Average Flow (gpm)	21,910
Maximum Flow Rate (gpm)	26,180
Minimum Flow Rate (gpm)	5,000
Max Hydraulic Retention Time (hrs)	15
Existing Dissolved Sulfides (mg/L)	3
Site Elevation Above Sea Level (ft)	16
Max Temperature of Sewage (°C)	25
Oxygen Uptake Rate (OUR) (mg/L/hr)	15
Daily Oxygen Addition Required Based on Above Parameters (lbs O_2/day)	20,205

2.02 PERFORMANCE CRITERIA

A. The SuperOxygenation System shall be designed to achieve an oxygen transfer efficiency of greater than 90%.

1. The System Supplier shall submit performance data from a minimum of 10 permanently installed and operational systems that prove a minimum oxygen transfer efficiency of greater than 90% under actual operating conditions. Data from factory tests with clean water or data from temporary pilot tests is not acceptable.
2. To achieve the high oxygen transfer efficiency, the system shall provide a large oxygen/water interface generated by an intense bubble swarm to achieve oxygen dissolution such that the gaseous oxygen is completely dissolved into the wastewater before being blended back into the main flow.
3. Systems with a pressurized pure oxygen headspace shall not be considered.
4. Systems which insert venturis, nozzles, diffusers, mixers, or other such devices into the force main will not be considered.
5. Discharge D.O. levels shall be measured upon system start-up to confirm transfer efficiency.

B. The SuperOxygenation System should run continuously with a minimum amount of maintenance to guarantee reliable D.O. control. Therefore, the system shall contain no internal nozzles, mixers or inner baffles that are prone to clogging, and all openings shall be a minimum of 3 inches to avoid scaling and clogging. Additionally, no device such as a venturi, nozzle, mixer or diffuser shall be installed within the force main.

C. The SuperOxygenation System shall be operated at or near the existing pressure in the force main line to prevent the potential for oversaturation of dissolved oxygen and pure oxygen gas off-gassing. The SuperOxygenation System shall not be pressurized above the operating pressure of the force main. The side stream pump shall not be used to maintain a pressure differential across nozzles or venturis.

2.3 INJECTION CONE

A. The SuperOxygenation Injection cone shall be constructed of Type 304 stainless steel and fabricated to ASME standards for 300 psig pressure rated vessels.

B. Features:

1. Self-cleaning bottom discharge design.
2. Sight glasses.
3. Manway.
4. 10 inch flanged inlet and discharge ports.
5. 1 inch female NPT threaded oxygen port.
6. System discharge instrumentation ports.
7. Bead blast finish.
8. Free standing vessel with lower mounting flange/feet for anchoring.

C. SuperOxygenation System Dimensions and Parameters:

1. Model Number: ECO2-7-12-PC
2. Cone Diameter: 7 feet.
3. Cone Nominal Height: 18 feet.
4. Total head loss shall not exceed 15 feet through the SuperOxygenation System at design conditions.
5. Side Stream Flow Rate: 4,200 gpm.
6. Side Stream Pump Duty Head: 28feet.

2.4 SIDE STREAM PUMP

A. General:

1. Provide a complete, coordinated, and fully functional operating system.
2. Coordinate pump requirements with motor manufacturer and be responsible for pump and motor requirements.
3. Pumps supplied under this section to be a standard product of manufacturer and to have proven reliability.

B. Pump:

Furnish and install two vertical non-clog wastewater pump(s). Each pump shall be equipped with a 40 HP electric motor, connected for operation on 480 volts, 3 phase, and 60 hertz.

C. Performance Requirements:

1. Capacity: 4,200 gpm.

2. Total Dynamic Head: 28 feet of head.
3. Minimum Rated Pump Hydraulic Efficiency at Rated Capacity: 75 percent
4. Constant speed.
5. Motor Size: 40 Horsepower.

.

D. Pump Construction:

1. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The lifting handle shall be of stainless steel. All exposed nuts or bolts shall be of stainless steel construction. All metal surfaces coming into contact with raw sewage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
2. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
3. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

E. Cooling System:

1. Each unit shall be provided with an integral motor cooling system. A stainless steel motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F (40°C). Operational restrictions at temperatures

below 104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

F. Motor:

1. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber.
2. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%.
3. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.
4. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable.
5. The motor shall be designed for continuous duty while handling pumped media of up to 104°F.
6. The motor shall be capable of no less than 30 evenly spaced starts per hour.
7. The rotor bars and short circuit rings shall be made of aluminum.
8. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.
9. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.
10. The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%.
11. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and

efficiency. The chart shall also include data on motor starting and no-load characteristics.

12. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out.

G. Bearings:

1. The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease.
2. The upper motor bearing shall be a two row angular contact ball bearing.
3. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces.
4. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

H. Mechanical Seals:

1. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring.
2. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring.
3. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal.
4. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber.
5. All seal rings shall be individual solid sintered rings.
6. Each seal interface shall be held in place by its own spring system.
7. The seals shall not depend upon direction of rotation for sealing.
8. Mounting of the lower seal on the impeller hub is not acceptable.
9. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable.
10. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

11. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.
12. The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.
13. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

I. Pump Shaft

1. The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T. Shaft sleeves will not be acceptable.

J. Impeller

1. The impeller shall be of Hard-Iron^{TM} (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the gray iron impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

K. Volute/Suction Cover

1. The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-Iron^{TM} (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

L. Protection

1. Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.
2. The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.

M. Manufacturer: Fairbanks Pentair or Approved Equal.

2.5 PIPING, VALVES, AND ACCESSORIES

A. By others as necessary and as shown on the drawings.

2.6 INSTRUMENTATION AND CONTROL

A. General:

1. Provide control panels, electrical components and wiring for a complete, functional system.
2. Provide all items not specifically specified which are required to implement the specified functions and the functions required for proper system operation.

3. Coordinate controls with existing SCADA system.

B. Process Control Panel: PLC driven automatic system control with sensing features. The system shall be designed for automatic flow control with full manual backup control of oxygen flow and side stream pump control. The oxygen feed rate shall be continuously adjusted to the actual process water flow rate. The control panel shall be rated for use on a 120 volt power supply and shall be housed in a NEMA Type 4X 304 stainless steel enclosure. The control panel shall contain an Allen-Bradley Programmable Logic Control (PLC), operator interface screen and have the capability to monitor system parameters for alarm indication and data logging and trending.

1. Instrumentation included with the system and controlled/monitored by the Process Control Panel:
   a. Oxygen mass flow controller.
   b. One (1) solenoid valve.
   c. One (1) actuated ball valve.
   d. Side stream flow meter.
   e. Side stream pressure sensor.
   f. Side stream temperature sensor.
2. PLC and I/O:
   a. Allen-Bradley MicroLogix Processor.
   b. Ethernet switch.
   c. MicroLogix fixed racks, power supplies, expansion analog and digital I/O.
   d. Trend recording: The PLC shall record the following data as a minimum:
      1) Oxygen addition, current day's total.
      2) Oxygen addition, previous day's total.
      3) Force main flow.
      4) Side stream flow.
      5) Side stream pressure.
      6) Side stream temperature.
3. Operator Interface:
   a. Panel Door-mounted HMI:
      1) Trending and logging.
      2) Ethernet communication capable (for remote connection).
4. Main Control Enclosure:
   a. Preassemble and wired, NEMA 4X 304 stainless steel construction.
   b. System Hand-Off-Auto switch.

c. Interposing I/O relays as necessary.
d. Disconnects and fusing for AC power distribution.
e. DC power supply and fusing for DC power distribution.
f. All necessary wireways, wiring, labels, and miscellaneous hardware for a complete control panel.

C. Oxygen Control Panel: NEMA 4X 304 stainless steel panel complete with oxygen mass flow controller, rotameter, solenoid valve, check valves, isolation valves and stainless steel tubing and fittings as required. Panel will be powered, monitored and controlled by the Process Control Panel.

D. Additional Components: The following additional components will be provided for mounting on the Injection Cone for redundant control and system isolation of the oxygen delivery piping:

1. Isolation valve
2. Check valve.
3. Actuated ball valve.

E. Inputs to Process Control Panel:

1. Force main flow rate.
2. Side stream pump signal(s).
3. System enable/permission to run.

F. Description of Operation:

1. The Super Oxygenation System shall operate by redirecting a side stream of raw wastewater from the force main and pumping it through the Injection Cone. Gaseous oxygen is fed into the Injection Cone by the Oxygen Control Panel as controlled by the Process Control Panel. The Injection Cone shall provide a large oxygen/water interface as generated by an intense bubble swarm to achieve rapid oxygen dissolution such that the gaseous oxygen is completely dissolved before being blended back into the force main. The Super Oxygenation System shall not have a pure oxygen headspace inside of the vessel.
2. The Process Control Panel PLC shall monitor the force main flow rate, side stream water flow rate, and water temperature and system pressure. Based on this data, the PLC shall calculate the amount of oxygen required to meet the

oxygen demand of the wastewater. The PLC shall be capable of adjusting the oxygen feed rate into the Injection Cone by means of the mass flow controller to match the calculated oxygen demand.

3. The Super Oxygenation System shall be capable of automatically adding variable amounts of oxygen as required by varying force main flow rates.
4. The PLC shall also monitor the side stream pump operation, side stream water flow rate, oxygen flow rate, and water temperature and system pressure. These parameters shall be checked against design inputs to ensure optimal system performance and provide for system shutdown and/or alarm notification if the operation is out of tolerance.

G. Alarms shall be capable of being transmitted to the owner in accordance with their requirements, specified herein under specifications Division 40.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

A. Manufacturer shall provide written instructions for installation of equipment by Contractor.

B. Anchor Bolts: Contractor shall provide all necessary anchor bolts and field install after receipt of equipment. All anchor bolts, nuts, washers, etc. shall be type 316 stainless steel.

3.2 PUMP INSTALLATION

A. Provide pump manufacturer's written instructions for pump installation by Contractor.

3.3 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom as designated by Owner, for minimum person-days listed below, travel time excluded:

1. Function Testing, Performance Testing, Training of Owner's Staff, and Completion of Manufacturer's Certificate of Proper Installation: 3 days and two trip.

B. Schedule with Owner's manufacturer's services/Contractor to avoid conflict with other onsite testing or other onsite activities.

C. Furnish trained, articulate personnel to perform manufacturer's services.

D. Establish training schedule to ensure adequate training of appropriate personnel as deemed necessary by Owner.

E. Training Lesson Plan: Provide the following:

1. Title and objectives.
2. Course description and outline of course content.
3. Recommended attendees and time required.
4. Format (e.g. lecture, hands-on).

3.4 FIELD TESTING

A. Prior to acceptance by Owner, an operational test of the SuperOxygenation system shall be conducted to determine if the installed equipment meets the purpose and intent of the Specifications. Tests shall demonstrate that all equipment is electrically, mechanically, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

B. All equipment shall be tested to check for proper operation, proper alignment, faulty equipment, and for excessive vibration.

C. Any and all alterations, modifications, additions and/or work necessary to rectify defects or nonconformance with the Section of the Specifications shall be in such a manner as to provide for the satisfactory operation of the system, all at no additional cost to the Owner.

D. Upon completion of Field Testing, the Manufacturer shall provide a summary report documenting the results of the required field testing.

E. All labor, instruments, equipment, apparatus, fuel, temporary piping, water and electrical power required for testing shall be provided by the Contractor at no additional cost to the Owner.

END OF SECTION

SECTION 44 47 28.26
ACTIVATED CARBON ODOR CONTROL SYSTEMS

EQUIPMENT AND COMPONENT NUMBER(S)

1. Screening Facility Odor Control Scrubbers (OCS-01 and OCS-02).
2. Wet Well Odor Control Scrubbers (OCS-03 and OCS-04).

PART 1 GENERAL

1.1 WORK OF THIS SECTION

A. This Section covers the work necessary to provide two odor control systems as described herein.

1. Screening Facility Odor Control System: Two (2) Dual-bed carbon odor control scrubbers, two exhaust fans EF-01 and EF-02, activated carbon, control panels and all appurtenances as specified herein.
2. Wet Well Odor Control System: Two (2) dual-bed carbon odor control scrubbers, two exhaust fans EF-04 and EF-05, activated carbon, control panels and all appurtenances as specified herein.

1.2 GENERAL

A. Like items of equipment provided hereunder shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts, and manufacturers' services.

B. The design of the odor control systems as shown on the Drawings is based upon the equipment from the first-named manufacturer listed in this Specification. The Contractor shall be responsible for making all necessary changes to the facility design to accommodate the equipment, including but not limited to layout changes and interfaces connections to other work and equipment which are different than that shown on the Drawings. The Contractor shall be responsible for coordinating this work and the changes will be at the sole expense of the Contractor. At a minimum these changes may include:

1. Layout and mounting of the equipment, including concrete equipment pads.
2. Coordination of equipment elevations.
3. Rerouting of any piping required to meet the manufacturer's system requirements.
4. Additional utilities required to support manufacturer's system.

1.3 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

1. American National Standards Institute (ANSI).
2. American Society of Mechanical Engineers (ASME).
3. ASTM International (ASTM):
    a. C582, Standard Specification for Contact Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
    b. D2563, Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.
    c. D2583, Standard Test Method for Indentation hardness of Rigid Plastics by Means of a Barcol Impressor.
    d. D2584, Standard Test Method for Ignition Loss of Cured Reinforced Resins.
    e. D2854, Standard Test Method for Apparent Density of Activated Carbon.
    f. D2867, Standard Test Methods for Moisture in Activated Carbon.
    g. D3299, Standard Specification for Filament-Wound, Fiberglass Reinforced Thermoset Resin Chemical Resistant Tanks.
    h. D3802, Standard Test Method for Ball-Pan Hardness of Activated Carbon.
    i. D4097, Standard Specification for Contact Molded, Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks
    j. D6646, Standard Test Methods for Determination of Accelerated Hydrogen Sulfide Breakthrough Capacity of Granular and Pelletized Activated Carbon.
    k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
    l. E544, Standard Practices for Referencing Suprathreshold Odor Intensity.
    m. E679, Standard Practice for the Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series Method of Limits.
4. National Fire Protection Association (NFPA): 820; Fire Protection in Wastewater Treatment and Collection Systems.

1.4 DEFINITIONS

A. The following is a list of abbreviations which may be used in this Section:

1. D/T: Dilutions to Threshold.
2. FRP: Fiberglass Reinforced Plastic.
3. OU: Odor Units.

4. ppmv: Parts Per Million, volume.
5. ppbv: Parts Per Billion, volume.
6. PVC: Poly Vinyl Chloride.
7. WG: Water Gauge.
8. H2S: Hydrogen Sulfide.
9. PSI: Pounds per Square Inch.

1.5 SYSTEM DESCRIPTION

A. Unit Responsibility and Scope of Supply:

1. The Work requires that the odor control system manufacturer/supplier furnish all of the following items including:
   a. The carbon adsorption units (the vessels), fans, control panel, activated carbon media and associated media support system and media grounding hardware complete with all accessories and appurtenances.
2. The products shall be the end product of one responsible system supplier.
3. The system supplier shall provide media and components suitable for the service conditions listed herein.
4. The system supplier shall provide and guarantee the required hydrogen sulfide performance listed herein.
5. The system supplier shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features, and functions.
6. The system supplier is responsible for the carbon vessel design including all layouts, structural calculations for floors and walls, reinforcing and vessel material sizing.
7. The Contractor shall be responsible for coordinating with the system supplier for Contractor's scope of supply.
8. The Contractor shall be responsible for, but not limited to, the following:
   a. Ductwork, piping and supports.
   b. Installation and assembly of all equipment components for a complete system, including labor.
   c. External drain piping from odor control system package.

B. Design Requirements:

1. Refer to Contract Drawings for additional information to supplement this Section.
2. Equipment Anchorage:

a. Provide structural design and anchorage Drawings and calculations.
b. Drawings and calculations shall be stamped by an engineer registered in the State of California.
c. Design shall comply with project design loads provided on the General Structural Notes on the Drawings and all applicable codes and standards.

3. Equipment Components:
   a. The stiffness of mechanical and electrical component attachments shall be designed such that the load path for the component performs its intended function.
   b. Equipment shall be demonstrated as functionally rugged. The equipment shall provide an ampleness of construction that renders equipment the ability to survive design ground motions without loss of function.
4. Equipment Materials:
   a. All components of the system shall be compatible with the conditions and chemicals to which they will be subjected to during normal operation.
   b. Compounds with which the materials of construction must be compatible include, but are not limited to:
      1) Hydrogen sulfide.
      2) Sulfuric acid.
      3) Ammonia.
      4) Dimethyl sulfide.
      5) Dimethyl disulfide.
      6) Methyl mercaptan.

1.6 SUBMITTALS

A. Procedures:

1. In accordance with Section 01 33 00, Submittal Procedures.
2. System supplier shall include project title and date of transmittal on each submittal.
3. System supplier shall identify and describe each deviation or variation from Contract Documents.
4. Resubmittals: Clearly identify each correction or change made.

B. Action Submittals: Submit Shop Drawings as follows:

1. Make, model and weight of each equipment assembly.
2. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.

3. Complete design calculations for odor control system including annual utility calculations, media residence time calculations and component pressure drop calculations.
4. Equipment anchorage and support drawings and/or cut sheets indicating size, material, spacing, embedment and edge distances of anchors and other relevant information. Drawings should reflect the results of the calculations submitted below.
5. External utility requirements such as air, water, power, drain, etc., for each component.
6. Detailed mechanical and structural layout drawings showing system fabrication, dimensions, size and locations of connections to other work.
7. Vessel data indicating equipment number, pressure rating, resin type, diameter, straight shell lengths, and overall lengths.
8. Manufacturer's Information on the Carbon Media:
    a. Pressure drop data through media.
    b. Media physical characteristics demonstrating compliance with this specification.
9. Shop and Field Painting Systems: Include manufacturer's descriptive technical catalog literature and specifications.
10. Control panel details including electrical wiring diagrams
11. Detailed Performance Testing Plan meeting the requirements of Article Performance Testing.

C. Informational Submittals:

1. Manufacturer's Certificate of Compliance:
    a. Submit prior to shipment of product.
    b. Refer to Section 01 43 33, Manufacturers' Field Services.
2. Operation and Maintenance Data in accordance with Section 01 78 23, Operation and Maintenance Data.
3. Manufacturer's Certificate of Proper Installation:
    a. Submit a certificate for each installed system.
    b. Refer to Section 01 43 33, Manufacturers' Field Services.
4. Manufacturer's Training Program in accordance with Section 01 43 33, Manufacturers' Field Services.
5. Final Performance Test Report meeting the requirements of Article Performance Testing.
6. All deviations and/or exceptions to this Specification, detailed and explained with the reason for the deviation and the effect of the deviation on the operation and/or performance of the equipment.
7. Anchorage, Thrust Restrain, and Bracing for odor control equipment shall be in accordance with section 01 88 15. Support and anchorage calculations stamped by an Engineer licensed in the State of California. Anchorage, bracing and support design criteria and calculations shall conform to the manufacturer's requirements as well as design criteria

indicated on the Structural General Notes on the Drawings and any other referenced standards. Provide ICC-ES reports and special inspection requirements for anchors to be drilled and installed into completed concrete or masonry. Anchor calculations shall indicate edge distance, embedment, concrete thickness and strength, and other conditions assumed in the design calculations. All assumed field conditions shall be verified by the Contractor prior to installation of the anchors and bracing.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. The manufacturer shall be recognized in the design, production and operation of activated carbon odor control systems in the United States.
2. The manufacturer's place of business shall be open for inspection.
3. The odor control system supplier shall have complete, ongoing service capability with factory trained personnel. The supplier shall have a service center/manufacturing facility located in southern California within 25 miles of the jobsite for quick response. The service center/manufacturing facility shall be staffed with at least five (5) full-time employees of the odor control system supplier. A manufacturer's sales representative office and sales representative personnel staffing shall not be acceptable. No exception to this requirement will be allowed.
4. The service center/manufacturing facility shall be able to provide the following services: Field H2S measurements, Airflow rate measurements, and provision of replacement parts and operational trouble-shooting.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, components, and accessories specified in this Section shall be products of:

1. Integrity Municipal Systems, LLC
2. Or approved equal.

2.2 SERVICE CONDITIONS – GENERAL

A. The odor control systems shall be designed to remove odorous constituents from wastewater process air streams under the following operating conditions:

Process Parameter	Value
Duty	Continuous
Elevation Above Sea Level	16 feet
Location	As indicated on Drawings
Ambient Air Temperature	20 to 122 degrees F
Inlet Air Temperature	50 to 100 degrees F
Ambient Air RH	10 to 90%

2.3 SERVICE CONDITIONS – SCREENING FACILITY ODOR CONTROL (OCS-01 & OCS-02)

A. The screening facility odor control system shall be designed to remove odorous constituents from process air stream under the following operating conditions:

Process Parameter	Value
System Design Air Flow	27,000 cfm
Inlet Air RH	10 to 60%
Odorous Air Source Processes	Screening Facility channels & removal bins area
Design H2S Concentration at System Inlet	1.25 ppmv

B. The screening facility odor control carbon adsorber design shall conform to the following parameters:

Design Parameter	Value
Number of Treatment Stages	One
Number of Treatment Vessels	Two
Vessel Configuration	Dual bed, vertical flow

Design Parameter	Value
Normal Vessel Design Flow Rate	13,500 cfm
Maximum Vessel Design Flow Rate (During Maintenance of one Vessel)	16,200 cfm
Minimum Bed depth, per bed	3 ft
Unit Diameter	12'-0" – Basis of Design
Unit overall Height (with stack)	20'-6" – Basis of Design
Configuration	As indicated on Drawings
Total Vessel Air Pressure Drop	Maximum: 5.0 inches WG at vessel design flow rate
H2S Removal Required	Removal efficiency greater than 99 percent for inlet concentrations greater than 1 ppmv Outlet concentration less than 100 ppbv for inlet concentrations less than 1 ppmv

2.4 SERVICE CONDITIONS – WET WELL ODOR CONTROL SYSTEM (OCS-03 & OCS-04)

A. The wet well odor control system shall be designed to remove odorous constituents from process air stream under the following operating conditions:

Process Parameter	Value
Design Air Flow	9,000 cfm
Inlet Air RH	10 to 60%
Odorous Air Source Processes	Pump Station Wet Well
Design H2S Concentration at System Inlet	2.0 ppmv

B. The wet well odor control carbon adsorber design shall conform to the following parameters:

Design Parameter	Value
Number of Treatment Stages	One
Number of Treatment Units	Two
Vessel Configuration	Dual bed, vertical flow
Normal Vessel Design Flow Rate	4,500 cfm
Maximum Vessel Design Flow Rate (During Maintenance of one Vessel)	5,400 cfm
Minimum Bed Depth, per bed	3.0 feet
Unit Diameter	7'-0" – Basis of Design
Unit overall Height (with stack)	20'-6" – Basis of Design
Configuration	As indicated on Drawings
Total Vessel Air Pressure Drop	Maximum: 5.0 inches WG at design flow rate
H2S Removal Required	Removal efficiency greater than 99 percent for inlet concentrations greater than 1 ppmv Outlet concentration less than 100 ppbv for inlet concentrations less than 1 ppmv

2.5 CARBON VESSELS

A. General:

1. Freestanding dual bed, vertical flow tower configuration.
2. Designed to support the required bed depth of activated carbon media.
3. Manways, drains, etc., provided as needed for access to internals of the vessel and drainage of the vessel.
4. Designed to support the vessel stacks without the use of external supports or structure.
5. No exposed metal allowed inside the air plenum.
6. Vessel configuration, location and orientation as indicated on Drawings.
7. Vessel construction shall conform to the requirements of Article Vessel Construction.

B. Media Support:

1. Quantity: Sufficient to hold required bed depth of carbon media.
2. Opening size shall not allow passage of carbon media.
3. The support system shall consist of removable FRP grating with a polypropylene screen. The support system shall be designed to withstand a load of at least 150 lbs/ft2 with a minimum deflection of 6 mm under all conditions.

C. Media Grounding Rods:

1. Provide a Type 316 stainless steel grounding rod for the carbon bed to prevent static electricity from accumulating. Grounding rod shall be inserted a minimum of 12 inches into the bed.
2. Provide a predrilled and tapped copper grounding pad located on external vessel wall for connection to grounding system.

D. Vessel Stacks:

1. Provide a vertical stack accessory for each vessel outlet.
2. Each stack shall extend a minimum of five feet above the vessel.
3. Stack shall have a flange connection to the outlet. No guy wires or external support structure will be allowed.

2.6 VESSEL CONSTRUCTION

A. Material – FRP:

1. Vessel to be helically filament-wound in accordance with ASTM D2399.
2. Vessel to be designed for positive pressure service conditions.
3. A 10:1 safety factor shall be used for internal pressure loadings and a 5:1 safety factor shall be used for packing support.
4. Contact molded components and accessories shall be fabricated in accordance with ASTM D4097.
5. Visual defects shall be better than Level II on the inside of the vessel and better than Level III on the outside in accordance with ASTM D2563.
6. Other than nozzles, couplings, manways, and top and bottom heads, the towers shall be filament-wound in one piece, without joints.
7. Nozzles: Threaded or flanged, gusseted with conical type gusset. Gaskets to be 1/8-inch thick Hypalon or Viton® full-face gaskets of 40 to 50 durometer. Press-molded flanges are not acceptable.
8. Resin:

a. Resin shall be premium corrosion-resistant vinyl ester resin such as Ashland Chemical Hetron FR 992, Dow Chemical Derakane 510-A, or approved equal.
b. FRP fabrications shall not exceed a flame spread index of 25 when tested in accordance with ASTM E84 Tunnel Test.
c. Structural wall resin shall contain a minimum of 3 percent antimony trioxide to achieve the designed low flame spread index requirement.
d. Add ultraviolet absorbers to surfacing resin to improve weather resistance.
e. Color: Use no dyes, pigments, or colorants, except in the exterior gel coat. Gel coat color shall be white.
f. Curing System: Per manufacturer's recommendations.

9. Reinforcement:
   a. Veil: Chemical surfacing mat, Type C (chemical) glass, 10 mils thick, with a finish and a binder compatible with the lay-up resin.
   b. Corrosion Barrier: Resin-rich interior surface of nominal 100 mils using chopped strand mat backing the veil. Use no additive in the corrosion barrier.
   c. Chopped Stand Mat: Type E glass, minimum 1-1/2 ounces per square foot, with silane finish and styrene soluble binder.
   d. Continuous Roving Used in Chopper Gun for Spray-Up: Type E glass.
   e. Woven Roving: Type E glass, nominal 24 ounces per square yard, 4 by 5 weave, with silane type finish.
   f. Continuous Roving Used for Filament Winding: Type E glass with a silane type finish, with a nominal yield of at least 110 strand yards per pound.
10. Laminate:
   a. Laminate shall consist of an inner surface (corrosion barrier), an interior layer, and an exterior layer.
   b. Reinforce inner surface with a resin-rich surfacing veil of 10 to 20 mils thick.
   c. The resin content of the inner surface shall be minimum of 80 percent by weight.
   d. Construct interior layer of resin reinforced with at least two plies of chopped strand mat. Thickness of interior layer shall be at least 100 mils.
   e. Glass content of combined inner surface and interior layer shall be 27 percent plus or minus 5 percent.
   f. The exterior or structural layer shall be filament-wound. Filament winding shall be with continuous strand roving to provide a glass content of 50 to 80 percent.

B. Workmanship:

1. Finished tank wall shall be free, as commercially practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminations that will impair the serviceability of the vessel.
2. All cut edges where openings are cut into the tanks shall be trimmed smooth.

C. Dimensions and Tolerances:

1. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support.
2. Flat areas shall be provided to allow locating large fittings on the cylinder straight shell.
3. All dimensions will be taken with the tank in the vertical position, unfilled.
4. Tank dimensions will represent the exterior measurements.
5. The tolerance for the outside diameter, including out of roundness, shall be per ASTM D1998.
6. The tolerance for fitting placements shall be plus or minus 0.5 inch in elevation and 2 degrees radial at ambient temperature.

D. Tank Access:

1. Provide sealed carbon media access, constructed of same material as vessel.
2. Bolts shall be Type 316 stainless steel material.
3. The gaskets shall be Hypalon, EPDM or Viton® materials.

E. Marking: Identify each tank with the fabricator's name, maximum temperature, design pressure/vacuum, minimum thickness, vessel number, vessel name, and date of manufacture.

2.7 ACTIVATED CARBON MEDIA

A. Activated carbon shall be high H2S capacity, pelletized, derived from high grade bituminous coal, vapor phase type suitable for control of sewage treatment plant odors. The carbon shall have the following performance specifications:

Iodine Number, mgi2/g	1050 min
Maximum moisture content, percent by weight (per ASTM D2867)	15

Apparent density, poured, minimum (per ASTM D2854)	0.48 g/cc
Maximum head loss through bed at 30 fpm linear velocity, in. water/ft bed depth	0.5
H2S breakthrough capacity, minimum (per ASTM D6646)	0.3 g H2S removal/cc carbon
Mean Particle Diameter	4.0mm
Butane Activity	26 min
Hardness No.	95 min

B. Manufacturers and Products:

1. Integrity Municipal Systems LLC
2. Approved Equal.

2.8 ACCESSORIES

A. Lifting Lugs: For equipment weighing over 70 pounds.

B. Provide Type 316 stainless steel anchor bolts, as specified in Section 05 50 00, Metal Fabrications.

C. Equipment Identification Plates: Furnish 16-gauge Type 316 stainless steel or FRP laminated identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear 3/8-inch high engraved block type black enamel filled equipment name, model number, and performance data.

D. Each vessel shall have one (1) 1 in diameter air outlet sample probes per bed with piping extending to within operator reach. The sample probes shall be blocked off with a ball valve constructed of PVC. An air inlet sample probe shall be provided at the vessel inlet.

E. Differential Pressure Gauge: A Series 2000 differential pressure gauge as manufactured by Dwyer Instruments shall be provided to continuously monitor the pressure drop across each carbon bed. The differential pressure gauge shall be isolated with isolation valves and shall be mounted on the vessel.

2.9 SOURCE QUALITY CONTROL

A. Factory Test: Perform manufacturer's standard tests on equipment.

2.10 EXHAUST FANS

A. Fan shall have fiberglass reinforced plastic centrifugal backward inclined impeller. Wheel shall be statically and dynamically balanced. Resin shall be suitable for exposure to the specific service conditions. Shaft shall be 316SS. Shaft seal shall be Teflon or Neoprene.

B. Bearings shall be heavy duty, self-aligning grease lubricated ball type with minimum of 100,000 hour B-10 life. OSHA approved weather cover or guards shall be provided.

C. Fan shall be supplied with a TEFC inverter-duty motor with 1.15 service factor suitable for three-phase, 60 Hz, 480 volt service. The fan shall be belt driven.

D. Fan housing shall be constructed of fiberglass and reinforced with rigid bracing to increase structural integrity. The fan shall include graphite impregnation for grounding. The fan inlet shall be slip type and the fan outlet shall have a flanged connection. The fan inlet shall be connected to the inlet ductwork via a flexible boot with stainless-steel straps.

E. Performance. The fan shall be tested and rated in accordance with AMCA and shall bear the AMCA seal.

F. The fan shall be New York Blower, Hartzell or equal. The fan shall be designed for the following performance:

Model Number	**EF-01/EF-02**	**EF-04/EF-05**
Maximum Airflow Rate, cfm	16,200	5,400
Normal Airflow Rate, cfm	13,500	4,500
S.P. up to System Inlet, in W.C	2.0	2.0
Total Pressure Drop, in W.C	7.0	7.0
Motor, HP	30	10

2.11 ELECTRICAL CONTROL PANEL

A. Each carbon adsorber system shall be provided with an electrical control panel that houses all required controls for the entire system. The electrical control panel shall be shipped loose for installation by the contractor next to each odor control system.

B. The control panel enclosure shall be rated NEMA 4X and shall be made of FRP. The control panel shall be factory tested prior to shipment.

C. The control panel shall provide electrical control for the entire system with as a minimum the following switches, alarms and accessories:

1. "Hand-Off" switch for exhaust fan
2. "Exhaust Fan Running" indicator light
3. Exhaust fan VFD (Allen_Bradley Model 523)
4. Power disconnect switch
5. Control transformer (step down from 480V to 120V)

D. The power supply shall be 480V, 3 hp, 60 Hz.

2.12 INTERCONNECTING DUCTWORK AND DAMPER

A. The odor control system manufacturer shall provide the required FRP transition piece between the fan outlet and the adsorber vessel inlet. The vessel inlet shall include a volume control damper with lockable louver for flow adjustment.

2.13 PORTABLE H2S ANALYZERS

A. The odor control system manufacturer shall provide two (2) portable H2S analyzer to allow the end-user to take H2S measurements. One analyzer shall be for high H2S concentrations and the second one for low H2S concentrations.

B. The analyzers shall be Interscan 4000 Series Compact Portable Analyzers including a 3.5" digit LCD readout display, an integral sample pump and plug-in charger, an H2S sensor, a user-adjustable single alarm level activating audible and visual alarm, 0-100 mV output, a carrying case with shoulder strap and a 12 inch Teflon sample probe.

C. The high range analyzer shall have a 0-200 ppm sensor with resolution of 0.1 ppm and minimum detectability up to 2 ppm. The low range analyzer shall have a 0-2 ppm sensor with resolution of 0.01 ppm and minimum detectability up to 0.02 ppm.

D. A spare sensor shall be provided for each H2S analyzer.

PART 3 EXECUTION

3.1 GENERAL

A. Packaged Equipment: When any system is provided as prepackaged equipment, coordination shall include space and structural requirements, clearances, utility connections, signals, outputs and features required by the manufacturer, including safety interlocks.

3.2 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. Anchor Bolts: Anchor and brace per Contractor's anchorage and bracing design calculations.

3.3 FIELD FINISHING AND CORROSION PROTECTION

A. Field touchup as determined by manufacturer.

3.4 PERFORMANCE TESTING

A. General:

1. To demonstrate that the odor control systems furnished hereunder are installed and perform in accordance with the provisions of this Specification, the manufacturer shall conduct a performance test in accordance with an approved testing protocol.
2. The performance test shall not commence until a Performance Testing Plan has been submitted and approved, and the functional testing has been completed. The detailed Performance Testing Plan shall include as a minimum:
    a. Test equipment and apparatus.
    b. Calibration and setup procedures.
    c. The specific testing methodology to be used.
    d. The sampling and analysis procedures.
3. The manufacturer shall provide, install, and maintain, if required, all temporary metering or analytical equipment necessary to measure the various performance parameters.
4. The manufacturer shall inform the Engineer at least 14 days prior to the start of any performance testing. The Engineer shall have the right to

observe, sample, and make any parallel determinations during the performance test.

5. Within 30 days after the conclusion of the test period, the manufacturer shall submit a Performance Test Report, including:
   a. Narrative of the testing activities.
   b. All laboratory and field test data, a copy of the original sampling log, photographs showing locations of flow and pressure measurements, tabular summary of velocity, airflow rates, pressures, H2S data, and calculated results.
   c. The conclusions of the test with regard to the performance criteria.
   d. Description of all deviations to the Performance Testing Plan.

B. Performance Tests:

1. Conduct performance test on the system under actual operating conditions as described in this section.
2. Test under actual loading condition for 8 continuous hours.

C. Test Conditions:

1. The performance test shall be conducted while the sources being controlled are fully operational.
2. All testing, adjusting, and balancing of the entire odor control system shall have been completed and approved.
3. The test shall be conducted over an 8-hour period.
4. The actual sample day shall be chosen for low wind speeds and no rain.

D. Sampling and Data Measurement: During the test period, as a minimum, the following data and measurements shall be taken at the frequency indicated:

1. System Airflow Rate:
   a. Every 8 hours.
   b. Measurement of airflows will be performed using an anemometer or pitot tube instrument previously approved by Engineer.
2. Differential Pressures:
   a. Vessel Differential Pressure in Inches of WC: Every 4 hours.
3. Hydrogen Sulfide Concentrations:
   a. Vessel Inlet: Every 4 hours.
   b. Vessel Outlet: Every 4 hours.
   c. Hydrogen sulfide sampling shall be completed using an approved analyzer with a detection limit of 1 ppbv and operated in compliance with the manufacturer's instructions.
4. Sampling Log: A sampling log shall be maintained that will include:
   a. Date, time, location, sampler, and results of each sample.
   b. A description of each photograph taken.

c. Weather conditions for the sampling day.
d. A qualitative description of the operation of the treatment processes.
e. A description of any exceptions from the sampling plan.

E. Analysis:

1. Vessel Pressure Drop: Pressure differential measurements shall demonstrate that differential pressure (pressure drop) across the vessel does not exceed pressure limits specified.
2. Hydrogen Sulfide Sampling and Analysis:
   a. Individual performance results will then be calculated by Percent Removal equals (Inlet - Outlet)/Inlet. Individual removal rates shall demonstrate that the minimum removal efficiencies or minimum outlet concentrations are achieved as specified.

F. Retesting: In the event the system fails to meet the performance requirements, the manufacturer shall immediately make the necessary modifications, adjustments, and/or facility expansions to meet these requirements. The steps taken by the manufacturer shall include, as necessary, design and construction of additional capacity, upgrades to the system, and replacement of the media, all at no additional cost to the Owner.

1. Additional performance tests will be conducted by manufacturer until the performance requirements are met, at no additional cost to the Owner.
2. If after two retests the performance requirements are still not met, the Owner will have the option, at the Owner's sole discretion, to accept the system as is or obtain a replacement at the expense of the manufacturer.
3. The maximum time between each retest will be 30 days.

3.5 FIELD QUALITY CONTROL

A. System Startup:

1. Performed by manufacturer.
2. Startup will commence following a visual inspection and check out of the system by the manufacturer's technical representative.

3.6 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection and certification of proper installation, equipment testing, startup assistance, and training of Owner's personnel for specified component, subsystem, equipment, or system.

B. Manufacturer's Representative: Present at Site or classroom designated by Owners, for minimum person-days listed below, travel time excluded:

1. 2 person-day for installation assistance and inspection.
2. 3 person-day for functional testing and completion of Manufacturer's Certificate of Proper Installation.
3. 1 person-day for facility startup.
4. 1 person-day for post-startup training of Owner's personnel.

C. Provide manufacturer's factory engineer to perform monthly services at the jobsite during the warranty period. The services shall include a monthly site visit by a factory engineer from the local service center/manufacturing facility for equipment inspection and performance review. Only services conducted by a factory engineer are acceptable. Factory engineer shall have intimate familiarity with design and operation of identical carbon systems through documented experience in the odor control industry designing, testing and servicing odor control systems of the size, materials, and scope specified herein. Services conducted by a manufacturer's sales representative or agent are not acceptable.

D. Each month, all components of the system shall be checked by the factory engineer to verify proper operation and performance. The airflow rate shall be checked and the system's proper operation and performance shall be verified. A report shall be provided for the monthly visits.

END OF SECTION

SECTION 46 21 17
MECHANICAL AND MANUAL BAR SCREENS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Welding Society (AWS):
   a. D1.1, Structural Welding Code – Steel.
   b. QC 1, Standard for AWS Certification of Welding Inspectors.
2. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. MG 1, Motors and Generators.
3. National Fire Protection Association (NFPA): 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
4. Underwriters Laboratories, Inc. (UL): 674, Standard for Safety for Electric Motors and Generators for Use in Hazardous (Classified) Locations.

1.2 UNIT RESPONSIBILITY

A. Unit Responsibility: The Work requires screens, complete with accessories and appurtenances (including, but not limited to, electric motors, shafting, safety guards, speed reducers, specified controls, and spare parts) be end product of one responsible system manufacturer or responsible system supplier. Unless otherwise indicated, obtain each system from responsible supplier of the equipment. Supplier shall furnish and coordinate components and accessories as necessary to place equipment in operation in conformance with specified performance, features, and functions indicated without altering or modifying Contractor's responsibilities under the Contract. Contractor is responsible to Owner to providing equipment systems as specified herein.

B. Design of the process for removing solids larger than 1.2 inches (30 mm) diameter from raw sewage into plant is based upon equipment from manufacturer herein listed and as shown on Drawings. Manufacturers other than named manufacturer will be responsible for coordinating layout changes and interface connections to other work and equipment which are different than that shown on Drawings. Contractor shall be responsible for coordinating this work and changes will be at sole expense of Contractor. At a minimum, these changes will include:

1. Layout of equipment within Screening Facility.
2. Coordination of equipment elevations and transitions of screenings from one piece of equipment to another.

3. Changes in electrical requirements due to differences in motor horsepower requirements or adjustable speed drive arrangements.
4. Instrumentation and control interface requirements.
5. Rerouting of piping required to meet manufacturer's system requirements.

C. Equipment specified herein shall be required to fit general overall dimensions shown on Drawings. Equipment provided under this section shall be suitable for use in a Class 1, Division 2, Group D environment.

1.3 SAFETY REQUIREMENTS

A. Equipment provided under this Contract shall be constructed with due regard to safety of operation, accessibility, and durability of parts, and shall comply with applicable safety regulations.

1.4 SUBMITTALS

A. Action Submittals:

1. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials for construction.
2. Detailed structural, mechanical, and electrical drawings showing equipment fabrications and interface with other items.
3. Dimensions, size, configuration, and locations of connections to other work, including capture/containment system.
4. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
5. Details of attachment and support in channel.
6. Gear output torque and rake weight lifting capacity calculations.
7. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and motor modifications. See Section 26 20 00, Low Voltage AC Induction Motors, for submittal requirements.
8. Functional description of internal and external instrumentation and controls including list of parameters monitored, controlled, or alarmed.
9. Control panel elevation drawings showing fabrication and placement of operator interface devices and associated elements.
10. Power and control wiring diagrams, including terminals and numbers.
11. Shop painting systems, including manufacturer's descriptive technical catalog literature and specifications.
12. External utility requirements for air, water, power, drain, for each component.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements of factory-applied coating system.
3. Welder/welding operator qualifications.
4. Welding inspector credentials.
5. Written factory test report of inspection.
6. Special shipping, storage and protection, and handling instructions.
7. Manufacturer's installation instructions.
8. Field functional test reports.
9. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data, including routine maintenance requirements prior to plant startup.
10. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.5 QUALIFICATIONS

A. Welder/Welding Operator: In accordance with AWS D1.1/D1.1M.

B. Welding Inspector: Certified in accordance with AWS QC 1, and having prior experience with welding codes specified.

1.6 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at option of Owner, removal and replacement of Work specified in this Specification section found defective during period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. Furnish two (2) model ag-s-t 85, 6'-0" wide x 38'-6" discharge height, 30 mm Aqua guard® mechanical filter screen units, as supplied by Parkson Corporation, Vernon hills, IL, or approved equal. The Aqua guard® units will consist of a frame assembly, filter belt/screen assembly, drive assembly, rotating brush assembly, and discharge chute.

B. The automatic bar/filter screens will be designed to positively clean and remove debris up to 7 inches in diameter from the influent stream by means of high impact plastic filter elements designed to retain and elevate debris to the discharge point of the unit where the rotating brush assembly cleans the

elements.

C. The units shall be suitable for installation and operation in a channel measuring 6 feet wide and 11 feet deep. The angle of inclination shall be 85 degrees from horizontal. The opening from which the unit discharges screenings from its enclosure shall be at least 6 feet above the operating floor elevation at which the screen is supported. this is the available clearance for the container/compactor to collect the debris. The total discharge height of the screen, as measured from its base to the screenings discharge point, shall be 38'-6" feet. There shall be a 6-inch recess (notch) in the channel bottom to accommodate the base of the screen.

D. The screen shall be capable of passing a maximum peak flow of 37.7 mgd based on a nominal unit width of 6 feet, with a downstream water level of 4 feet. The head loss at the maximum flow of clean water shall not exceed 13 inches. The calculated head loss is based on the assumption of a clean screen, clean water, and steady state flow conditions.

E. The screen shall be capable of presenting a clean filtration surface to the influent stream at all times during continuous operation. it shall be capable of intermittent operation in order to form a mat of material to provide maximum trash removal. Additionally, in order to maximize the capture of paper, rags, and other flexible debris, which tends to drape over and adhere to the filtration surfaces, the screen shall have 0.547 square feet of contact surface area per square foot of wetted filtration belt frontal surface.

2.2 MANUFACTURERS

A. Where manufacturer's standard equipment name and/or model number is listed, equipment system shall be provided as modified to conform to performance, functions, features, and materials of construction as specified herein.

B. Equipment Layout: Layout depicted on Drawings is based upon first named manufacturers' products. Provide detailed drawings showing proposed variations from the Contract Documents including but not limited to affected equipment, access requirements, piping, or other auxiliary equipment to be provided per these Specifications.

C. Equipment and accessories specified in this section shall be products of:

1. Model ag-s-t 85, Aqua guard® mechanical filter screen units, as supplied by Parkson Corporation, Vernon hills, IL.
2. Or approved equal.

2.3 SERVICE CONDITIONS

A. Material Handled: Raw, unscreened sewage

B. Location:

1. Indoors.
2. Exposure: Variable concentrations of hydrogen sulfide, methane, and ammonia. Air inside equipment enclosure will be saturated with moisture.

C. Equipment Environment Application Rating: Class I, Division 2.

2.4 SCREEN EQUIPMENT

A. FRAME ASSEMBLY

1. The frame of the unit, which is stationary, shall be constructed from type 316 stainless steel with a minimum thickness of 5/8 inch. It supports and locates all of the operating components. The unit shall rest at the bottom of the channel, and be anchored at the operating floor elevation. No mounting or fastening of the unit frame shall be required to the sidewalls or bottom of the channel.
2. The "T" frame unit shall be supported at the operating floor elevation by welded supports on each side of the unit. The supports will be constructed from type 316 stainless steel. It will not be possible to pivot the screen from the channel, and an alternate method of bypassing the screen should be available. Routine service of the unit is possible with the screen in the channel.

3. Guide rails shall be mounted to each side on the inside surface of the frame to direct the filter belt during its ascension out of the channel. The guide rails shall be 1 inch thick and will be constructed from type 316 stainless steel. A center guide rail shall be supplied to direct the center chain of the filter belt during its ascension out of the channel. The guide rail shall be 1 inch thick and will be constructed from type 316 stainless steel.
4. At the top of the screen, circular chain guides shall gently direct the filter belt from its ascending path out of the channel towards the drive sprockets. These circular guides shall be constructed from type 316 stainless steel and shall be welded to a type 316 stainless steel shaft. In order to reduce the wear on both the chain and chain guides, the shaft shall be secured to bearings on each side of the frame and free to rotate.
5. Circular chain guides shall also be provided to direct the filter belt from the drive sprockets to the descending path into the channel. These circular guides shall be constructed from 3/4-inch thick type 316 stainless steel and shall be welded to a type 316 stainless shaft. In order to reduce the wear on both the chain and chain guides, the shaft shall be secured to bearings on each side of the frame and free to rotate.
6. Lower return guides shall be provided at the base of the screen to direct the filter belt during its 180-degree turn from the descending to ascending paths. The lower guide rails shall be constructed from type 316 stainless steel and shall be fixed in place as low as possible in the frame to optimize the submerged screen area. No submerged bearing or rotating guides are used that will require routine maintenance or that may become fouled by trash and debris.
7. Neoprene rubber seals with type 316 stainless steel backing plates shall be mounted along the upstream edges of the frame to seal the outer edge of the frame against the channel wall, and the area between the frame and filter belt side plates. Neoprene rubber seals with type 316 stainless steel backing plates shall be mounted to the upstream side of the screen to seal the area occupied by the center chain assembly
8. The bottom of the unit shall be sealed with two rows of nylon brushes, which allow the elements to pass through, but prevents trash from passing beneath the filter elements, ensuring capture of all solids and trash by the filter belt.
9. All shaft bearings shall be mounted externally to the side frame for ease of access and maintenance.
10. The portion of the screen above the intermediate level (elevation -4.00) shall be equipped with covers to help control the emission of odors and protect operators from contact with moving parts. The covers will also minimize misting and dripping. All enclosures shall be removable. There shall be hinged sections on the front and rear of the unit for access to the screen for periodic maintenance. The covers shall be fabricated from 14-gauge type 316 stainless steel.

B. FILTER BELT/SCREEN ASSEMBLY

1. The screen shall provide dual filtration of all materials in order to minimize compaction of captured debris and minimize the head loss through the screen. This shall be accomplished by recessing the horizontal fine filtration opening in the face of the screen. The coarse horizontal openings formed by the upper or forward shank/arm of the elements shall be 68 millimeters and shall be the first opening the flow stream contacts as it passes through the screen. The lower or recessed shank/arm of the elements shall create a two dimensional grid which limits the maximum vertical opening to 35 millimeters and the fine horizontal opening of 30 millimeters. This restricted opening profile is required to prevent long, thin materials from passing through the grid by aligning themselves so that the long axis is parallel with the vertical opening. The elements are arranged in a staggered fashion to form an endless belt and to create a range of motion that allows the recessed shank/arm of one row of elements to pass through the plane of the forward arm of the next row of elements it meshes with. Each filter element shall be a single molded component with a rake integral to its shape. The filter belt shall form a row of these rakes spaced every 8 inches, capable of lifting material of up to 7 inches in diameter out of the channel. The elements are secured to two separate filter shafts that pass through individual bosses in the elements.
2. The side plates (or end plates) are mounted next to the outermost elements of each filter row, and overlap to form a continuous moving sidewall for the filter belt. This moving wall prevents captured trash and debris from spilling over the sides of the filter belt. The side plates shall be constructed from a high strength phenolic resin.
3. The tension of the moving screen/filter belt assembly shall be completely supported by a stainless steel link chain. The chain must connect the filter shaft ends on both sides of the belt assembly so that the elements are free of tension, and support no weight of the assembly. The chain shall be of closed link design with 2 link sidebars, chain rollers and pins per link. The chain assembly shall have a minimum cross sectional area of 0.203 square inches at the weakest point of any individual link.
4. In order to ensure that the filter belt is adequately supported, an additional stainless steel link chain shall be provided at the center of the filter belt assembly. The chain shall be of closed link design with 2 link sidebars and pins per link. The chain assembly shall have a minimum cross sectional area of 0.203 square inches at the weakest point of any individual link sidebar.
5. Chains shall be supplied with hollow pins that allow for the removal and replacement of the filter shafts, side plates and filter elements without releasing the chain tension. The unit is designed to allow this function to take place at the operating floor elevation with the screen in the channel. Chain rollers shall have a diameter of 3 inches.

6. All chain components shall be corrosion resistant stainless steel. Sidebars shall be type 316 stainless steel. Pins, rollers, and bushings shall be type 17/4 stainless steel. 17/4 series components shall be heat treated to a minimum hardness of 39 on the Rockwell C Scale.
7. The filter shafts shall have a maximum diameter of 1-3/8 inch and be spaced on 8-inch centers in the direction of travel of the filter belt. The shafts shall be constructed from type 316 stainless steel.

C. DRIVE ASSEMBLY

1. The drive assembly consists of a gear reducer, motor, drive sprocket, driven sprocket, drive chain, drive chain idler, drive shaft, and take up bearings. The drive mechanism shall be protected from the trash stream to ensure that the screen runs smoothly without jamming. The driving force must be transmitted to clean, trash free components to avoid mis-tracking or binding, which could render the screen inoperable, requiring manual cleaning and realignment.
2. The gear reducer is to be of cycloid gear design by Sumitomo, mounted directly to the unit at the top of the frame and connected to the drive shaft with a with the drive chain, drive and driven sprockets. The reducer shall be designed in accordance with AGMA recommendations for Class II service based on the required horsepower for operation of the machine.
3. The motor shall be a squirrel cage induction motor, TEFC, 230/460 volt, 3- phase, 60 Hertz, 1800 RPM by Baldor. The motor shall be minimum 2 HP. Motor shall be rated for use in a Class 1, Division 1, Group D environment.
4. Overload protection shall be provided by an electrical overload device that senses motor current draw.
5. The filter belt drive shaft is located in the head of the unit and is supported at each end by the take up bearings. The filter belt sprockets that engage the filter belt chain rollers and transmit motion to the filter belt assembly are welded to the drive shaft. The drive shaft and sprockets shall be constructed from type 316 stainless steel. The stub ends shall be constructed from type AISI 4140.

D. ROTATING BRUSH ASSEMBLY

1. The filter belt assembly is cleaned via the interaction of the filter elements, the rotating brush assembly. No other mechanical devices capable of jamming (i.e. doctor blade) are required to remove the captured material.
2. The rotating brush assembly is supported by bearings on each side of the machine mounted externally to the machine frame. The brush is chain driven by the filter belt drive shaft.
3. The brush is comprised of three separate components, the brush shaft, the brush and the brush hubs. The shaft is made of type 316 stainless steel. The brush is composed of nylon bristles and secured to the shaft at each end by the brush hubs. The brush hubs are made of stainless steel.

4. The brush shall be orientated in a paddlewheel design with rows of bristles located at 90,180, 270, and 360 degrees. Between each of the bristles are bridge flaps to reduce wrapping of solids around the brush shaft. The brush diameter shall be 15 inches minimum.

E. DISCHARGE CHUTE

1. A discharge chute shall be provided integral to the machine, constructed from 14 gauge type 316 stainless steel and designed to direct the screenings to the collection equipment below.

F. LUBRICATION

1. Lubrication lines shall be extended from each bearing housing to central point's located on each side of the machine, accessible from the operating floor for ease of maintenance.

G. FASTENERS

1. All fasteners shall be type 316 stainless steel.

H. SURFACE FINISH

1. All structural members will be mechanically cleaned using Dupont Starblast. Sheet metal components such as covers or the discharge chute will be furnished with a 2B finish.
2. All other appurtenances including roller chain, brush sprockets, bearing housings, motor, reducer, etc. shall be supplied with the manufacturer's standard finish.

2.5 ELECTRICAL DEVICES AND CONTROLS

A. ELECTRICAL DEVICES: Interconnecting conduit and wiring will be the responsibility of the installing contractor. In addition to the drive motor, the following electrical devices will be furnished with each unit:

1. E-STOP STATION: A NEMA 7 local E-stop pushbutton will be mounted to the frame of the unit.
2. EXPLOSION PROOF ULTRASONIC LEVEL TRANSDUCER: A NEMA 4X Milltronics HydroRanger 200 ultrasonic level controller will be supplied with one (1) ST-H transducer, FM rated for Class 1, Division 1, Groups C and D. Provide integral transducer cable with a 1 inch NPT conduit connection of length required from transducer to transmitter. A type 316 stainless steel mounting bracket will be provided for each sensor.

B. CONTROLS: The following controls will be provided:

1. A 480 Volt primary control panel in a remotely located NEMA 4X type

316 stainless steel enclosure suitable for wall mounting. It will contain the following logic devices for proper operation of the equipment:

a. Programmable relay to perform necessary logic functions and monitor equipment mounted electrical devices.
b. Emergency Stop push button.
c. Hand-Off-Auto and Timer Enable/Disable selector switch for screen operation.
d. Control power and run indicating lights.
e. Motor current monitor and hour meter.
f. Fault indicating light and system reset pushbutton.
g. Run and fault auxiliary output contacts for customer use.

2. A step-down control transformer, motor starter and fused disconnect will be provided.

C. SEQUENCE OF OPERATION

1. Refer to the control panel drawing for project specific sequence of operations.

D. SPARE PARTS

1. The following spare parts will be provided for each unit
   a. Twenty (20) Filter elements.
   b. Ten (10) Side plates.
   c. Twenty (20) Snap rings 1-3/8" diameter.
   d. Ten (10) Snap rings 1-11/16" diameter.
   e. One (1) Rotating brush core replacement assembly.

E. ANCHOR BOLTS

1. Anchors are supplied by others. The anchorage of the screen is designed around the HILTI HY-200 Epoxy Anchoring system. Anchor size and embedment to be confirmed with structural calculation submittal.

2.6 MANUAL BAR RACK WITH TOP HINGE

A. Provide an aluminum manual bar rack with a top swivel as shown on the Drawings. All fixed and moving parts shall be fabricated of aluminum. Clear opening between bars shall be 1 inch. Bar thickness perpendicular to flow direction shall be 3/8-inch. Bar width parallel to flow direction shall be 1 inch. Top hinge shall be a solid shaft. Provide 316 stainless steel lifting hooks factory welded to each of the four corners. Range of travel for bar rack swivel shall be a minimum of 180 degrees.

2.7 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments:

1. Test each screen assembly including control panel, in its operating position, to ensure meshing of rakes and bar screen field, and operation of protective devices and override controls.
2. Run equipment and test for minimum of 1 hour in dry conditions and 5 hours in wet conditions. Testing shall be done in factory with unit oriented in its installed position.

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. Anchor Bolts: Accurately place using templates provided by manufacturer and as specified in Section 05 50 00, Metal Fabrications.

3.2 FIELD FINISHING

A. Finish coat, following touchup of damage to primed areas, of non-stainless-steel ferrous metal, in accordance with and as specified in Section 09 90 00, Painting.

3.3 FIELD QUALITY CONTROL

A. Functional Test: Conduct on each mechanically cleaned bar screen assembly. Test shall include 6 hours continuous operation of each screen.

B. Field Tests:

1. Demonstrate screening systems are capable of meeting performance requirements. All installed screens shall be tested. Noticeable damage to equipment shall be considered a failure. Deflection greater than approved by Engineer shall be considered a failure.
   a. Screen Operation—Maximum Headloss: Demonstrate screen drive system is sufficient to move rakes with maximum allowable headloss as shown in performance criteria. Amperage draw shall be monitored to verify motor is within capacity.
   b. Headloss at Operating Condition: Demonstrate a headloss less than maximum while passing design flow.

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner for minimum person-days listed below, travel time excluded:

1. Two person-days for installation assistance and inspection.
2. Two person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. One person-day for prestartup classroom and field training.
4. Two person-days for facility startup.
5. Two person-day for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Owner.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Testing, Integration, and Startup.

3.5 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are part of this Specification.
   1. Screen Data Sheet.

END OF SECTION

SCREEN DATA SHEET

Project: Morena Pump Station and Conveyance System Project: Construction Package A

Owner: City of San Diego Public Utilities

Equipment Name: Mechanical Screen

Equipment Tag Number(s): ME-01 and ME-02

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer

Hazardous Location: ☒ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark

Motor Horsepower: _____ Guaranteed Minimum Efficiency at Full Load: See Section 26 20 00, Low-Voltage AC Induction Motors

Voltage: 460 Guaranteed Minimum Power Factor at Full Load: See Section 26 20 00, Low-Voltage AC Induction Motors

Phase: 3 Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☒ 1.15

Frequency: 60 Enclosure Type: CISD TEFC

Synchronous Speed: _____ rpm Mounting Type: ☐ Horizontal ☐ Vertical

☐ Multispeed, Two-Speed:

_____ / _____ rpm

☒ Constant Speed

☐ Variable Torque

☐ Constant Torque

Winding: ☐ One ☐ Two

☐ Vertical Shaft: ☐ Solid ☐ Hollow

☐ Vertical Thrust Capacity (lb): Up _____ Down _____

☐ Adjustable Speed Drive: See Section 26 29 23, Low-Voltage Variable Frequency Drive System

Operating Speed Range: _____ to _____ % of Rated Speed

☐ Thermal Protection: _

☐ Space Heater: _____ volts, single phase Oversize

☐ main terminal (conduit) box for motors

☐ Terminal for connection of equipment grounding wire in each terminal box

Additional Motor Requirements: ☒ See Section 26 20 00, Low-Voltage AC Induction Motors

Special Features: _____

Rated for Class I, Division 1, Group D areas.

SUPPLEMENTARY SPECIAL PROVISIONS

APPENDICES

APPENDIX A

MITIGATION MEASURES

EXHIBIT C

MITIGATION MONITORING AND REPORTING PROGRAM
PURE WATER NORTH CITY PROJECT SITE DEVELOPMENT PERMIT
PROJECT NO. 499621/SCH NO. 2016081016

This Mitigation Monitoring and Reporting Program is designed to ensure compliance with Public Resources Code Section 21081.6 during implementation of mitigation measures. This program identifies at a minimum: the department responsible for the monitoring, what is to be monitored, how the monitoring shall be accomplished, the monitoring and reporting schedule, and completion requirements. A record of the Mitigation Monitoring and Reporting Program will be maintained at the offices of the Land Development Review Division, 1222 First Avenue, Fifth Floor, San Diego, CA, 92101. All mitigation measures contained in the Environmental Impact Report No. 499621 shall be made conditions of Pure Water North City Project Site Development Permit as may be further described below.

Mitigation Monitoring and Reporting Program (MMRP)

Section 21081.6 of the California Environmental Quality Act (CEQA) requires that a mitigation, monitoring, and reporting program (MMRP) be adopted upon certification of an Environmental Impact Report (EIR) to ensure that the mitigation measures are enforceable and implemented. It stipulates that "the public agency shall adopt a reporting or monitoring program for the changes made to the project or conditions of project approval, adopted in order to mitigate or avoid significant effects on the environment. The reporting or monitoring program shall be designed to ensure compliance during project implementation."

This MMRP has been developed in compliance with Section 21081.6 of CEQA and identifies (1) mitigation measures to be implemented prior to, during, and after construction of the North City Project; (2) the individual/agency responsible for that implementation; and (3) criteria for completion or monitoring of the specific measures.

The Environmental Impact Report/Environmental Impact Statement (EIR/EIS), incorporated herein as referenced, focused on issues determined to be potentially significant by the City. Public Resources Code Section 21081.6 requires mitigation of only those impacts identified as significant or potentially significant. The environmental analysis resulted in the identification of mitigation measures that would reduce potentially significant impacts for the following issue areas: air quality; biological resources; health and safety/hazards; historical resources; noise; paleontological resources; public utilities; and transportation, circulation, and parking.

A. GENERAL REQUIREMENTS – PART I: Plan Check Phase (prior to permit issuance/NTP)

1. Prior to issuance of a Notice to Proceed (NTP) or any construction permits, including but not limited to, the first Demolition Plans/Permits, and Building Plans/Permits, the Assistant Deputy Director (ADD) Environmental Designee of the Land Development Review Division shall verify that all mitigation measures listed in this EIR/EIS have been included in entirety on the submitted construction documents and contract specifications, and included under the heading, "Environmental Mitigation Requirements." In addition, the requirements for a Preconstruction Meeting shall be noted on all construction documents.

2. The ED shall verify that the MMRP Conditions/Notes that apply ONLY to the construction phases of this project are included VERBATIM, under the heading, "**ENVIRONMENTAL/MITIGATION REQUIREMENTS**."

3. These notes must be shown within the first three (3) sheets of the construction documents in the format specified for engineering construction document templates as shown on the City website:

   http://www.sandiego.gov/development-services/industry/standtemp.shtml

4. The TITLE INDEX SHEET must also show on which pages the "Environmental/Mitigation Requirements" notes are provided.

B. GENERAL REQUIREMENTS – PART II: Post Plan Check (After permit issuance/Prior to start of construction)

1. **PRE- CONSTRUCTION MEETING IS REQUIRED TEN (10) WORKING DAYS PRIOR TO BEGINNING ANY WORK ON THIS PROJECT.** The PERMIT HOLDER/OWNER is responsible to arrange and perform this meeting by contacting the CITY RESIDENT ENGINEER (RE) of the Field Engineering Division and City staff from MITIGATION MONITORING COORDINATION (MMC). Attendees must also include the Permit holder's Representative(s), Job Site Superintendent and the following consultants:

   Qualified Monitoring Biologist
   Qualified Archaeologist/Archaeological Monitor
   Qualified Native American Monitor
   Qualified Paleontological Monitor

   Note: Failure of all responsible Permit Holder's representatives and consultants to attend shall require an additional meeting with all parties present.

CONTACT INFORMATION:

a) The PRIMARY POINT OF CONTACT is the **RE** at the **Field Engineering Division – (858) 627-3200**

b) For Clarification of ENVIRONMENTAL REQUIREMENTS, it is also required to call **RE and MMC at (858) 627-3360**

2. **MMRP COMPLIANCE:** This Project, Project Tracking System (PTS) No. 499621 and Environmental Document No. 49962 shall conform to the mitigation requirements contained in the associated Environmental Document and implemented to the satisfaction of the DSD's Environmental Designee (MMC) and the City Engineer (RE). The requirements may not be reduced or changed but may be annotated (i.e. to explain when and how compliance is being met and location of verifying proof, etc.). Additional clarifying information may also be added to other relevant plan sheets and/or specifications as appropriate (i.e., specific locations, times of monitoring, methodology, etc.

   Note: Permit Holder's Representatives must alert RE and MMC if there are any discrepancies in the plans or notes, or any changes due to field conditions. All conflicts must be approved by RE and MMC BEFORE the work is performed.

3. **OTHER AGENCY REQUIREMENTS:** Evidence of compliance with all other agency requirements or permits shall be submitted to the RE and MMC for review and acceptance prior to the beginning of work or within one week of the Permit Holder obtaining documentation of those permits or requirements. Evidence shall include copies of permits, letters of resolution or other documentation issued by the responsible agency.

   The owner/permittee shall provide evidence that all required regulatory permits, such as those required under Section 404 of the federal Clean Water Act, Section 1600 of the California Fish and Game Code, and the Porter-Cologne Water Quality Control Act, has been obtained.

4. **MONITORING EXHIBITS:** All consultants are required to submit, to RE and MMC, a monitoring exhibit on a 11x17 reduction of the appropriate construction plan, such as site plan, grading, landscape, etc., marked to clearly show the specific areas including the **LIMIT OF WORK**, scope of that discipline's work, and notes indicating when in the construction schedule that work will be performed. When necessary for clarification, a detailed methodology of how the work will be performed shall be included.

5. **OTHER SUBMITTALS AND INSPECTIONS:** The Permit Holder/Owner's representative shall submit all required documentation, verification letters, and requests for all associated inspections to the RE and MMC for approval per the following schedule:

Document Submittal/Inspection Checklist

Document Submittal/Inspection Checklist		
Issue Area	**Document Submittal**	**Associated Inspection/Approvals/Notes**
General	Consultant Qualification Letters	Prior to Preconstruction Meeting
General	Consultant Construction Monitoring Exhibits	Prior to or at Preconstruction Meeting
Biology	Biologist Limit of Work Verification	Limit of Work Inspection
Biology	Biology Reports	Biology/Habitat Restoration Inspection
Visual Quality	Retaining Wall Verification Letter	Retaining Wall Inspection
Paleontology	Geology	As graded Soils Report
Archaeology	Archaeology Reports	Archaeology/Historic Site Observation
Noise	Acoustical Reports	Noise Mitigation Features Inspection
Traffic	Traffic Reports	Traffic Features Site Observation

C. Specific MMRP Issue Area Conditions/Requirements

Air Quality

MM-AQ-1 The following best management practices shall be implemented during construction to comply with applicable San Diego Air Pollution Control District (SDAPCD) rules and regulations and to further reduce daily construction emissions:

- Best management practices that could be implemented during construction to reduce particulate emissions and reduce soil erosion and trackout include the following:
    - Cover or water, as needed, any on-site stockpiles of debris, dirt, or other dusty material.
    - Use adequate water and/or other dust palliatives on all disturbed areas in order to avoid particle blow-off. Due to current drought conditions, the contractor shall consider use of a SDAPCD-approved dust suppressant where feasible to reduce the amount of water to be used for dust control. Use of recycled water in place of potable water shall also be considered provided that the use is approved by the City of San Diego and other applicable regulatory agencies prior to initiation of construction activity.[1]

1 The use of recycled water for construction purposes requires approval of the City and other regulatory agencies on a case-by-case basis. The permit shall be obtained prior to beginning construction. Recycled water used for construction purposes may only be used for soil compaction during grading operations, dust control, and consolidation and compaction of backfill in trenches for non-potable water, sanitary sewer, storm drain, gas and electric pipelines. Equipment operators shall be instructed about the requirements contained herein and the potential health hazards involved with the use of recycled water. Water trucks, hoses, drop tanks, etc. shall be identified as containing non-potable water and not suitable for drinking. Determinations as to specific uses to be allowed shall be in accordance with the standards set forth in Title 22, Division 4 of the California Code of Regulations and with the intent of this ordinance to preserve the public health. The City may, at its discretion, set forth specific requirements as conditions to providing such services and/or require specific approval from the appropriate regulatory agencies (City of San Diego 2016a).

Use of recycled water shall be in compliance with all applicable City of San Diego Rules and Regulation for Recycled Water (City of San Diego 2016a), particularly for the protection of public health per the California Code of Regulations, Title 22, Division 4.

- Wash down or sweep paved streets as necessary to control trackout or fugitive dust.
- Cover or tarp all vehicles hauling dirt or spoils on public roads if sufficient freeboard is not available to prevent material blow-off during transport.
- Use gravel bags and catch basins during ground-disturbing operations.
- Maintain appropriate soil moisture, apply soil binders, and plant stabilizing vegetation.

MM-AQ-2 The following measures shall be adhered to during construction activities associated with the North City Project to reduce oxides of nitrogen (NO_x):

a. All diesel-fueled construction equipment shall be equipped with Tier 3 or better (i.e., Tier 4 Interim or Tier 4 Final) diesel engines.

b. The engine size of construction equipment shall be the minimum size suitable for the required job.

c. Construction equipment shall be maintained in accordance with the manufacturer's specifications.

MM-AQ-3 The City shall implement odor control systems at the NCWRP Expansion, Morena Pump Station, and Morena Wastewater Forcemain specifically designed to abate the potential odors of the facility. Odor control systems would be similar to those currently employed at City of San Diego wastewater treatment facilities to reduce odor impacts. The following odor control systems or equivalent measures shall be implemented to mitigate nuisance odors:

a. North City Water Reclamation Plant Expansion and the Morena Pump Station: NaOCl/NaOH Wet Scrubber plus carbon or Biofilter plus carbon.

b. Air/vacuum relief valves at high points along the wastewater forcemain: ferric chloride and/or High Purity Oxygen injection.

Alternatively, odors could be abated through the addition of chemicals such as iron chloride, nitrate, hydrogen peroxide, sodium hypochlorite, high purity oxygen, magnesium hydroxide, and/or caustic solutions to reduce the liquid phase concentration and thus, reduce the amount volatilized into the gas phase.

Biological Resources

Introduction to MM-BIO-6

Project construction within 500 feet of the San Diego River, Rose Creek, San Clemente Creek and any other sensitive riparian areas may have adverse indirect impacts on least Bell's vireo and southwestern willow flycatcher if construction occurs during the breeding season from March 15 through September 15 for least

Bell's vireo and May 1 through September 1 for southern willow flycatcher and the species are determined to be present.

MM-BIO-6 **Riparian Birds.** Prior to the preconstruction meeting, the Assistant Deputy Director (ADD) or MMC shall verify that MHPA boundaries and the Project requirements regarding the least Bell's vireo and southwestern willow flycatcher, as specified below, are shown on the construction plans.

No clearing, grubbing, grading, or other construction activities shall occur during the least Bell's vireo breeding season (March 15 to September 15) and southwestern willow flycatcher breeding season (May 1 to September 1), until the following requirements have been met to the satisfaction of the ADD/MMC:

1. A Qualified Biologist (possessing a valid Endangered Species Act Section 10(a)(1)(a) Recovery Permit) shall survey those habitat areas within the MHPA that would be subject to construction noise levels exceeding 60 decibels [dB(A)] hourly average for the presence of the least Bell's vireo and southwestern willow flycatcher. Surveys for least Bell's vireo and southwestern willow flycatcher shall be conducted pursuant to the protocol survey guidelines established by the USFWS within the breeding season prior to the commencement of any construction. If least Bell's vireo, and/or southwestern willow flycatcher are present, then the following conditions must be met:

    a. Between March 15 to September 15 for least Bell's vireo and May 1 to September 1 for southwestern willow flycatcher, no clearing, grubbing, or grading of occupied habitat shall be permitted. Areas restricted from such activities shall be staked or fenced under the supervision of a Qualified Biologist; and

    b. Between March 15 to September 15 for least Bell's vireo and/or May 1 to September 1 for southwestern willow flycatcher no construction activities shall occur within any portion of the site where construction activities would result in noise levels exceeding 60 dB(A) hourly average at the edge of occupied habitat. An analysis showing that noise generated by construction activities would not exceed 60 dB(A) hourly average at the edge of occupied habitat must be completed by a Qualified Acoustician (possessing current noise engineer license or registration with monitoring noise level experience with listed animal species) and approved by the ADD/MMC at least 2 weeks prior to the commencement of construction activities. Prior to the commencement of construction activities during the breeding season, areas restricted from such activities shall be staked or fenced under the supervision of a Qualified Biologist; or

    c. At least 2 weeks prior to the commencement of construction activities, under the direction of a Qualified Acoustician, attenuation measures (e.g., berms, walls) shall be implemented to ensure that noise levels resulting from construction activities would not exceed 60 dB(A) hourly average at the edge of habitat occupied by the least Bell's vireo, and/or southwestern willow flycatcher. Concurrent with the commencement of construction activities and the construction of necessary noise attenuation facilities, noise

monitoring shall be conducted at the edge of the occupied habitat area to ensure that levels do not exceed 60 dB(A) hourly average. If the noise attenuation techniques implemented are determined to be inadequate by the Qualified Acoustician or Biologist, then the associated construction activities shall cease until such time that adequate noise attenuation is achieved or until the end of the breeding season (August 16). Construction noise monitoring shall continue to be monitored at least twice weekly on varying days, or more frequently depending on the construction activity, to verify that noise levels at the edge of occupied habitat are maintained below 60 dB(A) hourly average or to the ambient noise level if it already exceeds 60 dB(A) hourly average. If not, other measures shall be implemented in consultation with the biologist and the ADD/MMC, as necessary, to reduce noise levels to below 60 dB(A) hourly average or to the ambient noise level if it already exceeds 60 dB(A) hourly average. Such measures may include, but are not limited to, limitations on the placement of construction equipment and the simultaneous use of equipment.

2. If least Bell's vireo and/or southwestern willow flycatcher are not detected during the protocol survey, the Qualified Biologist shall submit substantial evidence to the ADD/MMC and applicable resource agencies which demonstrates whether or not mitigation measures such as noise walls are necessary between March 15 to September 15 for least Bell's vireo and/or May 1 to September 1 for southwestern willow flycatcher adherence to the following is required:

   a. If this evidence indicates that the potential is high for least Bell's vireo and/or southwestern willow flycatcher to be present based on historical records or site conditions, then Condition 1(a) shall be adhered to as specified above.

   b. If this evidence concludes that no impacts to this species are anticipated, no mitigation measures would be necessary.

Introduction to MM-BIO-9

Mitigation measure MM-BIO-9 will be included in the design and construction documents for each Project component and will reduce the potential for short-term and long-term indirect impacts to sensitive vegetation communities. A biological monitor will be present during construction within or adjacent to sensitive resources and would ensure that the Project adheres to and implements the appropriate measures to protect sensitive resources.

MM-BIO-9 The following measures will be included in the design and construction documents for each Project component to reduce potential impacts to sensitive resources:

   a. **Qualified Biologist.** The owner/permittee shall provide a letter to the City's Mitigation Monitoring Coordination (MMC) section stating that a Project Biologist (Qualified Biologist) as defined in the City of San Diego Municipal Code, Land Development Code—Biology Guidelines (City of San Diego 2012), has been retained to implement the Project's biological monitoring program. The letter shall include the names and contact

information of all persons involved in the biological monitoring of the Project.

b. **Preconstruction Meeting.** The Qualified Biologist shall attend the preconstruction meeting, discuss the Project's biological monitoring program, and arrange to perform any follow up mitigation measures and reporting including site-specific monitoring, restoration or revegetation, and additional fauna/flora surveys/salvage.

c. **Documentation.** The Qualified Biologist shall submit all required documentation to MMC verifying that any special mitigation reports including but not limited to, maps, plans, surveys, survey timelines, or buffers are completed or scheduled per City Biology Guidelines, Multiple Species Conservation Program (MSCP), Environmentally Sensitive Lands Ordinance, project permit conditions; California Environmental Quality Act (CEQA); National Environmental Policy Act (NEPA); endangered species acts (federal Endangered Species Act and California Endangered Species Act); and/or other local, state or federal requirements.

d. **Biological Construction Mitigation/Monitoring Exhibit.** The Qualified Biologist shall present a Biological Construction Mitigation/Monitoring Exhibit (BCME), which includes the biological documents above. In addition, the BCME would include restoration/revegetation plans, plant salvage/relocation requirements (e.g., burrowing owl exclusions, etc.), avian or other wildlife surveys/survey schedules (including general avian nesting and U.S. Fish and Wildlife (USFWS) protocol), timing of surveys, wetland buffers, avian construction avoidance areas/noise buffers/barriers, other impact avoidance areas, and any subsequent requirements determined by the Qualified Biologist and the City Assistant Deputy Director (ADD)/MMC. The BCME shall include a site plan, written and graphic depiction of the Project's biological mitigation/monitoring program, and a schedule. The BCME shall be approved by MMC and referenced in the construction documents.

e. **Construction Fencing.** Prior to construction activities, the Qualified Biologist shall supervise the placement of orange construction fencing or equivalent along the limits of disturbance adjacent to sensitive biological habitats and verify compliance with any other project conditions as shown on the BCME. This phase shall include flagging plant specimens and delineating buffers to protect sensitive biological resources (e.g., habitats/flora and fauna species, including nesting birds) during construction. Appropriate steps/care should be taken to minimize attraction of nest predators to the site.

f. **On-site Education.** Prior to commencement of construction activities, the Qualified Biologist shall meet with the owner/permittee or designee and the construction crew and conduct an on-site educational session regarding the need to avoid impacts outside of the approved construction area and to protect sensitive flora and fauna (e.g., explain the avian and wetland buffers, flag system for removal of invasive species or retention of sensitive plants, and clarify acceptable access routes/methods and staging areas).

g. **Biological Monitoring.** During construction, a Qualified Biologist would be present to assist in the avoidance of impacts to native vegetation, jurisdictional aquatic resources, sensitive plants and wildlife, and nesting birds. Specific biological monitoring and or mitigation measures for sensitive wildlife, sensitive vegetation communities, and jurisdictional aquatic resources are described further in the mitigation measures.

j. **Best Management Practices/Erosion/Runoff.** The City will incorporate methods to control runoff, including a Stormwater Pollution Prevention Plan (SWPPP) to meet National Pollutant Discharge Elimination System (NPDES) regulations or batch discharge permit from the City. Implementation of stormwater regulations are expected to substantially control adverse edge effects (e.g., erosion, sedimentation, habitat conversion) during and following construction both adjacent and downstream from the study area. Typical construction Best Management Practices (BMPs) specifically related to reducing impacts from dust, erosion, and runoff generated by construction activities would be implemented. During construction, material stockpiles shall be placed such that they cause minimal interference with on-site drainage patterns. This will protect sensitive vegetation from being inundated with sediment-laden runoff. Dewatering shall be conducted in accordance with standard regulations of the Regional Water Quality Control Board (RWQCB). An NPDES permit, issued by RWQCB to discharge water from dewatering activities, shall be required prior to start of dewatering. This will minimize erosion, siltation, and pollution within sensitive communities. Design of drainage facilities shall incorporate long-term control of pollutants and stormwater flow to minimize pollution and hydrologic changes.

k. **Toxics/Project Staging Areas/Equipment Storage.** Projects that use chemicals or generate by-products such as pesticides, herbicides, and animal waste, and other substances that are potentially toxic or impactive to native habitats/flora/fauna (including water) shall incorporate measures to reduce impacts caused by the application and/or drainage of such materials into the MHPA. No trash, oil, parking, or other construction/development-related material/activities shall be allowed outside any approved construction limits. Where applicable, this requirement shall be incorporated into leases on publicly owned property when applications for renewal occur. Provide a note in/on the CDs that states: "All construction-related activity that may have potential for leakage or intrusion shall be monitored by the Qualified Biologist/Owners Representative or Resident Engineer to ensure there is no impact to the MHPA."

Health and Safety/Hazards

MM-HAZ-2 A Hazardous Materials Reporting Form shall be prepared, as determined necessary by the City of San Diego, and a Hazardous Materials Review conducted by the Development Services Department for each North City Project component in compliance with the City of San Diego's Information Bulletin 116.

MM-HAZ-3 A Spill Prevention and Emergency Response Plan shall be completed, as determined necessary by the City of San Diego, for each North City Project component which includes on-site storage of hazardous materials (i.e., Morena Pump Station, NCWRP Expansion, North City Renewable Energy Facility, NCPWF, and Dechlorination Facility) prior to the commencement of operation. Other safety programs, including a worker safety program, fire response program, a plant safety program, and the facility's standard operating procedures, shall be developed addressing hazardous materials storage locations, emergency response procedures, employee training requirements, hazard recognition, fire safety, first aid/emergency medical procedures, hazard communication training, and release reporting requirements.

MM-HAZ-4 In the event that hazardous substances are encountered during construction, construction activities in the area shall immediately cease. All applicable procedures outlined in the City of San Diego "WHITEBOOK" Part 1 – General Provisions (A), Section 7-22, Encountering or Releasing Hazardous Substances shall be followed (City of San Diego 2015). In the case that groundwater contaminated with petroleum is encountered, the requirements of Section 7-8.6.6 of the "WHITEBOOK" shall be followed.

These procedures and requirements include, but are not limited to:

(1) Comply with all applicable federal, state, and local laws and regulations and notification requirements.

(2) Follow the guidelines of the current edition of the County of San Diego Department of Environmental Health (DEH) SAM Manual in the event that contaminated soil is encountered.

(3) Immediately notify the Engineer, who in turn shall contact the City's Environmental Services Department, Hazardous Materials Management Program.

(4) In areas of known petroleum-contaminated soil, monitoring for the presence of contamination shall be the contractor's responsibility, and an operational Photo Ionization Device shall be used at all times.

(5) All suspected contaminated soil shall be stockpiled at a location approved by the Engineer and the HMMP on a relatively impervious surface.

(6) Contaminated soil shall be disposed of dependent on classification and as approved by the Hazardous Substances Management Plan.

Historical Resources

The mitigation measures (MMs) provided in this section have been designed to fulfill the requirements of Section 106 of the National Historic Preservation Act, the CEQA Guidelines, and the City of San Diego Historic Resource Guidelines. The City of San Diego will be the lead agency implementing cultural resource mitigation measures and will provide information to the Bureau of Reclamation for their ongoing Section 106 oversight and consultation obligations.

MM-HIS-3 To reduce potential impacts to unknown archaeological resources and/or grave sites during construction of all Project components (i.e., Components Common to the Project Alternatives, Miramar Reservoir Alternative, and San Vicente Reservoir Alternative) the following measures shall be implemented:

I. Prior to Permit Issuance or Bid Opening/Bid Award

A. Entitlements Plan Check

1. Prior to permit issuance or bid opening/bid award, whichever is applicable, the Assistant Deputy Director (ADD) environmental designee shall verify that the requirements for archaeological monitoring and Native American monitoring have been noted on the applicable construction documents through the plan check process.

B. Letters of Qualification have been submitted to ADD

1. Prior to bid award, the applicant shall submit a letter of verification to Mitigation Monitoring Coordinator (MMC) identifying the Principal Investigator (PI) for the Project and the names of all persons involved in the archaeological monitoring program, as defined in the City Historical Resources Guidelines (HRG). If applicable, individuals involved in the archaeological monitoring program must have completed the 40-hour HAZWOPER training with certification documentation.

2. MMC will provide a letter to the applicant confirming the qualifications of the PI and all persons involved in the archaeological monitoring of the Project meet the qualifications established in the City Historical Resources Guidelines.

3. Prior to the start of work, the applicant must obtain written approval from MMC for any personnel changes associated with the monitoring program.

II. Prior to Start of Construction

A. Verification of Records Search

1. The PI shall provide verification to MMC that a site-specific records search (0.25-mile radius) has been completed. Verification includes, but is not limited to a copy of a confirmation letter from South Coastal Information Center, or, if the search was in-house, a letter of verification from the PI stating that the search was completed.

2. The letter shall introduce any pertinent information concerning expectations and probabilities of discovery during trenching and/or grading activities.

3. The PI may submit a detailed letter to MMC requesting a reduction to the 0.25-mile radius.

B. PI Shall Attend Preconstruction Meetings

1. Prior to beginning any work that requires monitoring, the applicant shall arrange a Preconstruction Meeting that shall include the PI, Native American consultant/monitor (where Native American resources may be impacted), Construction Manager (CM), Grading Contractor, Resident Engineer (RE), Building Inspector (BI), if appropriate, and MMC. The qualified archaeologist and Native American monitor shall attend any grading/excavation related Preconstruction Meetings to make comments and/or suggestions concerning the archaeological monitoring program with the CM and/or Grading Contractor.

   a. If the PI is unable to attend the Preconstruction Meeting, the applicant shall schedule a focused Preconstruction Meeting with MMC, the PI, RE, CM, if appropriate, prior to the start of any work that requires monitoring.

2. Acknowledgment of Responsibility for Curation (Capital Improvement Program or Other Public Projects)

   The applicant shall submit a letter to MMC acknowledging their responsibility for the cost of curation associated with all phases of the archaeological monitoring program.

3. Identify Areas to be Monitored

   a. Prior to the start of any work that requires monitoring, the PI shall submit an Archaeological Monitoring Exhibit (AME) (with verification that the AME has been reviewed and approved by the Native American consultant/monitor when Native American resources may be impacted) based on the appropriate construction documents (reduced to 11×17) to MMC identifying the areas to be monitored, including the delineation of grading/excavation limits.

b. The AME shall be based on the results of a site-specific records search as well as information regarding the age of existing pipelines, laterals and associated appurtenances, and/or any known soil conditions (native or formation).

c. MMC shall notify the PI that the AME has been approved.

4. When Monitoring Will Occur

a. Prior to the start of any work, the PI shall also submit a construction schedule to MMC through the RE indicating when and where monitoring will occur.

b. The PI may submit a detailed letter to MMC prior to the start of work or during construction requesting a modification to the monitoring program. This request shall be based on relevant information such as review of final construction documents which indicate conditions such as age of existing pipe to be replaced, depth of excavation and/or site graded to bedrock, etc., which may reduce or increase the potential for resources to be present.

5. Approval of AME and Construction Schedule

After approval of the AME by MMC, the PI shall submit to MMC written authorization of the AME and Construction Schedule from the CM.

III. During Construction

A. Monitor Shall be Present During Grading/Excavation/Trenching

1. The Archaeological Monitor shall be present full-time during all soil-disturbing and grading/excavation/trenching activities that could result in impacts to archaeological resources as identified on the AME. **The CM is responsible for notifying the RE, PI, and MMC of changes to any construction activities such as in the case of a potential safety concern within the area being monitored. In certain circumstances Occupational Safety and Health Administration safety requirements may necessitate modification of the AME.**

2. The Native American consultant/monitor shall determine the extent of their presence during soil-disturbing and grading/excavation/trenching activities based on the AME and provide that information to the PI and MMC. If prehistoric resources are encountered during the Native American consultant/monitor's absence, work shall stop, and the Discovery Notification Process detailed in Section III.B–III.C and IV.A–IV.D shall commence.

3. The PI may submit a detailed letter to MMC during construction requesting a modification to the monitoring program when a field condition such as modern disturbance post-dating the previous grading/trenching activities, presence of fossil formations, or when native soils are encountered that may reduce or increase the potential for resources to be present.

4. The archaeological and Native American consultant/monitor shall document field activity via the Consultant Site Visit Records. The Consultant Site Visit Records shall be emailed by the CM to the RE the first day of monitoring, the last day of monitoring, monthly (Notification of Monitoring Completion), and in the case of ANY discoveries. The RE shall forward copies to MMC.

B. Discovery Notification Process

1. In the event of a discovery, the Archaeological Monitor shall direct the contractor to temporarily divert all soil-disturbing activities, including but not limited to digging, trenching, excavating, or grading activities in the area of discovery and in the area reasonably suspected to overlay adjacent resources and immediately notify the RE or CM, as appropriate.

2. The Archaeological Monitor shall immediately notify the PI (unless monitor is the PI) of the discovery.

3. The PI shall immediately notify MMC by phone of the discovery, and shall also submit written documentation to MMC within 24 hours by email with photos of the resource in context, if possible.

4. No soil shall be exported off site until a determination can be made regarding the significance of the resource specifically if Native American resources are encountered.

C. Determination of Significance

1. The PI and Native American consultant/monitor, where Native American resources are discovered shall evaluate

the significance of the resource. If Human Remains are involved, follow protocol in Section IV below.

a. The PI shall immediately notify MMC by phone to discuss significance determination and shall also submit a letter to MMC indicating whether additional mitigation is required.

b. If the resource is significant, the PI shall submit an Archaeological Data Recovery Program (ADRP) and obtain written approval of the program from MMC, CM, and RE. The ADRP and any mitigation must be approved by MMC, RE, and/or CM before ground-disturbing activities in the area of discovery will be allowed to resume. **Note: If a unique archaeological site is also an historical resource as defined in CEQA Guidelines Section 15064.5, then the limits on the amount(s) that a Project applicant may be required to pay to cover mitigation costs as indicated in CEQA Section 21083.2 shall not apply.**

   (1) Note: For pipeline trenching and other linear projects in the public Right-of-Way, the PI shall implement the Discovery Process for Pipeline Trenching projects identified below under "D."

c. If the resource is not significant, the PI shall submit a letter to MMC indicating that artifacts will be collected, curated, and documented in the Final Monitoring Report. The letter shall also indicate that that no further work is required.

   (1) Note: For pipeline trenching and other linear projects in the public right-of-way, if the deposit is limited in size, both in length and depth; the information value is limited and is not associated with any other resource; and there are no unique features/artifacts associated with the deposit, the discovery should be considered not significant.

   (2) Note: For pipeline trenching and other linear projects in the public right-of-way, if significance cannot be determined, the Final Monitoring Report and Site Record (DPR Form 523A/B) shall identify the discovery as potentially significant.

D. Discovery Process for Significant Resources – Pipeline Trenching and Other Linear Projects in the Public Right-of-Way

The following procedure constitutes adequate mitigation of a significant discovery encountered during pipeline trenching activities or for other linear project types within the public right-of-way, including but not limited to excavation for jacking pits, receiving pits, laterals, and manholes to reduce impacts to below a level of significance:

1. Procedures for documentation, curation, and reporting

a. One hundred percent (100%) of the artifacts within the trench alignment and width shall be documented in situ, to include photographic records, plan view of the trench and profiles of side walls, recovered, photographed after cleaning and analyzed and curated. The remainder of the deposit within the limits of excavation (trench walls) shall be left intact.

b. The PI shall prepare a Draft Monitoring Report and submit to MMC via the RE as indicated in Section VI-A.

c. The PI shall be responsible for recording (on the appropriate State of California Department of Parks and Recreation forms DPR 523 A/B) the resource(s) encountered during the Archaeological Monitoring Program in accordance with the City's HRG. The DPR forms shall be submitted to the South Coastal Information Center for either a Primary Record or SDI Number and included in the Final Monitoring Report.

d. The Final Monitoring Report shall include a recommendation for monitoring of any future work in the vicinity of the resource.

IV. Discovery of Human Remains

If human remains are discovered, work shall halt in that area, and no soil shall be exported off site until a determination can be made regarding the provenance of the human remains; and the following procedures as set forth in CEQA Guidelines Section 15064.5(e), the California Public Resources Code Section 5097.98, and the California Health and Safety Code Section 7050.5, shall be undertaken:

A. Notification

1. Archaeological Monitor shall notify the RE or CM as appropriate, MMC, and the PI, if the monitor is not qualified as a PI. MMC will

notify the appropriate Senior Planner in the Environmental Analysis Section of the Development Services Department to assist with the discovery notification process.

2. The PI shall notify the Medical Examiner after consultation with the RE, either in person or via telephone.

B. Isolate discovery site

1. Work shall be directed away from the location of the discovery and any nearby area reasonably suspected to overlay adjacent human remains until a determination can be made by the Medical Examiner in consultation with the PI concerning the provenience of the remains.

2. The Medical Examiner, in consultation with the PI, will determine the need for a field examination to determine the provenience.

3. If a field examination is not warranted, the Medical Examiner will determine with input from the PI, if the remains are or are most likely to be of Native American origin.

C. If human remains are determined to be Native American

1. The Medical Examiner will notify the Native American Heritage Commission (NAHC) within 24 hours. By law, only the Medical Examiner can make this call.

2. NAHC will immediately identify the person or persons determined to be the Most Likely Descendant (MLD) and provide contact information.

3. The MLD will contact the PI within 24 hours or sooner after the Medical Examiner has completed coordination, to begin the consultation process in accordance with CEQA Guidelines Section 15064.5(e) and the California Public Resources and Health and Safety Codes.

4. The MLD will have 48 hours to make recommendations to the property owner or representative, for the treatment or disposition with proper dignity, of the human remains and associated grave goods.

5. Disposition of Native American human remains will be determined between the MLD and the PI, and, if:

a. The NAHC is unable to identify the MLD, OR the MLD failed to make a recommendation within 48 hours after being notified by the Commission, OR

b. The landowner or authorized representative rejects the recommendation of the MLD and mediation in accordance with California Public Resources Code Section 5097.94(k), by the NAHC fails to provide measures acceptable to the landowner, THEN

c. To protect these sites, the landowner shall do one or more of the following:

(1) Record the site with the NAHC,

(2) Record an open space or conservation easement, or

(3) Record a document with the County.

d. Upon the discovery of multiple Native American human remains during a ground-disturbing land development activity, the landowner may agree that additional conferral with descendants is necessary to consider culturally appropriate treatment of multiple Native American human remains. Culturally appropriate treatment of such a discovery may be ascertained from review of the site utilizing cultural and archaeological standards. Where the parties are unable to agree on the appropriate treatment measures, the human remains and items associated and buried with Native American human remains shall be reinterred with appropriate dignity, pursuant to Section 5.c.

D. If human remains are not Native American

1. The PI shall contact the Medical Examiner and notify them of the historic era context of the burial.

2. The Medical Examiner will determine the appropriate course of action with the PI and City staff (California Public Resources Code, Section 5097.98).

3. If the remains are of historic origin, they shall be appropriately removed and conveyed to the San Diego Museum of Man for analysis. The decision for internment of the human remains shall be made in consultation with MMC, Environmental Analysis Section, the applicant/landowner, any known descendant group, and the San Diego Museum of Man.

V. Night and/or Weekend Work

A. If night and/or weekend work is included in the contract

1. When night and/or weekend work is included in the contract package, the extent and timing shall be presented and discussed at the Preconstruction Meeting.

2. The following procedures shall be followed.

a. No Discoveries

In the event that no discoveries were encountered during night and/or weekend work, the PI shall record the information on the Consultant Site Visit Record and submit to MMC by email by 8 a.m. of the next business day.

b. Discoveries

All discoveries shall be processed and documented using the existing procedures detailed in Sections III – During Construction, and IV – Discovery of Human Remains. Discovery of human remains shall always be treated as a significant discovery.

c. Potentially Significant Discoveries

If the PI determines that a potentially significant discovery has been made, the procedures detailed under Section III – During Construction and IV – Discovery of Human Remains shall be followed.

d. The PI shall immediately contact the RE and MMC, or by 8 a.m. of the next business day to report and discuss the findings as indicated in Section III-B, unless other specific arrangements have been made.

B. If night and/or weekend work becomes necessary during the course of construction

1. The CM shall notify the RE, as appropriate, a minimum of 24 hours before the work is to begin.

2. The RE, or CM, as appropriate, shall notify MMC immediately.

C. All other procedures described above shall apply, as appropriate.

VI. Post Construction

A. Submittal of Draft Monitoring Report

1. The PI shall submit two copies of the Draft Monitoring Report (even if negative), prepared in accordance with the HRG (Appendix C/D) that describes the results, analysis, and conclusions of all phases of the Archaeological Monitoring Program (with appropriate graphics) to MMC via the RE for review and approval within 90 days following the completion of monitoring. **It should be noted that if the PI is unable to submit the Draft Monitoring Report within the allotted 90-day time frame as a result of delays with analysis, special study results or other complex issues, a schedule shall be submitted to MMC establishing agreed due dates and the provision for submittal of monthly status reports until this measure can be met.**

   a. For significant archaeological resources encountered during monitoring, the ADRP or Pipeline Trenching Discovery Process shall be included in the Draft Monitoring Report.

   b. Recording Sites with State of California Department of Parks and Recreation

      The PI shall be responsible for recording (on the appropriate State of California Department of Parks and Recreation forms DPR 523 A/B) any significant or potentially significant resources encountered during the Archaeological Monitoring Program in accordance with the City's HRG, and submittal of such forms to the South Coastal Information Center with the Final Monitoring Report.

2. MMC shall return the Draft Monitoring Report to the PI via the RE for revision or for preparation of the Final Report.

3. The PI shall submit revised Draft Monitoring Report to MMC via the RE for approval.

4. MMC shall provide written verification to the PI of the approved report.

5. MMC shall notify the RE or CM, as appropriate, of receipt of all Draft Monitoring Report submittals and approvals.

B. Handling of Artifacts

1. The PI shall be responsible for ensuring that all cultural remains collected are cleaned and catalogued

2. The PI shall be responsible for ensuring that all artifacts are analyzed to identify function and chronology as they relate to the history of the area; that faunal material is identified as to species; and that specialty studies are completed, as appropriate.

C. Curation of artifacts: Accession Agreement and Acceptance Verification

1. The PI shall be responsible for ensuring that all artifacts associated with the survey, testing and/or data recovery for this project are permanently curated with an appropriate institution. This shall be completed in consultation with MMC and the Native American representative, as applicable.

2. When applicable to the situation, the PI shall include written verification from the Native American consultant/monitor indicating that Native American resources were treated in accordance with state law and/or applicable agreements. If the resources were reinterred, verification shall be provided to show what protective measures were taken to ensure no further disturbance occurs in accordance with Section IV – Discovery of Human Remains, Subsection C.

3. The PI shall submit the Accession Agreement and catalogue record(s) to the RE or CM, as appropriate for donor signature with a copy submitted to MMC.

4. The RE or CM, as appropriate shall obtain signature on the Accession Agreement and shall return to PI with copy submitted to MMC.

5. The PI shall include the Acceptance Verification from the curation institution in the Final Monitoring Report submitted to the RE or CM and MMC.

D. Final Monitoring Report(s)

1. The PI shall submit one copy of the approved Final Monitoring Report to the RE or CM as appropriate, and one copy to MMC (even if negative), within 90 days after notification from MMC of the approved report.

2. The RE shall in no case issue the Notice of Completion until receiving a copy of the approved Final Monitoring Report from MMC which includes the Acceptance Verification from the curation institution.

Noise

MM-NOI-4 A noise and vibration study shall be conducted during the final design phase for the NCPWF Influent Pump Station, Morena Pump Station, North City Pump Station, North City Renewable Energy Facility (both Project Alternatives), and the Mission Trails Booster Station (San Vicente Reservoir Alternative only). Pump station machinery and/or generators shall be housed within concrete structures with acoustically absorptive treatments where necessary, and additional measures such as sound enclosures, separate rooms for high noise equipment, etc. shall be incorporated into the final project design as necessary to assure that noise and vibration produced by operation of the facility shall not exceed the applicable limits in the municipal code.

Paleontological Resources

MM-PALEO-1 If construction of a project would occur within a formation with a moderate to high resource potential, monitoring during construction would be required, and a paleontological resources mitigation program consisting of the following components shall be implemented:

I. Prior to Permit Issuance or Bid Opening/Bid Award

A. Entitlements Plan Check

1. Prior to permit issuance or Bid Opening/Bid Award, whichever is applicable, the Assistant Deputy Director (ADD) Environmental designee shall verify that the requirements for Paleontological Monitoring have been noted on the appropriate construction documents.

B. Letters of Qualification have been submitted to ADD

1. Prior to Bid Award, the applicant shall submit a letter of verification to Mitigation Monitoring Coordinator (MMC) identifying the Principal Investigator (PI) for the Project and the names of all persons involved in the paleontological monitoring program, as defined in the City of San Diego Paleontology Guidelines.

2. MMC will provide a letter to the applicant confirming the qualifications of the PI and all persons involved in the paleontological monitoring of the Project.

3. Prior to the start of work, the applicant shall obtain approval from MMC for any personnel changes associated with the monitoring program.

II. Prior to Start of Construction

A. Verification of Records Search

1. The PI shall provide verification to MMC that a site-specific records search has been completed. Verification includes, but is not limited

to, a copy of a confirmation letter from San Diego Natural History Museum, other institution or, if the search was in-house, a letter of verification from the PI stating that the search was completed.

2. The letter shall introduce any pertinent information concerning expectations and probabilities of discovery during trenching and/or grading activities.

B. PI Shall Attend Precon Meetings

1. Prior to beginning any work that requires monitoring, the applicant shall arrange a Precon Meeting that shall include the PI, Construction Manager (CM), Grading Contractor, Resident Engineer (RE), Building Inspector (BI), if appropriate, and MMC. The qualified paleontologist shall attend any grading/excavation related Precon Meetings to make comments and/or suggestions concerning the Paleontological Monitoring program with the Construction Manager and/or Grading Contractor.

a. If the PI is unable to attend the Precon Meeting, the applicant shall schedule a focused Precon Meeting with MMC, the PI, RE, CM or BI, if appropriate, prior to the start of any work that requires monitoring.

2. Acknowledgement of Responsibility for Curation (CIP or Other Public Projects)

The applicant shall submit a letter to MMC acknowledging their responsibility for the cost of curation associated with all phases of the paleontological monitoring program.

3. Identify Areas to be Monitored

a. Prior to the start of any work that requires monitoring, the PI shall submit a Paleontological Monitoring Exhibit (PME) based on the appropriate construction documents (reduced to 11x17) to MMC for approval identifying the areas to be monitored including the delineation of grading/excavation limits. Monitoring shall begin at depths below 10 feet from existing grade or as determined by the PI in consultation with MMC. The determination shall be based on site-specific records search data which supports monitoring at depths less than 10 feet.

b. The PME shall be based on the results of a site-specific records search as well as information regarding existing known soil conditions (native or formation).

c. MMC shall notify the PI that the PME has been approved.

4. When Monitoring Will Occur

a. Prior to the start of any work, the PI shall also submit a construction schedule to MMC through the RE indicating when and where monitoring will occur.

b. The PI may submit a detailed letter to MMC prior to the start of work or during construction requesting a modification to the monitoring program. This request shall be based on relevant information such as review of final construction documents which indicate conditions such as depth of excavation and/or site graded to bedrock, presence or absence of fossil resources, etc., which may reduce or increase the potential for resources to be present.

5. Approval of PME and Construction Schedule

After approval of the PME by MMC, the PI shall submit to MMC written authorization of the PME and Construction Schedule from the CM.

III. During Construction

A. Monitor Shall be Present During Grading/Excavation/Trenching

1. The monitor shall be present full-time during grading/excavation/trenching activities including, but not limited to mainline, laterals, jacking and receiving pits, services and all other appurtenances associated with underground utilities as identified on the PME that could result in impacts to formations with high and/or moderate resource sensitivity. The Construction Manager is responsible for notifying the RE, PI, and MMC of changes to any construction activities such as in the case of a potential safety concern within the area being monitored. In certain circumstances Occupational Safety and Health Administration safety requirements may necessitate modification of the PME.

2. The PI may submit a detailed letter to MMC during construction requesting a modification to the monitoring program when a field condition such as trenching activities that do not encounter formational soils as previously assumed, and/or when unique/unusual fossils are encountered, which may reduce or increase the potential for resources to be present.

3. The monitor shall document field activity via the Consultant Site Visit Record (CSVR). The CSVR shall be emailed by the CM to the RE the first day of monitoring, the last day of monitoring, monthly (Notification of Monitoring Completion), and in the case of ANY discoveries. The RE shall forward copies to MMC.

B. Discovery Notification Process

1. In the event of a discovery, the Paleontological Monitor shall direct the contractor to temporarily divert trenching

activities in the area of discovery and immediately notify the RE or CM, as appropriate.

2. The Monitor shall immediately notify the PI (unless Monitor is the PI) of the discovery.

3. The PI shall immediately notify MMC by phone of the discovery, and shall also submit written documentation to MMC within 24 hours by email with photos of the resource in context, if possible.

C. Determination of Significance

1. The PI shall evaluate the significance of the resource.

a. The PI shall immediately notify MMC by phone to discuss significance determination and shall also submit a letter to MMC indicating whether additional mitigation is required. The determination of significance for fossil discoveries shall be at the discretion of the PI.

b. If the resource is significant, the PI shall submit a Paleontological Recovery Program (PRP) and obtain written approval of the program from MMC, MC and/or RE. PRP and any mitigation must be approved by MMC, RE, and/or CM before ground-disturbing activities in the area of discovery will be allowed to resume.

(1) Note: For pipeline trenching projects only, the PI shall implement the Discovery Process for Pipeline Trenching projects identified below under "D."

c. If resource is not significant (e.g., small pieces of broken common shell fragments or other scattered common fossils) the PI shall notify the RE, or CM as appropriate, that a non-significant discovery has been made. The Paleontologist shall continue to monitor the area without notification to MMC unless a significant resource is encountered.

d. The PI shall submit a letter to MMC indicating that fossil resources will be collected, curated, and documented in the Final Monitoring Report. The letter shall also indicate that no further work is required.

(1) Note: For Pipeline Trenching Projects Only. If the fossil discovery is limited in size, both in length and depth; the information value is limited and

there are no unique fossil features associated with the discovery area, then the discovery should be considered not significant.

(2) Note, for Pipeline Trenching Projects Only: If significance cannot be determined, the Final Monitoring Report and Site Record shall identify the discovery as Potentially Significant.

D. Discovery Process for Significant Resources - Pipeline Trenching Projects

The following procedure constitutes adequate mitigation of a significant discovery encountered during pipeline trenching activities including but not limited to excavation for jacking pits, receiving pits, laterals, and manholes to reduce impacts to below a level of significance.

1. Procedures for documentation, curation, and reporting

a. One hundred percent (100%) of the fossil resources within the trench alignment and width shall be documented in-situ photographically, drawn in plan view (trench and profiles of side walls), recovered from the trench and photographed after cleaning, then analyzed and curated consistent with Society of Invertebrate Paleontology Standards. The remainder of the deposit within the limits of excavation (trench walls) shall be left intact and so documented.

b. The PI shall prepare a Draft Monitoring Report and submit to MMC via the RE as indicated in Section VI-A.

c. The PI shall be responsible for recording (on the appropriate forms for the San Diego Natural History Museum) the resource(s) encountered during the Paleontological Monitoring Program in accordance with the City's Paleontological Guidelines (PG). The forms shall be submitted to the San Diego Natural History Museum and included in the Final Monitoring Report.

d. The Final Monitoring Report shall include a recommendation for monitoring of any future work in the vicinity of the resource.

IV. Night and/or Weekend Work

A. If night and/or weekend work is included in the contract

1. When night and/or weekend work is included in the contract package, the extent and timing shall be presented and discussed at the precon meeting.

2. The following procedures shall be followed.

a. No Discoveries

In the event that no discoveries were encountered during night and/or weekend work, the PI shall record the information on the CSVR and submit to MMC via the RE by email by 8AM on the next business day.

b. Discoveries

All discoveries shall be processed and documented using the existing procedures detailed in Sections III - During Construction.

c. Potentially Significant Discoveries

If the PI determines that a potentially significant discovery has been made, the procedures detailed under Section III - During Construction shall be followed.

d. The PI shall immediately contact the RE and MMC, or by 8:00 a.m. on the next business day to report and discuss the findings as indicated in Section III-B, unless other specific arrangements have been made.

B. If night and/or weekend work becomes necessary during the course of construction

1. The Construction Manager shall notify the RE, as appropriate, a minimum of 24 hours before the work is to begin.

2. The RE, or CM, as appropriate, shall notify MMC immediately.

C. All other procedures described above shall apply, as appropriate.

V. Post Construction

A. Preparation and Submittal of Draft Monitoring Report

1. The PI shall submit two copies of the Draft Monitoring Report (even if negative), prepared in accordance with the PG, which describes the

results, analysis, and conclusions of all phases of the Paleontological Monitoring Program (with appropriate graphics) to MMC via the RE for review and approval within 90 days following the completion of monitoring.

a. For significant paleontological resources encountered during monitoring, the Paleontological Recovery Program or Pipeline Trenching Discovery Process shall be included in the Draft Monitoring Report.

b. Recording Sites with the San Diego Natural History Museum

The PI shall be responsible for recording (on the appropriate forms) any significant or potentially significant fossil resources encountered during the Paleontological Monitoring Program in accordance with the City's PG, and submittal of such forms to the San Diego Natural History Museum with the Final Monitoring Report.

2. MMC shall return the Draft Monitoring Report to the PI via the RE for revision or for preparation of the Final Report.

3. The PI shall submit revised Draft Monitoring Report to MMC via the RE for approval.

4. MMC shall provide written verification to the PI of the approved report.

5. MMC shall notify the RE or CM, as appropriate, of receipt of all Draft Monitoring Report submittals and approvals.

B. Handling of Fossil Remains

1. The PI shall be responsible for ensuring that all fossil remains collected are cleaned and catalogued.

C. Curation of Fossil Remains: Deed of Gift and Acceptance Verification

1. The PI shall be responsible for ensuring that all fossil remains associated with the monitoring for this project are permanently curated with an appropriate institution.

2. The PI shall submit the Deed of Gift and catalogue record(s) to the RE or CM, as appropriate for donor signature with a copy submitted to MMC.

3. The RE or CM, as appropriate shall obtain signature on the Deed of Gift and shall return to PI with copy submitted to MMC.

4. The PI shall include the Acceptance Verification from the curation institution in the Final Monitoring Report submitted to the RE or CM and MMC.

D. Final Monitoring Report(s)

1. The PI shall submit two copies of the Final Monitoring Report to MMC (even if negative), within 90 days after notification from MMC of the approved report.

2. The RE shall, in no case, issue the Notice of Completion until receiving a copy of the approved Final Monitoring Report from MMC which includes the Acceptance Verification from the curation institution.

Summary of Mitigation Measures – Morena Pump Station

Mitigation Measure	Timing of Mitigation			Responsible Person	Location/Notes
	Pre Const.	*During Const.*	*Post Const.*		
MM-AQ-1 (construction BMPs)		X		Construction Manager	Entire site
MM-AQ-2 (construction NO_x)		X		Construction Manager	Entire site
MM-AQ-3 (odor reduction)			X	City of San Diego	Entire site
MM-BIO-6 (riparian birds)	X	X		City of San Diego	San Diego River at Friars Road
MM-BIO-9a (qualified biologist)	X			Owner/Permittee	Overflow pipe near San Diego River at Friars Road
MM-BIO-9b (preconstruction meeting)	X			City of San Diego	San Diego River at Friars Road
MM-BIO-9c (documentation)	X	X	X	Owner/Permittee	San Diego River at Friars Road
MM-BIO-9d (biological construction mitigation/monitoring exhibit)	X			City of San Diego	San Diego River at Friars Road
MM-BIO-9e (construction fencing)	X			City of San Diego	San Diego River at Friars Road
MM-BIO-9f (on-site education)	X			City of San Diego	San Diego River at Friars Road
MM-BIO-9g (biological monitoring)		X		City of San Diego	San Diego River at Friars Road
MM-BIO-9j (BMPs/erosion/runoff)		X	X	City of San Diego	San Diego River at Friars Road
MM-BIO-9k (toxics/project staging areas/equipment storage)	X	X	X	Construction Manager/owner	San Diego River at Friars Road
MM-HAZ-2 (hazardous material reporting form)			X	City of San Diego	Entire site

Summary of Mitigation Measures – Morena Pump Station

Mitigation Measure	Timing of Mitigation			Responsible Person	Location/Notes
	Pre Const.	*During Const.*	*Post Const.*		
MM-HAZ-3 (spill prevention and emergency response plan)			X	City of San Diego	Entire site
MM-HAZ-4 (hazardous substances encounter)		X		Construction Manager	Entire site
MM-HIS-3 (archaeological monitoring)	X	X	X	Principal Investigator (Archaeologist)	Entire site
MM-NOI-4 (noise and vibration study)	X			Construction Contractor	Entire site
MM-PALEO-1 (paleontological monitoring)	X	X	X	Principal Investigator (Paleontologist)	Entire site

APPENDIX B

FIRE HYDRANT METER PROGRAM

CITY OF SAN DIEGO CALIFORNIA DEPARTMENT INSTRUCTIONS	NUMBER **DI** 55.27	DEPARTMENT Water Department
SUBJECT **FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)**	**PAGE** 1 **OF** 10	**EFFECTIVE DATE** October 15, 2002
	SUPERSEDES **DI** 55.27	**DATED** April 21, 2000

1. **PURPOSE**

1.1 To establish a Departmental policy and procedure for issuance, proper usage and charges for fire hydrant meters.

2. **AUTHORITY**

2.1 All authorities and references shall be current versions and revisions.

2.2 San Diego Municipal Code (NC) Chapter VI, Article 7, Sections 67.14 and 67.15

2.3 Code of Federal Regulations, Safe Drinking Water Act of 1986

2.4 California Code of Regulations, Titles 17 and 22

2.5 California State Penal Code, Section 498B.0

2.6 State of California Water Code, Section 110, 500-6, and 520-23

2.7 Water Department Director

Reference

2.8 State of California Guidance Manual for Cross Connection Programs

2.9 American Water Works Association Manual M-14, Recommended Practice for Backflow Prevention

2.10 American Water Works Association Standards for Water Meters

2.11 U.S.C. Foundation for Cross Connection Control and Hydraulic Research Manual

3. **DEFINITIONS**

3.1 **Fire Hydrant Meter:** A portable water meter which is connected to a fire hydrant for the purpose of temporary use. (These meters are sometimes referred to as Construction Meters.)

3.2 **Temporary Water Use:** Water provided to the customer for no longer than twelve (12) months.

3.3 **Backflow Preventor:** A Reduced Pressure Principal Assembly connected to the outlet side of a Fire Hydrant Meter.

4. POLICY

4.1 The Water Department shall collect a deposit from every customer requiring a fire hydrant meter and appurtenances prior to providing the meter and appurtenances (see Section 7.1 regarding the Fees and Deposit Schedule). The deposit is refundable upon the termination of use and return of equipment and appurtenances in good working condition.

4.2 Fire hydrant meters will have a 2 ½" swivel connection between the meter and fire hydrant. The meter shall not be connected to the 4" port on the hydrant. All Fire Hydrant Meters issued shall have a Reduced Pressure Principle Assembly (RP) as part of the installation. Spanner wrenches are the only tool allowed to turn on water at the fire hydrant.

4.3 The use of private hydrant meters on City hydrants is prohibited, with exceptions as noted below. All private fire hydrant meters are to be phased out of the City of San Diego. All customers who wish to continue to use their own fire hydrant meters must adhere to the following conditions:

a. Meters shall meet all City specifications and American Water Works Association (AWWA) standards.

b. Customers currently using private fire hydrant meters in the City of San Diego water system will be allowed to continue using the meter under the following conditions:

1. The customer must submit a current certificate of accuracy and calibration results for private meters and private backflows annually to the City of San Diego, Water Department, Meter Shop.

2. The meter must be properly identifiable with a clearly labeled serial number on the body of the fire hydrant meter. The serial number shall be plainly stamped on the register lid and the main casing. Serial numbers shall be visible from the top of the meter casing and the numbers shall be stamped on the top of the inlet casing flange.

3. All meters shall be locked to the fire hydrant by the Water Department, Meter Section (see Section 4.7).

4. All meters shall be read by the Water Department, Meter Section (see Section 4.7).

5. All meters shall be relocated by the Water Department, Meter Section (see Section 4.7).

6. These meters shall be tested on the anniversary of the original test date and proof of testing will be submitted to the Water Department, Meter Shop, on a yearly basis. If not tested, the meter will not be allowed for use in the City of San Diego.

7. All private fire hydrant meters shall have backflow devices attached when installed.

8. The customer must maintain and repair their own private meters and private backflows.

9. The customer must provide current test and calibration results to the Water Department, Meter Shop after any repairs.

10. When private meters are damaged beyond repair, these private meters will be replaced by City owned fire hydrant meters.

11. When a private meter malfunctions, the customer will be notified and the meter will be removed by the City and returned to the customer for repairs. Testing and calibration results shall be given to the City prior to any re-installation.

12. The register shall be hermetically sealed straight reading and shall be readable from the inlet side. Registration shall be in hundred cubic feet.

13. The outlet shall have a 2 ½ "National Standards Tested (NST) fire hydrant male coupling.

14. Private fire hydrant meters shall not be transferable from one contracting company to another (i.e. if a company goes out of business or is bought out by another company).

4.4 All fire hydrant meters and appurtenances shall be installed, relocated and removed by the City of San Diego, Water Department. All City owned fire hydrant meters and appurtenances shall be maintained by the City of San Diego, Water Department, Meter Services.

4.5 If any fire hydrant meter is used in violation of this Department Instruction, the violation will be reported to the Code Compliance Section for investigation and appropriate action. Any customer using a fire hydrant meter in violation of the requirements set forth above is subject to fines or penalties pursuant to the Municipal Code, Section 67.15 and Section 67.37.

4.6 **Conditions and Processes for Issuance of a Fire Hydrant Meter**

Process for Issuance

a. Fire hydrant meters shall only be used for the following purposes:

1. Temporary irrigation purposes not to exceed one year.

2. Construction and maintenance related activities (see Tab 2).

b. No customer inside or outside the boundaries of the City of San Diego Water Department shall resell any portion of the water delivered through a fire hydrant by the City of San Diego Water Department.

c. The City of San Diego allows for the issuance of a temporary fire hydrant meter for a period not to exceed 12 months (365 days). An extension can only be granted in writing from the Water Department Director for up to 90 additional days. A written request for an extension by the consumer must be submitted at least 30 days prior to the 12 month period ending. No extension shall be granted to any customer with a delinquent account with the Water Department. No further extensions shall be granted.

d. Any customer requesting the issuance of a fire hydrant meter shall file an application with the Meter Section. The customer must complete a "Fire Hydrant Meter Application" (Tab 1) which includes the name of the company, the party responsible for payment, Social Security number and/or California ID, requested location of the meter (a detailed map signifying an exact location), local contact person, local phone number, a contractor's license (or a business license), description of specific water use, duration of use at the site and full name and address of the person responsible for payment.

e. At the time of the application the customer will pay their fees according to the schedule set forth in the Rate Book of Fees and Charges, located in the City Clerk's Office. All fees must be paid by check, money order or cashiers check, made payable to the City Treasurer. Cash will not be accepted.

f. No fire hydrant meters shall be furnished or relocated for any customer with a delinquent account with the Water Department.

g. After the fees have been paid and an account has been created, the

meter shall be installed within 48 hours (by the second business day). For an additional fee, at overtime rates, meters can be installed within 24 hours (within one business day).

4.7 **Relocation of Existing Fire Hydrant Meters**

a. The customer shall call the Fire Hydrant Meter Hotline (herein referred to as "Hotline"), a minimum of 24 hours in advance, to request the relocation of a meter. A fee will be charged to the existing account, which must be current before a work order is generated for the meter's relocation.

b. The customer will supply in writing the address where the meter is to be relocated (map page, cross street, etc). The customer must update the original Fire Hydrant Meter Application with any changes as it applies to the new location.

c. Fire hydrant meters shall be read on a monthly basis. While fire hydrant meters and backflow devices are in service, commodity, base fee and damage charges, if applicable, will be billed to the customer on a monthly basis. If the account becomes delinquent, the meter will be removed.

4.8 **Disconnection of Fire Hydrant Meter**

a. After ten (10) months a "Notice of Discontinuation of Service" (Tab 3) will be issued to the site and the address of record to notify the customer of the date of discontinuance of service. An extension can only be granted in writing from the Water Department Director for up to 90 additional days (as stated in Section 4.6C) and a copy of the extension shall be forwarded to the Meter Shop Supervisor. If an extension has not been approved, the meter will be removed after twelve (12) months of use.

b. Upon completion of the project the customer will notify the Meter Services office via the Hotline to request the removal of the fire hydrant meter and appurtenances. A work order will be generated

for removal of the meter.

c. Meter Section staff will remove the meter and backflow prevention assembly and return it to the Meter Shop. Once returned to the Meter Shop the meter and backflow will be tested for accuracy and functionality.

d. Meter Section Staff will contact and notify Customer Services of the final read and any charges resulting from damages to the meter and backflow or its appurtenance. These charges will be added on the customer's final bill and will be sent to the address of record. Any customer who has an outstanding balance will not receive additional meters.

e. Outstanding balances due may be deducted from deposits and any balances refunded to the customer. Any outstanding balances will be turned over to the City Treasurer for collection. Outstanding balances may also be transferred to any other existing accounts.

5. EXCEPTIONS

5.1 Any request for exceptions to this policy shall be presented, in writing, to the Customer Support Deputy Director, or his/her designee for consideration.

6. MOBILE METER

6.1 Mobile meters will be allowed on a case by case basis. All mobile meters will be protected by an approved backflow assembly and the minimum requirement will be a Reduced Pressure Principal Assembly. The two types of Mobile Meters are vehicle mounted and floating meters. Each style of meters has separate guidelines that shall be followed for the customer to retain service and are described below:

a) **Vehicle Mounted Meters**: Customer applies for and receives a City owned Fire Hydrant Meter from the Meter Shop. The customer mounts the meter on the vehicle and brings it to the Meter Shop for

inspection. After installation is approved by the Meter Shop the vehicle and meter shall be brought to the Meter Shop on a monthly basis for meter reading and on a quarterly basis for testing of the backflow assembly. Meters mounted at the owner's expense shall have the one year contract expiration waived and shall have meter or backflow changed if either fails.

b) **Floating Meters**: Floating Meters are meters that are not mounted to a vehicle. **(Note: All floating meters shall have an approved backflow assembly attached.)** The customer shall submit an application and a letter explaining the need for a floating meter to the Meter Shop. The Fire Hydrant Meter Administrator, after a thorough review of the needs of the customer, (i.e. number of jobsites per day, City contract work, lack of mounting area on work vehicle, etc.), may issue a floating meter. At the time of issue, it will be necessary for the customer to complete and sign the "Floating Fire Hydrant Meter Agreement" which states the following:

    1) The meter will be brought to the Meter Shop at 2797 Caminito Chollas, San Diego on the third week of each month for the monthly read by Meter Shop personnel.

    2) Every other month the meter will be read and the backflow will be tested. This date will be determined by the start date of the agreement.

If any of the conditions stated above are not met the Meter Shop has the right to cancel the contract for floating meter use and close the account associated with the meter. The Meter Shop will also exercise the right to refuse the issuance of another floating meter to the company in question.

Any Fire Hydrant Meter using reclaimed water shall not be allowed use again with any potable water supply. The customer shall incur the cost of replacing the meter and backflow device in this instance.

7. FEE AND DEPOSIT SCHEDULES

7.1 **Fees and Deposit Schedules:** The fees and deposits, as listed in the Rate Book of Fees and Charges, on file with the Office of the City Clerk, are based on actual reimbursement of costs of services performed, equipment and materials. Theses deposits and fees will be amended, as needed, based on actual costs. Deposits, will be refunded at the end of the use of the fire hydrant meter, upon return of equipment in good working condition and all outstanding balances on account are paid. Deposits can also be used to cover outstanding balances.

All fees for equipment, installation, testing, relocation and other costs related to this program are subject to change without prior notification. The Mayor and Council will be notified of any future changes.

8. UNAUTHORIZED USE OF WATER FROM A HYDRANT

8.1 Use of water from any fire hydrant without a properly issued and installed fire hydrant meter is theft of City property. Customers who use water for unauthorized purposes or without a City of San Diego issued meter will be prosecuted.

8.2 If any unauthorized connection, disconnection or relocation of a fire hydrant meter, or other connection device is made by anyone other than authorized Water Department personnel, the person making the connection will be prosecuted for a violation of San Diego Municipal Code, Section 67.15. In the case of a second offense, the customer's fire hydrant meter shall be confiscated and/or the deposit will be forfeited.

8.3 Unauthorized water use shall be billed to the responsible party. Water use charges shall be based on meter readings, or estimates when meter readings are not available.

8.4 In case of unauthorized water use, the customer shall be billed for all applicable charges as if proper authorization for the water use had been obtained, including but not limited to bi-monthly service charges, installation charges and removal charges.

8.5 If damage occurs to Water Department property (i.e. fire hydrant meter, backflow, various appurtenances), the cost of repairs or replacements will be charged to the customer of record (applicant).

Water Department Director

Tabs:
1. Fire Hydrant Meter Application
2. Construction & Maintenance Related Activities With No Return To Sewer
3. Notice of Discontinuation of Service

APPENDIX

Administering Division: Customer Support Division

Subject Index:
Construction Meters
Fire Hydrant
Fire Hydrant Meter Program
Meters, Floating or Vehicle Mounted
Mobile Meter
Program, Fire Hydrant Meter

Distribution: DI Manual Holders

Application for Fire Hydrant Meter (EXHIBIT A)

City of San Diego PUBLIC UTILITIES Water & Wastewater

(For Office Use Only)

NS REQ	FAC#
DATE	BY

METER SHOP (619) 527-7449

Application Date	Requested Install Date:

Meter Information

Fire Hydrant Location: (Attach Detailed Map//Thomas Bros. Map Location or Construction drawing.) Zip:	T.B.	G.B. (CITY USE)
Specific Use of Water:		
Any Return to Sewer or Storm Drain, If so , explain:		
Estimated Duration of Meter Use:	☐	Check Box if Reclaimed Water

Company Information

Company Name:			
Mailing Address:			
City:	State:	Zip:	Phone: ( )
*Business license#	*Contractor license#		
A Copy of the Contractor's license OR Business License is required at the time of meter issuance.			
Name and Title of Billing Agent: (PERSON IN ACCOUNTS PAYABLE)			Phone: ( )
Site Contact Name and Title:			Phone: ( )
Responsible Party Name:			Title:
Cal ID#			Phone: ( )
Signature:		Date:	

Guarantees Payment of all Charges Resulting from the use of this Meter. Insures that employees of this Organization understand the proper use of Fire Hydrant Meter

☐ Fire Hydrant Meter Removal Request		Requested Removal Date:
Provide Current Meter Location if Different from Above:		
Signature:	Title:	Date:
Phone: ( )	Pager: ( )	

☐ City Meter	☐ Private Meter	
Contract Acct #:	Deposit Amount: $ 936.00	Fees Amount: $ 62.00
Meter Serial #	Meter Size: 05	Meter Make and Style: 6-7
Backflow #	Backflow Size:	Backflow Make and Style:
Name:	Signature:	Date:

WATER USES WITHOUT ANTICIPATED CHARGES FOR RETURN TO SEWER

Auto Detailing
Backfilling
Combination Cleaners (Vactors)
Compaction
Concrete Cutters
Construction Trailers
Cross Connection Testing
Dust Control
Flushing Water Mains
Hydro Blasting
Hydro Seeing
Irrigation (for establishing irrigation only; not continuing irrigation)
Mixing Concrete
Mobile Car Washing
Special Events
Street Sweeping
Water Tanks
Water Trucks
Window Washing

Note:

1. If there is any return to sewer or storm drain, then sewer and/or storm drain fees will be charges.

Date

Name of Responsible Party
Company Name and Address
Account Number:_____

Subject: Discontinuation of Fire Hydrant Meter Service

Dear Water Department Customer:

The authorization for use of Fire Hydrant Meter #_____, located at *(Meter Location Address)* ends in 60 days and will be removed on or after *(Date Authorization Expires)*. Extension requests for an additional 90 days must be submitted in writing for consideration 30 days prior to the discontinuation date. If you require an extension, please contact the Water Department, or mail your request for an extension to:

City of San Diego
Water Department
Attention: Meter Services
2797 Caminito Chollas
San Diego, CA 92105-5097

Should you have any questions regarding this matter, please call the Fire Hydrant Hotline at (619)_____-_____.

Sincerely,

Water Department

APPENDIX C

MATERIALS TYPICALLY ACCEPTED BY CERTIFICATE OF COMPLIANCE

MATERIALS TYPICALLY ACCEPTED BY CERTIFICATE OF COMPLIANCE

1. Soil amendment
2. Fiber mulch
3. PVC or PE pipe up to 16 inch diameter
4. Stabilizing emulsion
5. Lime
6. Preformed elastomeric joint seal
7. Plain and fabric reinforced elastomeric bearing pads
8. Steel reinforced elastomeric bearing pads
9. Waterstops (Special Condition)
10. Epoxy coated bar reinforcement
11. Plain and reinforcing steel
12. Structural steel
13. Structural timber and lumber
14. Treated timber and lumber
15. Lumber and timber
16. Aluminum pipe and aluminum pipe arch
17. Corrugated steel pipe and corrugated steel pipe arch
18. Structural metal plate pipe arches and pipe arches
19. Perforated steel pipe
20. Aluminum underdrain pipe
21. Aluminum or steel entrance tapers, pipe downdrains, reducers, coupling bands and slip joints
22. Metal target plates
23. Paint (traffic striping)
24. Conductors
25. Painting of electrical equipment
26. Electrical components
27. Engineering fabric
28. Portland Cement
29. PCC admixtures
30. Minor concrete, asphalt
31. Asphalt (oil)
32. Liquid asphalt emulsion
33. Epoxy

APPENDIX D

SAMPLE CITY INVOICE WITH CASH FLOW FORECAST

City of San Diego, CM&FS Div., 9753 Chesapeake Drive, SD CA 92123

Project Name:

Work Order No or Job Order No.

City Purchase Order No.

Resident Engineer (RE):

RE Phone#: Fax#:

Contractor's Name:

Contractor's Address:

Contractor's Phone #:

Contractor's fax #:

Contact Name:

Invoice No.

Invoice Date:

Billing Period: (To)

Item #	Item Description	Contract Authorization				Previous Totals To Date		This Estimate		Totals to Date	
		Unit	Price	Qty	Extension	%/QTY	Amount	% / QTY	Amount	% / QTY	Amount
1					$ -		$ -		$ -	0.00	$ -
2					$ -		$ -		$ -	0.00%	$ -
3					$ -		$ -		$ -	0.00%	$ -
4					$ -		$ -		$ -	0.00%	$ -
5					$ -		$ -		$ -	0.00%	$ -
6					$ -		$ -		$ -	0.00%	$ -
7					$ -		$ -		$ -	0.00%	$ -
8					$ -		$ -		$ -	0.00%	$ -
5					$ -		$ -		$ -	0.00%	$ -
6					$ -		$ -		$ -	0.00%	$ -
7					$ -		$ -		$ -	0.00%	$ -
8					$ -		$ -		$ -	0.00%	$ -
9					$ -		$ -		$ -	0.00%	$ -
10					$ -		$ -		$ -	0.00%	$ -
11					$ -		$ -		$ -	0.00%	$ -
12					$ -		$ -		$ -	0.00%	$ -
13					$ -		$ -		$ -	0.00%	$ -
14					$ -		$ -		$ -	0.00%	$ -
15					$ -		$ -		$ -	0.00%	$ -
16					$ -		$ -		$ -	0.00%	$ -
17	**Field Orders**				$ -		$ -		$ -	0.00%	$ -
					$ -		$ -		$ -	0.00%	$ -
	CHANGE ORDER No.				$ -		$ -		$ -	0.00%	$ -
					$ -		$ -		$ -	0.00%	$ -
	Total Authorized Amount (including approved Change Order)				**$ -**		**$ -**		$ -	**Total Billed**	$ -

SUMMARY

A. Original Contract Amount	$ -
B. Approved Change Order #00 Thru #00	$ -
C. Total Authorized Amount (A+B)	$ -
D. Total Billed to Date	$ -
E. Less Total Retention (5% of D)	$ -
F. Less Total Previous Payments	$ -
G. Payment Due Less Retention	**$0.00**
H. Remaining Authorized Amount	$0.00

I certify that the materials have been received by me in the quality and quantity specified

_____

Resident Engineer

_____

Construction Engineer

Retention and/or Escrow Payment Schedule

Total Retention Required as of this billing (Item E)	$0.00
Previous Retention Withheld in PO or in Escrow	$0.00
Add'l Amt to Withhold in PO/Transfer in Escrow:	***$0.00***
Amt to Release to Contractor from PO/Escrow:	

Contractor Signature and Date: _____

NOTE: CONTRACTOR TO CALCULATE TO THE 2ND DECIMAL PLACE.

WBS #:	B18108
Date Submitted:	10/10/2018
NTP Date:	3/23/2018
Final Statement of WD Date:	5/23/2020
Contract #:	K-XX-XXXX-XXX-X
Contract Amount:	$5,617,000

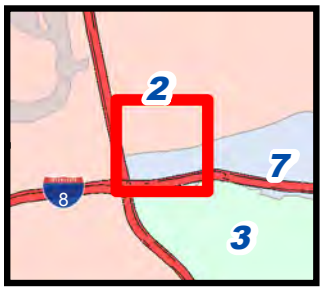
Construction Cash Flow Forecast

"Sewer and Water Group Job 965 (W)"

Year	January	February	March	April	May	June	July	August	September	October	November	December
2018				15,000	25,000	52,000	52,000	100,000	10,000	100,000	100,000	100,000
2019	10,000	10,000	85,000	58,000	100,000	100,000	100,000	100,000	100,000	100,000	1,000,000	1,000,000
2020	100,000	100,000	100,000	1,000,000	1,000,000							
2021												
2022												
2023												
2024												
2025												

APPENDIX E

LOCATION MAP



The City of SAN DIEGO Public Works

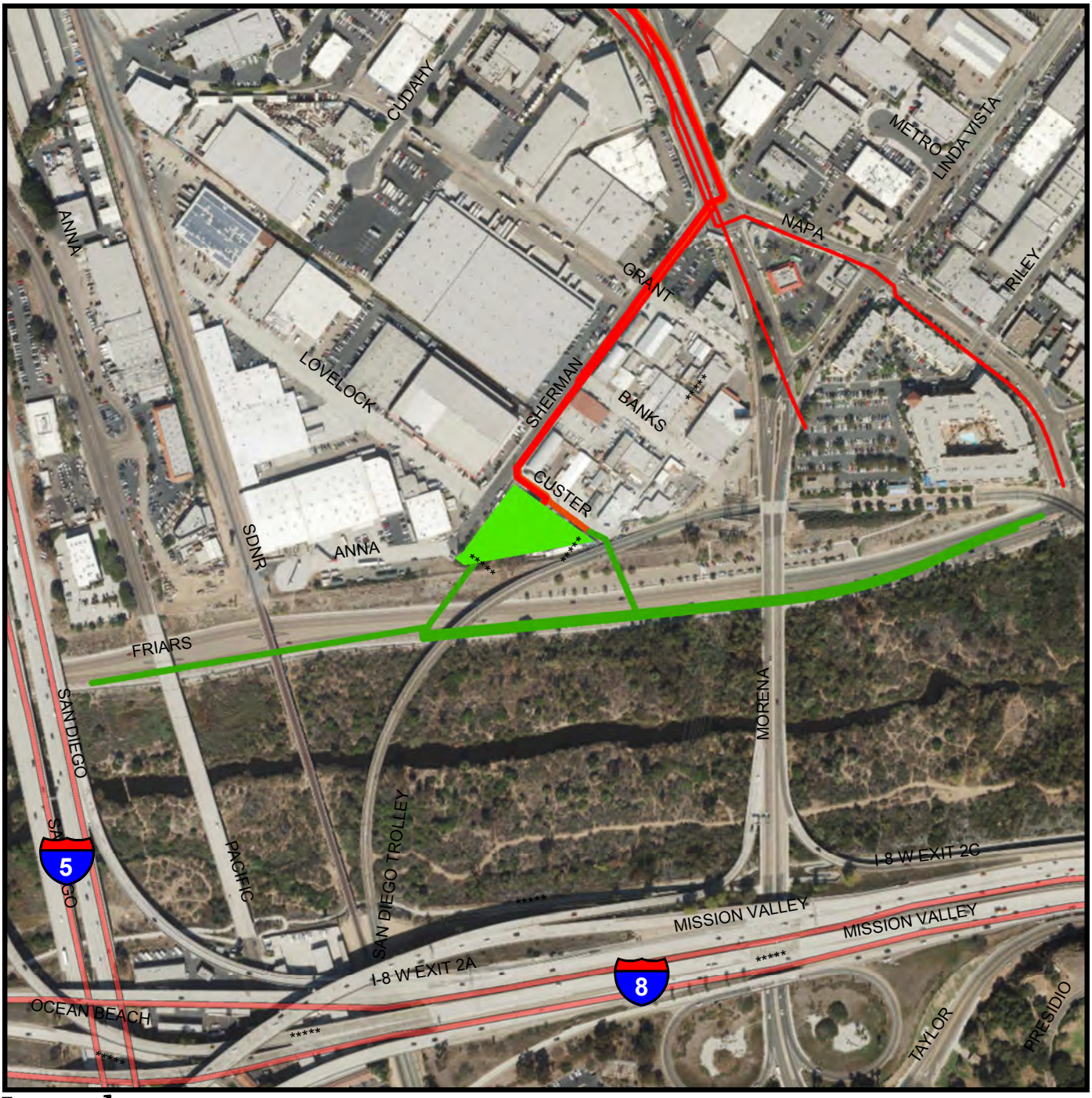
Morena Pump Station

SENIOR ENGINEER
Nabil Batta
858-614-4524

PROJECT MANAGER
Nabil Batta
858-614-4524

PROJECT ENGINEER
Darin Sanchez
858-292-6420

FOR QUESTIONS ABOUT THIS PROJECT
Call: 619-533-4207
Email: engineering@sandiego.gov



Legend

- Morena Pump Station
- Influent and Overflow Sewers
- Morena Conveyance South (Outside of Contract)

COMMUNITY NAME: Linda Vista, Morena

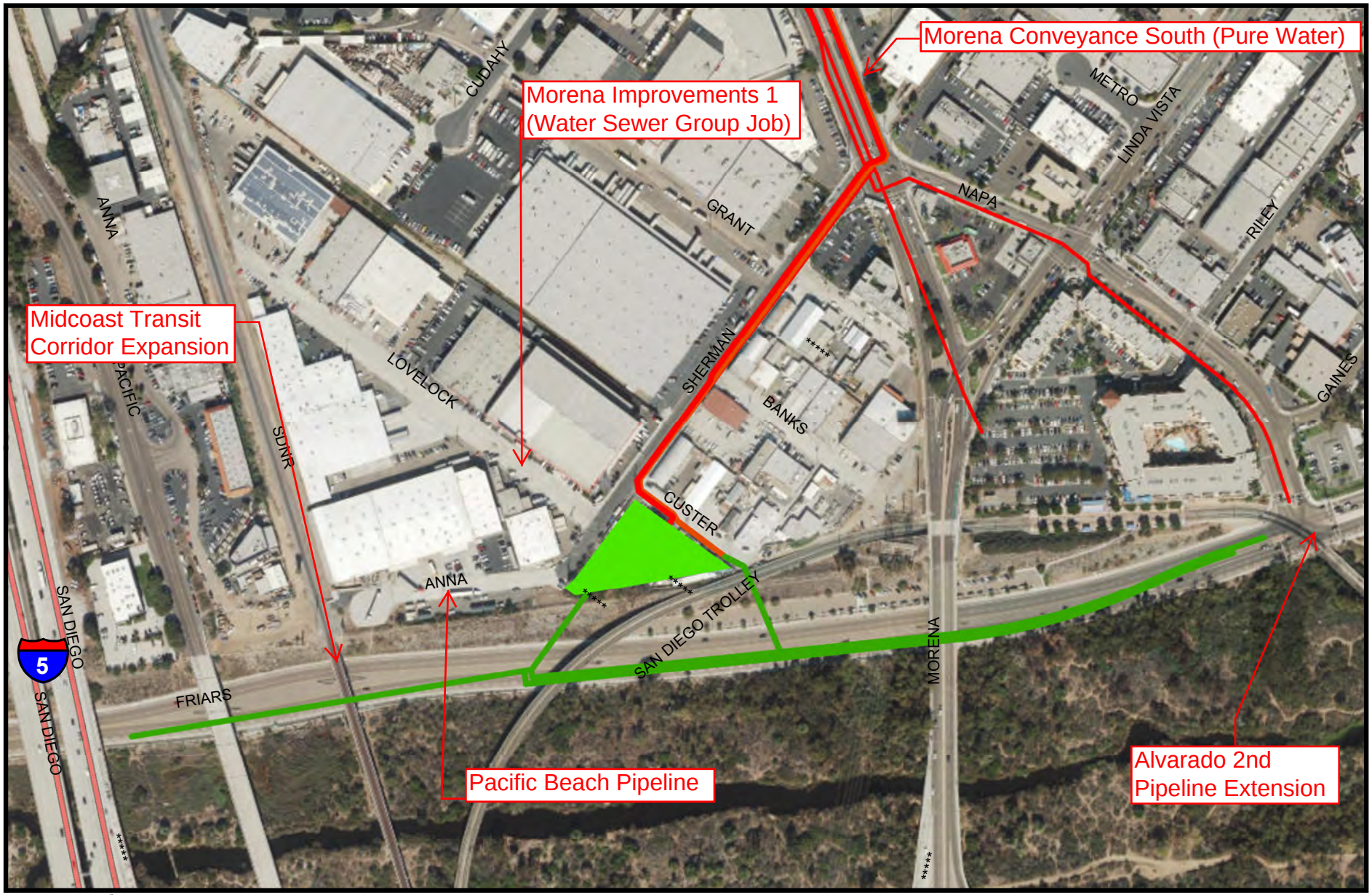
COUNCIL DISTRICT: 2, 7

SAP ID: B15141 (S)

APPENDIX F

ADJACENT PROJECTS

Adjacent Projects



Legend

- Morena Pump Station
- Influent and Overflow Sewers
- Morena Conveyance South (Outside of Contract)

COMMUNITY NAME: Linda Vista, Morena

COUNCIL DISTRICT: 2, 7

SAP ID: B15141 (S)

APPENDIX G

SAMPLE CERTIFICATION LETTER FOR AMERICAN IRON AND STEEL (AIS) COMPLIANCE

SAMPLE CERTIFICATION LETTER

The following information is provided as a sample letter of **step** certification for AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name

Company Address

City, State Zip

Subject: American Iron and Steel Step Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the (melting, bending, coating, galvanizing, cutting, etc.) process for (manufacturing or fabricating) the following products and/or materials shipped or provided for the subject project is in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. Xxxx
2. Xxxx
3. Xxxx

Such process took place at the following location:

_____

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

The following information is provided as a sample letter of certification for AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name

Company Address

City, State Zip

Subject: American Iron and Steel Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. Xxxx
2. Xxxx
3. Xxxx

Such process took place at the following location:

_____

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

APPENDIX H

MONTHLY DRINKING WATER DISCHARGE MONITORING FORM

DRINKING WATER DISCHARGE MONITORING FORM

(Use for All Discharges to the Storm Drain)

All discharge activities related to this project comply with the State Water Resources Control Board ORDER WQ 2014-0194-DWQ, STATEWIDE GENERAL NPDES PERMIT FOR DRINKING WATER SYSTEMS DISCHARGES as referenced by (http://www.waterboards.ca.gov/water_issues/programs/npdes/docs/drinkingwater/final_statewide_wqo2014_0194_dwq.pdf), and as follows:

Project Name:		**WBS No.:**		**Watershed No.**	
Qualified Person Conducting Tests:		**signature**			

BMPs MUST BE IN PLACE PRIOR TO ANY SCHEDULED DISCHARGE

By signing, I certify that all of the statements and conditions for drinking water discharge events are correct.

Event #1

Discharge Location[1]	Catergory[2] (Select one)	Notification[3] (Select all that apply)	BMPs in Place[4] (Select all that apply)	Volume[5] (gal)	Sampling[6] (take samples at 10 mins, 50-60 mins & last 10 mins)				Exceedence[7]			Notes
					Measure	Unit	Time	Result	Limit	*No*	*Yes*	Report exceedence to RE & complete page 2 of 2
Inlet Location	☐ Superchlorinated (Chlorine added for disinfection)	☐ TSW (All Categories)	☐ Sweep flow path (gutter, street, etc.)	**Total**	*Chlorine*	mg/L			0.1 mg/L= Exceedance			
	☐ Large Volume (≥ 325,850 gal)	☐ PUD (All Categories)	☐ Dechlorination (diffusers, chemicals, etc.)	**Reused** (if any)								
Start Date: Time:	☐ Well Dev/Rehab (Not Typical)	☐ Water Board (Large Volume Only)	☐ Inlet Protection		*Turbidity*	NTU			20 NTU= Exceedance 225 NTU= Exceedance for Ocean			
			☐ Erosion Controls									
End Date: Time:	☐ Small Volume/Other (No Sampling Required)	☐ County (≥100,000 gal & within ¼ mile of ocean/bay; or if enters the County's MS4)	☐ Sediment Controls		*pH*	Unit			Range 6.5 to 8.5			

Event #2

Discharge Location[1]	Catergory[2] (Select one)	Notification[3] (Select all that apply)	BMPs in Place[4] (Select all that apply)	Volume[5] (gal)	Sampling[6] (take samples at 10 mins, 50-60 mins & last 10 mins)				Exceedence[7]			Notes
					Measure	Unit	Time	Result	Limit	*No*	*Yes*	Report exceedence to RE & complete page 2 of 2
Inlet Location	☐ Superchlorinated (Chlorine added for disinfection)	☐ TSW (All Categories)	☐ Sweep flow path (gutter, street, etc.)	**Total**	*Chlorine*	mg/L			0.1 mg/L= Exceedance			
	☐ Large Volume (≥ 325,850 gal)	☐ PUD (All Categories)	☐ Dechlorination (diffusers, chemicals, etc.)	**Reused** (if any)								
Start Date: Time:	☐ Well Dev/Rehab (Not Typical)	☐ Water Board (Large Volume Only)	☐ Inlet Protection		*Turbidity*	NTU			20 NTU= Exceedance 225 NTU= Exceedance for Ocean			
			☐ Erosion Controls									
End Date: Time:	☐ Small Volume/Other (No Sampling Required)	☐ County (≥100,000 gal & within ¼ mile of ocean/bay; or if enters the County's MS4)	☐ Sediment Controls		*pH*	Unit			Range 6.5 to 8.5			

Instructional Notes found on the Page 2 of 2

Submit completed Form to RE

Receiving Water Monitoring

(Complete only if limits exceed on Page 1 of 2)

Event #1		
1) Go to the location where the discharge enters the receiving water.		
☐ Accessible ☐ Unable to Determine ☐ No Safe Access		
2) If accessible, take photos and complete the visual monitoring below. If unable to determine, stop here. If no safe access, stop here.		
3) Visual Monitoring: Is the discharge into the receiving water…		
…causing erosion	☐ Yes	☐ No
…carrying floating or suspended matter	☐ Yes	☐ No
…causing discoloration	☐ Yes	☐ No
…causing and impact to the aquatic life present	☐ Yes	☐ No
…observed with visible film	☐ Yes	☐ No
…observed with an sheen or coating	☐ Yes	☐ No
…causing potential nuisance conditions	☐ Yes	☐ No
3) If all answers are NO, stop here.		
4) If any answers are YES, Notify the RE immediately for further action		

Event #2		
1) Go to the location where the discharge enters the receiving water.		
☐ Accessible ☐ Unable to Determine ☐ No Safe Access		
2) If accessible, take photos and complete the visual monitoring below. If unable to determine, stop here. If no safe access, stop here.		
3) Visual Monitoring: Is the discharge into the receiving water…		
…causing erosion	☐ Yes	☐ No
…carrying floating or suspended matter	☐ Yes	☐ No
…causing discoloration	☐ Yes	☐ No
…causing and impact to the aquatic life present	☐ Yes	☐ No
…observed with visible film	☐ Yes	☐ No
…observed with an sheen or coating	☐ Yes	☐ No
…causing potential nuisance conditions	☐ Yes	☐ No
3) If all answers are NO, stop here.		
4) If any answers are YES, Notify the RE immediately for further action		

Instructional Notes

1) Log the location of the inlet or discharge point. For example: Albatross St & 5th Av. Log the start date and time and the end date and time of the discharge.
2) Log the discharge category. "Superchlorinated" are discharges where additional chlorine is added in order to adequately disinfect and sanitize drinking water system facilities. This does NOT include potable water containing residual chlorine from the water treatment process. "Large Volume" discharges are greater than 325,850 gallons of total volume for one event. "Well Dev/Rehab" are discharges of potable ground water from a well. This is not typical. If none of these categories apply, then select "Small Volume/Other."
3) Notifications of the location, date, time, category, and estimated volume of discharge must be made to the contacts and per the requirements below:

Contact	When to Notify	Email
TSW	3 days prior to all discharges	SWPPP@SanDiego.gov
PUD	3 days prior to all discharges	CompReports@SanDiego.gov Rdavenport@SanDiego.gov
San Diego Water Board	3 days prior to Large Volume discharges	SanDiego@WaterBoards.ca.gov Ben.Neill@WaterBoards.ca.gov
County of San Diego	3 days prior if 100,000 gal and within 1/4 mile of ocean/bay	DEH: Joseph.Palmer@SDCounty.ca.gov Dominique.Edwards@SDCounty.ca.gov
	3 days prior if enter county MS4 or unincorporated County	WPP:Nicholas.DeValle@SDCounty.ca.gov LUEG.Watersheds@sdcounty.ca.gov

4) At a minimum, sweep gutters prior to starting discharge and use dechlorination BMPs. The contractor and RE must monitor and determine if BMPs need to be removed or modified. For example if inlet protection is causing flooding at a storm drain inlet, contractor may elect to remove BMPs. Document any modification to BMPs in the notes
5) Total volume must be logged for all discharges. If discharge water is reused for other purposes such as watering a golf course, log that volume under "Reused"
6) Sampling is required for categories per the following table:

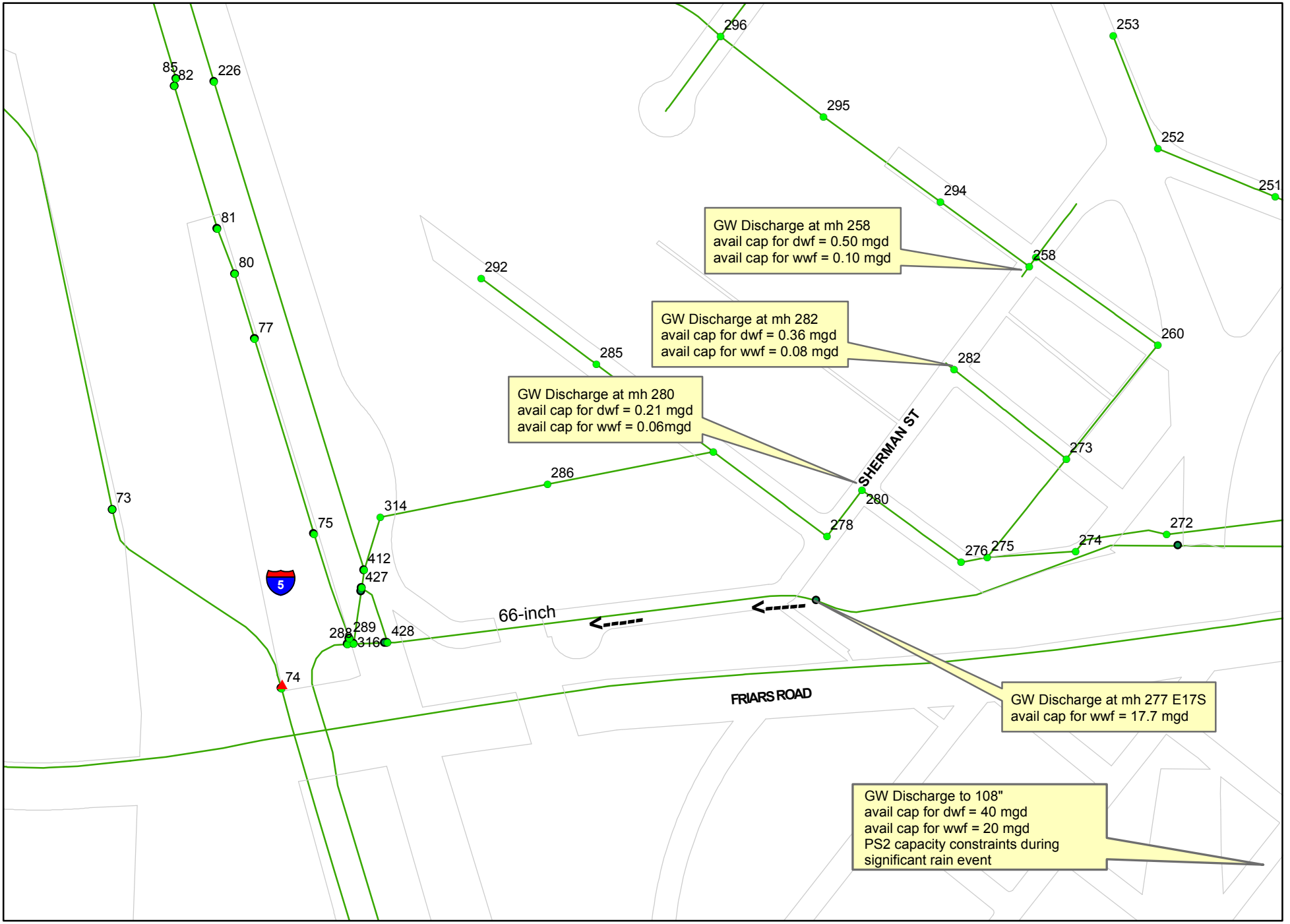
Category	Measure	Sample Frequency
Superchlorinated	Chlorine, Turbidity, pH	first 10 min, 50-60 min, last 10 min
Large Volume	Chlorine Turbidity	first 10 min, 50-60 min, last 10 min
Well Dev/Rehab	Chlorine Turbidity	first 10 min, 50-60 min, last 10 min
Small Volume/Other	None required	N/A

7) Effluent limitations must be monitored not to exceed per the following table:

Measure	Method	Limit
Chlorine	Field Measure	0.10 mg/L-Cl
Turbidity	Visual Estimate	20 NTU for inland waters 225 NTU for ocean 100 NTU for wells
pH	Field Meausre	6.5 - 8.5

APPENDIX I

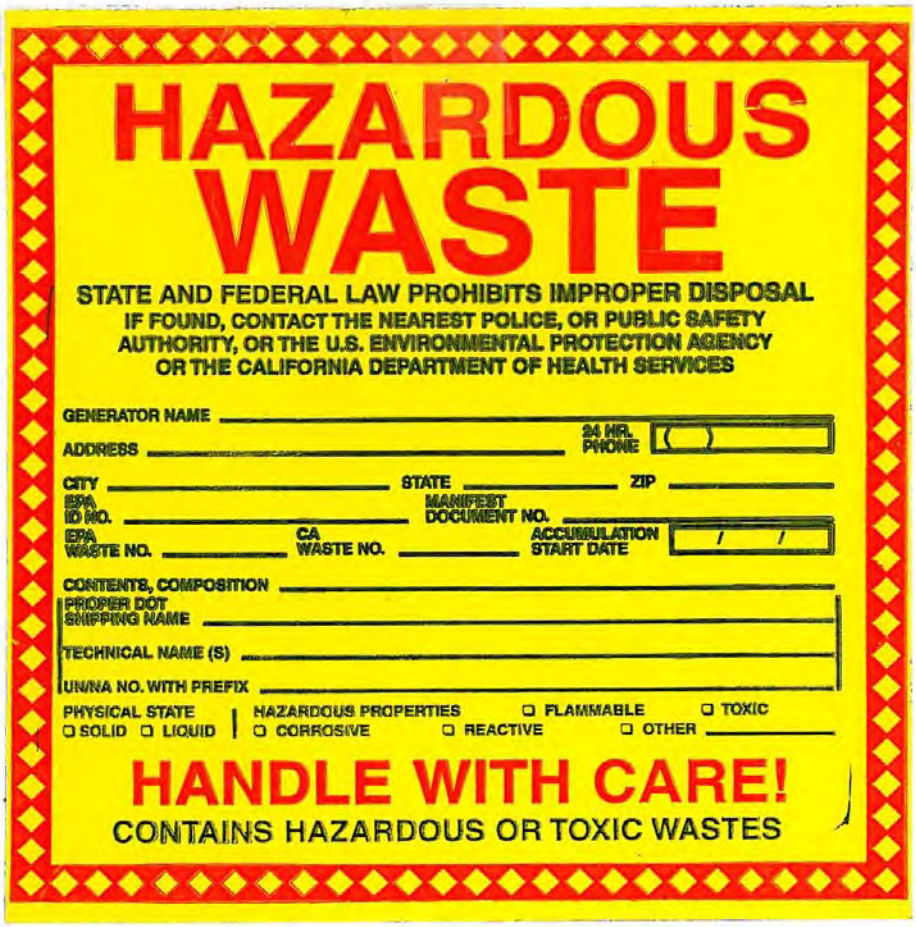
DISCHARGE POINTS AND FLOW DATA



MORENA PUMP STATION GROUNDWATER DISCHARGES

APPENDIX J

HAZARDOUS LABEL/FORMS


HAZARDOUS
WASTE
STATE AND FEDERAL LAW PROHIBITS IMPROPER DISPOSAL
IF FOUND, CONTACT THE NEAREST POLICE, OR PUBLIC SAFETY
AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY
OR THE CALIFORNIA DEPARTMENT OF HEALTH SERVICES
GENERATOR NAME
ADDRESS
24 HR. PHONE
CITY
STATE
ZIP
EPA ID NO.
MANIFEST DOCUMENT NO.
EPA WASTE NO.
CA WASTE NO.
ACCUMULATION START DATE
CONTENTS, COMPOSITION
PROPER DOT SHIPPING NAME
TECHNICAL NAME (S)
UN/NA NO. WITH PREFIX
PHYSICAL STATE
SOLID LIQUID
HAZARDOUS PROPERTIES
CORROSIVE
FLAMMABLE
REACTIVE
TOXIC
OTHER
HANDLE WITH CARE!
CONTAINS HAZARDOUS OR TOXIC WASTES

INCIDENT/RELEASE ASSESSMENT FORM [1]

If you have an emergency, Call 911

Handlers of hazardous materials are required to report releases. The following is a tool to be used for assessing if a release is reportable. Additionally, a non-reportable release incident form is provided to document why a release is not reported (see back).

Questions for Incident Assessment:	YES	NO
1. Was anyone killed or injured, or did they require medical care or admitted to a hospital for observation?	❒	❒
2. Did anyone, other than employees in the immediate area of the release, evacuate?	❒	❒
3. Did the release cause off-site damage to public or private property?	❒	❒
4. Is the release greater than or equal to a reportable quantity (RQ)?	❒	❒
5. Was there an uncontrolled or unpermitted release to the air?	❒	❒
6. Did an uncontrolled or unpermitted release escape secondary containment, or extend into any sewers, storm water conveyance systems, utility vaults and conduits, wetlands, waterways, public roads, or off site?	❒	❒
7. Will control, containment, decontamination, and/or clean up require the assistance of federal, state, county, or municipal response elements?	❒	❒
8. Was the release or threatened release involving an unknown material or contains an unknown hazardous constituent?	❒	❒
9. Is the incident a threatened release (a condition creating a substantial probability of harm that requires immediate action to prevent, reduce, or mitigate damages to persons, property, or the environment)?	❒	❒
10. Is there an increased potential for secondary effects including fire, explosion, line rupture, equipment failure, or other outcomes that may endanger or cause exposure to employees, the general public, or the environment?	❒	❒

If the answer is YES to any of the above questions – report the release to the California Office of Emergency Services at 800-852-7550 and the local CUPA daytime: (619) 338-2284, after hours: (858) 565-5255. Note: other state and federal agencies may require notification depending on the circumstances.

Call 911 in an emergency

If all answers are NO, complete a Non Reportable Release Incident Form (page 2 of 2) and keep readily available. Documenting why a "no" response was made to each question will serve useful in the event questions are asked in the future, and to justify not reporting to an outside regulatory agency.

If in doubt, report the release.

[1] This document is a guide for accessing when hazardous materials release reporting is required by Chapter 6.95 of the California Health and Safety Code. It does not replace good judgment, Chapter 6.95, or other state or federal release reporting requirements.

NON REPORTABLE RELEASE INCIDENT FORM

1. RELEASE AND RESPONSE DESCRIPTION Incident #_____

Date/Time Discovered	Date/Time Discharge	Discharge Stopped ☐ Yes ☐ No
Incident Date / Time:		
Incident Business / Site Name:		
Incident Address:		
Other Locators (Bldg, Room, Oil Field, Lease, Well #, GIS)		
Please describe the incident and indicate specific causes and area affected. Photos Attached?: ☐Yes ☐No		
Indicate actions to be taken to prevent similar releases from occurring in the future.		

2. ADMINISTRATIVE INFORMATION

Supervisor in charge at time of incident:	Phone:
Contact Person:	Phone:

3. CHEMICAL INFORMATION

Chemical	Quantity ☐ GAL ☐ LBS ☐ FT^3
Chemical	Quantity ☐ GAL ☐ LBS ☐ FT^3
Chemical	Quantity ☐ GAL ☐ LBS ☐ FT^3
Clean-Up Procedures & Timeline:	
Completed By:	Phone:
Print Name:	Title:

EMERGENCY RELEASE FOLLOW - UP NOTICE REPORTING FORM

A

BUSINESS NAME	FACILITY EMERGENCY CONTACT & PHONE NUMBER ( ) -

B

INCIDENT DATE MO DAY YR	TIME OES NOTIFIED (use 24 hr time)	OES CONTROL NO.

C

INCIDENT ADDRESS LOCATION	CITY / COMMUNITY	COUNTY ZIP

D

CHEMICAL OR TRADE NAME (print or type)	CAS Number

CHECK IF CHEMICAL IS LISTED IN 40 CFR 355, APPENDIX A ☐	CHECK IF RELEASE REQUIRES NOTIFI - CATION UNDER 42 U.S.C. Section 9603 (a) ☐

PHYSICAL STATE CONTAINED ☐ SOLID ☐ LIQUID ☐ GAS	PHYSICAL STATE RELEASED ☐ SOLID ☐ LIQUID ☐ GAS	QUANTITY RELEASED

ENVIRONMENTAL CONTAMINATION ☐ AIR ☐ WATER ☐ GROUND ☐ OTHER	TIME OF RELEASE	DURATION OF RELEASE ___DAYS ___HOURS ___MINUTES

E

ACTIONS TAKEN

F

KNOWN OR ANTICIPATED HEALTH EFFECTS (Use the comments section for addition information)

☐ ACUTE OR IMMEDIATE (explain) _____

☐ CHRONIC OR DELAYED (explain) _____

☐ NOTKNOWN (explain)

G

ADVICE REGARDING MEDICAL ATTENTION NECESSARY FOR EXPOSED INDIVIDUALS

H

COMMENTS (INDICATE SECTION (A - G) AND ITEM WITH COMMENTS OR ADDITIONAL INFORMATION)

I

CERTIFICATION: I certify under penalty of law that I have personally examined and I am familiar with the information submitted and believe the submitted information is true, accurate, and complete.

REPORTING FACILITY REPRESENTATIVE (print or type) _____

SIGNATURE OF REPORTING FACILITY REPRESENTATIVE _____ DATE: _____

EMERGENCY RELEASE FOLLOW-UP NOTICE
REPORTING FORM INSTRUCTIONS

GENERAL INFORMATION:

Chapter 6.95 of Division 20 of the California Health and Safety Code requires that written emergency release follow-up notices prepared pursuant to 42 U.S.C. § 11004, be submitted using this reporting form. Non-permitted releases of reportable quantities of Extremely Hazardous Substances (listed in 40 CFR 355, appendix A) or of chemicals that require release reporting under section 103(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [42 U.S.C. § 9603(a)] must be reported on the form, as soon as practicable, but no later than 30 days, following a release. The written follow-up report is required in addition to the verbal notification.

BASIC INSTRUCTIONS:

- The form, when filled out, reports follow-up information required by 42 U.S.C § 11004. Ensure that all information requested by the form is provided as completely as possible.
- If the incident involves reportable releases of more than one chemical, prepare one report form for each chemical released.
- If the incident involves a series of separate releases of chemical(s) at different times, the releases should be reported on separate reporting forms.

SPECIFIC INSTRUCTIONS:

Block A: Enter the name of the business and the name and phone number of a contact person who can provide detailed facility information concerning the release.

Block B: Enter the date of the incident and the time that verbal notification was made to OES. The OES control number is provided to the caller by OES at the time verbal notification is made. Enter this control number in the space provided.

Block C: Provide information pertaining to the location where the release occurred. Include the street address, the city or community, the county and the zip code.

Block D: Provide information concerning the specific chemical that was released. Include the chemical or trade name and the Chemical Abstract Service (CAS) number. Check all categories that apply. Provide best available information on quantity, time and duration of the release.

Block E: Indicate all actions taken to respond to and contain the release as specified in 42 U.S.C. § 11004(c).

Block F: Check the categories that apply to the health effects that occurred or could result from the release. Provide an explanation or description of the effects in the space provided. Use Block H for additional comments/information if necessary to meet requirements specified in 42 U.S.C. § 11004(c).

Block G: Include information on the type of medical attention required for exposure to the chemical released. Indicate when and how this information was made available to individuals exposed and to medical personnel, if appropriate for the incident, as specified in 42 U.S.C. § 11004(c).

Block H: List any additional pertinent information.

Block I: Print or type the name of the facility representative submitting the report. Include the official signature and the date that the form was prepared.

MAIL THE COMPLETED REPORT TO:

State Emergency Response Commission (SERC)
Attn: Section 304 Reports
Hazardous Materials Unit
3650 Schriever Avenue
Mather, CA 95655

NOTE: Authority cited: Sections 25503, 25503.1 and 25507.1, Health and Safety Code. Reference: Sections 25503(b)(4), 25503.1, 25507.1, 25518 and 25520, Health and Safety Code.

APPENDIX K

SAMPLE OF PUBLIC NOTICE

The City of SAN DIEGO

CONSTRUCTION NOTICE

PROJECT TITLE

Work on your street will begin within one week to replace the existing water mains servicing your community.

The work will consist of:

- Saw-cutting and trench work on Ingulf Street from Morena Boulevard to Galveston Street to install new water mains, water laterals and fire hydrants.
- Streets where trenching takes place will be resurfaced and curb ramps will be upgraded to facilitate access for persons with disabilities where required.
- This work is anticipated to be complete in your community by December 2016.

How your neighborhood may be impacted:

- Water service to some properties during construction will be provided by a two-inch highline pipe that will run along the curb. To report a highline leak call 619-515-3525.
- Temporary water service disruptions are planned. If planned disruptions impact your property, you will receive advance notice.
- Parking restrictions will exist because of the presence of construction equipment and materials.
- "No Parking" signs will be displayed 72 hours in advance of the work.
- Cars parked in violation of signs will be TOWED.

Hours and Days of Operation:
Monday through Friday X:XX AM to X:XX PM.

City of San Diego Contractor:
Company Name, XXX-XXX-XXXX

To contact the City of San Diego: SD Public Works
619-533-4207 | engineering@sandiego.gov | sandiego.gov/CIP

This information is available in alternative formats upon request.

The City of SAN DIEGO

CONSTRUCTION NOTICE

PROJECT TITLE

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Monday through Friday X:XX AM to X:XX PM.

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Company Name, XXX-XXX-XXXX

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619-533-4207 | engineering@sandiego.gov | sandiego.gov/CIP

This information is available in alternative formats upon request.

APPENDIX L

ADVANCED METERING INFRASTRUCTURE (AMI) DEVICE PROTECTION

Protecting AMI Devices in Meter Boxes and on Street Lights

The Public Utilities Department (PUD) has begun the installation of the Advanced Metering Infrastructure (AMI) technology as a new tool to enhance water meter reading accuracy and efficiency, customer service and billing, and to be used by individual accounts to better manage the efficient use of water. **All AMI devices shall be protected per Section 402-2, "Protection", of the 2018 Whitebook.**

AMI technology allows water meters to be read electronically rather than through direct visual inspection by PUD field staff. This will assist PUD staff and customers in managing unusual consumption patterns which could indicate leaks or meter tampering on a customer's property.

Three of the main components of an AMI system are the:

A. Endpoints, see Photo 1:

Photo 1

B. AMI Antenna attached to Endpoint (antenna not always required), see Photo 2:

Photo 2

Network Devices, see Photo 3:

Photo 3

AMI endpoints transmit meter information to the AMI system and will soon be on the vast majority of meters in San Diego. These AMI devices provide interval consumption data to the PUD's Customer Support Division. If these devices are damaged or communication is interrupted, this Division will be alerted of the situation. The endpoints are installed in water meter boxes, coffins, and vaults adjacent to the meter. A separate flat round antenna may also be installed through the meter box lid. This antenna is connected to the endpoint via cable. The following proper installation shall be implemented when removing the lid to avoid damaging the antenna, cable, and/or endpoint. Photo 4 below demonstrates a diagram of the connection:

Photo 4

The AMI device ERT/Endpoint/Transmitter shall be positioned and installed as discussed in this Appendix. If the ERT/Endpoint/Transmitter is disturbed, it shall be re-installed and returned to its original installation with the end points pointed upwards as shown below in Photo 5.

The PUD's code compliance staff will issue citations and invoices to you for any damaged AMI devices that are not re-installed as discussed in the Contract Document
Photo 5 below shows a typical installation of an AMI endpoint on a water meter.

Photo 5

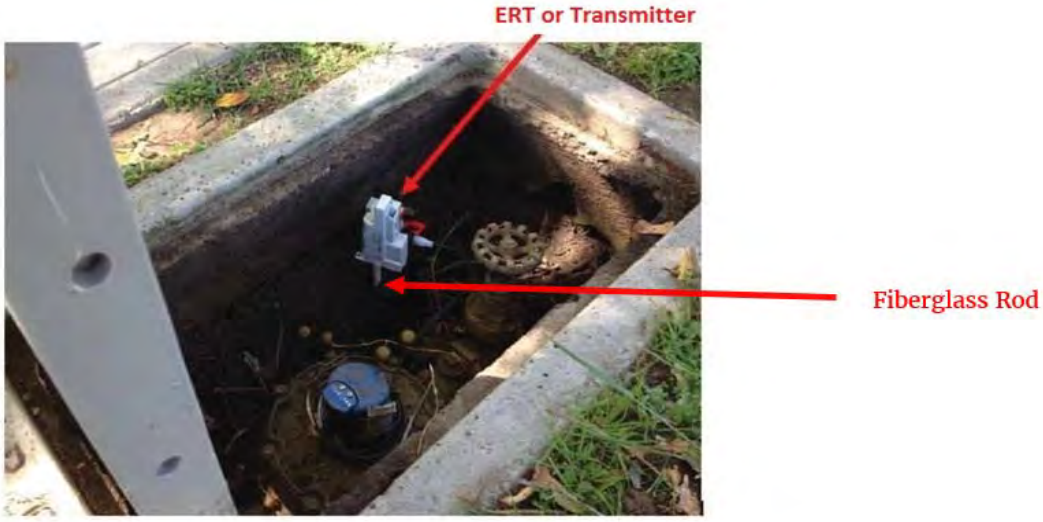


Photo 6 below is an example of disturbance that shall be avoided:

Photo 6

You are responsible when working in and around meter boxes. If you encounter these endpoints, use proper care and do not disconnect them from the registers on top of the water meter. If the lid has an antenna drilled through, do not change or tamper with the lid and inform the Resident Engineer immediately about the location of that lid. Refer to Photo 7 below:

Photo 7

Another component of the AMI system are the Network Devices. The Network Devices are strategically placed units (mainly on street light poles) that collect interval meter reading data from multiple meters for transmission to the Department Control Computer. **If you come across any of these devices on street lights that will be removed or replaced (refer to Photos 8 and 9 below), notify AMI Project Manager Arwa Sayed at (619) 362-0121 immediately.**

Photo 8 shows an installed network device on a street light. On the back of each Network Device is a sticker with contact information. See Photo 9. **Call PUD Water Emergency Repairs at 619-515-3525 if your work will impact these street lights.** These are assets that belong to the City of San Diego and you shall be responsible for any costs of disruption of this network.

Photo 8

Photo 9

If you encounter any bad installations, disconnected/broken/buried endpoints, or inadvertently damage any AMI devices or cables, notify the Resident Engineer immediately. The Resident Engineer will then immediately contact the AMI Project Manager, Arwa Sayed, at (619) 362-0121.

APPENDIX M

NONDISCLOSURE AGREEMENT

NONDISCLOSURE AGREEMENT
REGARDING
[Permanent Security Measures/Morena Pump Station]

This Nondisclosure Agreement ("Agreement") is made as of [date] by and between [name] [legal form of entity] ("Consultant") and the City of San Diego, a municipal corporation ("City") (collectively "parties"0.

1. **Purpose.** This Agreement is intended to allow the Consultant to view certain Confidential Information (defined herein) of the City who will be involved with the construction and providing support for the installation of the permanent security measures as proposed for the Morena Pump Station, while ensuring that the Confidential Information is protected against unauthorized use or disclosure.

2. **Confidential Information.** "Confidential Information" means the project security plans (SEC-01 through SEC-12) and specifications (Division 28) of buildings and other improvements of the City's Public Utilities Department's ("Department") infrastructure. Consultant's access to the Confidential Information will be provided through the Department's document management system.

3. **Nondisclosure of Confidential Information.**

(a) Consultant agrees it shall not use the Confidential Information for any purpose other than that stated in Section 1. Consultant shall restrict access to the Confidential Information to only those employees who are necessary to perform the purpose stated in Section 1. Consultant shall not disclose or permit disclosure of the Confidential Information to third parties (including subconsultants and agents) or to employees of Consultant who are not required to have the information for the purpose stated in Section 1. Consultant shall advise its employees who have access to the Confidential Information of the confidentiality obligations in this Agreement. Consultant shall take all reasonable measures to protect the secrecy and use of the Confidential Information and to prevent its disclosure to or use by persons not authorized by this Agreement and to prevent it from falling into the public domain. Such measures shall include, but not be limited to, the highest degree of care that Consultant exercises to protect its own confidential or proprietary information, which shall be no less than reasonable care. Consultant shall notify the City in writing of any actual or suspected misuse, misappropriation or unauthorized disclosure of Confidential Information that comes to Consultant's attention.

(b) Consultant shall not have liability to the City with regard to any Confidential Information that the Consultant can prove:

(i) was in the public domain at the time it was disclosed or has entered the public domain through no fault of the Consultant;

(ii) was known to the Consultant without restriction at the time of disclosure, as demonstrated by files in existence at the time of disclosure;

(iii) is disclosed with the prior written approval of the City;

(iv) becomes known to the Consultant, without restriction, from a source other than the City without breach of this Agreement by the Consultant and otherwise not in violation of City's rights;

(v) is disclosed generally to third parties by the City without restrictions similar to those contained in this Agreement; or

(vi) is disclosed pursuant to the order or requirement of a court, administrative agency, or other governmental body; provided, however, that the Consultant shall give prompt notice of such court order or requirement to the City to enable the City to seek a protective order or otherwise prevent or restrict such disclosure.

4. **Remedies; Indemnification.** The Consultant agrees that its obligations set forth in this Agreement are necessary and reasonable in order to protect the City and its business. The Consultant agrees that due to the unique nature of the Confidential Information, monetary damages would be inadequate to compensate the City for any breach by the Consultant of its covenants and agreements set forth in this Agreement. Accordingly, the Consultant agrees and acknowledges that any such violation or threatened violation shall cause irreparable injury to the City and that, in addition to any other remedies that may be available, in law, in equity or otherwise, the City shall be entitled (a) to obtain injunctive relief against the threatened breach of this Agreement or the continuation of any such breach by the Consultant, without the necessity of proving actual damages, and (b) to be indemnified by the Consultant from any loss or harm, including but not limited to attorney's fees, arising out of or in connection with any breach or enforcement of the Consultant's obligations under this Agreement or the unauthorized use or disclosure of the disclosing party's Confidential Information.

5. **Return of Materials.** All copies of the Confidential Information shall be promptly returned to the City by the Consultant at the conclusion of its services or within ten (10) days after the written request of the City.

6. **No Rights Granted.** Nothing in this Agreement shall be construed as granting the Consultant any rights in or to the Confidential Information other than the limited right to review such Confidential Information solely for the purpose stated in Section 1.

7. **No Publicity.** Consultant shall not, without the prior consent of the City, disclose to any other person the fact that Confidential Information has been and/or may be disclosed under this Agreement, or any of the terms, conditions, status or other facts with respect thereto, except as required by law and then only with prior notice as soon as possible to the City.

8. **Term.** Consultant's confidentiality and nondisclosure obligations shall survive into perpetuity.

9. **Successors and Assigns.** The terms and conditions of this Agreement shall inure to the benefit of and be binding upon the respective successors and assigns of the parties, provided that access to the Confidential Information and any Confidential Information in Consultant's possession may not be assigned without the prior written consent of the City unless the assignee is the successor entity to the assignor upon the dissolution of the assignor in its present form. Nothing in this Agreement, express or implied, is intended to

confer upon any party other than the parties hereto or their respective successors and assigns any rights, remedies, obligations, or liabilities under or by reason of this Agreement, except as expressly provided in this Agreement.

10. **Severability.** If one or more provisions of this Agreement are held to be unenforceable under applicable law, the parties agree to renegotiate such provision in good faith. In the event that the parties cannot reach a mutually agreeable and enforceable replacement for such provision, then (a) such provision shall be excluded from this Agreement, (b) the balance of the Agreement shall be interpreted as if such provision were so excluded and (c) the balance of the Agreement shall be enforceable in accordance with its terms.

11. **Governing Law; Jurisdiction.** This Agreement and all acts and transactions pursuant hereto and the rights and obligations of the parties hereto shall be governed, construed and interpreted in accordance with the laws of the State of California, without giving effect to principles of conflicts of law. Each of the parties hereto consents to the exclusive jurisdiction and venue of the courts of San Diego County, California.

12. **Amendment and Waiver.** No amendment of this Agreement is valid or effective unless made in writing and consented to by the Consultant and City. Any amendment or waiver effected in accordance with this Section shall be binding upon the parties and their respective successors and assigns. Failure to enforce any provision of this Agreement by a party shall not constitute a waiver of any term hereof by such party.

13. **Counterparts.** This Agreement may be executed in two or more counterparts, each of which shall be deemed an original and all of which together shall constitute one instrument.

14. **Entire Agreement.** This Agreement is the product of both of the parties hereto, and constitutes the entire agreement between such parties pertaining to the subject matter hereof, and merges all prior negotiations and drafts of the parties with regard to the transactions contemplated herein. Any and all other written or oral agreements existing between the parties hereto regarding such transactions are expressly canceled.

[REMAINDER OF THIS PAGE INTENTIONALLY LEFT BLANK]

IN WITNESS WHEREOF, the undersigned parties hereby execute this Nondisclosure Agreement Regarding [state nature of work/project scope of work ("a condition assessment of the City's buildings pursuant to its scope of work under Agreement XXXX")] as of the date first above written.

[consultant name]

By: _____

Name:

Title:

Address:

The City of San Diego

By: _____

Name:

Title:

Address:

APPENDIX N

SWPPP CONSTRUCTION BMP MAINTENANCE LOG

SWPPP Construction BMP Maintenance Log

Examples of construction BMP maintenance activites include but are not limited to tasks listed below. The contractor is ultimately responsible for compliance with the Storm Water Standards Manual and/or the Construction General Permit, and for ensuring all BMPs function per manufacturer's specifications. Use the attached log to schedule and document maintenance activities. The log shall be kept with the project SWPPP document at all times.

Construction BMP Maintenance Acitivities

- Maintain stabilized construction entrances/exits
- Redress gravel/rock to full coverage and remove any sediment accumulation
- Remove and replace geotextile/compost blanket/plastic with holes or tears
- Redress and restabilize erosion or rilling greater than 1-inch deep
- Reapply hydraulic stabilization products to full coverage
- Remove and replace silt fence/fiber roll/gravel bags/etc. with holes or tears
- Reinstall or replace silt fence/fiber roll/etc. with sags
- Remove sediment accumulation from perimeter controls
- Remove sediment accumulation from storm drain inlet protection and check dams
- Remove sediment accumulation from energy dissipators
- Repair or remove any vehicle/equipment that leaks
- Remove any accumulation in drip pans or containment
- Empty concrete washouts when they reach 75% capacity
- Empty waste disposal containers when they reach 95% capacity

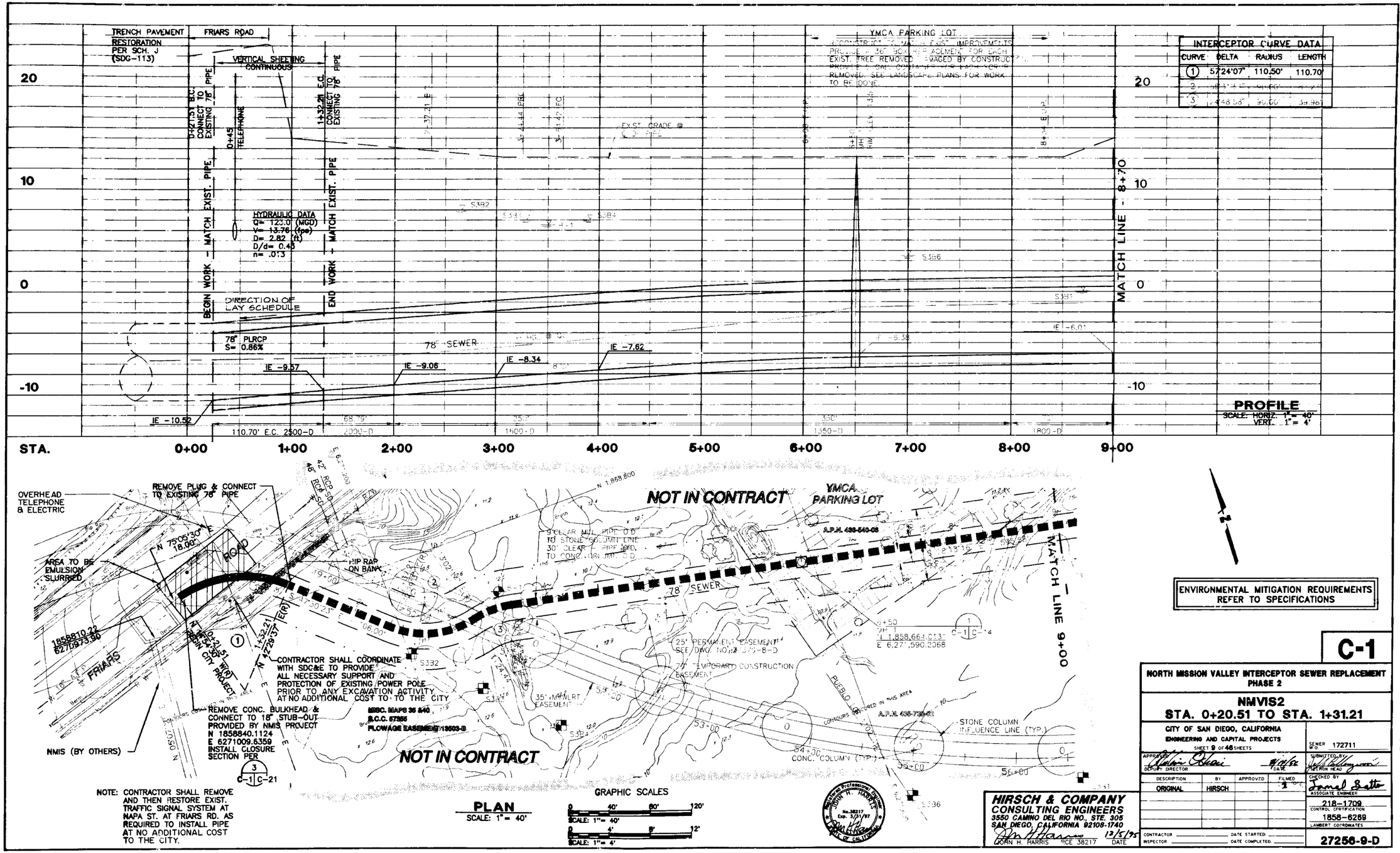
Construction BMP Maintenance Log

Project Title:
WBS/IO No:
WDID:

Scheduled Date/Time	Completion Date/Time	Location	Maintenance Tasks Performed	Logged By

APPENDIX O

AS-BUILT DRAWINGS



C-1

NORTH MISSION VALLEY INTERCEPTOR SEWER REPLACEMENT PHASE 2

NMVIS2

STA. 0+20.51 TO STA. 1+31.21

CITY OF SAN DIEGO, CALIFORNIA
ENGINEERING AND CAPITAL PROJECTS
SHEET 9 OF 46 SHEETS

SEWER W.O. 172711

APPROVED: DEPUTY DIRECTOR — DATE 8/11/95
SUBMITTED BY: SECTION HEAD
CHECKED BY: ASSOCIATE ENGINEER

DESCRIPTION	BY	APPROVED	FILMED
ORIGINAL	HIRSCH		

218-1709 CONTROL CERTIFICATION
1858-6259 LAMBERT COORDINATES
27256-9-D

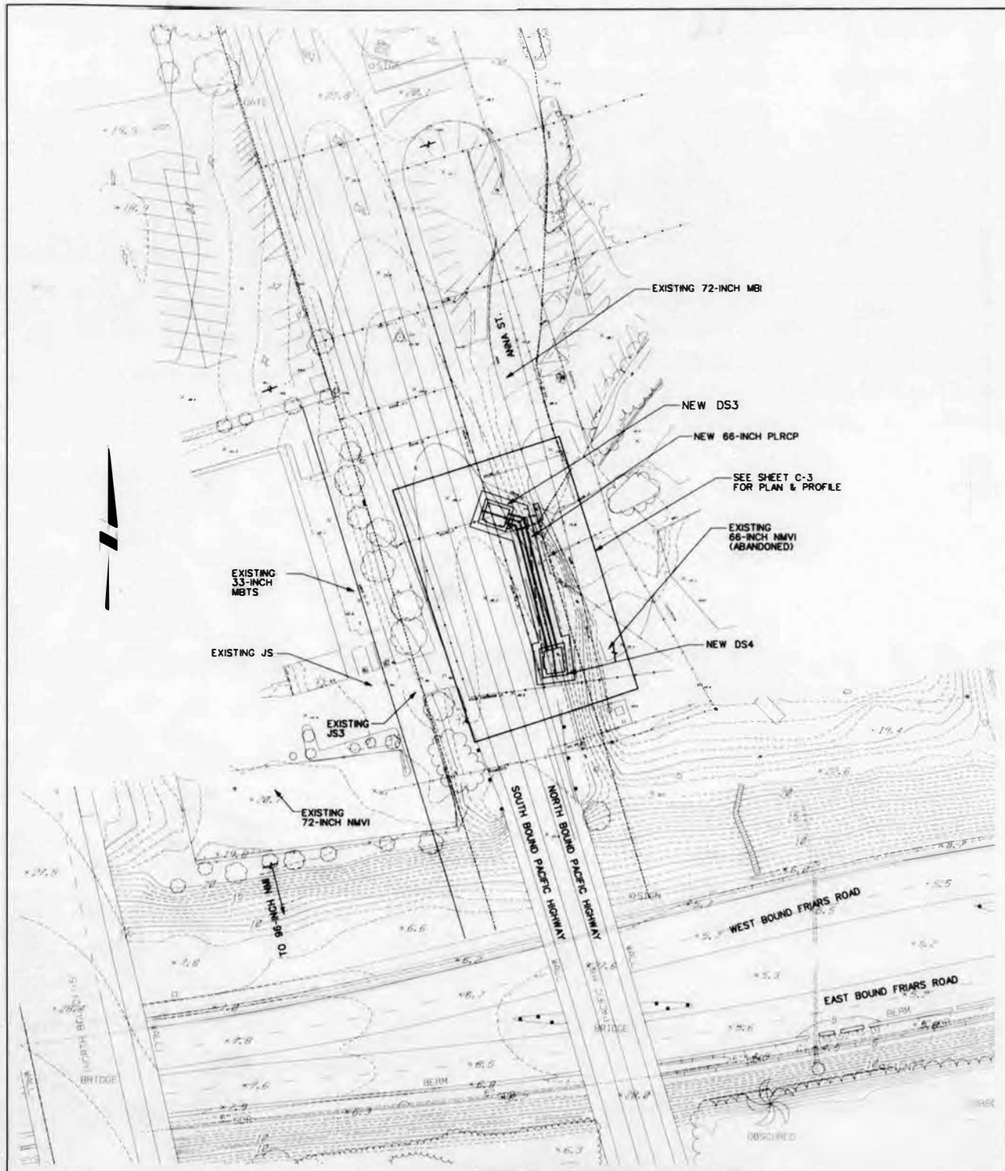
CONTRACTOR _____ DATE STARTED _____
INSPECTOR _____ DATE COMPLETED _____

HIRSCH & COMPANY
CONSULTING ENGINEERS
3550 CAMINO DEL RIO NO., STE. 305
SAN DIEGO, CALIFORNIA 92108-1740
JOHN H. HARRIS RCE 38217 DATE 12/5/95

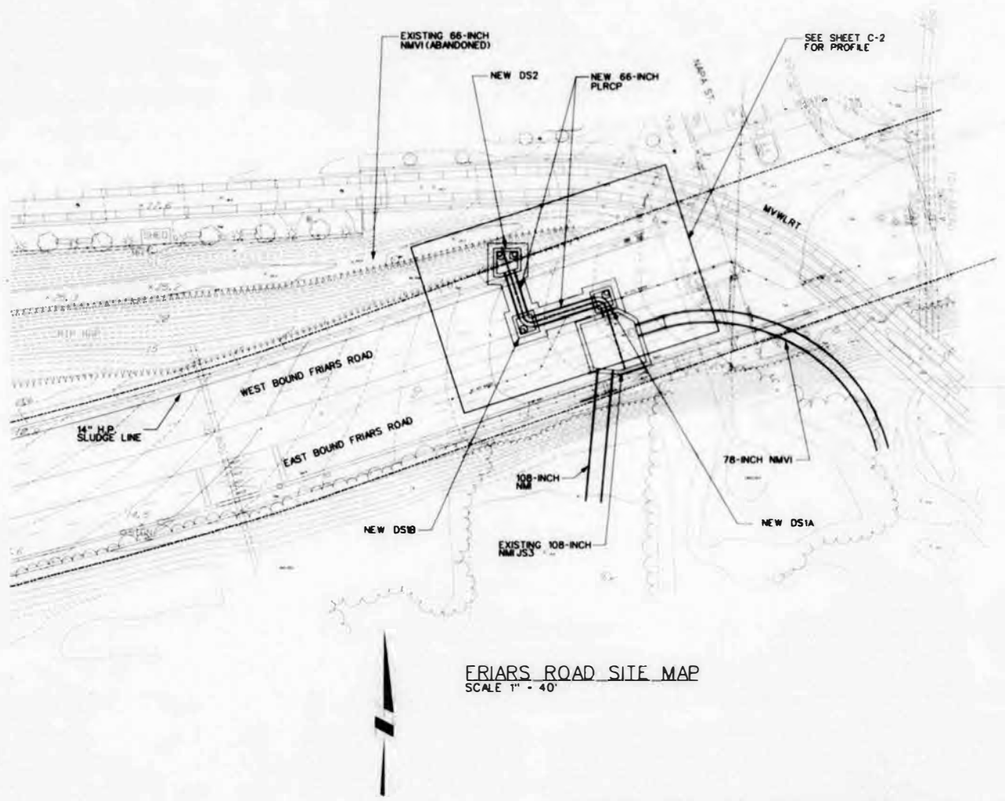
HCWO: 9312 FILE: 9312201T.DWG 1:1

NMVIS2 78" PIPELINE - STA. 0+20.51 TO STA. 1+31.21

\HIRSCH1\CURRENT PROJECTS\NORTH METRO DESIGN\DRAWING FILES\9948-C1.DGN
6-16-00 12:00PM



PACIFIC HIGHWAY SITE MAP
SCALE 1" = 40'



FRIARS ROAD SITE MAP
SCALE 1" = 40'

DRAWING NO.	C-1
SHEET NO.	7
CIP NO.	46-104.0
SPECIFICATION NO.	01-001

NORTH METRO INTERCEPTOR DIVERSION - 3A (NMI3A)

SITE PLANS

CITY OF SAN DIEGO, CALIFORNIA
SHEET 7 OF 38 SHEETS

Lisa K. Mey — Sept. 20, 2000
PROJECT MANAGER — DATE

WATER NO.
SEWER NO. 171711

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	HIRSCH			

DESIGN ENGINEER

CONTRO. CERTIFICATION 218-1707

LAMBERT COORDINATES 30507-7-D

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

REGISTERED PROFESSIONAL ENGINEER — JOHN H. HARRIS — No. 3829 — Exp. 3/31/01 — CIVIL — STATE OF CALIFORNIA

WARNING
0 ½ 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

HIRSCH & COMPANY
CONSULTING ENGINEERS
3550 CAMINO DEL RIO NO., STE. 305
SAN DIEGO, CALIFORNIA 92108-1740
JOHN H. HARRIS RCE 3829, DATE 6/16/00

SCALE — HORIZONTAL 1" = 40' — VERTICAL NONE

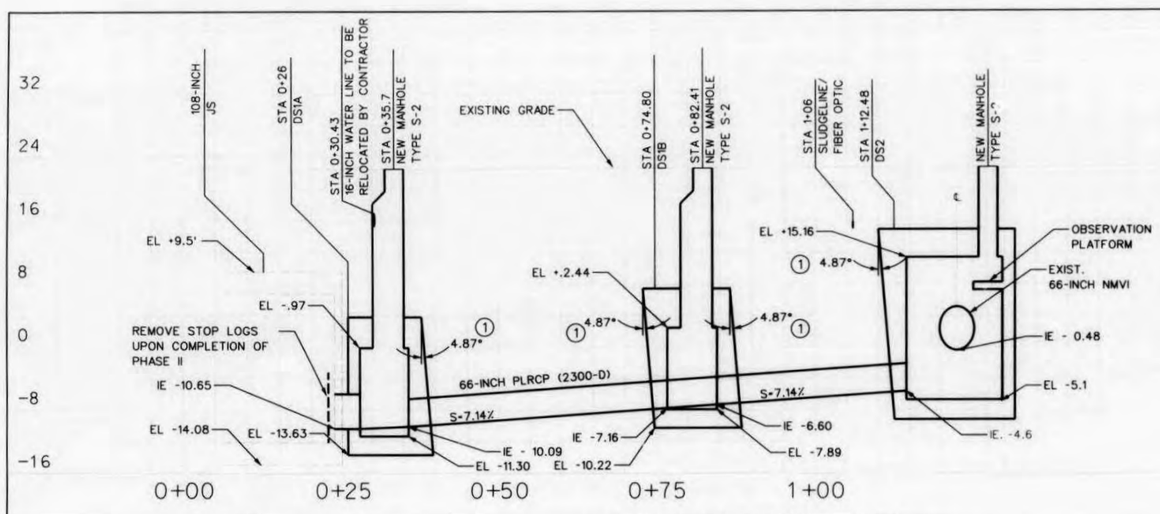
METROPOLITAN WASTEWATER DEPARTMENT
City of San Diego

DRAWING STATUS

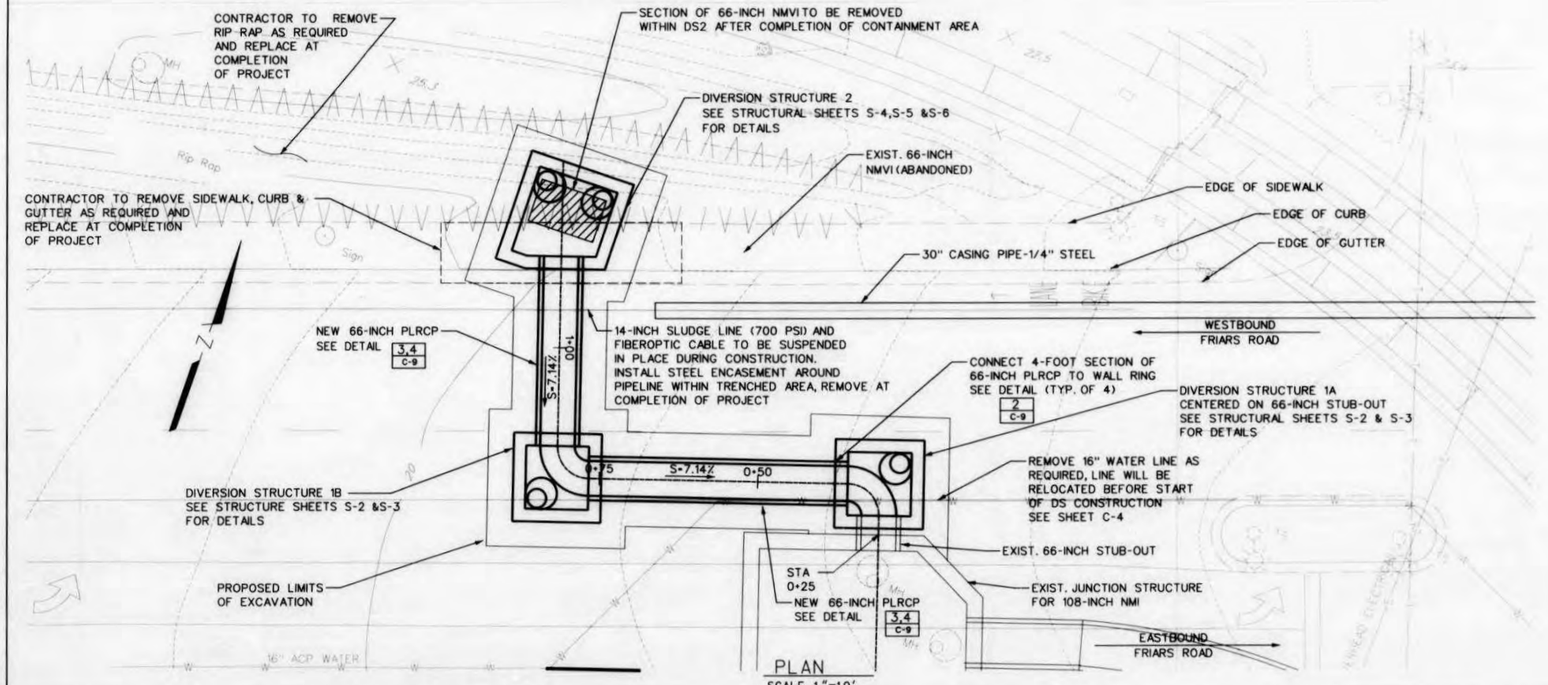
NO.	DATE	REQ.	REVISION DESCRIPTION	DRAWN	CKD	APD.	PE	EM	QA/QC

FILMED FROM THE ORIGINAL. BEST QUALITY OBTAINABLE. EXCESSIVE GRAY BACKGROUND MAY CAUSE A POOR QUALITY REPRODUCTION.

0 1 2 3 4 IN.



① CONTRACTOR TO SKEW FACE OF DIVERSION STRUCTURE BY 4.87° OR PERPENDICULAR WITH NEW PIPE SLOPE (TYP. OF 4)



NOTE: CONSTRUCTION PHASING

PHASE I

1. EXCAVATE AND CONSTRUCT DS1A, DS1B AND 66-INCH PIPELINE BETWEEN DS1A & DS1B
2. BACK FILL DS1A, DS1B & 66-INCH PIPELINE BETWEEN DS1A & DS1B

PHASE II

1. EXCAVATE AND CONSTRUCT DS2 & 66-INCH PIPELINE BETWEEN DS2 &DS1B
2. BACKFILL DS2 & 66-INCH PIPELINE BETWEEN DS2 & DS1B
3. REMOVE STOP LOGS WITHIN THE 108-INCH JS

PROFILE SCALES
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 8'

WARNING
0 ½ 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

JOHN H. HARRIS No. 38217 Exp. 3/31/01 CIVIL STATE OF CALIFORNIA

HIRSCH & COMPANY
CONSULTING ENGINEERS
3550 CAMINO DEL RIO NO., STE. 305
SAN DIEGO, CALIFORNIA 92108-1740
JOHN H. HARRIS RCE 38217 DATE 6/16/00

SCALE HORIZONTAL 1" = 10'
VERTICAL 1" = 8'

METROPOLITAN WASTEWATER DEPARTMENT
City of San Diego

DRAWING STATUS

NO.	DATE	REQ.	REVISION DESCRIPTION	DRAWN	CKD	APD	PE	EM	QA/QC

DRAWING NO.	C-2
SHEET NO.	8
CIP NO.	46-104.0
SPECIFICATION NO.	01-001

NORTH METRO INTERCEPTOR DIVERSION - 3A (NMI3A)

PLAN & PROFILE DS1A, DS1B & DS2
FRIARS ROAD

CITY OF SAN DIEGO, CALIFORNIA
SHEET 8 OF 38 SHEETS

WATER W.O.
SEWER W.O. 171711

Gina L. Mayo Sept. 20, 2000
PROJECT MANAGER DATE

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	HIRSCH			JAN 12 02

DESIGN ENGINEER

CONTROL CERTIFICATION 218-1707
LAMBERT COORDINATES 30507-8-0

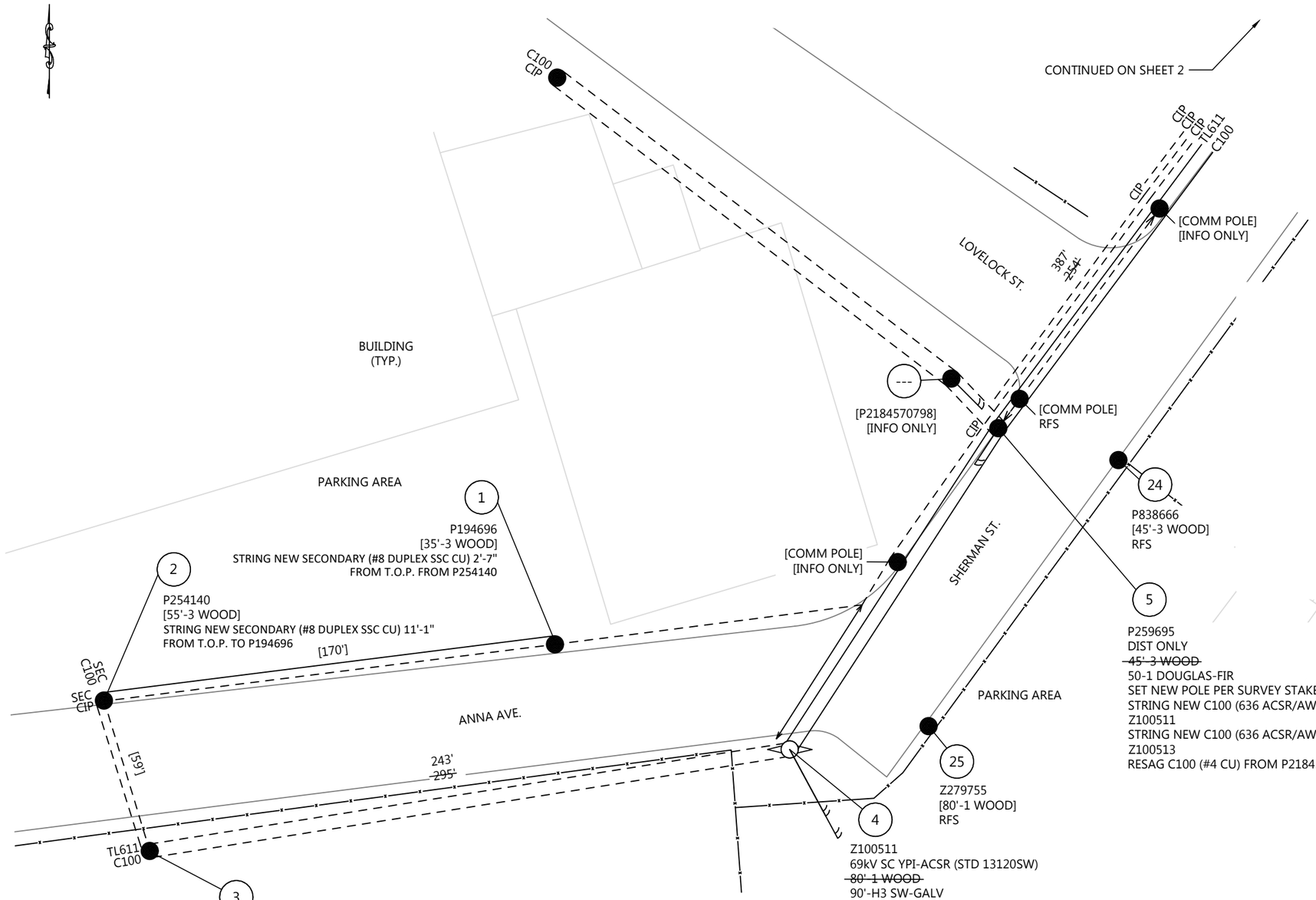
CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED

0 1 2 3 4IN.

\HIRSCH1\CURRENT PROJECTS\NORTH METRO DESIGN\DRAWING FILES\9948-C2.DGN
6-16-00 12:00PM

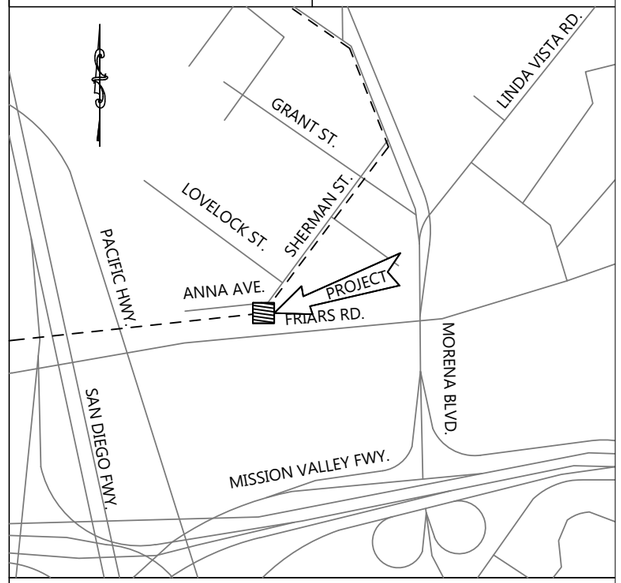
APPENDIX P

SDGE OH RELOCATION - FOR REFERENCE



VICINITY MAP (NOT TO SCALE)

THOMAS BROS #	1268-EF/F3



GPS COORDINATES

Z100511	N 32°45'47.065", W 117°12'03.373"
P259695	N 32°45'48.291", W 117°12'02.469"

GENERAL NOTES:

1. ALL NEW STEEL POLES SHALL BE FIELD-DRILLED.
2. A YELLOW MARKING BAND SHALL BE PAINTED ON ALL NEW STEEL POLES PER GO95 RULE 51.6 AND SDG&E STANDARD 22105.
3. ALL PHASING SYMBOLS ARE CONCEPTUAL ONLY. MAINTAIN EXISTING PHASING UNLESS OTHERWISE NOTED.
4. CIP RESPONSIBLE FOR TRANSFERRING 3RD PARTY ATTACHMENTS TO MEET GO95 REQUIREMENTS AND REPLACING GUY WIRES WITH ANCHORS.

DIGALERT

CALL 811: TWO WORKING DAYS BEFORE YOU DIG!

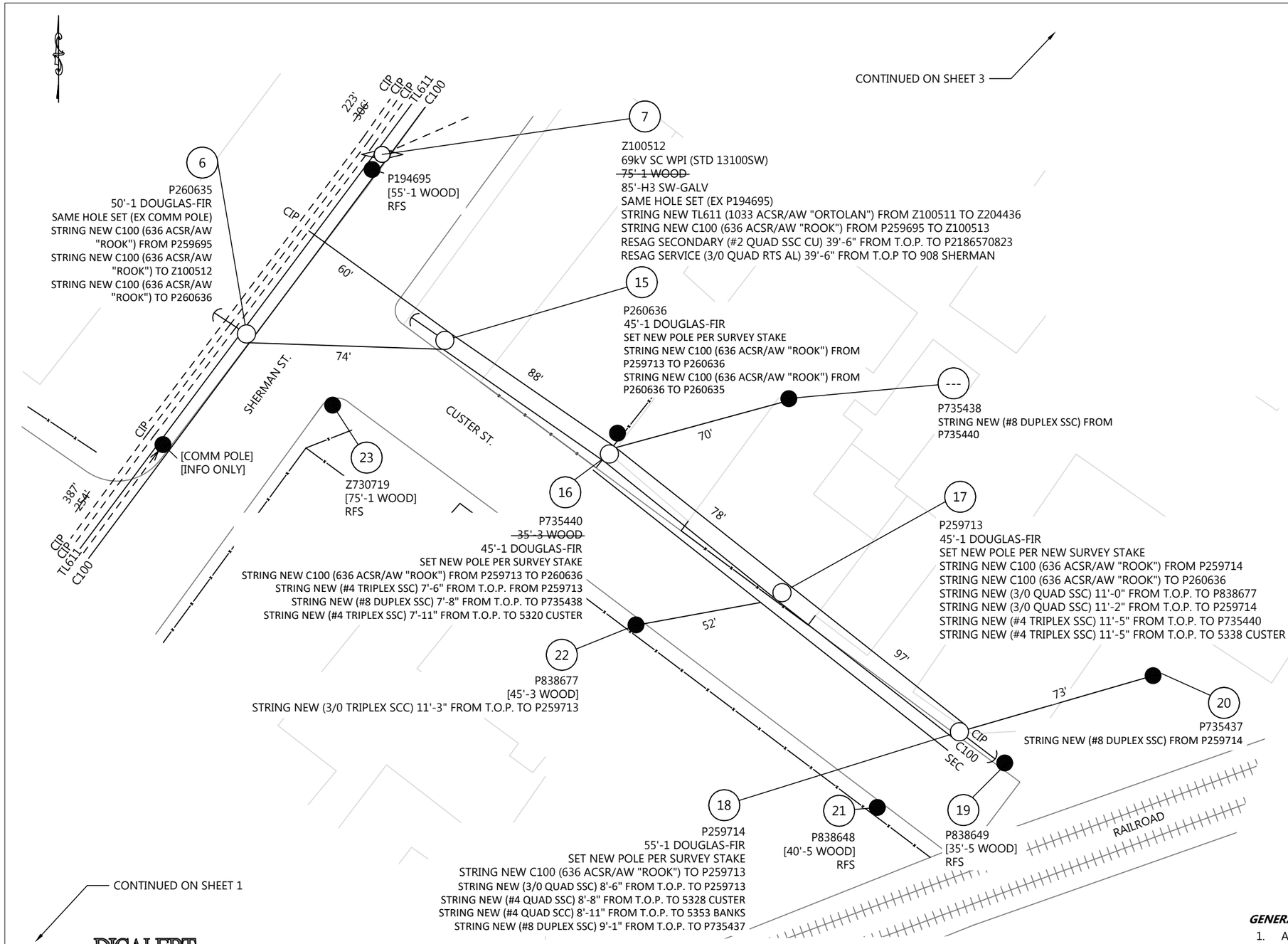
REV	BUDGET	WORK ORDER	CHANGE	DRAWN	CHK'D	APPV'D	DATE
D							
C							
B							
A							
	18242.1	2651954	ORIGINAL	RAJ	RH	EH	10/02/2020

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
ALIGNMENT MAP
TL611/C100

SHEET 1 OF 11 | SCALE: NONE

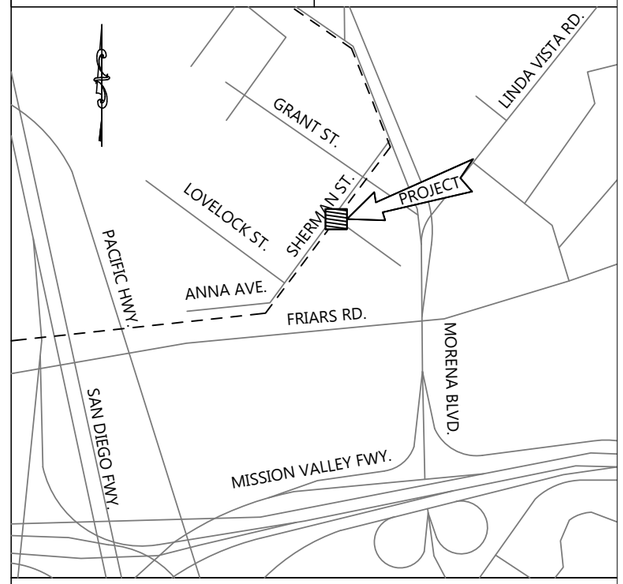
MORENA PUMP STATION
SAN DIEGO, CA

DRAWING NUMBER
2651954-01



VICINITY MAP (NOT TO SCALE)

THOMAS BROS #	1268-EF/F3



GPS COORDINATES

Z100512	N 32°45'50.213", W 117°12'00.788"
P260635	N 32°45'49.517", W 117°12'01.388"
P260636	N 32°45'49.515", W 117°12'00.520"
P259714	N 32°45'47.981", W 117°11'58.041"
P259713	N 32°45'48.548", W 117°11'58.959"
P735440	N 32°45'49.001", W 117°11'59.691"

GENERAL NOTES:

1. ALL NEW STEEL POLES SHALL BE FIELD-DRILLED.
2. A YELLOW MARKING BAND SHALL BE PAINTED ON ALL NEW STEEL POLES PER GO95 RULE 51.6 AND SDG&E STANDARD 22105.
3. ALL PHASING SYMBOLS ARE CONCEPTUAL ONLY. MAINTAIN EXISTING PHASING UNLESS OTHERWISE NOTED.
4. CIP RESPONSIBLE FOR TRANSFERRING 3RD PARTY ATTACHMENTS TO MEET GO95 REQUIREMENTS AND REPLACING GUY WIRES WITH ANCHORS.

DIGALERT

CALL 811: TWO WORKING DAYS BEFORE YOU DIG!

REV	BUDGET	WORK ORDER	CHANGE	DRAWN	CHK'D	APPV'D	DATE
D							
C							
B							
A							
	18242.1	2651954	ORIGINAL	RAJ	RH	EH	10/02/2020

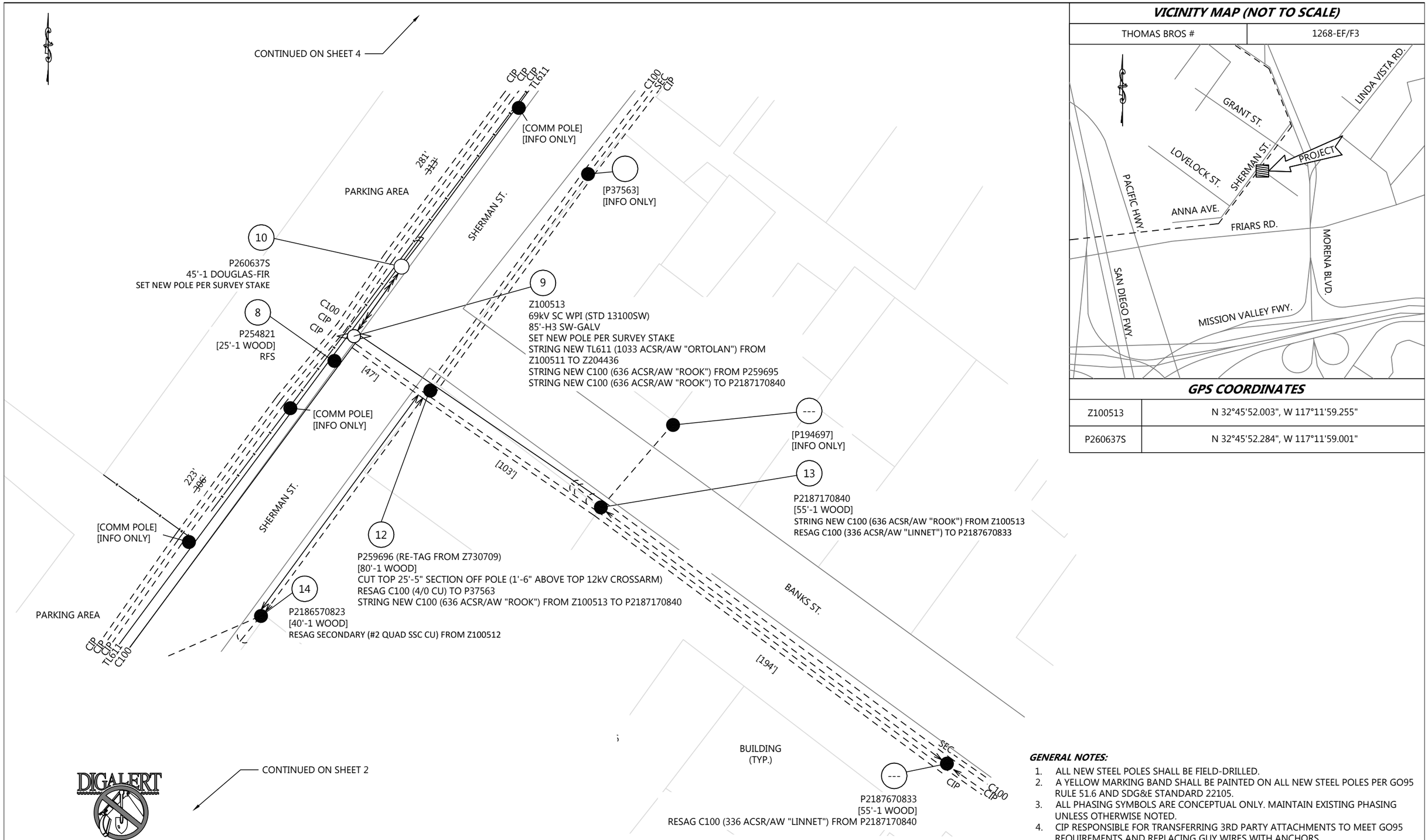
SDGE — AQUAWOLF

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
ALIGNMENT MAP
TL611/C100

SHEET 2 OF 11 | SCALE: NONE

MORENA PUMP STATION
SAN DIEGO, CA

DRAWING NUMBER
2651954-01



VICINITY MAP (NOT TO SCALE)

THOMAS BROS # 1268-EF/F3

GPS COORDINATES

Z100513	N 32°45'52.003", W 117°11'59.255"
P260637S	N 32°45'52.284", W 117°11'59.001"

DIGALERT

CALL 811: TWO WORKING DAYS BEFORE YOU DIG!

GENERAL NOTES:

1. ALL NEW STEEL POLES SHALL BE FIELD-DRILLED.
2. A YELLOW MARKING BAND SHALL BE PAINTED ON ALL NEW STEEL POLES PER GO95 RULE 51.6 AND SDG&E STANDARD 22105.
3. ALL PHASING SYMBOLS ARE CONCEPTUAL ONLY. MAINTAIN EXISTING PHASING UNLESS OTHERWISE NOTED.
4. CIP RESPONSIBLE FOR TRANSFERRING 3RD PARTY ATTACHMENTS TO MEET GO95 REQUIREMENTS AND REPLACING GUY WIRES WITH ANCHORS.

REV	BUDGET	WORK ORDER	CHANGE	DRAWN	CHK'D	APPV'D	DATE
D							
C							
B							
A							
	18242.1	2651954	ORIGINAL	RAJ	RH	EH	10/02/2020

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
ALIGNMENT MAP
TL611/C100

SHEET 3 OF 11 | SCALE: NONE

MORENA PUMP STATION
SAN DIEGO, CA

DRAWING NUMBER
2651954-01

CONTINUED ON SHEET 5

TL611

C100 --- [P37511] [INFO ONLY]

PARKING AREA

332'

SHERMAN ST.

C100 --- [P37515] [INFO ONLY]

CIP CIP CIP

[COMM POLE] [INFO ONLY]

CIP C100

GRANT ST.

PARKING AREA

26

Z100514
69kV SC WPI (STD 13100SW)
85'-H3 SW-GALV
SET NEW POLE PER SURVEY STAKE
STRING NEW TL611 (1033 ACSR/AW "ORTOLAN") FROM Z100511 TO Z204436

281'

11

P259697 (RE-TAG FROM Z731408)
[85'-1 WOOD]
CUT TOP 23'-5" SECTION OFF POLE (1' ABOVE TOP 12kV CROSSARM)

--- [P838665] [INFO ONLY]

[COMM POLE] [INFO ONLY]

CIP CIP TL611

--- [P37565] [INFO ONLY]

GRANT ST.

BUILDING (TYP.)

C100 SEC CIP

28

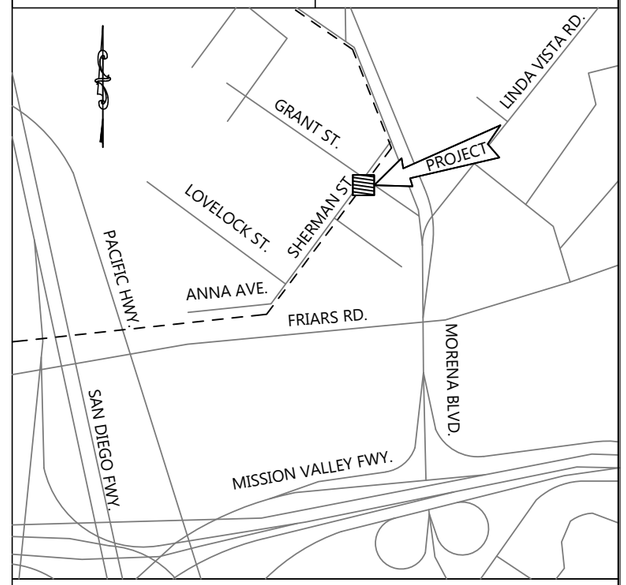
C100 P137295 [60'-1 WOOD]

CONTINUED ON SHEET 3

CALL 811: TWO WORKING DAYS BEFORE YOU DIG!

VICINITY MAP (NOT TO SCALE)

THOMAS BROS #	1268-EF/F3



GPS COORDINATES

Z100514	N 32°45'54.243", W 117°11'57.300"

GENERAL NOTES:

1. ALL NEW STEEL POLES SHALL BE FIELD-DRILLED.
2. A YELLOW MARKING BAND SHALL BE PAINTED ON ALL NEW STEEL POLES PER GO95 RULE 51.6 AND SDG&E STANDARD 22105.
3. ALL PHASING SYMBOLS ARE CONCEPTUAL ONLY. MAINTAIN EXISTING PHASING UNLESS OTHERWISE NOTED.
4. CIP RESPONSIBLE FOR TRANSFERRING 3RD PARTY ATTACHMENTS TO MEET GO95 REQUIREMENTS AND REPLACING GUY WIRES WITH ANCHORS.

REV	BUDGET	WORK ORDER	CHANGE	DRAWN	CHK'D	APPV'D	DATE
D							
C							
B							
A							
	18242.1	2651954	ORIGINAL	RAJ	RH	EH	10/02/2020

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
ALIGNMENT MAP
TL611/C100

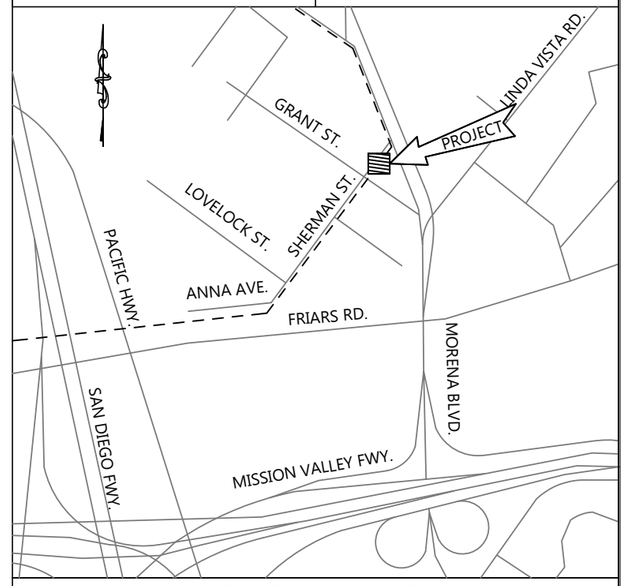
SHEET 4 OF 11 | SCALE: NONE

MORENA PUMP STATION
SAN DIEGO, CA

DRAWING NUMBER
2651954-01

VICINITY MAP (NOT TO SCALE)

THOMAS BROS #	1268-EF/F3



GPS COORDINATES

PARKING AREA

TL611

332'

TL611

27

Z204436
[83'-ESP GALV]
INSTALL NEW 69kV SUSPENSION INSULATORS (SEE STD 19240) SOUTHWEST SPAN
STRING NEW TL611 (1033 ACSR/AW "ORTOLAN") FROM Z100511 TO Z204436

MORENA BLVD.

CONTINUED ON SHEET 4

DIGALERT

CALL 811: TWO WORKING DAYS BEFORE YOU DIG!

GENERAL NOTES:

1. ALL NEW STEEL POLES SHALL BE FIELD-DRILLED.
2. A YELLOW MARKING BAND SHALL BE PAINTED ON ALL NEW STEEL POLES PER GO95 RULE 51.6 AND SDG&E STANDARD 22105.
3. ALL PHASING SYMBOLS ARE CONCEPTUAL ONLY. MAINTAIN EXISTING PHASING UNLESS OTHERWISE NOTED.
4. CIP RESPONSIBLE FOR TRANSFERRING 3RD PARTY ATTACHMENTS TO MEET GO95 REQUIREMENTS AND REPLACING GUY WIRES WITH ANCHORS.

REV	BUDGET	WORK ORDER	CHANGE	DRAWN	CHK'D	APPV'D	DATE
D							
C							
B							
A							
	18242.1	2651954	ORIGINAL	RAJ	RH	EH	10/02/2020

SDGE A Sempra Energy utility

AQUAWOLF

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING

ALIGNMENT MAP
TL611/C100

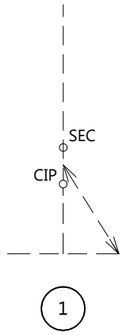
SHEET 5 OF 11 | SCALE: NONE

MORENA PUMP STATION
SAN DIEGO, CA

DRAWING NUMBER
2651954-01

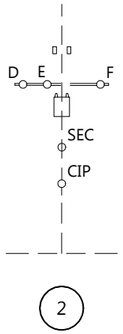
1

P194696
EXISTING
LOOKING EAST



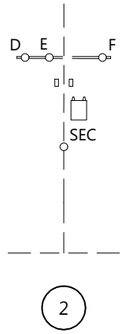
1

P194696
EXISTING
LOOKING NORTH



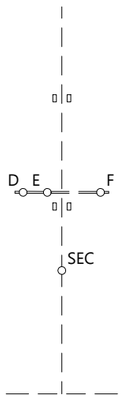
2

P254140
EXISTING
LOOKING EAST



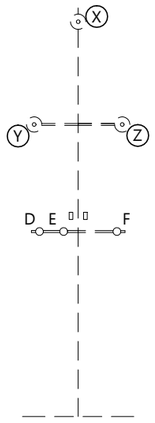
2

P254140
EXISTING
LOOKING SOUTH



3

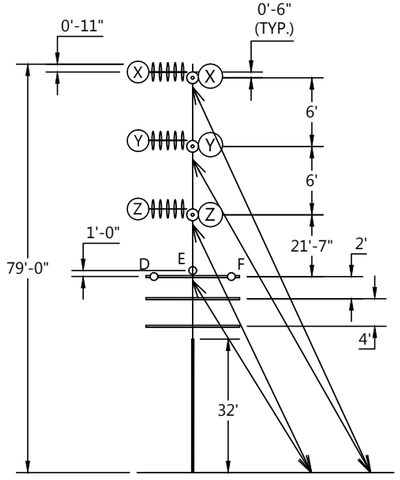
Z279756
EXISTING
LOOKING SOUTH



3

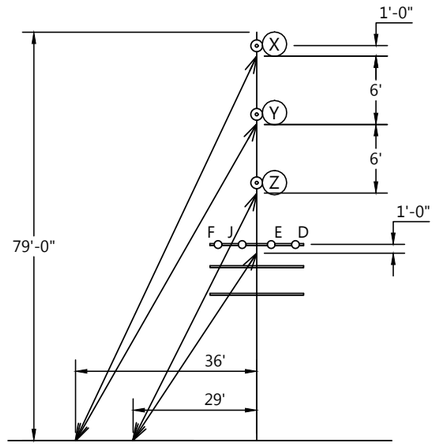
Z279756
EXISTING
LOOKING EAST

INSTALL 4-NEW DOWN GUYS
INSTALL AND SHARE 2-NEW ANCHORS



4

Z100511
PROPOSED
LOOKING EAST



4

Z100511
PROPOSED
LOOKING WEST

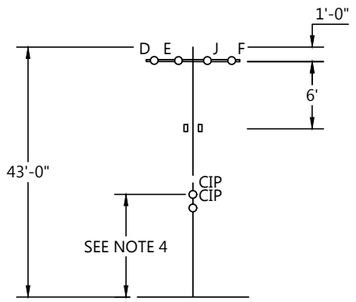
REV	BUDGET	WORK ORDER	CHANGE	DRAWN	CHK'D	APPV'D	DATE
D							
C							
B							
A							
	18242.1	2651954	ORIGINAL	RAJ	RH	EH	10/02/2020

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
ALIGNMENT MAP
TL611/C100

SHEET 6 OF 11 | SCALE: NONE

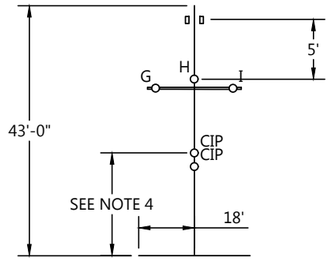
MORENA PUMP STATION
SAN DIEGO, CA

DRAWING NUMBER
2651954-01



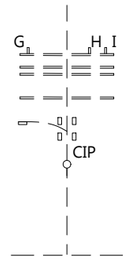
5

P259695
PROPOSED
LOOKING NORTHEAST



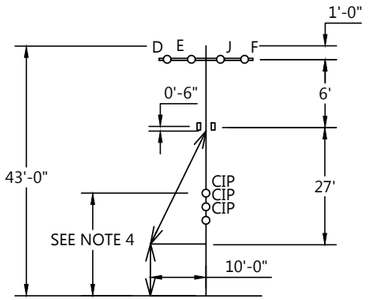
5

P259695
PROPOSED
LOOKING NORTHWEST



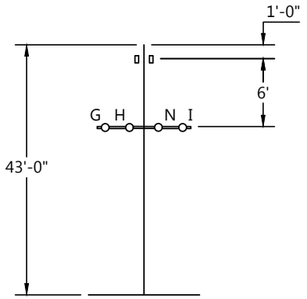
P2184570798
EXISTING
LOOKING NORTHWEST

INSTALL 1-NEW BISECT SIDEWALK GUY
INSTALL 1-NEW 9' STRUT
INSTALL 1-NEW ANCHOR



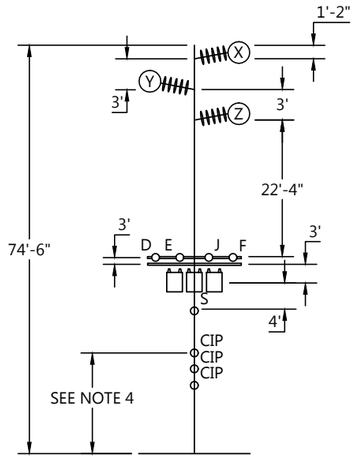
6

P260635
PROPOSED
LOOKING NORTHEAST



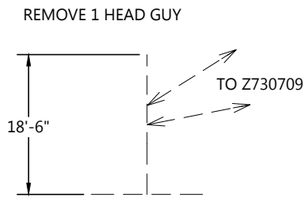
6

P260635
PROPOSED
LOOKING SOUTHEAST



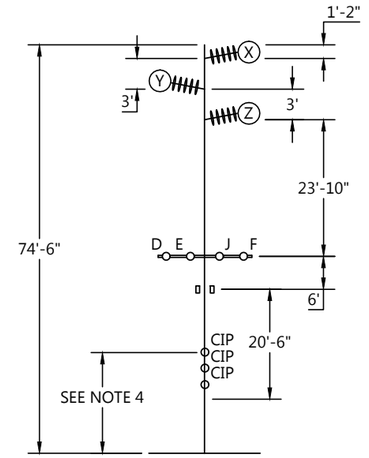
7

Z100512
PROPOSED
LOOKING NORTHEAST



8

P254821
EXISTING
LOOKING NORTHEAST



9

Z100513
PROPOSED
LOOKING NORTHEAST

REV	BUDGET	WORK ORDER	CHANGE	DRAWN	CHK'D	APPV'D	DATE
D							
C							
B							
A							
	18242.1	2651954	ORIGINAL	RAJ	RH	EH	10/02/2020

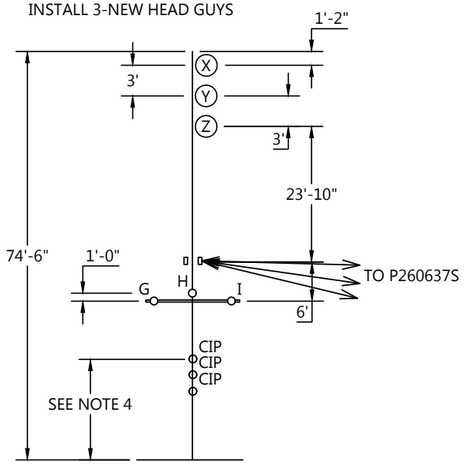
SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
ALIGNMENT MAP
TL611/C100

SHEET 7 OF 11 | SCALE: NONE

MORENA PUMP STATION
SAN DIEGO, CA

DRAWING NUMBER
2651954-01

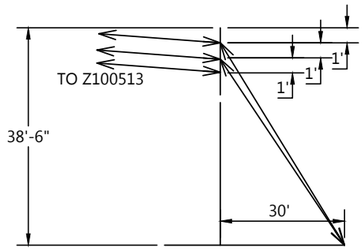
INSTALL 3-NEW HEAD GUYS



9

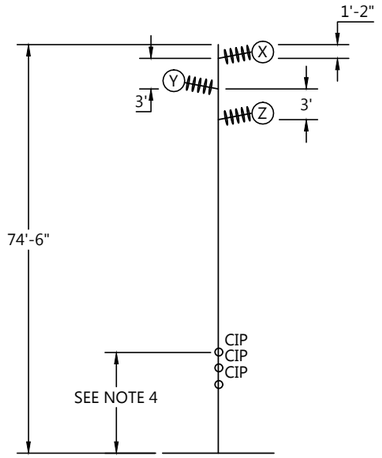
Z100513
PROPOSED
LOOKING NORTHWEST

INSTALL 3-NEW HEAD GUYS
INSTALL 2-NEW DOWN GUYS
INSTALL AND SHARE 1-NEW ANCHOR



10

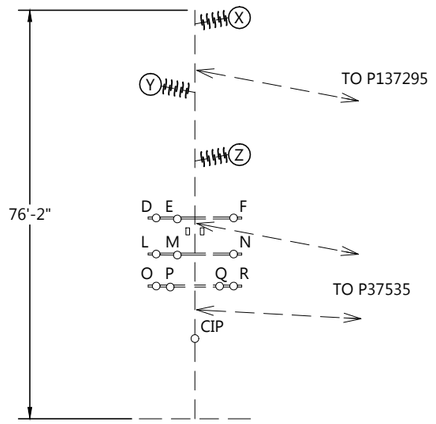
P260637S
PROPOSED
LOOKING NORTHWEST



26

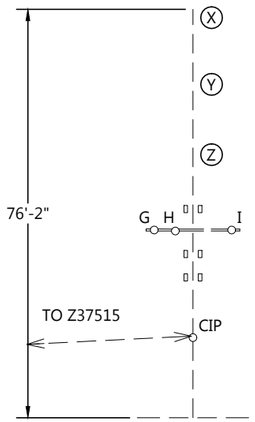
Z100514
PROPOSED
LOOKING NORTHEAST

REMOVE 1-EXISTING HEAD GUY



11

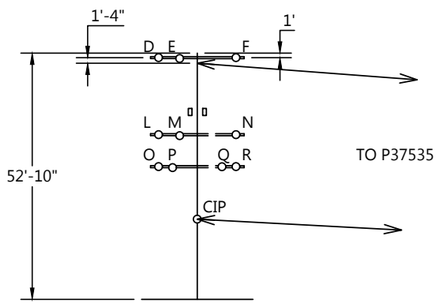
Z731408
EXISTING
LOOKING NORTHEAST



11

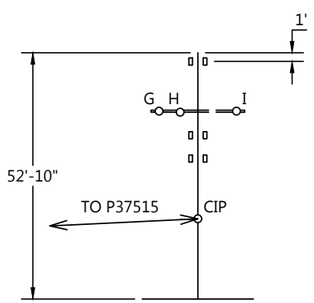
Z731408
EXISTING
LOOKING SOUTHEAST

REMOVE 1-EXISTING HEAD GUY



11

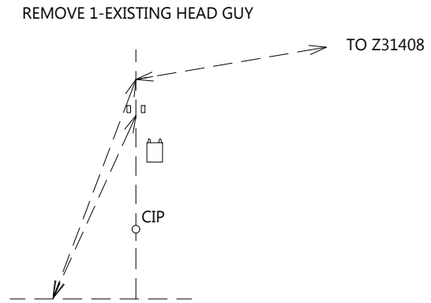
P259697(RE-TAG FROM Z731408)
PROPOSED
LOOKING NORTHEAST



11

P259697(RE-TAG FROM Z731408)
PROPOSED
LOOKING SOUTHEAST

REMOVE 1-EXISTING HEAD GUY



28

P137295
EXISTING
LOOKING SOUTHWEST

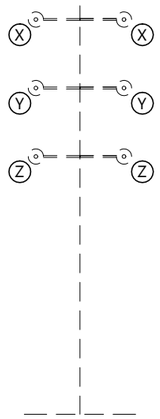
REV	BUDGET	WORK ORDER	CHANGE	DRAWN	CHK'D	APPV'D	DATE
D							
C							
B							
A							
	18242.1	2651954	ORIGINAL	RAJ	RH	EH	10/02/2020

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
ALIGNMENT MAP
TL611/C100

SHEET 8 OF 11 | SCALE: NONE

MORENA PUMP STATION
SAN DIEGO, CA

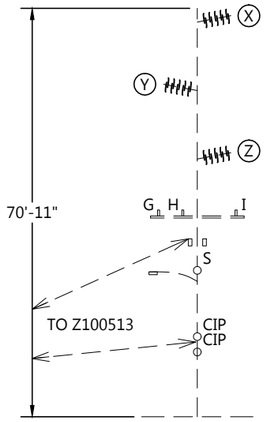
DRAWING NUMBER
2651954-01



27

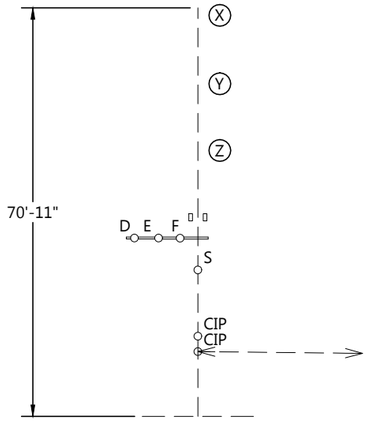
Z204436
EXISTING
LOOKING NORTHEAST

REMOVE 1-EXISTING HEAD GUYS



12

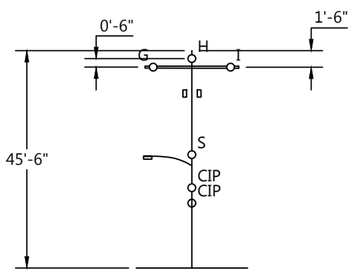
Z730709
EXISTING
LOOKING NORTHEAST



12

Z730709
EXISTING
LOOKING SOUTHEAST

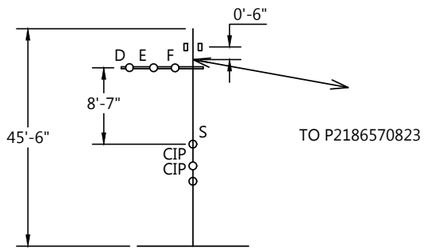
REMOVE 1-EXISTING HEAD GUYS



12

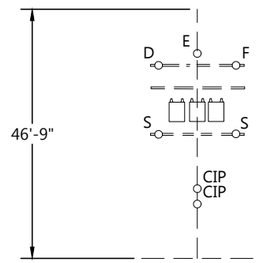
P259696 (RE-TAG FROM Z730709)
PROPOSED
LOOKING NORTHEAST

INSTALL 1-NEW HEAD GUY



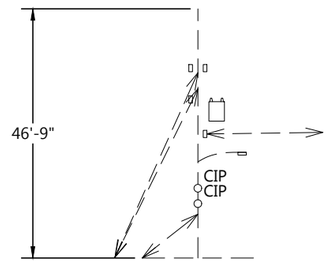
12

P259696 (RE-TAG FROM Z730709)
PROPOSED
LOOKING SOUTHEAST



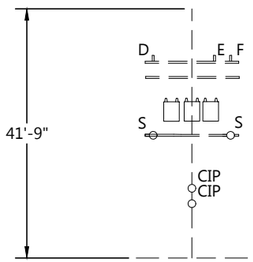
13

P2187170840
EXISTING
LOOKING SOUTHEAST



13

P2187170840
EXISTING
LOOKING NORTHEAST



P2187670833
EXISTING
LOOKING SOUTHEAST

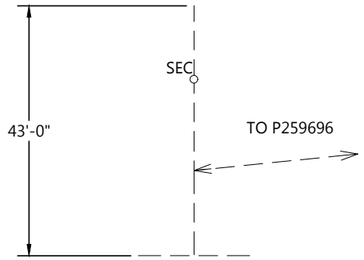
REV	BUDGET	WORK ORDER	CHANGE	DRAWN	CHK'D	APPV'D	DATE
D							
C							
B							
A							
	18242.1	2651954	ORIGINAL	RAJ	RH	EH	10/02/2020

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
ALIGNMENT MAP
TL611/C100

SHEET 9 OF 11 | SCALE: NONE

MORENA PUMP STATION
SAN DIEGO, CA

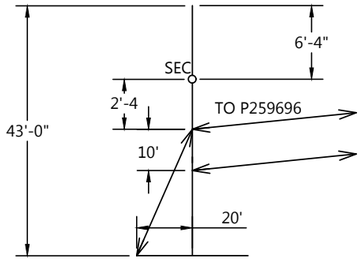
DRAWING NUMBER
2651954-01



14

P2186570823
EXISTING
LOOKING NORTHWEST

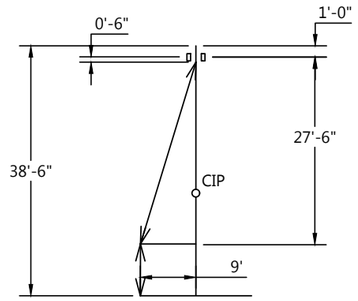
INSTALL 1-NEW HEAD GUY



14

P2186570823
PROPOSED
LOOKING NORTHWEST

INSTALL 1-NEW BISECT SIDEWALK GUY
INSTALL 1-NEW 8' STRUT
INSTALL 1-NEW ANCHOR



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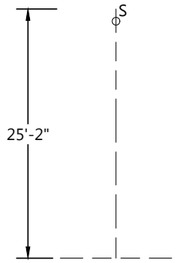
P260636
PROPOSED
LOOKING NORTHEAST



16

P735440
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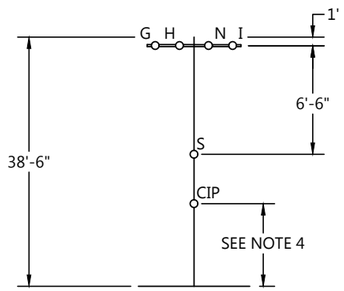
LOOKING SOUTHEAST



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P735440
PROPOSED
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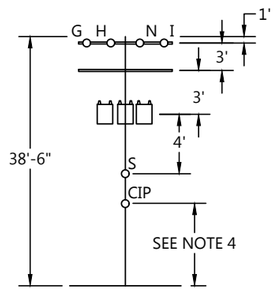

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P259713
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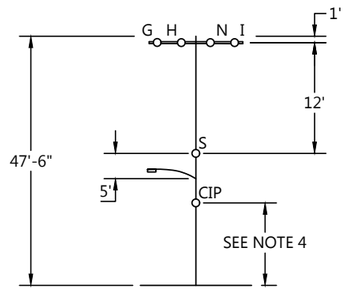
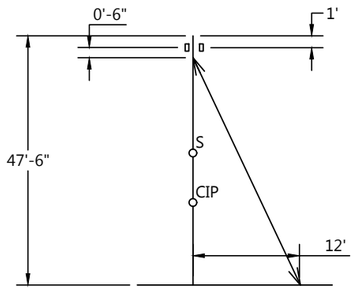


18

P259714
PROPOSED
LOOKING SOUTHEAST

INSTALL 1-NEW DOWN GUY
INSTALL 1-NEW ANCHOR



18

P259714
PROPOSED
LOOKING NORTHEAST

D							
C							
B							
A							
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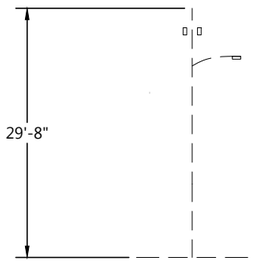
REV	BUDGET	WORK ORDER	CHANGE	DRAWN	CHK'D	APPV'D	DATE

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
ALIGNMENT MAP
TL611/C100

SHEET 10 OF 11 | SCALE: NONE

MORENA PUMP STATION
SAN DIEGO, CA

DRAWING NUMBER
2651954-01



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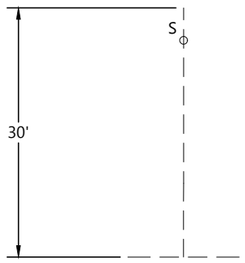
P838649
EXISTING
LOOKING SOUTHEAST



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P735437
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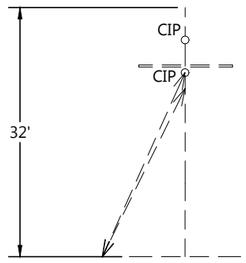
LOOKING SOUTHEAST



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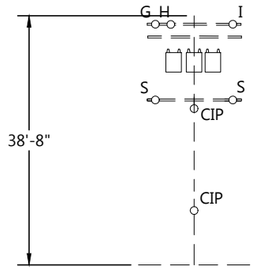
P838648
EXISTING
LOOKING SOUTH

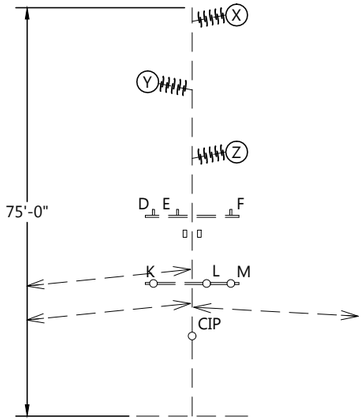
REMOVE 1-EXISTING HEAD GUYS



22

P838677
EXISTING
LOOKING SOUTHWEST

REMOVE 3-EXISTING HEAD GUYS



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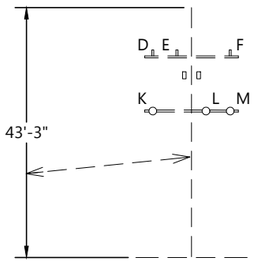
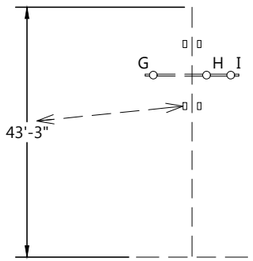
Z730719
EXISTING
LOOKING NORTHEAST



24

P838666
EXISTING
LOOKING NORTHEAST

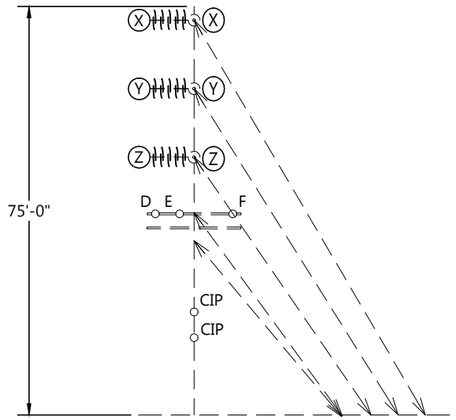
REMOVE 1-EXISTING HEAD GUYS



24

P838666
EXISTING
LOOKING NORTHWEST

REMOVE 5-EXISTING DOWN GUYS
REMOVE 4-EXISTING ANCHORS



25

Z279755
EXISTING
LOOKING EAST

D							
C							
B							
A							
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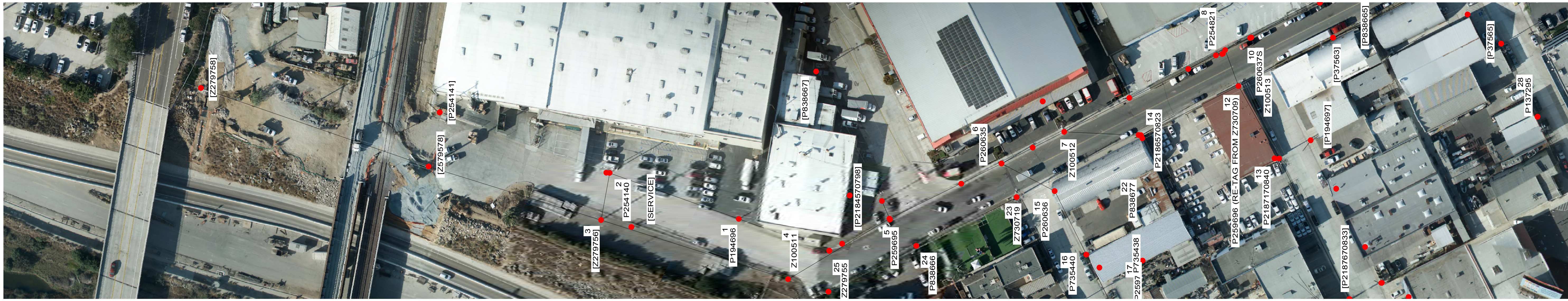
EV	BUDGET	WORK ORDER	CHANGE	DRAWN	CHK'D	APPV'D	DATE

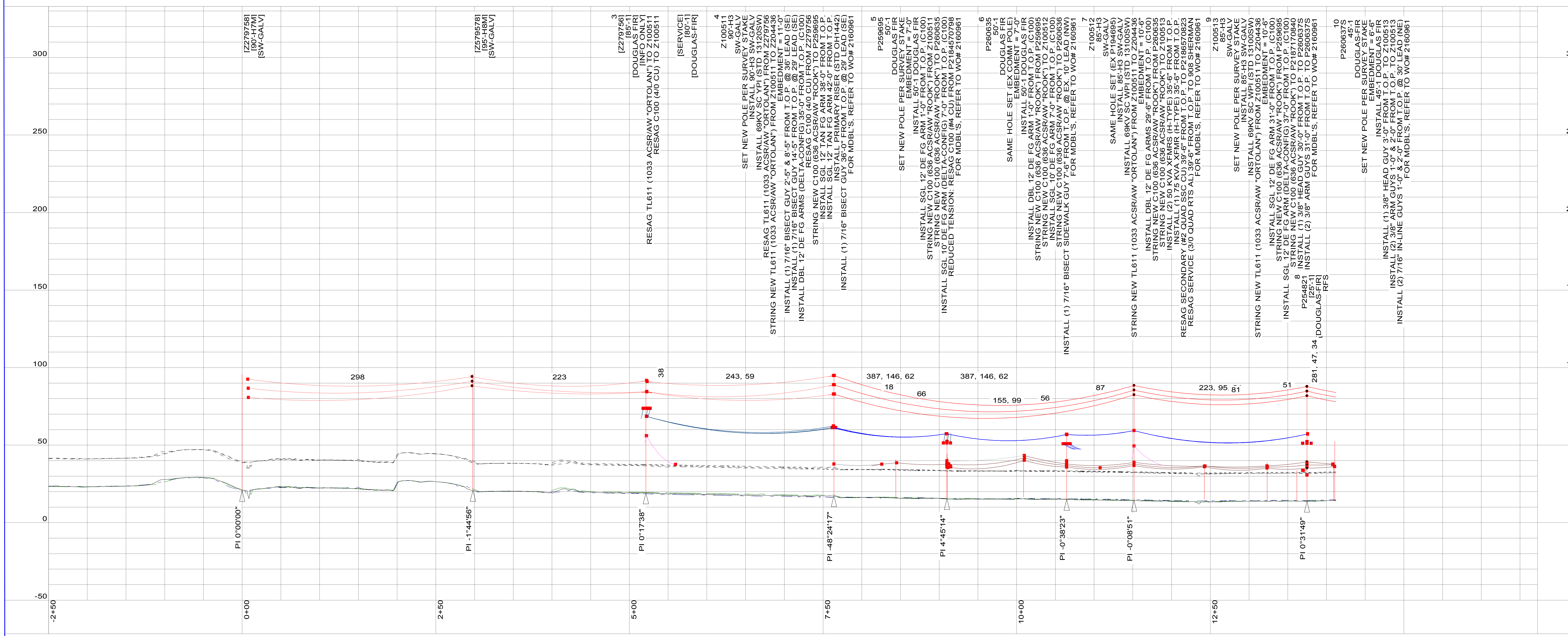
SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
ALIGNMENT MAP
TL611/C100

SHEET 11 OF 11 | SCALE: NONE

MORENA PUMP STATION
SAN DIEGO, CA

DRAWING NUMBER
2651954-01





C							
B							
A							
0	18242.1	2651954	ORIGINAL	RWH	DAM	EH	10/2/20
REV	BUDGET	WORK ORDER	REVISION DESCRIPTION	DRN	CHKD	APPV	DATE

CONDUCTOR DISPLAYED CONDITIONS

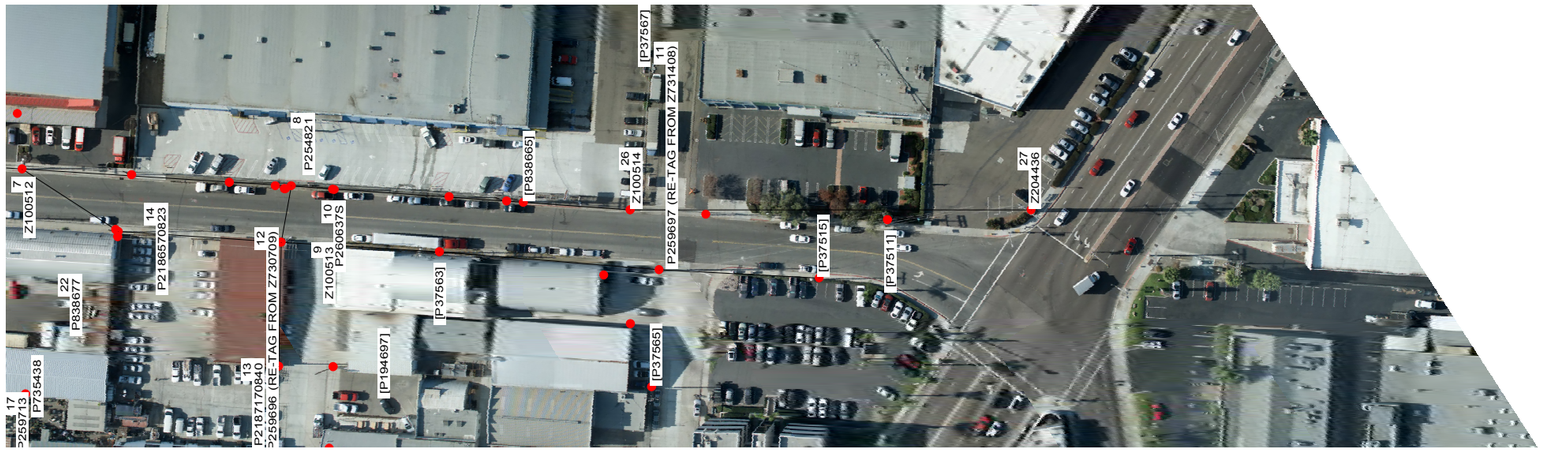
- NEW 69KV DISPLAYED AT 194°F FINAL
- NEW 12KV DISPLAYED AT 167°F FINAL
- NEW 0.75KV DISPLAYED AT 130°F FINAL
- NEW COMM DISPLAYED AT 130°F FINAL
- NEW GUYS DISPLAYED AT 130°F FINAL
- EX 69KV DISPLAYED AT 194°F FINAL
- EX 12KV DISPLAYED AT 167°F FINAL
- EX 0.75KV DISPLAYED AT 130°F FINAL
- EX COMM DISPLAYED AT 130°F FINAL
- EX GUYS DISPLAYED AT 130°F FINAL
- 18` GROUND CLEARANCE LINE DISPLAYED

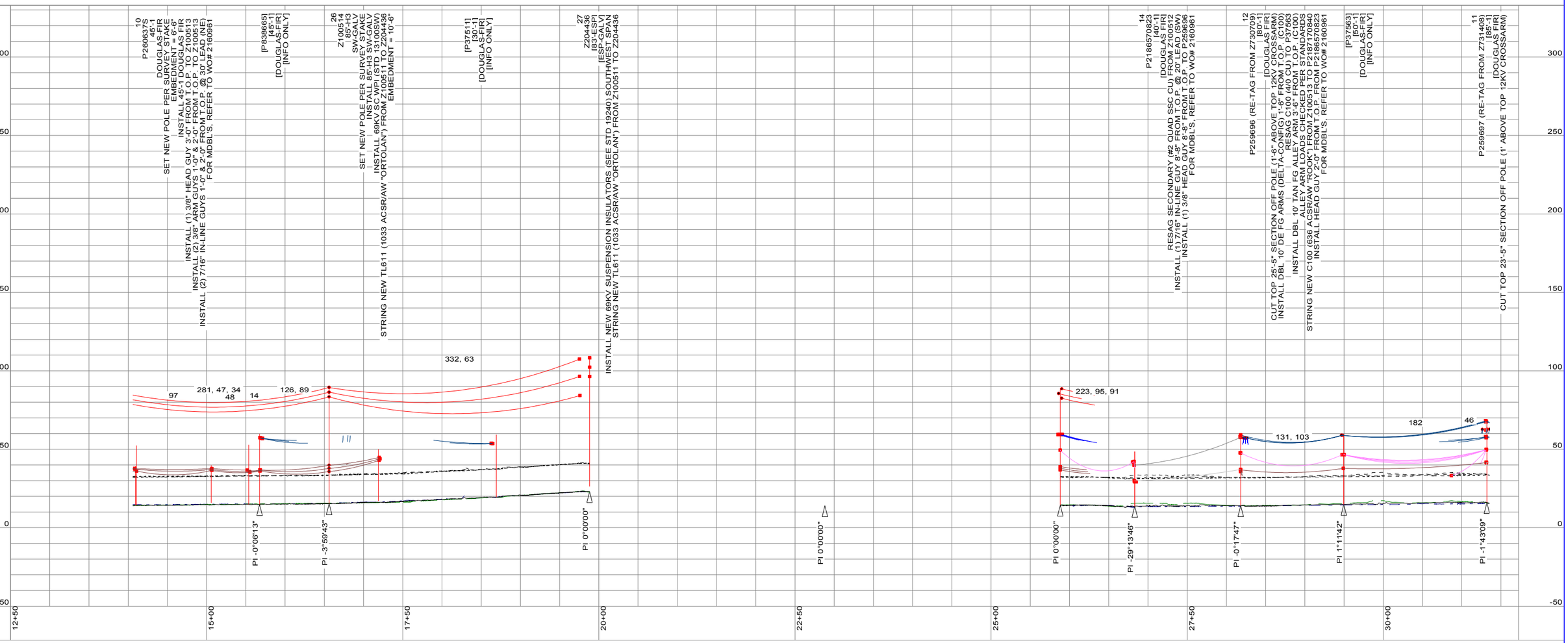
60.0 FT. HORIZ. SCALE
30.0 FT. VERT. SCALE
SCALE IS FROM 24X36 ORIGINAL

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
PLAN & PROFILE
TL611/C100 MORENA PUMP STATION - PHASE ONE

RELOCATION PROJECT
MORENA, CA

1 OF 6 | 66384-01





REV	BUDGET	WORK ORDER	REVISION DESCRIPTION	DRN	CHKD	APPV	DATE
C							
B							
A							
0	18242.1	2651954	ORIGINAL	RWH	DAM	EH	10/2/20

CONDUCTOR DISPLAYED CONDITIONS

- NEW 69KV DISPLAYED AT 194°F FINAL
- NEW 12KV DISPLAYED AT 167°F FINAL
- NEW 0.75KV DISPLAYED AT 130°F FINAL
- NEW COMM DISPLAYED AT 130°F FINAL
- NEW GUYS DISPLAYED AT 130°F FINAL
- EX 69KV DISPLAYED AT 194°F FINAL
- EX 12KV DISPLAYED AT 167°F FINAL
- EX 0.75KV DISPLAYED AT 130°F FINAL
- EX COMM DISPLAYED AT 130°F FINAL
- EX GUYS DISPLAYED AT 130°F FINAL
- 18' GROUND CLEARANCE LINE DISPLAYED

60.0 FT. HORIZ. SCALE
30.0 FT. VERT. SCALE
SCALE IS FROM 24X36 ORIGINAL

SDGE
AQUAWOLF

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
PLAN & PROFILE
TL611/C100 MORENA PUMP STATION - PHASE ONE

RELOCATION PROJECT
MORENA, CA

2 OF 6 | 66384-02

[P37515]
45°-3
[DOUGLAS FIR]
[INFO ONLY]

300
250
200
150
100
50
0
-50

194, 133, 97, 51

PI -1°43'09"

PI 0°00'00"

32+50

35+00

REV	BUDGET	WORK ORDER	REVISION DESCRIPTION	DRN	CHKD	APPV	DATE
C							
B							
A							
0	18242.1	2651954	ORIGINAL	RWH	DAM	EH	10/2/20

CONDUCTOR DISPLAYED CONDITIONS
- NEW 69KV DISPLAYED AT 194°F FINAL
- NEW 12KV DISPLAYED AT 167°F FINAL
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- NEW COMM DISPLAYED AT 130°F FINAL
- NEW GUYS DISPLAYED AT 130°F FINAL
- EX 69KV DISPLAYED AT 194°F FINAL
- EX 12KV DISPLAYED AT 167°F FINAL
- EX 0.75KV DISPLAYED AT 130°F FINAL
- EX COMM DISPLAYED AT 130°F FINAL
- EX GUYS DISPLAYED AT 130°F FINAL
- 18' GROUND CLEARANCE LINE DISPLAYED

60.0 FT. HORIZ. SCALE

30.0 FT. VERT. SCALE

SCALE IS FROM 24X36 ORIGINAL

SDGE

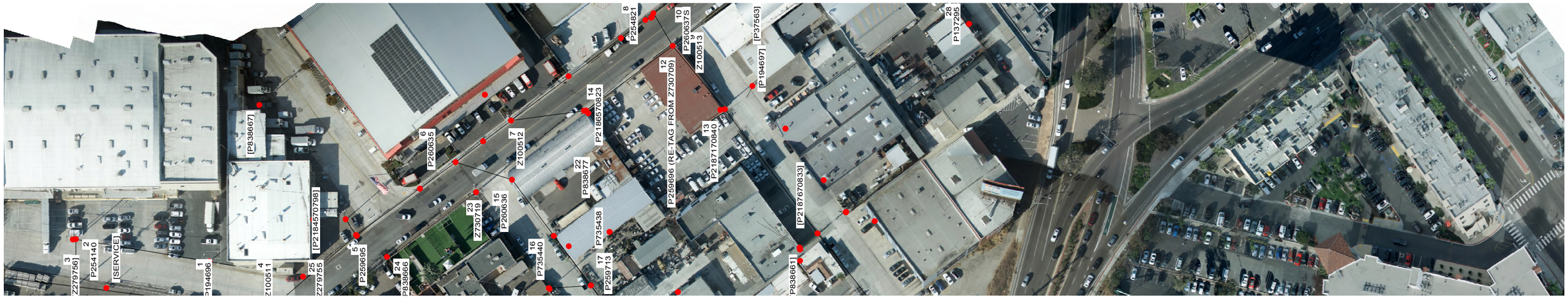
AQUAWOLF

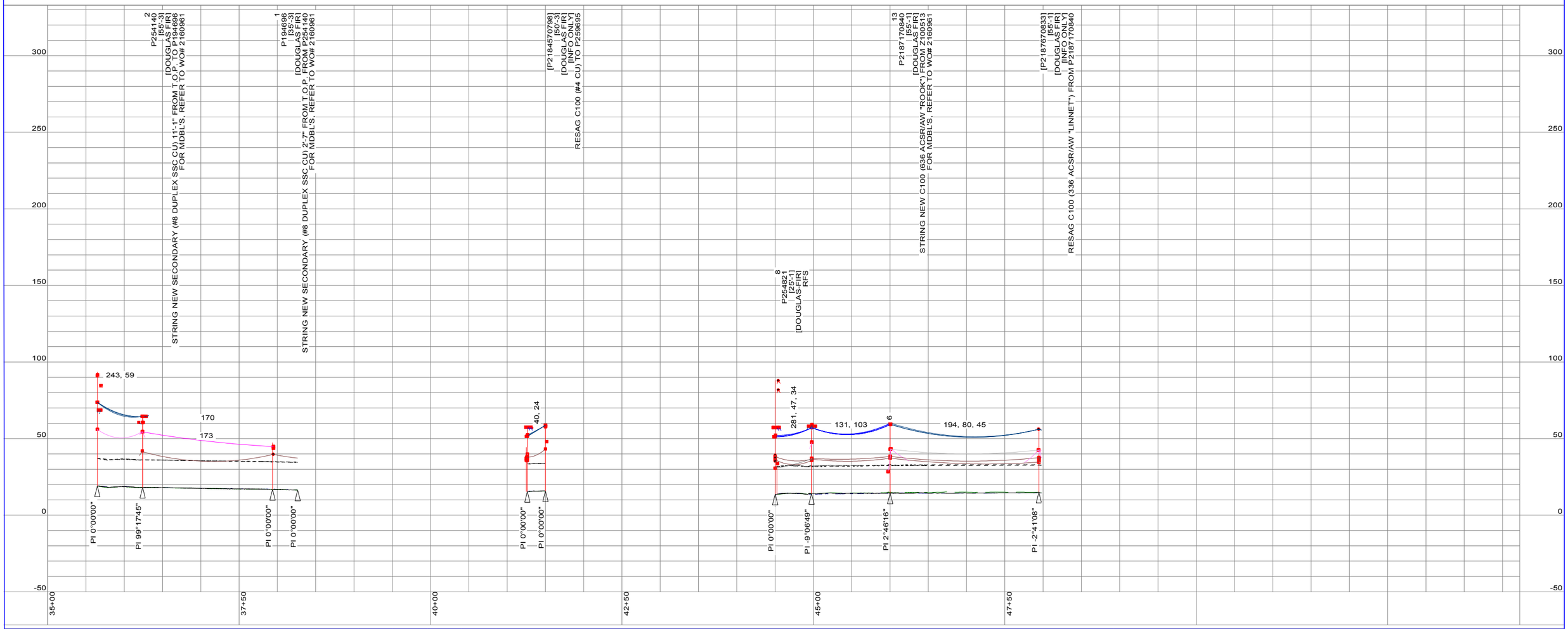
SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
PLAN & PROFILE
TL611/C100 MORENA PUMP STATION - PHASE ONE

RELOCATION PROJECT
MORENA, CA

3 OF 6

66384-03





REV	BUDGET	WORK ORDER	REVISION DESCRIPTION	DRN	CHKD	APPV	DATE
C							
B							
A							
0	18242.1	2651954	ORIGINAL	RWH	DAM	EH	10/2/20

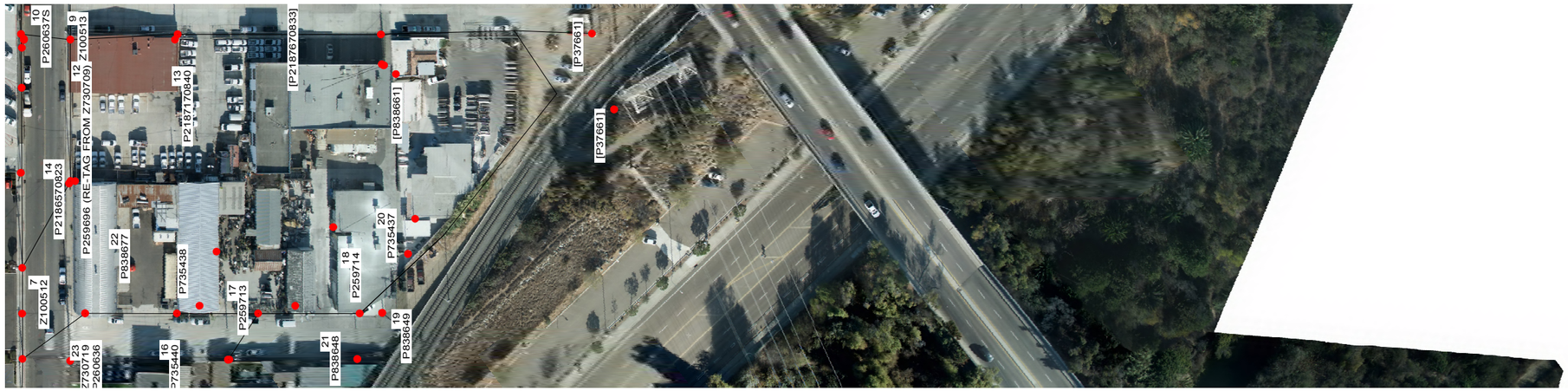
CONDUCTOR DISPLAYED CONDITIONS
- NEW 69KV DISPLAYED AT 194°F FINAL
- NEW 12KV DISPLAYED AT 167°F FINAL
- NEW 0.75KV DISPLAYED AT 130°F FINAL
- NEW COMM DISPLAYED AT 130°F FINAL
- NEW GUYS DISPLAYED AT 130°F FINAL
- EX 69KV DISPLAYED AT 194°F FINAL
- EX 12KV DISPLAYED AT 167°F FINAL
- EX 0.75KV DISPLAYED AT 130°F FINAL
- EX COMM DISPLAYED AT 130°F FINAL
- EX GUYS DISPLAYED AT 130°F FINAL
- 18' GROUND CLEARANCE LINE DISPLAYED

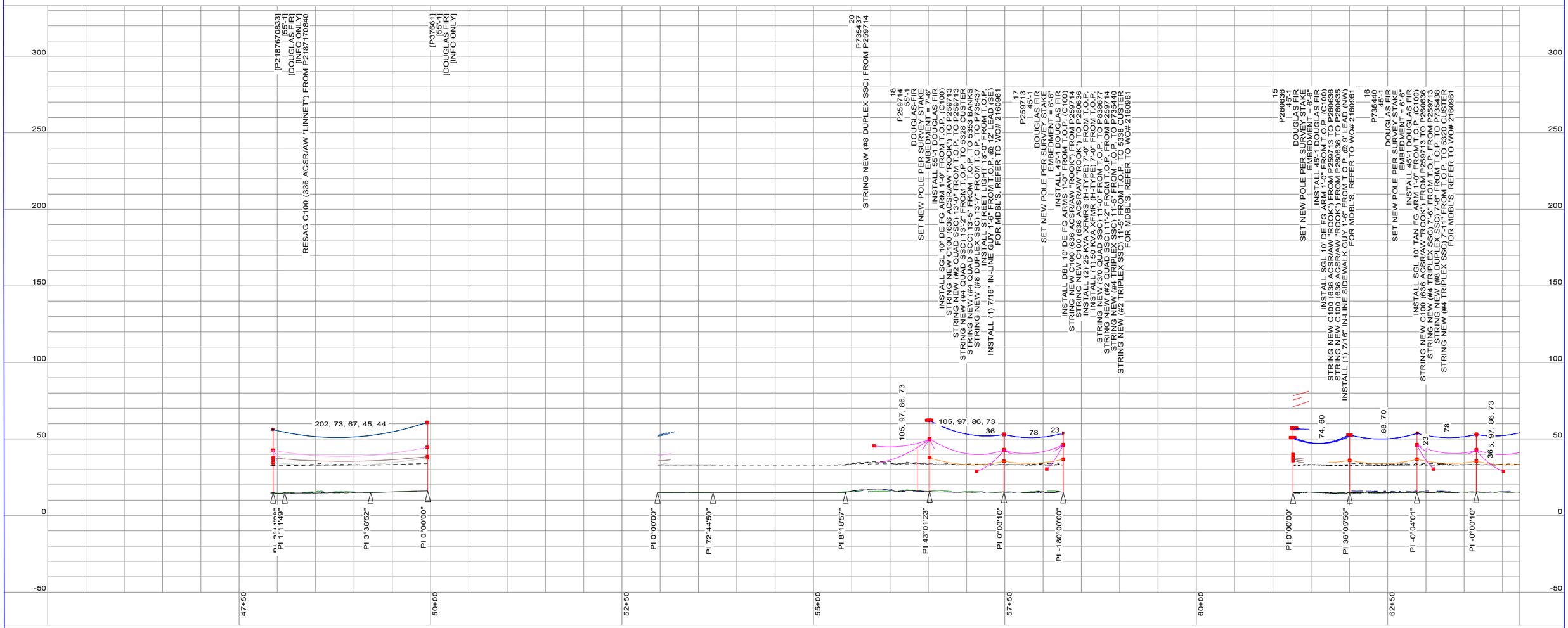
60.0 FT. HORIZ. SCALE
30.0 FT. VERT. SCALE
SCALE IS FROM 24X36 ORIGINAL

SDGE
AQUAWOLF
SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
PLAN & PROFILE
TL611/C100 MORENA PUMP STATION - PHASE ONE

RELOCATION PROJECT
MORENA, CA

4 OF 6 | 66384-04





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B							
A							
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CONDUCTOR DISPLAYED CONDITIONS

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- NEW 12KV DISPLAYED AT 167°F FINAL
- NEW 0.75KV DISPLAYED AT 130°F FINAL
- NEW COMM DISPLAYED AT 130°F FINAL
- NEW GUYS DISPLAYED AT 130°F FINAL
- EX 69KV DISPLAYED AT 194°F FINAL
- EX 12KV DISPLAYED AT 167°F FINAL
- EX 0.75KV DISPLAYED AT 130°F FINAL
- EX COMM DISPLAYED AT 130°F FINAL
- EX GUYS DISPLAYED AT 130°F FINAL
- 18' GROUND CLEARANCE LINE DISPLAYED

60.0 FT. HORIZ. SCALE

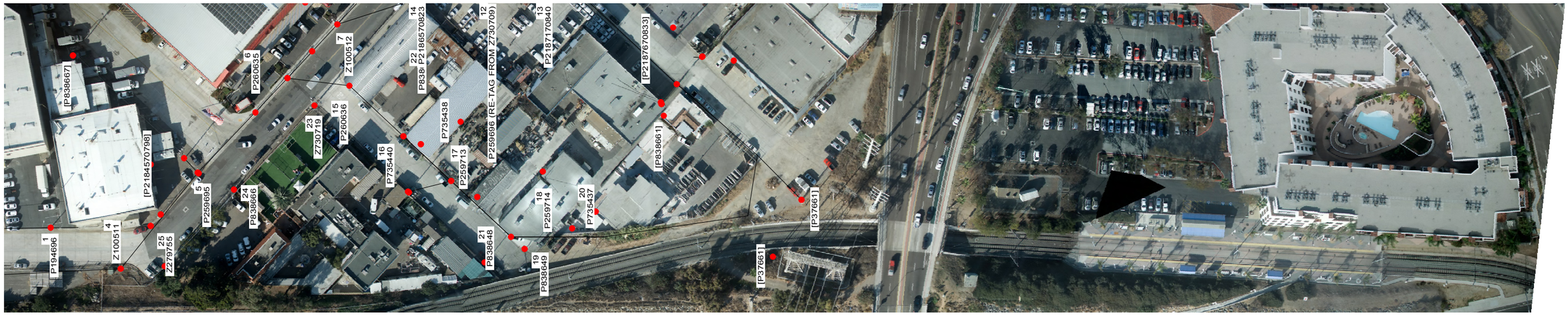
30.0 FT. VERT. SCALE

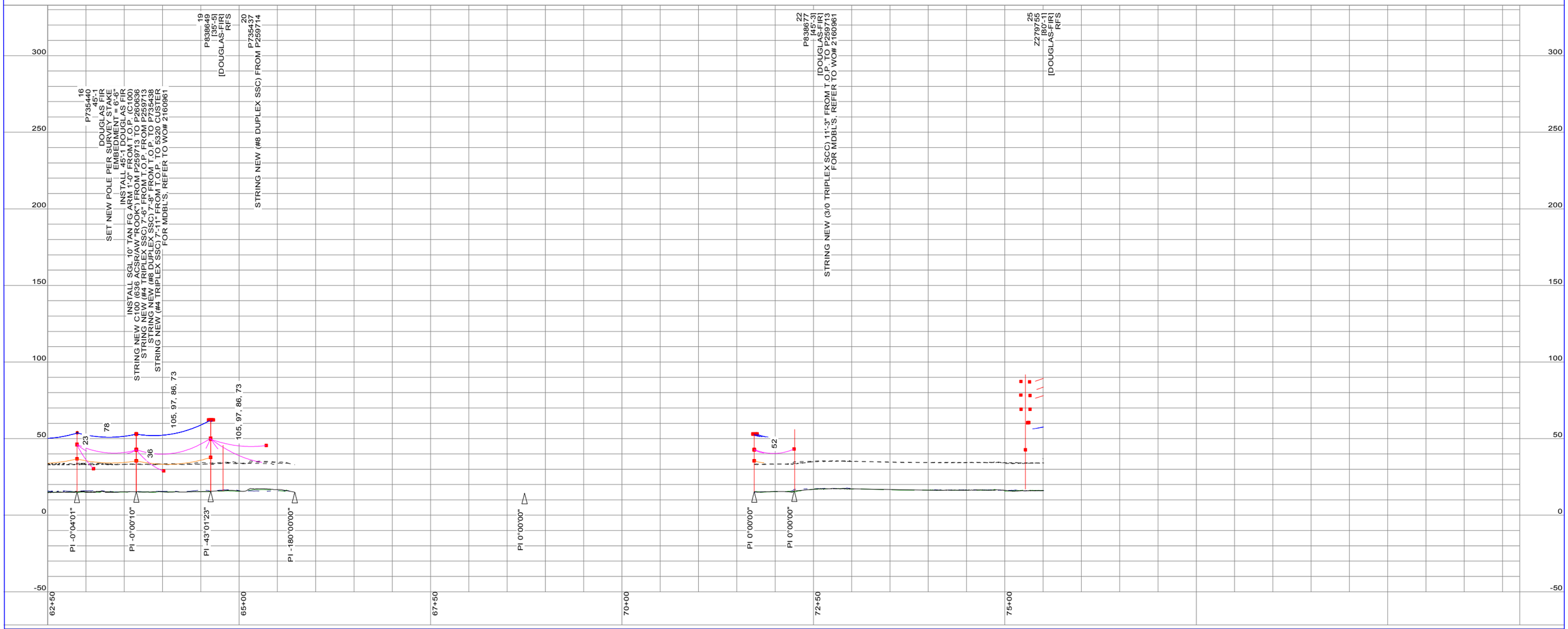
SCALE IS FROM 24X36 ORIGINAL

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
PLAN & PROFILE
TL611/C100 MORENA PUMP STATION - PHASE ONE

RELOCATION PROJECT
MORENA, CA

5 OF 6 | 66384-05





REV	BUDGET	WORK ORDER	REVISION DESCRIPTION	DRN	CHKD	APPV	DATE
C							
B							
A							
0	18242.1	2651954	ORIGINAL	RWH	DAM	EH	10/2/20

CONDUCTOR DISPLAYED CONDITIONS
- NEW 69KV DISPLAYED AT 194°F FINAL
- NEW 12KV DISPLAYED AT 167°F FINAL
- NEW 0.75KV DISPLAYED AT 130°F FINAL
- NEW COMM DISPLAYED AT 130°F FINAL
- NEW GUYS DISPLAYED AT 130°F FINAL
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- EX 0.75KV DISPLAYED AT 130°F FINAL
- EX COMM DISPLAYED AT 130°F FINAL
- EX GUYS DISPLAYED AT 130°F FINAL
- 18' GROUND CLEARANCE LINE DISPLAYED

60.0 FT. HORIZ. SCALE
30.0 FT. VERT. SCALE
SCALE IS FROM 24X36 ORIGINAL

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
PLAN & PROFILE
TL611/C100 MORENA PUMP STATION - PHASE ONE

RELOCATION PROJECT
MORENA, CA

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ATTACHMENT F

RESERVED

ATTACHMENT G

CONTRACT AGREEMENT

CONTRACT AGREEMENT

CONSTRUCTION CONTRACT

This Phase-Funded contract is made and entered into between **THE CITY OF SAN DIEGO**, a municipal corporation, herein called "City", and **Flatiron West, Inc**. herein called "Contractor" for construction of **Morena Pump Station**; Bid No. **K-21-1801-DBB-3-A;** in the total amount of **One Hundred Ten Million Three Hundred Eighty Six Thousand Three Hundred Fifty Dollars and Zero Cents ($110,386,350.00),** which is comprised of the Base Bid consisting of an amount not to exceed **$53,531,000.00** for Phase 1, not to exceed **$44,446,000.00** for Phase 2, not to exceed **$11,297,000.00** for Phase 3, and not to exceed **$1,112,350.00** for Phase 4. IN CONSIDERATION of the payments to be made hereunder and the mutual undertakings of the parties hereto, City and Contractor agree as follows:

1. The following are incorporated into this contract as though fully set forth herein:

   (a) The attached Faithful Performance and Payment Bonds.

   (b) The attached Proposal included in the Bid documents by the Contractor.

   (c) Reference Standards listed in the Instruction to Bidders and the Supplementary Special Provisions (SSP).

   (d) Phased Funding Schedule Agreement.

   (e) That certain documents entitled **Morena Pump Station**, on file in the office of the City Clerks Department as Document No. **B-15141** as well as all matters referenced therein.

2. The Contractor shall perform and be bound by all the terms and conditions of this contract and in strict conformity therewith shall perform and complete in a good and workmanlike manner **Morena Pump Station**, Bid Number **K-21-1801-DBB-3-A,** San Diego, California.

3. For such performances, the City shall pay to Contractor the amounts set forth at the times and in the manner and with such additions or deductions as are provided for in this contract, and the Contractor shall accept such payment in full satisfaction of all claims incident to such performances

4. No claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.

5. This contract is effective as of the date that the Mayor or designee signs the agreement.

IN WITNESS WHEREOF, this Agreement is signed by the City of San Diego, acting by and through its Mayor or designee, pursuant to Resolution No. **R - 312062** authorizing such execution.

THE CITY OF SAN DIEGO

By _____

Print Name: Alia Khouri
Deputy Chief Operating Officer

Date: 04/26/2021

APPROVED AS TO FORM

Mara W. Elliott, City Attorney

By _____

Print Name: Bonny Hsu
Deputy City Attorney

Date: April 28, 21

CONTRACTOR

By _____

Print Name: Mario Martinez

Title: Vice President

Date: March 23, 2021

City of San Diego License No.: 1992002921

State Contractor's License No.: 772589

DEPARTMENT OF INDUSTRIAL RELATIONS (DIR) REGISTRATION NUMBER: 1000003999

ATTACHMENT H

ESCROW BID DOCUMENTS

1. ESCROW BID DOCUMENTS

1.1. Definition and Purpose

The Escrow Bid Documents (EBD) are a compilation of all the documentary information generated in preparation of bid prices for this project. EBDs will be used to assist in the negotiation of price adjustments and variations and in the settlement of disputes, claims and other controversies. They will not be used for pre-award evaluation of the Contractor's anticipated methods of construction or to assess the Contractor's qualifications for performing the Work.

1.2. General

1.2.1. All bidders shall submit a copy of the EBD within 4 working days of the bid opening.

1.2.2. The successful bidder agrees, as a condition of award of the Contract, that the Escrow Bid Documents constitute the only complete documentary information used in preparation of his bid. No other bid preparation information shall be considered in resolving disputes.

1.2.3. Nothing in the Escrow Bid Documents shall change or modify the terms or conditions of the Contract.

1.3. Ownership

1.3.1. The EBDs are and shall always remain the property of the Contractor subject only to joint review by the City and the Contractor, except as provided for herein.

1.3.2. The City stipulates and expressly acknowledges that the EBDs, as defined herein, constitute trade secrets. This acknowledgment is based on the City's express understanding that the information contained in the EBDs is not known outside the Contractor's business, is known only to a limited extent and only by a limited number of employees of the Contractor, is safeguarded while in the Contractor's possession, and is extremely valuable to competitors by virtue of its reflecting the Contractor's contemplated techniques of construction.

1.3.3. The City acknowledges that EBDs and the information contained therein are made available to the City only because such action is an express prerequisite to award of the Contract. The City acknowledges that the EBDs include a compilation of information used in the Contractor's business, intended to give the Contractor an opportunity to obtain an advantage over competitors who do not know of or use the contents of the documentation. The City agrees to safeguard the EBDs and all information contained therein to the fullest extent permitted by law.

1.3.4. The City agrees to safeguard the EBDs and all information contained therein from any California Public Act Request to the fullest extent permitted by law.

1.4. Format and Contents

1.4.1. Bidders may submit EBDs in their usual cost estimating format. It is not intended that extra work is required in preparing the bid but to ensure that the EBDs will be adequate to enable complete and proper understanding and proper interpretation for their intended use. The EBDs shall be in the English language only.

1.4.2. The EBDs shall clearly itemize the estimated costs of performing the work of each item contained in the Bid Schedule. Items should be separated into sub-items as required to present a complete and detailed cost estimate and allow a detailed cost review. The EBDs shall include all quantity take-offs, crews, equipment, calculations of rates of production and progress, copies of quotations from sub-contractors and suppliers, and memoranda, narratives, consultants reports, add/deduct sheets and all other information used by the Contractor to arrive at the prices contained in the bid. Estimated costs shall be broken down into the Contractor's usual estimate categories such as direct labor, repair labor, equipment operation, equipment ownership, expendable materials, permanent material and subcontract costs as appropriate. Plant and equipment and indirect costs should be detailed in the Contractor's usual format. The Contractor's allocation of plant and equipment, indirect costs, contingencies, mark-up and other items to each bid item shall be clearly indicated.

1.4.3. The EBDs shall clearly show in calculations, text, or both, the relationship between baseline indications presented in the Contract Documents and assumptions that form the basis for the Contractor's means, methods, equipment selection, rates of production, and costs.

1.4.4. All costs shall be identified. For bid items where the extended amount is less than $10,000, estimated unit costs are acceptable without a detailed cost estimate, provided that labor, equipment, materials and subcontracts, as applicable, are included and provided that indirect costs, contingencies, and mark-up, as applicable, are allocated.

1.4.5. Bid Documents provided by the City should not be included in the EBDs unless needed to comply with the above requirements.

1.5. Submittal

1.5.1. All bidders shall submit their EBDs within 4 working days of the bid opening. The EBDs shall be submitted in a sealed container (e.g., sealed envelope, box or carton sealed with tape, locked strongbox, etc.), and the container shall be clearly marked on the outside with the Bidder's name, date of submittal, project name, Contract Number and the words "Escrow Bid Documents". The EBDs shall be submitted to:

Engineering & Capital Projects Department, Contracts Division
525 B Street, Suite 750 (7th Floor)
San Diego, California, 92101
Attention: Brittany Friedenreich

1.5.2. The EBDs shall be signed by an individual authorized by the bidder to execute the bid, stating that the material in the Escrow Bid Documentation constitutes all the documentary information used in the preparation of the bid and that he or she has personally examined the contents of the EBDs submission and has found that the documents are complete:

"ESCROW BID DOCUMENT CERTIFICATION"

THE UNDERSIGNED HEREBY CERTIFIES THAT THE BID DOCUMENTATION CONTAINED HEREIN CONSTITUTES ALL THE INFORMATION USED IN PREPARATION OF THE BID AND

THAT I HAVE PERSONALLY EXAMINED THESE CONTENTS AND HAVE FOUND THAT THIS BID DOCUMENTATION IS COMPLETE.

SIGNATURE: _____

NAME: _____
(Print)

TITLE: _____

FIRM: _____

DATE: _____

1.5.3. Prior to award of the contract, the EBDs of the apparent low bidder will be examined, organized and inventoried by representatives of the City, and members of the Contractor's staff who are knowledgeable in how the bid was prepared. This examination is to ensure that the EBDs are authentic, legible, and complete (as defined in 1.4). It will not include review of and will not constitute approval of proposed construction methods, estimating assumptions, or interpretations of the contract documents. Examination will not alter any condition(s) or term(s) of the Contract.

1.5.4. If the Contract is not awarded to the apparent low bidder, the EBDs of the next apparent low bidder to be considered for award shall be processed, as described above.

1.5.5. The City may reject the bid as non-responsive and ineligible for further consideration if the necessary EBDs are not submitted.

1.5.6. If the bidder's proposal is based on subcontracting any part of the Work, each subcontractor whose total subcontract price exceeds five percent of the total contract price proposed by the bidder, shall provide separate EBDs to be included with those of the bidder. These documents will be opened and examined in the same manner and at the same time as the examination described above for the apparent successful bidder. The failure to submit subcontractor EBDs may render contractor's bid non-responsive.

1.5.7. If the Contractor wishes to substitute a subcontractor for a portion of the Work which exceeds five percent of the total contract price proposed by the bidder after award, the City retains the right to require the Contractor to submit EBDs from the subcontractor before the subcontract is approved. This section is not intended to and shall not be interpreted as a waiver by the City of any of the requirements or provisions of public contract code section 4100 et seq. known as the Subletting and Subcontracting Fair Practices Act.

1.6. Storage

1.6.1. Absent a request from the Contractor to place the EBDs in possession of a third-party escrow agent, the EBDs will be stored by the City of San Diego, Public Works Department, Contracts Division. Upon written request from the Contractor, the EBDs shall be placed in escrow with a mutually agreeable institution for the life of the Contract, unless examination is required, which shall be conducted in accordance with this section. The cost of storage by third-party escrow agent will be borne by the Contractor.

1.7. Examination

1.7.1. The EBDs shall be examined by both the City and the Contractor, at any time deemed necessary by either the City or the Contractor, to assist in the negotiation of price adjustments and change orders, or the settlement of disputes.

1.7.2. Examination of the EBDs is subject to the following conditions:

1.7.2.1. As trade secrets, the EBDs are proprietary and confidential as described above

1.7.2.2. The City and the Contractor shall each designate, in writing to the other party a minimum of ten days prior to examination, representatives who are authorized to examine the EBDs. No other person shall have access to examine the EBDs.

1.7.2.3. Examination of the EBDs will take place only in the presence of duly designated representatives of both the City and the Contractor.

1.7.2.4. As escrow bid documents shall be examined by both the City and the Contractor to assist in the negotiation of price adjustments and change orders or the settlement of disputes as either party sees fit.

1.8. Final Disposition

1.8.1. The EBDs will be returned to the awarded Contractor upon completion and final settlement of the Contract.

1.8.2. The EBDs submitted by unsuccessful bidders will be returned unopened, unless opened as provided for above, following execution of the Contract.

ATTACHMENT I

PROJECT LABOR AGREEMENT (PLA)

CITY OF SAN DIEGO

PROJECT LABOR AGREEMENT

FOR CONSTRUCTION OF PURE WATER PROGRAM PHASE I PROJECTS

Effective Date: June 16, 2020

CITY OF SAN DIEGO

PROJECT LABOR AGREEMENT

FOR CONSTRUCTION OF PURE WATER PROGRAM

PHASE I COVERED PROJECTS

This Project Labor Agreement (hereinafter, "PLA" or "Agreement") is entered into this 16th day of June, 2020 by and between the San Diego Building and Construction Trades Council (hereinafter "Council"), and the signatory Craft Unions (hereinafter, together with the Council, collectively, the "Union" or "Unions"), and the Contractors performing work on Covered Projects that are subject to this Agreement. The City of San Diego is not a signatory Party to this Agreement, but shall be considered a "negotiating party" and will be responsible for implementing and administering the Agreement as described herein together with the Council, Unions and Contractors.

ARTICLE 1

RECITALS

WHEREAS, the City desires the completion of the Pure Water Program Phase I Projects in a professional, safe, efficient, and economical manner, without undue delay or work stoppage; and

WHEREAS, the successful completion of the City's Pure Water Program Phase I Projects are of the utmost importance to the rate payers and the City; and

WHEREAS, the Parties have pledged their full commitment to work towards a mutually satisfactory completion of the Pure Water Program Phase I Projects; and

WHEREAS, large numbers of workers of various skills will be required in the performance of the construction work on the Pure Water Program Phase I Projects, including workers affiliated with and/or represented by the Unions; and

WHEREAS, it is recognized that on construction projects with multiple contractors and bargaining units on the job site at the same time over an extended period of time, the potential for work disruption is substantial without an overriding commitment to maintain continuity of work; and

WHEREAS, the Parties agree that by establishing and stabilizing wages, hours, and working conditions for the workers employed on the Pure Water Program Phase I Projects, a

satisfactory, continuous, and harmonious relationship will exist among labor and management that will lead to the efficient and economical completion of Covered Projects; and

WHEREAS, in recognition of the special needs of the Project Work and to maintain a spirit of harmony, labor-management relations, peace, and stability during the term of this PLA, the Parties agree to establish effective and binding methods for the settlement of all misunderstandings, disputes and grievances without any strikes, slowdowns, work interruptions, or disruption of Project Work, and the Contractors agree not to engage in any lockout.

WHEREAS, the City places high priority upon the development of comprehensive programs for the recruitment, training, and employment of City Residents and Targeted Workers, and also recognizes the ability of local Apprenticeship Programs to provide meaningful and sustainable careers in the building and construction industry. The Parties will encourage City Residents and Targeted Workers to participate in Project Work through programs and procedures jointly developed to prepare and encourage such individuals for entrance into Apprenticeship Programs and formal employment on the Project Work through the referral programs sponsored and/or supported by the Parties to this PLA.; and

WHEREAS, the Project Work will provide opportunities for Disadvantaged Business Enterprises to participate as Contractors, subcontractors, or suppliers, and the Parties therefore agree that they will cooperate with all efforts of the City, the Project Labor Coordinator, and other organizations retained by the City for this purpose, to encourage and assist the participation of Disadvantaged Business Enterprises in the Project Work. Specifically, all Parties understand that the City has established and quantified goals which place a strong emphasis on the utilization of Disadvantaged Business Enterprises on the Project. Each Party agrees that it shall participate in outreach programs and provide education, and assistance to businesses not familiar with working on projects of this scope. Further, the Parties shall ensure that the provisions of this PLA do not inadvertently establish impediments to participation of such Disadvantaged Business Enterprises, City Residents and Targeted Workers.

WHEREAS, it is further understood that the City is a real party in interest to this Agreement and shall actively administer and enforce the obligations of this PLA to ensure that the benefits of this Agreement flow to all signatory Parties, craft persons working under it, and the rate payers and residents of the City. The City will send a letter to the Council to signify that the City will be performing its obligation under this Agreement and will designate a “Project Labor Coordinator,” either from its own staff and/or an independent contractor acting on behalf of the City, to monitor and enforce compliance with this PLA. In addition, this letter will state that the City will include and incorporate this Agreement into each Covered Project's construction documents. The Project Labor Coordinator, as the authorized representative of the City, will assist with the development and implementation of the programs referenced in this PLA, all of which are critical to fulfilling the intent and purposes of the Parties and this PLA.

NOW, THEREFORE, IT IS AGREED BETWEEN AND AMONG THE PARTIES AS FOLLOWS:

ARTICLE 2

DEFINITIONS

Capitalized terms utilized in this PLA which are not otherwise defined herein shall have the meanings ascribed to said terms below.

"Agreement" means this Project Labor Agreement (PLA).

"Applicable Prevailing Determination" means the prevailing wage determinations applicable to Project Work pursuant to the State of California Labor Code.

"Apprentice" means an apprentice properly registered in an Apprenticeship Program for the entire time they are employed on a Covered Project.

"Apprenticeship Program" as used in this PLA shall be defined as an apprenticeship program certified by the State of California.

"City" means the City of San Diego and its departments delivering the Covered Projects.

"City Resident" means a City of San Diego permanent resident at the time of initial employment on a Covered Project or a Veteran residing anywhere.

"Contractor" means any contractor to whom the City awards a Construction Contract for Project Work and all subcontractors utilized by such Contractors for Project Work. The term "Contractor" includes any individual, firm, partnership, corporation, owner operator, or combination thereof, including joint ventures, that has entered into a contract with the City for Project Work, or any subcontractor who has signed a contract with a Contractor or another subcontractor for Project Work.

"Core Employees" are defined in Article 4, Section 4.6 (e).

"Council" means the San Diego County Building & Construction Trades Council.

"Covered Contract" means a contract awarded to a Contractor by the City for a Pure Water Program Phase I Project identified in Appendix A.

"Covered Project" or "Project Work" means a Pure Water Program Phase I Project that is identified in Appendix A and is limited to the construction site of work.

"Disadvantaged Business Enterprise" means a firm that has been certified via the Department of Transportation, but also includes: Minority Business Enterprises or Woman Business Enterprises certified by the Department of Transportation or the California Public Utilities Commission; and Small Local Business Enterprises or Emerging Local Business Enterprises certified by the City.

"Prime Contractor" means the prime Contractor awarded a Covered Contract in privity directly with the City.

"Project Labor Coordinator" means the designee of the City, either from its own staff and/or an independent entity acting on behalf of the City, to monitor compliance with this Agreement and assist with developing, implementing and administering the requirements, policies and programs referenced herein.

"Schedule A's" means the local master labor agreements of the Unions.

"Targeted Worker" means any individual qualifying for one (1) or more of the following Targeted Worker categories:

(a) Is a Veteran, or is the eligible spouse of a "Veteran of the United States armed forces, under Section 2(a) of the Jobs for Veterans Act (38 United States Code [U.S.C.] 4215[a]);

(b) At initial time of employment on a Covered Project, is an Apprentice with less than ten (10) percent of the work hours required for graduation to become a Journeyperson;

(c) Has no high school diploma or general education diploma (GED);

(d) Is homeless or has been homeless within the last year;

(e) Is a former foster youth;

(f) Is a custodial single parent;

(g) Is experiencing protracted unemployment (receiving unemployment benefits for at least three [3] months);

(h) Is a current recipient of government cash or food assistance benefits;

(i) Has a documented income at or below 100 percent of the Federal Poverty Level;

(j) Is formerly incarcerated with a history of involvement with the criminal justice system.

"Union" or "Unions" means any labor organization signatory to this Agreement acting in their own behalf and on behalf of their respective affiliates and member organizations whose names are subscribed hereto and who have, through their officers, executed this Agreement.

"Veteran" means a veteran or the eligible spouse of a veteran of the United States armed forces, under Section 2(a) of the Jobs for Veterans Act (38 U.S.C. 4215[a]);

ARTICLE 3

SCOPE OF THE AGREEMENT

Section 3.1 This PLA is limited to covering all onsite construction work within the scope of each Covered Contract.

Section 3.2 Exclusions. Items specifically excluded from the scope of this PLA include the following:

(a) Work of non-manual employees including but not limited to, superintendents, supervisors, staff engineers, quality control and quality assurance personnel, timekeepers, mail carriers, clerks, office workers, messengers, guards, safety personnel, emergency medical and first aid technicians, and other professional, engineering, administrative, supervisory, and management employees; and

(b) All offsite manufacturing, fabrication, deliveries, maintenance, and handling of materials, equipment, or machinery, and the offsite hauling of materials of any kind to or from the Covered Project site. However, any lay down or storage areas for equipment or material and manufacturing (i.e. prefabrication) sites dedicated solely for the project, and the movement of materials or goods between locations on a Covered Project site are within the scope of the PLA. On-site fabrication work includes work done for the Project in temporary yards or areas near the Project. On-site construction shall also include the site of any batch plant constructed solely to supply materials to the Project; and

(c) All employees of the City, Project Labor Coordinator, design teams (including, but not limited to, architects, engineers, and master planners), or any other consultants for the City (including, but not limited to, project managers and

construction managers and their employees where not engaged in Project Work) and their subconsultants, and other employees of professional service organizations, not performing manual labor within the scope of this PLA. Notwithstanding the foregoing, however, this exclusion shall not apply to the classifications for Surveyors and/or Building/Construction Inspectors and/or Field Soils and Material Testers (Inspectors) unless they are City employees. This inclusion applies to the scope of work defined in the State of California Wage Determination for Surveyors and/or Building/Construction Inspectors and/or Field Soils and Material Testers (Inspectors). This shall also specifically include such work where it is referred to by utilization of such terms as "quality control" or "quality assurance." Every Inspector performing under these classifications on Covered Projects pursuant to a professional services agreement, a contract entered into directly with the City, or a contract with a Contractor shall be bound to all applicable requirements of this Agreement; and

(d) Any work performed on or near or leading to or into a site of work covered by this PLA and undertaken by state, county, city, or other governmental bodies, or their contractors (other than work within the scope of this PLA undertaken by contractors to the City); or by private utilities, or their contractors; and

(e) Work performed by employees of a manufacturer or vendor on the manufacturer's or vendor's equipment, if required by the warranty agreement in order to maintain the warranty or guarantee, and provided that the warranty agreement is the manufacturer's or vendor's usual and customary warranty agreement for such equipment and is consistent with industry practice; and

(f) Specialized or technical work requiring specialized training, unique skills, or a level of specific technical experience which employees represented by the Union do not possess. At least ten (10) working days notice shall be given to the Council before any work is performed pursuant to this exemption.; and

(g) Laboratory work for testing; and

(h) Non-construction support services contracted by the City, Project Labor Coordinator, or Contractor in connection with this Project.

Section 3.3 Awarding of Contracts.

(a) The City has the absolute right to bid or award Covered Contracts regardless of delivery method to any Contractor notwithstanding the existence or non-existence of any agreements between such Contractor and any Union Parties,

provided only that such Contractor is willing, ready, and able to execute and comply with this PLA should such Contractor be awarded work covered by this PLA.

(b) It is agreed that all Contractors who have been awarded a contract for Project Work shall be required to accept and be bound by the terms and conditions of this PLA. Contractors shall evidence their acceptance of this Agreement by executing a Letter of Assent as set forth in Attachment A hereto. The Prime Contractor must sign and submit the Letter of Assent as a condition of award prior to the execution of a Covered Contract. No Contractor shall commence Project Work without first providing a copy of the signed Letter of Assent to the Project Labor Coordinator.

(c) The City and Prime Contractors agree that to the extent permitted by law and consistent with the economy and efficiency of construction and operation, it will use its best efforts to purchase materials, equipment, and supplies that will not create labor strife. Under all circumstances, however, the City and Prime Contractors shall retain the absolute right to select the lowest responsive and responsible bidder for the award of contracts on all Covered Projects.

Section 3.4 Coverage Exception. The Parties agree and understand that this PLA shall not apply to any work that would otherwise be covered Project Work if a governmental agency or granting authority partially or fully funding such work determines that it will not fund the Project Work if it is covered by this PLA. The City agrees that it will make every effort to establish the inclusion of this PLA with any governmental agency or granting authority funding a Covered Project.

Section 3.5 Schedule A's.

(a) The provisions of this PLA, including the Schedule A's (which are the local Master Labor Agreements of the signatory Unions having jurisdiction over the work on the Project, as such may be changed from time to time consistent with Section 21.3, and which are incorporated herein by reference), shall apply to the work covered by this PLA, notwithstanding the provisions of any other local, area and/or national agreement that may conflict with or differ from the terms of this PLA. Where a subject covered by the provisions of this PLA is also covered by a Schedule A, the provisions of this PLA shall prevail. Where a subject is covered by a provision of a Schedule A and not covered by this PLA, the provisions of the Schedule A shall prevail. Any dispute as to the applicable source between this PLA and any Schedule A shall be resolved under the procedures established in Article 10.

(b) It is understood that this PLA, together with the referenced Schedule A's, constitutes a self-contained, stand-alone agreement and, by virtue of having become bound to this PLA, the Contractor will not be obligated to sign any other local, area, or national collective bargaining agreement as a condition of performing work within the scope of this PLA (provided, however, that the Contractor may be required to sign a uniformly applied non-discriminatory Participation or Subscription Agreement at the request of the trustees or administrator of a trust fund established pursuant to Section 302 of the Labor Management Relations Act, and to which such Contractor may be bound to make contributions under this PLA, provided that such Participation or Subscription Agreement does not purport to bind the Contractor beyond the terms and conditions of this PLA and/or expand its obligation to make contributions pursuant thereto). It shall be the responsibility of the Prime Contractor to have each of its Contractors of any tier sign the documents with the appropriate Union prior to the Contractor beginning Project Work.

Section 3.6 The Parties agree that this PLA will be made available to, and will fully apply to, any successful bidder for Project Work, without regard to whether that successful bidder performs work at other sites on either a Union or non-Union basis. This PLA shall not apply to any work of any Contractor other than that on Project Work specifically covered by this PLA.

Section 3.7 Binding Signatories Only. This PLA and Letter of Assent shall only be binding on the signatory Parties hereto, and shall not apply to the parents, affiliates, subsidiaries, or other ventures of any such Party.

Section 3.8 Other City Work. Nothing contained herein shall be interpreted to prohibit, restrict, or interfere with the performance of any other operation, work, or function not covered by this PLA, which may be performed by City employees or contracted for by the City for its own account, on its property, or in and around a project site.

Section 3.9 Separate Liability. It is understood that the liability of the Contractor(s) and the liability of the separate Unions under this PLA shall be several and not joint. The Unions agree that this PLA does not have the effect of creating any joint employment status between or among the City or Project Labor Coordinator and/or any Contractor.

Section 3.10 Completed Project Work. As areas of Project Work are accepted by the City, this PLA shall have no further force or effect on such items or areas except where the Contractor is directed by the City or its representatives to engage in repairs, modification and/or check-out functions required by its contract(s) with the City.

Section 3.11 Except for all work performed under the NTL Articles of Agreement, the National Stack/Chimney Agreement, and the National Cooling Tower Agreement, all instrument calibrations work and loop checking shall be performed under the terms of the UA/IBEW Joint National Agreement for Instrument and Control Systems Technicians, and the National Agreement of the International Union of Elevator Constructors, with the exception of Article 7 (Work Stoppages and Lockouts), Article 8 (Work Assignments and Jurisdictional Disputes) and Article 10 (Settlement of Grievances and Disputes) of this PLA, which shall apply to such work.

ARTICLE 4

UNION RECOGNITION AND EMPLOYMENT

Section 4.1 Recognition. The Contractor recognizes the Unions as the exclusive bargaining representative for the employees engaged in Project Work. Such recognition does not extend beyond the period when the employee is engaged in Project Work.

Section 4.2 Contractor Selection of Employees. The Contractor shall have the right to determine the competency of all employees, the number of employees required, the duties of such employees within their craft jurisdiction, and shall have the sole responsibility for selecting employees to be laid off, consistent with this Article. The Contractor shall also have the right to reject any applicant referred by a Union for any reason, subject to any reporting time requirements of the applicable Schedule A; provided, however, that such right is exercised in good faith and not for the purpose of avoiding the Contractor's commitment to employ qualified workers through the procedures endorsed in this PLA.

Section 4.3 Referral Procedures.

(a) For signatory Unions to this Agreement having a job referral system contained in a Schedule A, the Contractor agrees to comply with such system and it shall be used exclusively by such Contractor, except as modified by this PLA. Such job referral system will be operated in a nondiscriminatory manner and in full compliance with federal, state, and local laws and regulations that require equal employment opportunities and non-discrimination. All of the foregoing hiring procedures, including related practices affecting apprenticeship, shall be operated so as to consider the goals of the City to encourage employment of City Residents, Targeted Workers, and utilization of Disadvantaged Business Enterprises on the Project Work, and to facilitate the ability of all Contractors to meet their employment needs.

(b) The local Unions will exert their best efforts to recruit and refer sufficient numbers of skilled craft workers to fulfill the labor requirements of the Contractor, including specific employment obligations to which the Contractor may be legally and/or contractually obligated; and to refer Apprentices as requested to develop a larger, skilled workforce. The Unions will work with the Project Labor Coordinator and others designated by the City, to identify and refer competent craft persons as needed for Project Work, and to identify individuals, particularly City Residents and Targeted Workers, for entrance into Apprenticeship Programs, or participation in other identified programs and procedures to assist individuals in qualifying and becoming eligible for such Apprenticeship Programs, all maintained to increase the available supply of skilled craft personnel for Project Work and future construction work to be undertaken by the City.

(c) The Union shall not knowingly refer an employee currently employed by a Contractor on Project Work to any other Contractor.

Section 4.4 Non-Discrimination in Referral, Employment, and Contracting. The Unions and Contractors agree that they will not discriminate against any employee or applicant for employment on the basis of race, color, religion, gender, national origin, age, Union status, sex, sexual orientation, marital status, political affiliation, or disability. Further, it is recognized that the City has certain policies, programs, and goals for the utilization of Disadvantaged Business Enterprises. The Parties shall jointly endeavor to assure that these commitments are fully met, and that any provisions of this PLA that may appear to interfere with Disadvantaged Business Enterprises successfully bidding for work on Covered Projects shall be carefully reviewed, and adjustments made as may be appropriate and agreed upon among the Parties, to ensure full compliance with the spirit and letter of the City's policies and commitment to its goals for the significant utilization of Disadvantaged Business Enterprises as Contractors, vendors or suppliers on Project Work.

Section 4.5 Employment of City Residents and Targeted Workers.

(a) In recognition of the City's mission to serve the City and its residents, the Unions and Contractors agree that, to the extent allowed by law, and as long as they possess the requisite skills and qualifications, residents of the City of San Diego, hereafter “City Residents”, shall be first referred for Project Work. A “City Resident” is defined as a City of San Diego permanent resident at the time of initial employment on a Covered Project or a Veteran residing anywhere. The

list of qualifying zip codes for City Residents is included within Attachment B-1, Workforce Dispatch Request Form.

(b) The Contractors and Unions agree to work together to achieve a goal of at least thirty-five (35) percent of the total construction craft hours worked on each Covered Project be performed by City Residents.

(c) The Contractors and Unions agree to work together to achieve a goal of at least ten (10) percent of the total construction craft hours worked on each Covered Project be performed by Targeted Workers. Hours worked by Targeted Workers who are also City Residents may be applied to the City Resident participation goal.

(d) Professional services agreements entered into by the City for covered surveying or inspection services, which are separate and apart from the Construction Contract for a Covered Project, are exempt from the foregoing City Resident and Targeted Worker hiring goals.

(e) To facilitate the dispatch of City Residents, as well as all Contractor requests for referral and dispatch of workers from the applicable Union referral system, all Contractors are required to utilize the Workforce Dispatch Request Form for Covered Projects, a sample of which is attached as Attachment B-1.

(f) The Project Labor Coordinator shall work with the Unions and Contractors in the administration, monitoring, and the reporting of the foregoing City Resident and Targeted Worker hiring goals.

(g) The Parties recognize that the Pure Water Program Phase I Projects have multiple funding sources. If a particular funding source applied by the City to a Covered Project does not allow geographic preference for hiring local craft workers, the foregoing City Resident participation requirement will not be applicable to that Covered Project. The City reserves the right to apply Pure Water Program Phase I funding as it chooses and will make every effort to fund the Covered Projects to encourage inclusivity of City Residents.

Section 4.6 Core Employees. This Section only applies to Contractors who are not directly signatory to an applicable Schedule A.

(a) Disadvantaged Business Enterprise. The Parties recognize the City's interest in promoting competition and inclusion of Disadvantaged Business Enterprises, which may not be signatory to a current Schedule A. In order to promote participation and attract Disadvantaged Business Enterprises to work

under this Agreement, and subject to the limitations set forth below, each Contractor that is a Disadvantaged Business Enterprise may first employ three (3) of its core employees per craft on each Covered Project prior to employing an employee through the appropriate Union hiring hall. The next (fourth) employee shall be hired from the appropriate Union hiring hall and thereafter, such Contractor may employ, as needed, two (2) additional Core Employees in an alternating manner with Union referrals, up to a total of five (5) Core Employees. Thereafter, all additional employees in the affected trade or craft shall be requested and referred from the appropriate Union hiring hall.

The foregoing Core Employee hiring procedure for Disadvantaged Business Enterprises is subject to the following limitations:

(1) Disadvantaged Business Enterprises with an individual subcontract value of $500,000 or less and;

(2) Disadvantaged Business Enterprises are limited to utilizing the foregoing Core Employee hiring procedure to one (1) subcontract per Covered Project and;

(3) The total value of all subcontracts utilizing the foregoing Core Employee hiring procedure shall not exceed ten (10) percent of the total value of each Covered Project; and

(4) In order to assist the Project Labor Coordinator monitor compliance with this Section, each Prime Contractor will be responsible for tracking, reporting and providing notice to the Project Labor Coordinator describing each Disadvantaged Business Enterprise subcontract that qualifies for the foregoing hiring procedure prior to work commencing.

(b) Employers who do not qualify for the hiring procedure set forth in Section 4.6(a), and who are not otherwise signatory to a current Schedule A, may employ, as needed, first, a Core Employee, then an employee through a referral from the appropriate Union hiring hall, then a second Core Employee, then a second employee through the referral system, and so on until a maximum of three (3) Core Employees are employed per craft on each Covered Project. Thereafter, all additional employees in the affected trade or craft shall be requested and referred from the appropriate Union hiring hall in accordance with this Article. Contractors employing more than fifty (50) craft workers at the same time in a specific trade on a Covered Project may hire an additional two (2) Core Employees.

(c) Section 4.6 only applies to Contractors who are not directly signatory to a current Schedule A for the craft worker in its employ and is not intended to limit the transfer provisions of the Schedule A of any trade. As part of this process, and in order to facilitate the contract administration procedures, as well as appropriate fringe benefit fund coverage, all Contractors shall require their Core Employees and any other persons employed other than through the referral process, to register with the appropriate Union hiring hall, if any, prior to their first day of employment working under the Construction Contract at the project site.

(d) Prior to each Contractor performing any work on a Covered Project, each Contractor shall provide a list of Core Employees to the Project Labor Coordinator and the Council. After submitting the Core Employee list prior to commencing work, Contractors shall not make any changes or substitutions to the Core Employee list for the duration of the Covered Project. Failure to submit the Core Employee list prior to work commencing will prohibit the Contractor from using any Core Employees for 30 calendar days after the list is provided to the Project Labor Coordinator and Council.

(e) Upon request by any Party to this Agreement, the Contractor hiring any Core Employee shall provide satisfactory proof (i.e., payroll records, quarterly tax records, and such other documentation) evidencing the Core Employee's qualification as a Core Employee to the Project Labor Coordinator and the Council.

(f) Core Employees must meet the following eligibility requirements to qualify for employment on Covered Projects:

(1) A Core Employee must be either a journeyperson or Apprentice and appear on the Contractor's active payroll for at least ninety (90) of the last one-hundred-eighty (180) working days prior to being designated as a Core Employee. The date a Core Employee is designated is the date the Core Employee list is submitted to the Project Labor Coordinator and Council prior to the Contractor commencing work; and

(2) A Core Employee must possess any license required by state or federal law for the Project Work to be performed; and

(3) A Core Employee must have the ability to safely perform the basic functions of the applicable trade.

(g) In addition to the core employee provisions set forth herein, all Contractors may avail themselves of any opportunity provided for in the applicable Schedule A's to call for specific employees by name.

(h) During any layoffs or reductions in workforce, Contractors shall layoff employees in an order and manner consistent with the Core Employee hiring procedures and maintain the required Core Employee-to-Union referral ratios required by this Section for the duration of each Covered Project.

Section 4.7 Time for Referral. If any Union's registration and referral system does not fulfill the requirements for specific classifications of covered employees (including City Residents) requested by any Contractor within forty-eight (48) hours (excluding Saturdays, Sundays, and holidays), that Contractor may employ Core Employees without reference to the ratio requirements in Section 4.6 or use employment sources other than the Union registration and referral services, and may employ applicants from any other available source. The Contractor should promptly inform the Union of any applicants hired from other sources, and such applicants shall register with the appropriate hiring hall, if any.

Section 4.8 Lack of Referral Procedure. If a signatory local Union does not have a job referral system as set forth in Section 4.3 above, the Contractors shall give the Union equal opportunity to refer applicants. The Contractors shall notify the Union of employees so hired, as set forth in Section 4.7.

Section 4.9 Union Membership. Employees are not required to become or remain union members as a condition of performing Covered Work under this Agreement. Employers shall make and transmit all deductions for union dues, fees, and assessments that have been authorized by employees in writing in accordance with the applicable Schedule A. Nothing in this Section 4.9 is intended to supersede the requirements of the applicable Schedule A's as to those Employers otherwise signatory to such Schedule A and as to the employees of those Employers who are performing Covered Work.

Section 4.10 Foremen. The selection and number of craft foremen and/or general foremen shall be the responsibility of the Contractor, consistent with the Schedule A's. All foremen shall take orders exclusively from the designated Contractor representatives. Craft foremen shall be designated as working foreman at the request of the Contractors.

Section 4.11 Skilled and Trained Workforce. All Contractors performing Project Work are required to provide the City with an enforceable commitment that a skilled and

trained workforce will be used to complete the construction contract or project, in accordance with City Council Resolution Number R-312062.

ARTICLE 5

UNION ACCESS AND STEWARDS

Section 5.1 Access to Project Sites. Authorized representatives of the Union shall have access to Project Work, provided that they do not interfere with the work of employees and further provided that such representatives fully comply with posted visitor, security, and safety rules.

Section 5.2 Stewards.

(a) Each signatory local Union shall have the right to dispatch a working journeyperson as a steward for each shift, and shall notify the Contractor in writing of the identity of the designated steward or stewards prior to the assumption of such person's duties as steward. Such designated steward or stewards shall not exercise any supervisory functions. There will be no non-working stewards. Stewards will receive the regular rate of pay for their respective crafts.

(b) In addition to his/her work as an employee, the steward should have the right to receive, but not to solicit, complaints or grievances and to discuss and assist in the adjustment of the same with the employee's appropriate supervisor. Each steward should be concerned only with the employees of the steward's Contractor and not with the employees of any other Contractor. The Contractor will not discriminate against the steward in the proper performance of his/her Union duties.

(c) When a Contractor has multiple, non-contiguous work locations at one site, the Contractor may request and the Union shall appoint such additional working stewards as the Contractor requests to provide independent coverage of one or more such locations. In such cases, a steward may not service more than one work location without the approval of the Contractor.

(d) The stewards shall not have the right to determine when overtime shall be worked or who shall work overtime.

Section 5.3 Steward Layoff/Discharge. The Contractor agrees to notify the appropriate Union twenty-four (24) hours before the layoff of a steward, except in the case of

disciplinary discharge for just cause. If the steward is protected against such layoff by the provisions of the applicable Schedule A, such provisions shall be recognized when the steward possesses the necessary qualifications to perform the remaining work. In any case in which the steward is discharged or disciplined for just cause, the appropriate Union will be notified immediately by the Contractor, and such discharge or discipline shall not become final (subject to any later filed grievance) until twenty-four (24) hours after such notice has been given.

Section 5.4 Employees on Non-Project Work. On work where the personnel of the City may be working in close proximity to the construction activities covered by this PLA, the Union agrees that the Union representatives, stewards, and individual workers will not interfere with the City personnel, or with personnel employed by any other employer not a Party to this PLA.

ARTICLE 6

WAGES AND BENEFITS

Section 6.1 Wages. At a minimum, all employees covered by this PLA shall be classified in accordance with work performed and paid the hourly wage rates for those classifications in compliance with the Applicable Prevailing Wage Determination established pursuant to the California Labor Code by the California Department of Industrial Relations.

Section 6.2 Benefits.

(a) Subject to the exception set forth below for Disadvantaged Business Enterprises, otherwise, for all employees performing Project Work, Contractors shall pay all fringe benefits and other required employer contributions to the established Union employee benefit funds in the amounts required by the applicable Schedule A. In addition, the Contractors and Unions agree that only such bona fide employee benefits that accrue to the direct benefit of the employees (such as pension and annuity, health and welfare, vacation, apprenticeship, and training funds) shall be included in this requirement and required to be paid by the Contractor on Covered Projects. These Contractor contributions shall not exceed the contribution amounts set forth in the Applicable Prevailing Wage Determination.

Union Benefit Fund Contributions for Disadvantaged Business Enterprises. Disadvantaged Business Enterprises are exempt from paying fringe benefits and

other required employer contributions on behalf of their Core Employees to the Union employee benefit funds, subject to the following exemption limitations:

(1) The exemption is only applicable to Disadvantaged Business Enterprises with an individual subcontract value of $500,000 or less and;

(2) Disadvantaged Business Enterprises are limited to utilizing this exemption for one subcontract per Covered Project and;

(3) The total value of all subcontracts utilizing this exemption shall not exceed ten (10) percent of the total value of each Covered Project; and

(4) Disadvantaged Business Enterprises utilizing this exemption are still required to pay all fringe benefits and other required employer contributions to the established Union employee benefit funds for all employees other than their Core Employees, and must comply with the applicable prevailing wage requirements, including the payment of fringe benefits, for all employees performing Project Work; and

(5) In order to assist the Project Labor Coordinator monitor utilization of this exemption, each Prime Contractor will be responsible for tracking, reporting and providing notice to the Project Labor Coordinator about each Disadvantaged Business Enterprise subcontract that qualifies and intends to utilize this exemption prior to work commencing.

(b) Where applicable, the Contractor adopts and agrees to be bound by the written terms of the applicable, legally established, Union trust agreement(s) specifying the detailed basis how payments will be made into, and benefits paid out of, such trust funds for its employees. The Contractor authorizes the Parties to such trust funds to appoint trustees and successors' trustees to administer the trust funds and hereby ratifies and accepts the trustees so appointed as if made by the Contractor. The Contractor obligations to the applicable Union benefit fund(s) and trust agreement(s) are limited to work performed on a Covered Project. The applicable Union benefit funds and trust agreement(s) to each Contractor are determined by the pre-job conference and Union work assignment process described in Articles 8 and 16.

(c) Each Contractor is required to certify to the Project Labor Coordinator that it has paid all benefit contributions due and owing to the appropriate Union trust(s) and benefit funds prior to the receipt of its final payment and/or retention. Further, upon timely notification by a Union to the Project Labor Coordinator, the Project Labor Coordinator shall work with any Contractor who is delinquent in

payments to assure that proper benefit contributions are made, to the extent of requesting the City or the prime Contractor to withhold payments otherwise due such Contractor, until such contributions have been made or otherwise guaranteed.

(d) Notwithstanding any other provisions, this Agreement is an agreement under Section 8(f) of the National Labor Relations Act (NLRA), which covers work performed in the building and construction industry. In addition, the work performed under this Agreement qualifies for the Construction Industry Exemption under the Employee Retirement and Income Security Act of 1974 ("ERISA"), as amended as well. If any Union Pension Trust Fund ("Fund") covered by the terms and conditions of this Agreement does not qualify for the Construction Industry Exemption authorized by Section 4203 (B)(1)(i), of the Employee Retirement Income Security Act of 1974 ("ERISA") as amended, 29 U.S.C. 1383(b)(1)(i), or has not taken the necessary steps to amend the Fund documents to qualify for the Construction Industry Exemption as authorized by Section 4203(B)(1)(ii) of ERISA, as amended, 29 U.S.C. 1383(b)(1)(B)(ii); and to recognize the work performed under this Agreement to qualify for the Construction Industry Exemption, the Contractors signatory to this Agreement will not be obligated to make pension fund contributions to that Fund. In such an event, the Contractor shall pay all required amounts otherwise allocated for payment toward the non-exempt Fund to the employees' wages or other bona fide retirement plan program pursuant to applicable prevailing wage requirements.

Section 6.3 Wage Premiums. Wage premiums, including, but not limited to, pay based on height of work, shift premiums, hazard pay, scaffold pay, and special skills shall not be applicable to work under this PLA, except to the extent provided for in any applicable prevailing wage determination.

Section 6.4 Compliance with Prevailing Wage Laws. All complaints regarding possible prevailing wage violations may be referred to the Project Labor Coordinator or Labor Compliance Program, if any, for processing, investigation and resolution, and if not resolved within thirty (30) calendar days, may be referred by any Party to the State Labor Commissioner. To facilitate compliance with applicable prevailing wage laws, the City and each Contractor agree to provide copies of certified payroll reports, redacted only to the extent required by law, to the Unions (or to any Labor Management Cooperation Committee in which a Union or its affiliate participates) within ten (10) days of their request.

ARTICLE 7

WORK STOPPAGES AND LOCKOUTS

Section 7.1 No Work Stoppages or Disruptive Activity. The Council and the Unions signatory hereto agree that they, nor their respective officers, or agents or representatives, shall incite or encourage, condone or participate in any strike, walk-out, slowdown, picketing, observation of picket lines, or other activity of any nature or kind whatsoever, for any cause or dispute whatsoever with respect to or any way related to Project Work, or which interferes with or otherwise disrupts Project Work, or with respect to or related to the City or Contractors or subcontractors, including, but not limited to, economic strikes, unfair labor practice strikes, safety strikes, sympathy strikes, and jurisdictional strikes whether or not the underlying dispute is arbitrable. Any such actions by the Council, or Unions, or their members, agents, representatives, or the employees they represent shall constitute a material violation of this PLA. The Council and the Union shall take all steps necessary to obtain compliance with this Article.

Section 7.2 Employee Violations. The Contractor may discharge any employee violating Section 7.1 above, and any such employee will not be eligible for rehire under this PLA.

Section 7.3 Standing to Enforce. The City, the Project Labor Coordinator, or any Contractor affected by an alleged violation of Section 7.1 shall have standing and the right to enforce the obligations established therein.

Section 7.4 Expiration of Schedule A's. If a collective bargaining agreement between a signatory Contractor and one or more of the Union(s) expires before the Contractor completes the performance of a Covered Contract for a Covered Project, and the Union or the Contractor gives notice of demand for a new or modified collective bargaining agreement, the Unions agree that they will not strike the Contractor on any Covered Project, and the Union and the Contractor agree that the expired collective bargaining agreement will continue in full force and effect for the Project Work until a new or modified collective bargaining agreement is reached between the Union and the Contractor. If the new or modified collective bargaining agreement reached between the Union and the Contractor provides that any terms of the collective bargaining agreement shall be retroactive, the Contractor agrees to comply, consistent with the terms of this PLA and the Prevailing Wage Statute, with any retroactive terms of the new or modified collective bargaining agreement which are applicable to employees of said Contractor that are employed on a Covered Project within seven (7) days at

no cost to the City. All employees shall continue to work and to perform all their obligations with respect to Project Work despite the expiration of a Schedule A agreement. Should a Contractor engaged in Project Work enter into an interim agreement with the Unions for work being performed elsewhere after the expiration, and before the renewal of a local collective bargaining agreement forming the basis for Schedule A, such interim agreement shall be utilized by that Contractor for Project Work, subject to the provisions of Section 21.3.

Section 7.5 No Lock Outs. Contractors shall not cause, incite, encourage, condone or participate in any lock-out of employees with respect to Project Work during the term of this PLA. The term "lock-out" refers only to a Contractor's exclusion of employees in order to secure collective bargaining advantage, and does not refer to the discharge, termination, or layoff of employees by the Contractor for any reason in the exercise of rights pursuant to any provision of this PLA, or any other agreement, nor does "lock-out" include the City's decision to stop, suspend, or discontinue any Project Work or any portion thereof for any reason.

Section 7.6 Best Efforts to End Violations.

(a) If a Contractor contends that there is any violation of this Article, it shall, at least twenty-four (24) hours prior to invoking the procedures of Section 7.7, provide written notification to the Council of the involved Union(s) and to the Project Labor Coordinator, setting forth the facts which the Contractor contends violates this Article. The Council and the leadership of the involved Union(s) will immediately instruct, order, and use their best efforts to cause the cessation of any violation of the Article.

(b) If the Union contends that any Contractor has violated this Article, it will notify the Contractor and the Project Labor Coordinator, setting forth the facts which the Union contends violate this Article, at least twenty-four (24) hours prior to invoking the procedures of Section 7.7. The Project Labor Coordinator shall promptly order the involved Contractor(s) to cease any violation of the Article.

Section 7.7 Expedited Enforcement Procedure. Any Party, including the City, which is an intended beneficiary of this Article, or the Project Labor Coordinator, may institute the following procedures, in lieu of or in addition to any other action at law or equity, when a breach of this Article is alleged.

(a) The Party invoking this procedure shall notify Thomas Pagan, who has been selected by the negotiating Parties, and whom the Parties agree shall be the permanent arbitrator under this procedure, or Barry Winograd, as the alternate

arbitrator under this procedure. If the permanent arbitrator is unavailable at any time, the alternate will be contacted. If neither is available, then a selection shall be made from the list of arbitrators as set forth in Article 10. Notice to the arbitrator shall be by the most expeditious means available, with notices to the Parties alleged to be in violation, and to the Project Labor Coordinator and Council. For purposes of this Article, written notice may be given by email, facsimile, hand delivery, or overnight mail and will be deemed effective upon receipt.

(b) Upon receipt of said notice, the arbitrator named above or his/her alternate shall sit and hold a hearing within twenty-four (24) hours if it is contended that the violation still exists, but not sooner than twenty-four (24) hours after notice has been dispatched to the Council of the involved Union(s) and/or Contractor as required by Section 7.6, above.

(c) The arbitrator shall notify the Parties of the place and time chosen for this hearing. Said hearing shall be completed in one session, which, with appropriate recesses at the arbitrator's discretion, shall not exceed twenty-four (24) hours unless otherwise agreed upon by all Parties. A failure of any Party or Parties to attend said hearings shall not delay the hearing of evidence or the issuance of any award by the arbitrator.

(d) The sole issue at the hearing shall be whether or not a violation of this Article has in fact occurred. The arbitrator shall have no authority to consider any matter in justification, explanation, or mitigation of such violation or to award damages, (except for damages as set forth in Section 7.8 below) which issue is reserved for court proceedings, if any. The award shall be issued in writing within three (3) hours after the close of the hearing and may be issued without an opinion. If any Party desires a written opinion, one shall be issued within fifteen (15) days, but its issuance shall not delay compliance with, or enforcement of, the award. The arbitrator may order cessation of the violation of the Article and other appropriate relief, and such award shall be served on all Parties by hand or registered mail upon issuance.

(e) Such award shall be final and binding on all Parties and may be enforced by any court of competent jurisdiction upon the filing of this PLA and all other relevant documents referred to herein above in the following manner. Written notice of the filing of such enforcement proceedings shall be given to the other Party. In any judicial proceeding to obtain a temporary order enforcing the arbitrator's award as issued under Section 7.7(d) of this Article, all Parties waive the right to a hearing and agree that such proceedings may be ex parte. Such

agreement does not waive any Party's right to participate in a hearing for a final order of enforcement. The court's order or orders enforcing the arbitrator's award shall be served on all Parties by hand or by delivery to their address as shown on this PLA (for a Union), as shown on their business contract for work under this PLA (for a Contractor) and to the representing Union (for an employee), by certified mail by the Party or Parties first alleging the violation.

(f) Any rights created by statute or law governing arbitration proceedings inconsistent with the above procedure or which interfere with compliance hereto are hereby waived by the Parties to whom they accrue.

(g) The fees and expenses of the arbitrator shall be equally divided between the Party or Parties initiating this procedure and the respondent Party or Parties.

Section 7.8 Liquidated Damages.

(a) If the arbitrator determines in accordance with Section 7.7 above that a work stoppage has occurred, the respondent Union(s) shall, within eight (8) hours of receipt of the Award, direct all the employees they represent on the project to immediately return to work. If the craft(s) involved do not return to work by the beginning of the next regularly scheduled shift following such eight (8) hour period after receipt of the arbitrator's Award, and the respondent Union(s) have not complied with their obligations to immediately instruct, order, and use their best efforts to cause a cessation of the violation and return the employees they represent to work, then the non-complying Union(s) shall each pay a sum as liquidated damages to the City, and each will pay an additional sum per shift, as set forth in (c), below, for each shift thereafter on which the craft(s) has not returned to work.

(b) If the arbitrator determines in accordance with Section 7.7 above that a lock out has occurred, the respondent Contractor(s) shall, within eight (8) hours after receipt of the award, return all the affected employees to work on the Project, or otherwise correct the violations found by the arbitrator. If the respondent Contractor(s) do not take such action by the beginning of the next regular scheduled shift following the eight (8) hour period, each non-complying respondent Contractor shall pay or give as liquidated damages, to the affected Union(s) (to be apportioned among the affected employees and the benefit funds to which contributions are made on their behalf, as designated by the arbitrator) and each shall pay an additional sum per shift, as set forth in (c), below, for each shift thereafter in which compliance by the respondent Contractor(s) has not been completed.

(c) The Parties agree that project delays caused by violations of this Article will cause the City to sustain damages. They agree that it would be impractical or extremely difficult to fix the amount of such damages. Therefore, the Parties agree that, in the event of a breach of either of these provisions, the Party in breach shall pay to the City the sum of not less than $10,000.00 and no more than $20,000.00 per shift from the time the arbitrator determines that a delay has occurred until the arbitrator determines that the project is again on construction schedule. The payment, when made, shall constitute a damages remedy of the City for the delay specified, but shall not prevent the City from seeking an injunctive or other monetary relief, including termination of this PLA. Payment of these sums as liquidated damages is not intended as a forfeiture or penalty within the meaning of California Civil Code sections 3275 or 3369, but instead, is intended to constitute liquidated damages to the City pursuant to section 1671 of the California Civil Code.

ARTICLE 8

WORK ASSIGNMENTS AND JURISDICTIONAL DISPUTES

Section 8.1 No Jobsite Disruption. There will be no strikes, work stoppages, picketing, sympathy strikes, slowdowns, or other interferences with the work because of jurisdictional disputes between Unions. The assignment of work will be solely the responsibility of the Contractor performing the work involved; and such work assignments will be in accordance with the Plan for Settlement of Jurisdictional Disputes in the Construction Industry (the "Plan") or any successor Plan.

Section 8.2 All jurisdictional disputes on this project shall be settled and adjusted according to the present Plan established by the Building and Construction Trades Department or any other plan or method of procedure that may be adopted by the Building and Construction Trades Department. Decisions rendered shall be final and binding and conclusive on the Contractors and Unions parties to this PLA.

All jurisdictional disputes shall be resolved without the occurrence of any of the activities prohibited in Article 7 (Work Stoppages and Lockouts), and the Contractor's assignment shall be adhered to until the dispute is resolved. Individuals violating this section shall be subject to immediate discharge.

Section 8.2.1 If a dispute arising under this Article involves the Southwest Regional Council of Carpenters or any of its subordinate bodies, an arbitrator shall be chosen by the procedures specified in Article V, Section 5, of the Plan from a list composed of Thomas Pagan, Thomas Angelo, Robert Hirsch, and John Kagel, and the

arbitrator's hearing on the dispute shall be held at the offices of the Council within fourteen (14) days of the selection of the arbitrator. All other procedures shall be as specified in the Plan.

Section 8.3 Failure to Comply. If any Union or Contractor fails to immediately and fully comply with the final decision rendered by the Plan, affected Union(s) or Contractor(s) may seek legal redress for such conduct, including, but not limited to, injunctive relief and/or damages.

Section 8.4 Pre-job Conference. It is required that a pre-job conference be held not later than fourteen (14) calendar days prior to the start of work by each Contractor for the Covered Project in accordance with the procedure described in Article 16.

ARTICLE 9

MANAGEMENT RIGHTS

Section 9.1 Contractor and City Rights. The Contractors and the City have the sole and exclusive right and authority to oversee and manage construction operations on Project Work without any limitations unless expressly limited by a specific provision of this PLA. In addition to the following and other rights of the Contractors enumerated in this PLA, the Contractors expressly reserve their management rights and all the rights conferred upon them by law. The Contractor's rights include, but are not limited to, the right to:

(a) Plan, direct, and control operations of all work; and

(b) Hire, promote, transfer, and layoff their own employees, respectively, as deemed appropriate to satisfy work and/or skill requirements; and

(c) Promulgate and require all employees to observe reasonable job rules and security and safety regulations; and

(d) Discharge, suspend, or discipline their own employees for just cause; and

(e) Utilize, in accordance with City approval, any work methods, procedures, or techniques, and select, use, and install any types or kinds of materials, apparatus, or equipment, regardless of source of manufacture or construction; and

(f) Assign and schedule work at their discretion; and

(g) Assign overtime, determine when it will be worked and the number and identity of employees engaged in such work, subject to such provisions in the applicable Schedule A(s) requiring such assignments be equalized or otherwise made in a nondiscriminatory manner.

Section 9.2 Specific City Rights. In addition to the following and other rights of the City enumerated in this PLA, the City expressly reserves its management rights and all the rights conferred on it by law and contract. The City's rights (and those of the Project Labor Coordinator on its behalf) include, but are not limited to the right to:

(a) Inspect any construction site or facility to ensure that the Contractor follows the applicable safety and other work requirements; and

(b) At its sole option, terminate, delay, and/or suspend any and all portions of the Project Work at any time; prohibit some or all work on certain days or during certain hours of the day to accommodate the ongoing operations of the City and/or to mitigate the effect of ongoing Project Work on businesses and residents in the neighborhood of the Project sites; and/or require any other operational or schedule changes it deems necessary, in its sole judgment, to meet Project deadlines and remain a good neighbor to those in the area of the Covered Projects. (In order to permit the Contractors and Unions to make appropriate scheduling plans, the City will provide the Project Labor Coordinator, and the affected Contractor[s] and Union[s] with reasonable notice of any changes it requires pursuant to this section); and

(c) Approve any work methods, procedures, and techniques used by Contractors whether or not these methods, procedures, or techniques are part of industry practices or customs; and

(d) Investigate and process complaints or disagreements, through its Project Labor Coordinator.

Section 9.3 Use of Materials. There should be no limitations or restrictions by the Union upon a Contractor's choice of materials or design, nor, regardless of source or location, upon the full use and utilization of equipment, machinery, packaging, precast, prefabricated, prefinished, or preassembled materials, tools, or other labor-saving devices, subject to the application of the California Public Contract and Labor Codes. Generally, the onsite installation or application of such items shall be performed by the craft having jurisdiction over such work.

Section 9.4 Special Equipment, Warranties, and Guaranties.

(a) It is recognized that certain equipment of a highly technical and specialized nature may be installed at Covered Project sites. The nature of the equipment, together with the requirements for manufacturer's warranties, may dictate that it be prefabricated, pre-piped, and/or pre-wired and that it be installed under the supervision and direction of the City's and/or manufacturer's personnel. The Unions agree that such equipment is to be installed without incident.

(b) The Parties recognize that the Contractor will initiate from time to time the use of new technology, equipment, machinery, tools, and other labor-savings devices and methods of performing Project Work. The Unions agree that they will not restrict the implementation of such devices or work methods. The Unions will accept and will not refuse to handle, install, or work with any standardized and/or catalogue parts, assemblies, accessories, prefabricated items, preassembled items, partially assembled items, or materials whatever their source of manufacture or construction.

(c) If any disagreement between the Contractor and the Unions concerning the methods of implementation or installation of any equipment, device, or item, or method of work arises, or whether a particular part or pre-assembled item is a standardized or catalog part or item, the work will proceed as directed by the Contractor, and the Parties shall immediately consult over the matter. If the disagreement is not resolved, the affected Union(s) shall have the right to proceed through the procedures set forth in Article 10.

ARTICLE 10

SETTLEMENT OF GRIEVANCES AND DISPUTES

Section 10.1 Cooperation and Harmony on Site.

(a) This PLA is intended to establish and foster continued close cooperation between management and labor. The Council shall assign a representative to this Project for the purpose of assisting the local Unions, and working with the Project Labor Coordinator, together with the Contractors, to complete construction of the Project Work economically, efficiently, continuously, and without any interruption, delays, or work stoppages.

(b) The Project Labor Coordinator, the Contractors, Unions, and employees collectively and individually, realize the importance to all Parties of maintaining continuous and uninterrupted performance of Project Work, and agree to resolve

disputes in accordance with the grievance provisions set forth in this Article or, as appropriate, those of Article 7 or 8.

(c) The Project Labor Coordinator shall observe the processing of grievances under this Article and Articles 7 and 8, including the scheduling and arrangements of facilities for meetings, selection of the arbitrator from the agreed-upon panel to hear the case, and any other administrative matters necessary to facilitate the timely resolution of any dispute; provided, however, it is the responsibility of the principal Parties to any pending grievance to ensure the time limits and deadlines are met.

Section 10.2 Processing Grievances. Any questions arising out of and during the term of this PLA involving its interpretation and application, which includes applicable provisions of the Schedule A's, but not alleged violations of Articles 7 or 8, shall be considered a grievance and subject to resolution under the following procedures.

Step 1. (a) Employee Grievances. When any employee subject to the provisions of this PLA feels aggrieved by an alleged violation of this PLA, the employee shall, through his local Union business representative or job steward, within ten (10) working days after the occurrence of the violation, give notice to the work site representative of the involved Contractor stating the provision(s) alleged to have been violated, the details of the alleged violation and the remedy sought to resolve the matter. A grievance shall be considered null and void if notice of the grievance is not given within the ten (10) day period. A business representative of the local Union or the job steward and the work site representative of the involved Contractor shall meet and endeavor to adjust the matter within ten (10) working days after timely notice has been given. If they fail to resolve the matter within the prescribed period, the grieving Party may, within ten (10) working days thereafter, pursue Step 2 of this grievance procedure provided the grievance is reduced to writing, setting forth the relevant information, including a short description thereof, the date on which the alleged violation occurred, and the provision(s) of the applicable agreement alleged to have been violated. Grievances and disputes settled at Step 1 shall be non-precedential except as to the Parties directly involved.

(b) Union or Contractor Grievances. Should the Union(s) or any Contractor have a dispute with the other Party(ies) and, if after conferring within ten (10) working days after the disputing Party knew or should have known of the facts or occurrence giving rise to the dispute, a settlement is not reached within five (5) working days, the dispute shall be reduced to writing and processed to Step 2 in

the same manner as outlined in Step 1(a) above for the adjustment of an employee complaint.

Step 2. The business manager of the involved local Union or his designee, together with the site representative of the involved Contractor, and the labor relations representative of the Project Labor Coordinator shall meet within seven (7) working days of the referral of the dispute to this second step to arrive at a satisfactory settlement thereof. If the Parties fail to reach an agreement, the dispute may be appealed in writing in accordance with the provisions of Step 3 within seven (7) calendar days after the initial meeting at Step 2.

Step 3. (a) If the grievance shall have been submitted but not resolved under Step 2, either the Union or Contractor Party may request in writing to the Project Labor Coordinator (with copy[ies] to the other Party[ies]) within seven (7) calendar days after the initial Step 2 meeting, that the grievance be submitted to an arbitrator selected from the agreed-upon list below, on a rotational basis in the order listed. Those arbitrators are: (1) Thomas Pagan; (2) David Hart; (3) Edna Francis; (4) Mike Rappaport; (5) Michael Prihar; (6) Fred Horowitz; and (7) Sara Adler. The decision of the arbitrator shall be final and binding on all Parties, and the fee and expenses of such arbitrations shall be borne equally by the involved Contractor(s) and the involved Union(s).

(b) Failure of the grieving Party to adhere to the time limits established herein shall render the grievance null and void. The time limits established herein may be extended only by written consent of the Parties involved at the particular step where the extension is agreed upon. The arbitrator shall have the authority to make decisions only on issues presented and shall not have the authority to change, amend, add to, or detract from any of the provisions of this PLA.

Section 10.3 Limit on Use of Procedures. Procedures contained in this Article shall not be applicable to any alleged violation of Article 7 or 8, with a single exception that any employee discharged for violation of Section 7.2 may resort to the procedures of this Article to determine only if he/she was, in fact, engaged in that violation.

Section 10.4 Notice. The Project Labor Coordinator (and the City, in the case of any grievance regarding the Scope of this PLA), shall be notified by the involved Contractor of all actions at Steps 2 and 3, and further, the Project Labor Coordinator shall, upon its own request, be permitted to participate fully in all proceedings at such steps.

ARTICLE 11

COMPLIANCE

Section 11.1 Compliance with All Laws. The Council and all Unions, Contractors, and their employees shall comply with all applicable federal and state laws, ordinances, and regulations including, but not limited to, those relating to safety and health, employment, and applications for employment. All employees shall comply with the safety regulations established by the City, the Project Labor Coordinator, and the Contractor. Employees must promptly report any injuries or accidents to a supervisor.

Section 11.2 Monitoring Compliance. The Parties agree that the City shall require, and that the Project Labor Coordinator and Council shall monitor, compliance by all Contractors with all federal and state laws and regulations that, from time to time may apply to Project Work. It shall be the responsibility of both the Council and the Project Labor Coordinator (on behalf of the City) to investigate or monitor compliance with these various laws and regulations. The Council may recommend to the Project Labor Coordinator and/or the City procedures to encourage compliance with these laws and regulations.

Section 11.3 Prevailing Wage Compliance. The Council or Union may refer all complaints regarding any potential prevailing wage violation to the Project Labor Coordinator, who may process, investigate, and resolve such complaints. The Council or Union, as appropriate, shall be advised in a timely manner with regard to the facts and resolution, if any, of any complaint. It is understood that this Section does not restrict any individual rights as established under the State Labor Code, including the rights of an individual to file a complaint with the State Labor Commissioner.

Section 11.4 Violations of Law. Based upon a finding of violation by the City of a federal and state law, and upon notice to the Contractor that it is in such violation, the City, in the absence of the Contractor remedying such violation, shall take such action as it is permitted by law or contract to encourage the Contractor to come into compliance, including, but not limited to, assessing fines and penalties and/or removing the offending Contractor from Project Work.

ARTICLE 12

SAFETY AND PROTECTION OF PERSON AND PROPERTY

Section 12.1 Safety.

(a) It shall be the responsibility of each Contractor to ensure safe working conditions and employee compliance with all applicable safety laws and regulations and any safety rules contained herein or established by the City, the Project Labor Coordinator, or the Contractor. It is understood that employees have an individual obligation to use diligent care to perform their work in a safe manner and to protect themselves and the property of the Contractor and the City.

(b) All Parties and Contractor employees shall be bound by the safety, security, and visitor rules established by the Contractor, the Project Labor Coordinator, and the City. These rules will be published and posted. An employee's failure to satisfy his/her obligations under this Section will subject him/her to discipline, up to and including discharge.

Section 12.2 Drug and Alcohol Testing Policy. The Parties agree to adopt the Drug and Alcohol Testing Policy attached hereto as Attachment C, which is the exclusive Drug and Alcohol Testing Policy for Covered Projects.

Section 12.3 Inspection. The inspection of shipments of equipment, machinery, and construction materials of every kind shall be performed at the discretion of the Contractor by individuals of its choice.

ARTICLE 13

TRAVEL AND SUBSISTENCE

Section 13.1 Travel expenses, travel time, subsistence allowances and/or zone rates, and parking reimbursements shall not be applicable to work under this PLA, except to the extent provided for in any applicable prevailing wage determination. Parking for employees covered by this PLA shall be provided by the Contractor(s) according to the provision of the Schedule A(s) existing on the Effective Date of this PLA and upon presentation of proof of any expense incurred.

ARTICLE 14

APPRENTICES

Section 14.1 Importance of Training. The Parties recognize the need to maintain continuing support of the programs designed to develop adequate numbers of competent workers in the construction industry, the obligation to capitalize on the availability of the local work force in the area served by the City, and the opportunities to provide continuing work on Covered Projects for City Residents and Targeted Workers. To these ends, and consistent with any laws or regulations, the Parties will facilitate, encourage, and assist City Residents and Targeted Workers commence and progress in Apprenticeship Programs and/or apprenticeship readiness programs in the construction industry leading to participation in such Apprenticeship Programs. The City, the Project Labor Coordinator, other City consultants, the Contractors, and the Council and Unions, will work cooperatively to identify, or establish and maintain, effective programs and procedures for persons interested in entering the construction industry and which will help prepare them for the entry into Apprenticeship Programs. Apprentices, if utilized, must be enrolled in a California Apprenticeship Council-approved Apprenticeship Program.

Section 14.2 Use of Apprentices.

(a) The Unions and Contractors agree to cooperate in referring and employing Apprentices up to the maximum percentage allowed by the State Labor Code and the standards of each State-Approved Apprenticeship Program. The minimum ratios for Apprentice to journeyperson hours worked shall be in compliance, at a minimum, with the applicable provisions of the State Labor Code relating to utilization of Apprentices. The City, unless otherwise required by law, shall encourage such utilization, and, both as to Apprentices and the overall supply of experienced workers, the Project Labor Coordinator will work with the Council, Apprenticeship Programs, and Contractors to assure appropriate and maximum utilization of Apprentices and the continuing availability of both Apprentices and journey persons.

(b) The Parties agree that all Contractors will comply with all applicable laws and regulations in the request for dispatch and employment of Apprentices.

(c) The Parties agree that Apprentices will not be dispatched to Contractors working under this PLA unless there is a journeymen or other Contractor employee working on the Project where the Apprentice is to be employed who is

qualified to assist and oversee the Apprentice's progress through the program in which he/she is participating.

ARTICLE 15

LEGAL ACTION

Section 15.1 Legal Action. The City, Council and Unions recognize the substantial legal costs (including all attorney's fees and associated disbursements) that might accrue with regard to any legal challenge over the adoption by the City of this PLA, and related to claims directly challenging the legality of this PLA, or a particular section or language that has been adopted herein. In the event of a legal challenge, the Council, on behalf of itself and affiliated Unions, agrees to seek to intervene in the legal action and actively participate in the litigation or other action to defend the legality of this PLA, or a particular section or language herein. The failure of the Council to seek to intervene in the legal action and actively participate to defend the legality of this PLA will constitute a material breach of this PLA. In the event the Council is denied leave to intervene in the legal action, the Council shall have its counsel coordinate with the City's counsel, at the Council's own expense, regarding how the Council can best support the City's legal position.

ARTICLE 16

PRE-JOB CONFERENCE

Section 16.1 Each Contractor is required to conduct a pre-job conference with the Unions not later than fourteen (14) calendar days prior to commencing work. The purpose of the conference will be to, among other things, convey craft manpower needs, the schedule of work for the Covered Project, project work rules, and propose preliminary Union work assignments. The Project Labor Coordinator may work with the Prime Contractor and Council to facilitate the scheduling of all pre-job conferences, but ensuring each Contractor conducts a pre-job conference in accordance with this Agreement is the responsibility of the Prime Contractor. All preliminary Union work assignments shall be disclosed by each Contractor at a pre-job conference. Should there be work within the scope of a Construction Contract for a Covered Project that was not previously assigned at a pre-job conference, or additional work be added to the scope of the Covered Project, the Contractor(s) performing such work will conduct a separate pre-job conference.

Any Union in disagreement with a proposed assignment shall notify the affected Contractor of its position in writing, with a copy sent to the Project Labor Coordinator, within seven (7) calendar days after the pre-job conference occurred. Within seven (7) calendar days after the period allowed for Union notices of disagreement with the Employer's proposed assignments, but prior to the commencement of any work, the Employer shall make final assignments in writing with copies sent to the Project Labor Coordinator and Council.

ARTICLE 17

LABOR/MANAGEMENT AND COOPERATION

Section 17.1 Joint Committee. The Parties to this PLA will form a joint committee consisting of three (3) representatives selected by the Council and three (3) representatives selected by the Project Labor Coordinator, to be chaired jointly by a representative of the Project Labor Coordinator and the Council. The purpose of the Committee shall be to promote harmonious and stable labor management relations on this Project, to ensure effective and constructive communication between labor and management Parties, to advance the proficiency of work in the industry, and to evaluate and ensure an adequate supply of skilled labor for all Project Work. Representatives of the City may participate upon its request, and all Parties will be invited to attend.

Section 17.2 Functions of Joint Committee. The Committee shall meet on a schedule to be determined by the Committee or at the call of the joint chairs, to discuss the administration of the PLA, the progress of the project, general labor management problems that may arise, and any other matters consistent with this PLA. Substantive grievances or disputes arising under Articles 7, 8, or 10 shall not be reviewed or discussed by this Committee, but shall be processed pursuant to the provisions of the appropriate Article.

The Project Labor Coordinator shall be responsible for scheduling of the meetings and the preparation of the agenda topics for the meetings, with input from the Unions, the Contractors, and the City. Notice of the date, time and place of meetings, shall be given to the Committee members at least three (3) days prior to the meeting. The City shall be notified of the meetings and invited to send a representative(s) to participate.

The Project Labor Coordinator shall prepare quarterly reports on Apprentice utilization and the training and employment of City Residents, and a schedule of Project work and estimated number of craft workers needed. The Committee, or

an appropriate subcommittee, may review such reports and make any recommendations for improvement, if necessary, including increasing the availability of skilled trades, and the employment of local residents or other individuals who should be assisted with appropriate training to qualify for Apprenticeship Programs.

Section 17.3 Subcommittees. The Committee may form subcommittees to consider and advise the full Committee with regard to safety and health issues affecting the Project and other similar issues affecting the overall Project, including any workers' compensation program initiated under this PLA.

ARTICLE 18

SAVINGS AND SEPARABILITY

Section 18.1 Savings Clause. It is not the intention of the City, the Project Labor Coordinator, Contractor, or the Union Parties to violate any laws governing the subject manner of this PLA. The Parties hereto agree that in the event any provision of this PLA is finally held or determined to be illegal or void as being in contravention of any applicable law or regulation, the remainder of the PLA shall remain in full force and effect unless the part or parts so found to be void are wholly inseparable from the remaining portions of this PLA. Further, the Parties agree that if and when any provision(s) of this PLA is finally held or determined to be illegal or void by a court of competent jurisdiction, the Parties will promptly enter into negotiations concerning the substantive effect of such decision for the purposes of achieving conformity with the requirements of any applicable laws and the intent of the Parties hereto. If the legality of this PLA is challenged and any form of injunctive relief is granted by any court, suspending temporarily or permanently the implementation of this PLA, then the Parties agree that all Project Work that would otherwise be covered by this PLA should be continued to be bid and constructed without application of this PLA so that there is no delay or interference with the ongoing planning, bidding, and construction of any Project Work.

Section 18.2 Effect of Injunctions or Other Court Orders. The Parties recognize the right of the City to withdraw, at its absolute discretion, the utilization of the PLA as part of any bid specification should a court of competent jurisdiction issue any order, or any applicable statute that could result, temporarily or permanently, in delay of the bidding, awarding, and/or construction on the Project.

ARTICLE 19

WAIVER

Section 19.1 Waiver. A waiver of or a failure to assert any provisions of this PLA by any or all of the Parties hereto shall not constitute a waiver of such provision for the future. Any such waiver shall not constitute a modification of the PLA or change in the terms and conditions of the PLA and shall not relieve, excuse or release any of the Parties from any of their rights, duties, or obligations hereunder.

ARTICLE 20

AMENDMENTS

Section 20.1 Amendments. The provisions of this PLA can be renegotiated, supplemented, rescinded, or otherwise altered only by mutual agreement in writing, hereafter signed by the Parties.

ARTICLE 21

DURATION OF THE PLA

Section 21.1 Duration. This Agreement shall be effective on June 16, 2020, provided that the Council has signed the Agreement. The Agreement shall continue in full force and effect until all of the work within the scope of a Covered Contract is completed and accepted by the City.

Section 21.2 Turnover and Final Acceptance of Completed Work.

(a) Construction of any phase, portion, section, or segment of Project Work shall be deemed complete when such phase, portion, section or segment has been turned over to the City by the Contractor and the City has accepted such phase, portion, section, or segment. As areas and systems of the Project are inspected and construction-tested and/or approved and accepted by the City or third parties with approval of the City, the PLA shall have no further force or effect on such items or areas, except when the Contractor is directed by the City to engage in repairs or modifications required by its Contract(s) with the City.

(b) Notice of each final acceptance received by the Contractor will be provided to the Council with the description of what portion, segment, etc. has

been accepted. Final acceptance may be subject to a "punch" list, and in such case, the PLA will continue to apply to each such item on the list until it is completed to the satisfaction of the City and Notice of Acceptance is given by the City or its representative to the Contractor.

Section 21.3 Continuation of Schedule A's. Schedule A's incorporated as part of this PLA shall continue in full force and effect, as previously stated, until the Contractor and Union Parties to the collective bargaining agreement(s), which are the basis for such Schedule A's, notify the Project Labor Coordinator of the mutually agreed upon changes in such agreements and their effective date(s).

The Parties agree to recognize and implement all applicable changes on their effective dates, except as otherwise provided by this PLA; provided, however, that any such provisions negotiated in said collective bargaining agreements will not apply to work covered by this PLA if such provisions are less favorable to the Contractor under the PLA than those uniformly required of Contractors for construction work normally covered by those agreements; nor shall any provision be recognized or applied if it may be construed to apply exclusively or predominantly to work covered by this PLA. Any disagreement between the Parties over the incorporation into a Schedule A of any such provision agreed upon in a negotiation of the local collective bargaining agreement that is the basis for a Schedule A shall be resolved under the procedures established in Article 10.

Section 21.4 Final Termination. Final termination of all obligations, rights, and liabilities, and disagreements shall occur upon receipt by the Council of a Notice from the City saying that no work remains within the scope of the PLA.

Section 21.5 Pure Water Program Phase II Projects. The City and the Unions intend to have this Agreement or a succeeding Agreement include all construction projects in Pure Water Program Phase II. The Pure Water Program Phase II Projects are in the early development stage and cannot be specifically identified at this time to be included in the scope of this Agreement. Therefore, to reopen negotiations to include Pure Water Program Phase II Projects into this Agreement, the Council shall send written notice to the City's Project Labor Coordinator after the City has approved Pure Water Program Phase II Projects' Environmental Impact Report and no later than ninety (90) days after the City's final approval of the Environmental Impact Report.

ARTICLE 22

WORK AND ECONOMIC OPPORTUNITY

Section 22.1 The magnitude, duration, and complexity of the Pure Water Program Phase I Projects will require large numbers of skilled craft personnel and create significant economic opportunities for City Residents, Targeted Workers, Disadvantaged Business Enterprises and other businesses. It is therefore the understanding and intention of the Parties to use the opportunities provided by the extensive amount of work to collaborate and implement programs and procedures, which may include, for example, North America's Building Trades Unions Multi-Craft Core Curriculum (MC3) apprenticeship readiness programs, to prepare persons, especially City Residents and Targeted Workers, for entrance into Apprenticeship Programs to begin or continue their construction careers on Covered Projects. Further, the Parties agree to maximize the inclusion of Disadvantage Business Enterprises through outreach, training, and subcontracting for Covered Projects. With assistance from the Project Labor Coordinator, the City, the Contractors, the Unions and their affiliated regional and national organizations will work jointly to promptly develop and implement procedures for the identification of craft needs, the scheduling of work to facilitate the utilization of available craft workers, and the securing of services of craft workers in sufficient numbers to meet the high demands of the Project Work to be undertaken.

Section 22.2 The City, together with the Parties, supports the development of increased numbers of skilled construction workers who are City Residents and Targeted Workers to meet the labor needs of Covered Projects. Towards that end, the Parties, together with the City and its Project Labor Coordinator, agree to develop and implement a work opportunities program for City Residents and Targeted Workers to maximize construction career opportunities and create a construction career pipeline to becoming employed on Covered Projects. Further, the City together with the Parties, will create opportunities for Disadvantaged Business Enterprises consistent with the City's goals and inclusion programs for such businesses. In furtherance of the foregoing, the Council and Unions specifically agree to work with the City and the Project Labor Coordinator to:

(a) Collaborate with existing or newly created MC3 apprenticeship readiness programs in San Diego to offer opportunities for City Residents and Targeted Workers, including students, to enroll in free short-term construction apprenticeship readiness training to prepare them to enter into Apprenticeship Programs and become employed by a Contractor on a Covered Project. The

Project Labor Coordinator, with the assistance of the Parties, will assist with the recruitment, career placement, and tracking of such City Residents and Targeted Workers who graduate from these apprenticeship readiness programs; and

(b) The Parties will cooperate and collaborate with the City and Project Labor Coordinator to conduct outreach to and include City Residents and Targeted Workers from traditionally underrepresented segments of the City's population in the construction craft workforce for each Covered Project; and

(c) The Council will provide accurate data on a quarterly basis to the City and Project Labor Coordinator pertaining to their level of economic support provided to meet these objectives. Further, the Project Labor Coordinator shall produce detailed quarterly reports for the City and Council to measure and report the outcomes of the policies, requirements, and programs established in this Agreement; and

(d) The Unions will partner with the City and Project Labor Coordinator to conduct outreach and recruitment activities by establishing or continuing to maintain existing centers, programs, and events to facilitate the entry of City Residents and Targeted Workers into the building and construction trades. These programs shall serve as a resource for preliminary orientation, assessment of construction aptitude, referral to MC3 apprenticeship readiness programs or Apprenticeship Programs, referral to hiring halls, and provide tailored orientation and mentoring for women and Targeted Workers; and

(e) The Unions shall assist City Residents and Targeted Workers with contacting the Apprenticeship Programs for the crafts and trades they are interested in. The Unions shall assist City Residents and Targeted Workers who are seeking employment on Covered Projects and provide opportunities for Union membership by assessing their work experience and giving them credit for provable past experience in their relevant craft or trade, including experience gained working for non-Union Contractors. The Unions shall put on their rolls qualified bona fide City Residents and Targeted Workers for employment on Covered Projects.

Section 22.3 Joint Subcommittee on Work and Economic Opportunity. To carry out the intent and purpose of this Article, a subcommittee of the Labor Management Committee established pursuant to Article 17 shall be established, jointly chaired by a designee of the City and a designee of the Council, to oversee the effective development and implementation of the programs and policies described herein, and to work with representatives of each apprenticeship committee and representatives of the MC3 apprenticeship readiness programs to maximize

employment opportunities for City Residents and Targeted workers who reflect the diversity of the communities surrounding each Covered Project and who may not be previously qualified for the construction career opportunities created by the Covered Projects. The subcommittee will meet as necessary at the call of the joint chairs to promptly facilitate its purposes in an expeditious manner as soon as this PLA becomes effective. In addition to the joint chairs, the membership of the committee will consist of at least three (3) representatives of the signatory local Unions and three (3) representatives of Contractors (or organization to which the Contractors belong) signatory to this PLA and experienced in overseeing and participating in Apprenticeship Programs.

ARTICLE 23

HELMETS TO HARDHATS

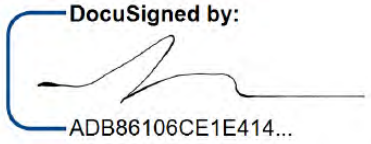
Section 23.1 Veterans Entry into Building and Construction Trades. The Parties recognize a desire to facilitate the entry into the building and construction trades of Veterans who are interested in careers in the building and construction industry. The Contractors and Unions agree to utilize the services of the Center for Military Recruitment, Assessment and Veterans Employment (hereinafter "Center") and the Center's "Helmets to Hardhats" program to serve as a resource for preliminary orientation, assessment, and construction aptitude, referral to Apprenticeship Programs or hiring halls, counseling and mentoring, support network, employment opportunities, and other needs as identified by the Parties.

Section 23.2 Integrated Database. The Unions and Contractors agree to coordinate with the Center to create and maintain an integrated database of Veterans interested in working on this Covered Project and of apprenticeship and employment opportunities for this Covered Project.

In witness whereof, the Parties have caused this Project Labor Agreement for City of San Diego Pure Water Program Phase I Projects to be executed as of the date and year above stated.

Dated: July 9, 2020

SAN DIEGO BUILDING AND CONSTRUCTION TRADES COUNCIL

By: 

Tom Lemmon, Business Manager

SIGNATORY UNIONS AND
(See Attached)

SIGNATORY UNIONS

By: ______________________ Allied Workers Local 5	By: ______________________ Boilermakers Local 92
By: Chad Boggio ______________________ Bricklayer & Allied Crafts Local 4	By: ______________________ Cement Masons Local 500 / Area 744
By: ______________________ Electrical Workers Local 569	By: ______________________ For BM Gazzaniga Elevator Constructors Local 18
By: ______________________ Glaziers, Floor Coverings & Painters Local 1399	By: ______________________ Iron Workers Local 229
By: ______________________ Laborers Local 89	By: ______________________ Plasterers Local 200
By: ______________________ Plasterer Tenders Local 1414	By: ______________________ Operating Engineers Local 12
By: ______________________ Operating Engineers Local 12	By: ______________________ Operating Engineers Local 12
By: ______________________ Plumbers & Pipefitters Local 230	By: ______________________ Road Sprinkler Fitters Local 669
By: ______________________ Roofers & Waterproofers Local 45	By: ______________________ Sheet Metal Workers Local 206
By: ______________________ Laborers Local 1184	By: ______________________ Sheet Metal Workers Local 206
By: ______________________ Laborers Local 345	By: ______________________ Teamsters Local 166
By: ______________________ UA Local 345	By: ______________________ Tradeshow & Sign Craft Local 831
By: ______________________ Southwest Regional Council of Carpenters	By: ______________________ Laborers Local 300

ATTACHMENT A – LETTER OF ASSENT

To be signed by all Contractors awarded work covered by the Project Labor Agreement prior to commencing work.

[CONTRACTOR'S LETTERHEAD]

DATE

Project Labor Coordinator
Address
Address
Address

Attention: _____

Re: City of San Diego Project Labor Agreement for Pure Water Program Phase I Project

Dear Sir:

This is to confirm [Name of Company] agrees to be party to and bound by the City of San Diego Project Labor Agreement for Construction of Pure Water Program Phase I Projects, effective May 1, 2020, as such Agreement may from time to time be amended by the negotiating Parties or interpreted pursuant to its terms. Such obligation to be a Party and bound by this Agreement shall extend to all work covered by the Agreement undertaken by this Company on the Project pursuant to [City Contract No. _____ and Name of Covered Project], and this Company shall require all of its subcontractors of whatever tier to be similarly bound for all work within the scope of the Agreement by signing and furnishing to you an identical Letter of Assent prior to their commencement of work.

Sincerely,

[Name of Construction Company]

By:
[Name and Title of Authorized Executive]

[Copies of this Letter must be submitted to the Project Labor Coordinator and to the Council consistent with Article 3, Section 3.3(b)]

ATTACHMENT B-1 – WORKFORCE DISPATCH REQUEST FORM

The City of San Diego's Project Labor Agreement for Pure Water Program Phase I Projects establishes a goal of at least thirty-five percent (35%) of the total craft hours on each Covered Project be performed by City Residents. The Unions and Contractors agree that, to the extent allowed by law, and as long as they possess the requisite skills and qualifications, City Residents shall be first referred for Project Work. A "City Resident" is defined as a City of San Diego permanent resident at the time of initial employment on a Covered Project or a Veteran residing anywhere.

*The list of qualifying zip codes for City Residents includes: 92014, 92037, 92038, 92067, 92093, 92101, 92102, 92103, 92104, 92105, 92106, 92107, 92108, 92109, 92110, 92111, 92113, 921 14, 92115, 92116, 92117, 92119, 92120, 92121, 92122, 92123, 92124, 92126, 92127, 92128, 92129, 92130, 92131, 92132, 92134, 92137, 92138, 92139, 92145, 92154, 92166, 92167, 92169, 92171, 92173, 92177.

C O N T R A C T O R U S E O N L Y

Please complete and fax or email this form to the applicable union to request craft workers that fulfill the hiring requirements for this project. After faxing your request, please call the Local to verify receipt and substantiate their capacity to furnish workers as specified below. Please print your Fax or Email Transmission Verification Reports and keep copies for your records.

TO:	Local Union and #	
	Email	
	Fax	

CC:	**City of San Diego Project Labor Coordinator**	
	Email	
	Fax	

FROM:	Contractor	
	Issued by	
	Email	
	Phone	
	Fax	

UNION CRAFT WORKER REQUEST:

Craft Classification	Journeyperson or Apprentice	City Resident and/or Veteran	# of Workers
	☐ JM ☐APP	YES*	
	☐ JM ☐APP	YES*	
	☐ JM ☐APP	YES*	
	☐ JM ☐APP	YES*	

WORKER REPORTING INSTRUCTIONS:

Reporting Date:	
Reporting Time:	
Project Name:	
Project Location:	
Reporting To:	
On Site Phone:	
Special Instructions:	

U N I O N U S E O N L Y

Please complete the "Union Use Only" section and fax or email both pages to the requesting Contractor and Project Labor Coordinator.

Date Dispatch Received:	
Dispatch Received by:	

Date Worker(s) Dispatched:			
Name	**Veteran (Y/N)**	**Zip Code**	**JM or App**
			☒ JM ☐APP
			☐ JM ☐APP
			☐ JM ☒APP
			☐ JM ☐APP

ATTACHMENT B-2 – CONTRACTOR CORE WORKFORCE FORM

CONTRACTOR INFORMATION			
Project Name:			
Contractor/Firm Name:			
Prime Tier:			
Submitted by:			
Email:		Phone:	

In accordance with the Project Labor Agreement, Article 4, Section 4.6 (f), a Core Employee must be either a journeyperson or Apprentice and appear on the Contractor's active payroll for at least ninety (90) of the last one-hundred-eighty (180) working days prior to being designated as a Core Employee; and must possess any license required by state or federal law for the Project Work to be performed; and must have the ability to safely perform the basic functions of the applicable.

Prior to each Contractor performing any work on a Covered Project, each Contractor shall provide a list of Core Employees to the Project Labor Coordinator and the Council. After submitting the Core Employee list prior to commencing work, Contractors shall not make any changes or substitutions to the Core Employee list for the duration of the Covered Project. Failure to submit the Core Employee list prior to work commencing will prohibit the Contractor from using any Core Employees for 30 calendar days after the list is provided to the Project Labor Coordinator and Council.

Please check all that apply:

☐ Our firm will not be self-performing any work on this project.
We will be subcontracting our work to: _____

☐ PLA Section 4.6 regarding Core Employees is not applicable to Contractors that are signatory to one or more Schedule As, which are the Master Labor Agreements of the Unions. If your company is signatory, please list the union and local number below. For crafts that you are not signatory, please complete the core employee list below.

Indicate Signatory Union Trade: _____ Local # _____
Indicate Signatory Union Trade: _____ Local # _____
Indicate Signatory Union Trade: _____ Local # _____

☐ We are not a union signatory contractor and will be using core employees on this project as indicated below:

Craft/Trade	Employee Name	MC3 Apprentice Y/N?	Last 4 SSN	Hire Date	Date Last Employed

ATTACHMENT C – DRUG AND ALCOHOL TESTING POLICY

The Parties recognize the problems that drug and alcohol abuse have created in the construction industry and the need to develop drug and alcohol abuse prevention programs. Accordingly, the Parties agree that in order to enhance the safety of the workplace and to maintain a drug and alcohol-free work environment, individual Contractors shall require applicants or employees to undergo drug and alcohol testing in accordance with this PLA and this policy, Attachment C – Drug and Alcohol Testing Policy, hereafter "Policy."

1. It is understood that the use, possession, transfer, or sale of illegal drugs, narcotics, or other unlawful substances, as well as being under the influence of alcohol and the possession of or consuming alcohol is absolutely prohibited while employees are on the Contractor's job premises or while working on any jobsite in connection with work performed under the PLA.

2. No Contractor may implement a drug and alcohol testing program that does not conform in all respects to the provisions of this Policy.

3. No Contractor may implement drug and alcohol testing at any jobsite unless written notice is given to the Union setting forth the location of the jobsite, a description of the project under construction, and the name and telephone number of the Prime Contractor's project manager. Said notice shall be provided at the pre-job conferences for each Covered Project. Failure to give such notice shall make any drug and alcohol testing engaged in by the Contractor a violation of the Agreement and subject to the Article 10 grievance procedure.

4. A Contractor who elects to implement drug and alcohol testing pursuant to this Policy shall require all craft employees on the Covered Project to be tested. With respect to individuals who become employed on the Covered Project subsequent to the proper implementation of a valid drug and alcohol testing program, such test shall be administered upon the commencement of employment on the project, whether by referral from a Union Dispatch Office, transfer from another project, or another method. Individuals who were employed on the project prior to proper implementation of a valid drug and alcohol testing program may only be subjected to testing for the reasons set forth in paragraphs 5(g)(l) through 5(g)(3) and paragraphs 6(a) through 6(e) of this Policy. Refusal to undergo such testing shall be considered sufficient grounds to deny employment on the project.

5. The following procedure shall apply to all drug and alcohol testing:

    a. The Contractor may request urine samples only. The applicant or employee shall not be observed when the urine specimen is given. An applicant or employee, at his or her sole option, shall, upon request, receive a blood test in lieu of a urine test. No employee of the Contractor shall draw blood from a bargaining unit employee, touch

or handle urine specimens, or in any way become involved in the chain of custody of urine or blood specimens. A Union Business Representative, subject to the approval of the individual applicant or employee, shall be permitted to accompany the applicant or employee to the collection facility to observe the collection, bottling, and sealing of the specimen.

b. A Contractor may request an applicant or employee promptly, within four (4) hours of the Contractor's request, perform an alcohol breathalyzer test at a certified laboratory only, and cutoff levels shall be those mandated by applicable state or federal law.

c. The testing shall be done by a laboratory approved by the Substance Abuse & Mental Health Services Administration (SAMHSA), which is chosen by the Contractor and the Union.

d. An initial test shall be performed using the Enzyme Multiplied Immunoassay Technique (EMIT). In the event a question or positive result arises from the initial test, a confirmation test must be utilized before action can be taken against the applicant or employee. The confirmation test will be by Gas Chromatography/Mass Spectrometry (GC/MS). Cutoff levels for both the initial test and confirmation test will be those established by SAMHSA and this Policy. Should these SAMHSA levels be changed during the course of the PLA or new testing procedures are approved, then these new regulations will be deemed as part of this existing PLA. Confirmed positive samples will be retained by the testing laboratory in secured long-term frozen storage for a minimum of one (1) year. Handling and transportation of each sample must be documented through strict chain-of-custody procedures.

e. In the event of a confirmed positive test result, the applicant or employee may request, within forty-eight (48) hours, a sample of his/her specimen from the testing laboratory for purposes of a second test to be performed at a second laboratory, designated by the Union and approved by SAMHSA. The retest must be performed within ten (10) days of the request. Chain of custody for this sample shall be maintained by the Contractor between the original testing laboratory and the Union's designated laboratory. Retesting shall be performed at the applicant's or employee's expense. In the event of conflicting test results, the Contractor may require a third test, at the Contractor's expense.

f. If, as a result of the above testing procedure, it is determined that an applicant or employee has tested positive, this shall be considered sufficient grounds to deny the applicant or employee his/her employment on the project.

g. No individual who tests negative for drugs and alcohol pursuant to the above procedure and becomes employed on the project shall again be subjected to drug and alcohol testing with the following exceptions:

    1) Employees who are involved in industrial accidents resulting in damage to plant, property, or equipment or injury to him/her or others may be tested for drugs or alcohol pursuant to the procedures stated hereinabove.

2) The Contractor may test employees following thirty (30) days' advance written notice to the employee(s) to be tested and to the applicable Union. Notice to the applicable Union shall be sent by certified mail to the affected Union with a copy to the Project Labor Coordinator. Such testing shall be pursuant to the procedures stated hereinabove.

3) The Contractor may test an employee where the Contractor has reasonable cause to believe that the employee is impaired from performing his/her job. Reasonable cause shall be defined as being aberrant or unusual behavior, the type of which is a recognized and accepted symptom of impairment (e.g., slurred speech, unusual lack of muscular coordination). Such behavior must be actually observed by at least two (2) persons, one (1) of whom shall be a supervisor who has been trained to recognize the symptoms of drug and alcohol abuse or impairment and the other of whom shall be the Job Steward. If the Job Steward is unavailable or there is no Job Steward on the Covered Project, the other person shall be a member of the applicable Union's bargaining unit. Testing shall be pursuant to the procedures stated hereinabove. Employees who are tested pursuant to the exceptions set forth in this paragraph and who test positive will be removed from the Contractor's payroll.

h. Applicants or employees who do not test positive shall be paid for all time lost while undergoing drug and alcohol testing. Payment shall be at the applicable wage and benefit rates set forth in the applicable Union's Master Labor Agreement. Applicants who have been dispatched from the Union and who are not put to work pending the results of a test will be paid waiting time until such time as they are put to work. It is understood that an applicant must pass the test as a condition of employment. Applicants who are put to work pending the results of a test will be considered probationary employees.

6. The Contractors will be allowed to conduct periodic jobsite drug and alcohol testing on the Project under the following conditions:

a. The entire jobsite must be tested, including any employee or subcontractor's employee who worked on that project three (3) working days before or after the date of the test;

b. Jobsite testing cannot commence sooner than fifteen (15) days after start of the work on the project;

c. Prior to start of periodic testing, a Business Representative will be allowed to conduct an educational period on company time to explain periodic jobsite testing program to affected employees;

d. Testing shall be conducted by an SAMHSA-certified laboratory, pursuant to the provisions set forth in paragraph 5 hereinabove.

e. Only two (2) periodic tests may be performed in a twelve (12)-month period.

7. It is understood that the unsafe use of prescribed medication, or where the use of prescribed medication impairs the employee's ability to perform work, is a basis for the Contractor to remove the employee from the jobsite.

8. Any grievance or dispute that may arise out of the application of this Policy shall be subject to the grievance and arbitration procedures set forth in the PLA.

9. The establishment or operation of this Policy shall not curtail any right of any employee found in any law, rule, or regulation. Should any part of this Policy be found unlawful by a court of competent jurisdiction or a public agency having jurisdiction over the Parties, the remaining portions of the Agreement shall be unaffected, and the Parties shall enter negotiations to replace the affected provision.

10. Present employees, if tested positive, shall have the prerogative for rehabilitation program at the employee’s expense. When such program has been successfully completed, the Contractor shall not discriminate in any way against the employee. If work for which the employee is qualified exists, he/she may be reinstated.

11. The Contractor agrees that results of urine and blood tests performed hereunder will be considered medical records held confidential to the extent permitted or required by law. Such records shall not be released to any persons or entities other than designated Contractor representatives and the applicable Union. Such release to the applicable Union shall only be allowed upon the signing of a written release by the employee, and the information contained therein shall not be used to discourage the employment of the individual applicant or employee on any subsequent occasion.

12. Employees who seek voluntary assistance for substance abuse may not be disciplined for seeking such assistance. Requests from employees for such assistance shall remain confidential and shall not be revealed to other employees or management personnel without the employee's consent. Employees enrolled in substance abuse programs will be subject to all Contractor rules, regulations, and job performance standards with the understanding that an employee enrolled in such a program is receiving treatment for an illness.

13. The Contractor shall indemnify and hold the Union harmless against any and all claims, demands, suits, or liabilities that may arise out of the application of this Policy.

14. This Policy shall constitute the only Policy in effect between the Parties concerning drug and alcohol abuse, prevention, and testing. Any modifications thereto must be accomplished pursuant to collective bargaining negotiations between the Parties.

SPECIMEN REPORTING CRITERIA

Initial Test Analyte	Initial Test Cutoff [1]	Confirmatory Test Analyte	Confirmatory Test Cutoff Concentration
Marijuana metabolites (THCA)[2]	50 ng/ml [3]	THCA	15 ng/ml
Cocaine metabolite (Benzoylecgonine)	150 ng/ml 3	Benzoylecgonine	100 ng/ml
Codeine/ Morphine	2000 ng/ml	Codeine Morphine	2000 ng/ml 2000 ng/ml
Hydrocodone/ Hydromorphone	300 ng/ml	Hydrocodone Hydromorphone	100 ng/ml 100 ng/ml
Alcohol	0.02%	Ethanol	0.02%
Oxycodone/ Oxymorphone	100 ng/ml	Oxycodone Oxymorphone	100 ng/ml 100 ng/ml
6-Acetylmorphine	10 ng/ml	6-Acetylmorphine	10 ng/ml
Phencyclidine	25 ng/ml	Phencyclidine	25 ng/ml
Amphetamine/ Methamphetamine	500 ng/ml	Amphetamine Methamphetamine	250 ng/ml 250 ng/ml
MDMA[4]/MDA[5]	500 ng/ml	MDMA MDA	250 ng/ml 250 ng/ml
Initial Test Analyte	Initial Test Cutoff	Confirmatory Test Analyte	Confirmatory Test Cutoff Concentration
Barbiturates	300 ng/ml	Barbiturates	200 ng/ml
Benzodiazepines	300 ng/ml	Benzodiazepines	300 ng/ml
Methadone[6]	300 ng/ml	Methadone	100 ng/ml
Methaqualone	300 ng/ml	Methaqualone	300 ng/ml
Propoxyphene	300 ng/ml	Propoxyphene	100 ng/ml

[1] For grouped analytes (i.e., two or more analytes that are in the same drug class and have the same initial test cutoff):

Immunoassay: The test must be calibrated with one analyte from the group identified as the target analyte. The cross-reactivity of the immunoassay to the other analyte(s) within the group must be 80 percent or greater; if not, separate immunoassays must be used for the analytes within the group.

Alternate technology: Either one analyte or all analytes from the group must be used for calibration, depending on the technology. At least one analyte within the group must have a concentration equal to or greater than the initial test cutoff or, alternatively, the sum of the analytes present (i.e., equal to or greater than the laboratory's validated limit of quantification) must be equal to or greater than the initial test cutoff.

[2] An immunoassay must be calibrated with the target analyte, 9-tetrahydrocannabinoJ-9- carboxylic acid (THCA).

[3] **Alternate technology (THCA and benzoylecgonine):** The confirmatory test cutoff must be used for an alternate technology initial test that is specific for the target analyte (i.e., 15 ng/ml for THCA, 100 ng/ ml for benzoylecgonine).

[4] Methylenedioxymethamphetamine (MDMA)

[5] Methylenedioxyamphetamine (MDA)

[6] Employees with a prescription for methadone who are using the medication as prescribed, and are not impaired and can safely perform their work, will not be considered to have violated this Policy.

MEMORANDUM OF UNDERSTANDING REGARDING
"QUICK" DRUG SCREENING TESTS PURSUANT TO
ATTACHMENT C – DRUG AND ALCOHOL TESTING POLICY

It is hereby agreed between the Parties hereto that a Contractor who has otherwise properly implemented drug and alcohol testing, as set forth in the Policy, shall have the right to offer an applicant or employee a "quick" drug screening test. This "quick" screen test shall consist either of the "ICUP" urine screen or similar test or an oral screen test. The applicant or employee shall have the absolute right to select either of the two "quick" screen tests, or to reject both and request a full drug test.

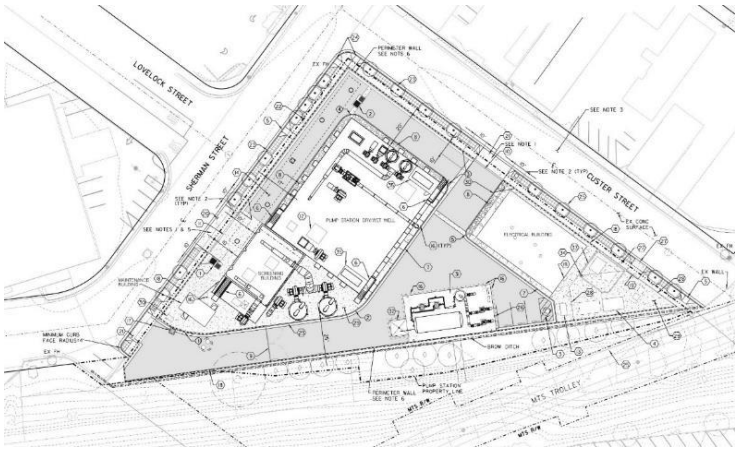
An applicant or employee who selects one of the "quick" screen tests, and who passes the test, shall be put to work immediately. An applicant or employee who fails the "quick" screen test, or who rejects the "quick" screen tests, shall be tested pursuant to the procedures set forth in the Policy. The sample used for the "quick" screen test shall be discarded immediately upon conclusion of the test. An applicant or employee shall not be deprived of any rights granted to them by the Policy as a result of any occurrence related to the "quick" screen test.

APPENDIX A – SAN DIEGO PURE WATER PROGRAM PHASE I COVERED PROJECTS

1. Morena PS/PL Construction Package 1: Morena Pump Station

- **Associated Pure Water Project:** Morena PS/PL Project
- **Summary:** The package is the construction of a new pump station that will transport approximately 32 mgd of wastewater to the NCWRP, where it will be treated before being sent to the NCPWF for further purification. Construction of the pump station will be on Sherman Street.
- **Summary of Major Construction Package Components**
  - 4+1 Dual Stage Sewer Pump Station
  - Screening Facility
  - High Purity Oxygen System
  - 48-inch to 60-inch diameter influent diversion sewers in Friars Road
  - 66-inch Overflow Sewer
  - Electrical and Instrumentation

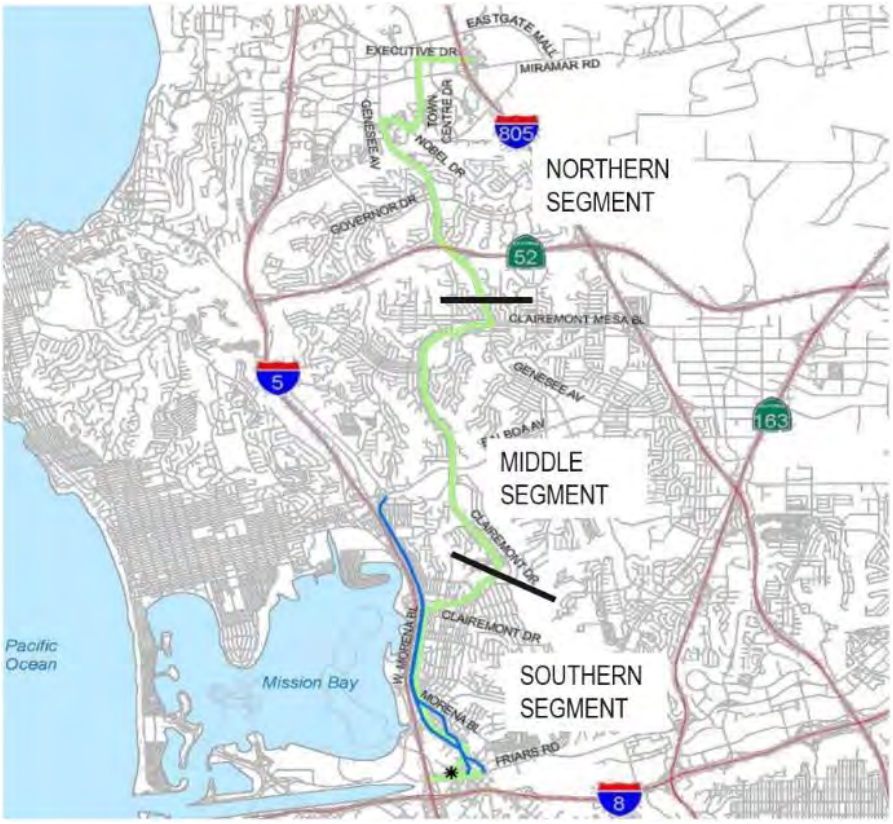
Morena Pump Station Rendering and Site Plan



2. Morena PS/PL Construction Package 2: Morena Northern Alignment and Tunnels

- **Associated Pure Water Project:** Morena PS/PL Project
- **Summary:** Two pipelines that will start at approximately Genesee Avenue/Highway 52, and will continue through University City to the NCWRP. Three short length tunnels are included in this section, each approximately 1000 feet; one at Highway 52, one at Rose Creek in University City and one at Interstate 805. One pipeline will transport wastewater to the NCWRP, while the other will transport salt and contaminants removed from the water at the NCPWF to the Point Loma Wastewater Treatment Plant.
- **Summary of Major Construction Package Components**
  - 4 miles of 48-inch force main
  - 4 miles of 36-inch brine/centrate pipeline
  - Tunnel crossing of I-805
  - Tunnel crossing of MTS/NCTD railroad at Rose Creek Canyon
  - Tunnel crossing at San Clemente Creek

Morena Conveyance Northern, Middle and Southern Segments Site Plan



3. Morena PS/PL Construction Package 3: Morena Middle Alignment

- **Associated Pure Water Project:** Morena PS/PL Project
- **Summary:** Two pipelines will start at Iroquois Avenue and will terminate at Genesee Avenue/Highway 52. One pipeline will transport wastewater to the NCWRP, while the other will transport salt and contaminants removed from the water at the NCPWF to the Point Loma Wastewater Treatment Plant.
- **Summary of Major Construction Package Components**
  - 3.6 miles of 48-inch welded steel force main
  - 3.6 miles of 36-inch brine/centrate high density polyethylene pipeline

4. Morena PS/PL Construction Package 4: Morena Southern Alignment

- **Associated Pure Water Project:** Morena PS/PL Project
- **Summary:** Two pipelines will start at Sherman Street, follow West Morena Boulevard and terminate at Iroquois Avenue. One pipeline will transport wastewater to the NCWRP, while the other will transport salt and contaminants removed from the water at the NCPWF to the Point Loma Wastewater Treatment Plant. A 36-inch diameter welded steel water transmission main will be constructed and a 16 inch steel water distribution main will be replaced by 16 inch PVC in this package.
- **Summary of Major Construction Package Components**
  - 3.2 miles of 48-inch force main
  - 3.2 miles of 30-inch brine/centrate pipeline
  - Brine/centrate pressure reducing station
  - 3.2 Miles of existing 16-inch steel water distribution main replacement with PVC
  - 3.3 miles of new 36-inch water transmission main

5. NCWRP Expansion Construction Package 1: NCWRP Flow Equalization Basin

- **Associated Pure Water Project:** NCWRP Expansion
- **Summary:** This package includes the construction of one concrete equalization tank that will balance high/low wastewater flows from primary effluent and will provide for consistent flow to the biological treatment basins.
- **Summary of Major Construction Package Components**
  - 2.35-million-gallon flow equalization basin
  - Grading, yard piping and stormwater basin
  - Electrical and instrumentation

NCWRP Equalization Basin Package 1 Rendering

6. NCWRP Construction Packages 2 and 3: NCWRP Expansion and NCPWF Influent Conveyance

- **Associated Pure Water Project:** NCWRP Expansion
- **Summary:** This package will increase the amount of recycled water that the plant produces to meet the needs of both the non-potable reuse recycled water system and the new NCPWF. Plant expansion includes the construction of a 42.5 mgd pump station that will convey water to the NCPWF across Eastgate Mall Road.
- **Summary of Major Construction Package Components**
  - Plant expansion from 30 mgd to 52 mgd
  - 42-mgd Influent Pump Station and pipeline to the NCPWF
  - New primary clarifies, new bioreactor basins and retrofit of existing basins, secondary clarifiers, new tertiary filter, chemical facilities, and yard piping
  - Equipment and electrical substation replacements
  - Electrical and instrumentation

NCWRP Expansion Rendering

7. NCPWF Construction Package 1: NCPWF and NCPW Pump Station

- **Associated Pure Water Project:** NCWPF
- **Summary:** A new Pure Water Facility will be built on Eastgate Mall across the street from the existing NCWRP to clean the recycled water further and produce 30 mgd of a safe, high-quality drinking water source. A new pump station will be constructed adjacent to the NCPWF on Eastgate Mall Road to pump an annual average of 30 mgd to Miramar Reservoir. The package includes widening a portion of Eastgate Mall Road.
- **Summary of Major Construction Package Components**
  - New 34-mgd Pure Water Facility, including:
    - Ozone Generation and Contactor
    - Biologically Active Carbon (BAC) Filters
    - Membrane Filtration (MF) System
    - Reverse Osmosis (RO)
    - Ultraviolet Disinfection and Advanced Oxidation (UV/AOP)
    - Chemical Feed Systems
    - Operations Building
    - 30-mgd Pump Station (3 + 1 vertical turbine pumps)
    - Electrical and instrumentation

NCPWF and NCPW Pump Station Rendering

8. NCPW PS/PL Construction Package 1: NCPW Pipeline and Dechlorination Facility

- **Associated Pure Water Project:** NCPW PS/PL
- **Summary:** This package includes infrastructure to convey 30 mgd of purified water produced by the NCPWF to Miramar Reservoir. The pipeline will start on Eastgate Mall, follow Miramar Road, continue through Scripps Ranch and end at Miramar Reservoir. The package includes the replacement of 6.4 miles of asbestos cement watermains with PVC.
- **Summary of Major Construction Package Components**
  - 8 Miles of 48-inch welded steel pipe transmission main (purified water pipeline)
  - Dechlorination Facility
  - Standpipe
  - 6.4 miles of watermain replacement of 6, 12 and 16-inch asbestos cement (AC) pipe with 16-inch polyvinylchloride (PVC) pipe.

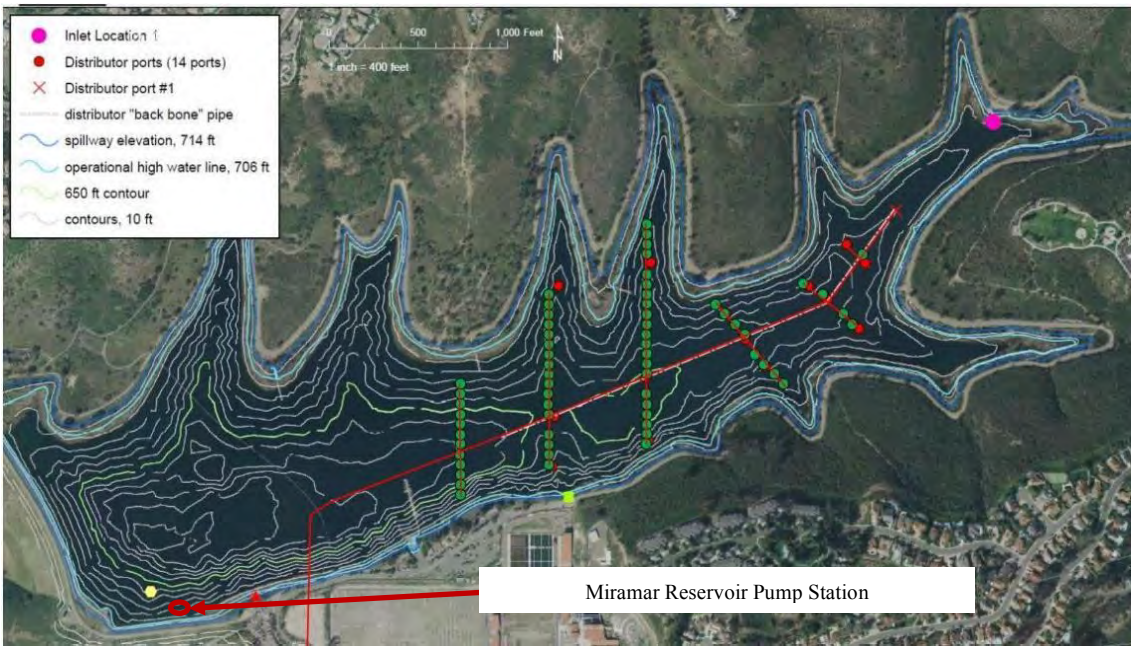
Pure Water Pipeline Alignment

Dechlorination Facility Rendering

9. NCPW PS/PL Construction Package 2: Subaqueous Pipeline and Miramar Reservoir Pump Station Improvements

- **Associated Pure Water Project:** NCPW PS/PL
- **Summary:** This package includes 0.9 miles of pipeline with duckbill outlets placed at the bottom of Miramar Reservoir together with the rehabilitation of a 100 mgd pump station that delivers raw water from Miramar Reservoir to the Miramar Water Treatment Plant.
- **Summary of Major Construction Package Components**
  - 54-inch to 8-inch Subaqueous pipe
  - 94 Dual duckbill valve outlet ports
  - Miramar Reservoir Pump Station Improvements
  - Electrical and instrumentation

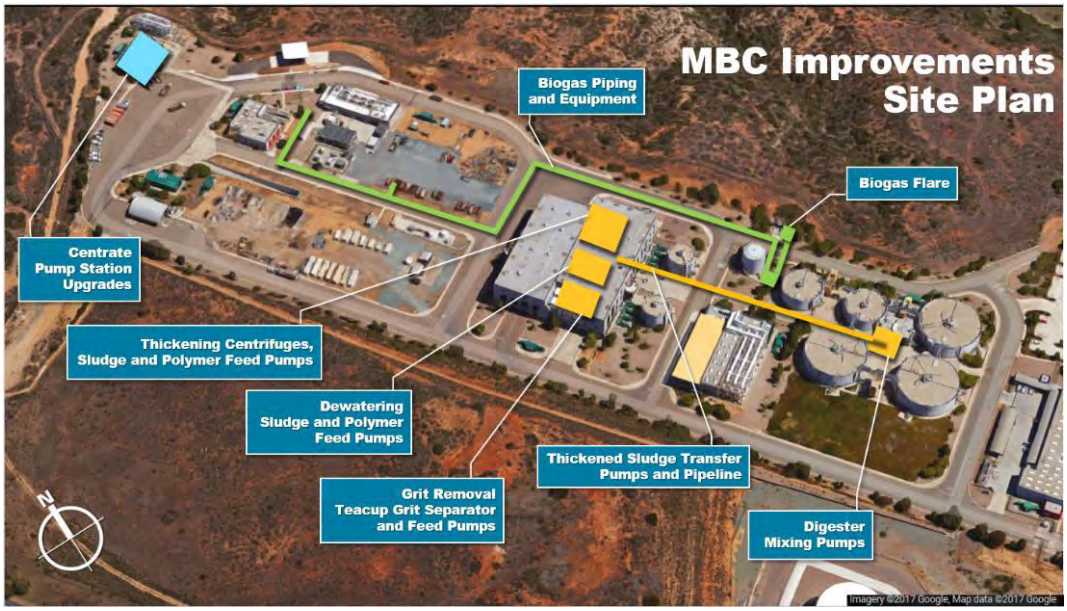
Subaqueous Pipeline Site Plan



10. MBC Construction Package 1: Metropolitan Biosolids Center Improvements

- **Associated Pure Water Project:** MBC Improvements
- **Summary:** This package will consist of improvements to the existing City biosolids center.
- **Summary of Major Construction Package Components**
  - Thickening centrifuges, sludge feed and polymer pumps, transfer pumps and supply pipeline
  - Digester mixing pump replacements, nozzles, overflow lines, biogas compressors, flare and biogas pipeline
  - Dewatering sludge feed pumps and polymer pumps
  - Centrate Pump Station pump and VFD replacements
  - Electrical and instrumentation

Metropolitan Biosolids Center Improvements Site Plan



APPENDIX B

MEMORANDUM OF UNDERSTANDING #1

PROJECT LABOR AGREEMENT SECTION 3.1

The City and the Parties agree that Project Work includes all onsite physical craft work that is part of startup and commissioning, including, but not limited to, system flushes and testing, loop checks, rework and modifications, and functional and operational testing up to and including the final running test. It is understood that the City's personnel and/or its representatives, together with the manufacturer's and/or vendor's representatives, and/or plant operating personnel may supervise and direct the startup, commissioning, rework, and modification activity, and that the onsite physical craft work is typically performed as part of a joint effort with these representatives and personnel. A manufacturer or its representatives may perform industry standard startup and commissioning work to satisfy its guarantee or warranty on a piece of equipment, and such work will be exempt from the Project Labor Agreement to the extent the work is excluded by Section 3.2(e) and/or Section 3.2(f).

MEMORANDUM OF UNDERSTANDING #2

NO DISCRIMINATION AND HARASSMENT

The City hereby provides notice that the City and its Contractors must not unlawfully discriminate, harass, or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, sexual orientation, physical disability (including HIV and AIDS), mental disability, medical condition (cancer), age (over 40), marital status, denial of family care leave, or genetic information, gender, gender identity, gender expression, or military and veteran status. The City and Contractors will ensure that the evaluation and treatment of their employees and applicants for employment are free from such discrimination and harassment. The City and Contractors must comply with the provisions of the Fair Employment and Housing Act and the applicable regulations promulgated thereunder. (Govt. Code §12990, subs. (a)-(f) et seq.; Cal. Code Regs., tit. 2 §7285, et seq.) These terms will be incorporated into every contract and subcontract for the Covered Project.

Dated: ____9-18-20_____

SAN DIEGO BUILDING AND CONSTRUCTION TRADES COUNCIL

By: _____

Tom Lemmon, Business Manager

CERTIFICATIONS AND FORMS

The Bidder, by submitting its electronic bid, agrees to and certifies under penalty of perjury under the laws of the State of California, that the certifications, forms and affidavits submitted as part of this bid are true and correct.

Bidder's General Information

To the City of San Diego:

Pursuant to "Notice Inviting Bids", specifications, and requirements on file with the City Clerk, and subject to all provisions of the Charter and Ordinances of the City of San Diego and applicable laws and regulations of the United States and the State of California, the undersigned hereby proposes to furnish to the City of San Diego, complete at the prices stated herein, the items or services hereinafter mentioned. The undersigned further warrants that this bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

The undersigned bidder(s) further warrants that bidder(s) has thoroughly examined and understands the entire Contract Documents (plans and specifications) and the Bidding Documents therefore, and that by submitting said Bidding Documents as its bid proposal, bidder(s) acknowledges and is bound by the entire Contract Documents, including any addenda issued thereto, as such Contract Documents incorporated by reference in the Bidding Documents.

NON-COLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID UNDER 23 UNITED STATES CODE 112 AND PUBLIC CONTRACT CODE 7106

State of California

County of San Diego

The bidder, being first duly sworn, deposes and says that he or she is authorized by the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

CONTRACTOR CERTIFICATION

DRUG-FREE WORKPLACE

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-17 regarding Drug-Free Workplace as outlined in the WHITEBOOK, Section 7-13.3, "Drug-Free Workplace", of the project specifications, and that;

This company has in place a drug-free workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of subdivisions a) through c) of the policy as outlined.

CONTRACTOR CERTIFICATION

AMERICAN WITH DISABILITIES ACT (ADA) COMPLIANCE CERTIFICATION

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-4 regarding the American With Disabilities Act (ADA) outlined in the WHITEBOOK, Section 7-13.2, "American With Disabilities Act", of the project specifications, and that:

This company has in place workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of the policy as outlined.

CONTRACTOR CERTIFICATION

CONTRACTOR STANDARDS – PLEDGE OF COMPLIANCE

I declare under penalty of perjury that I am authorized to make this certification on behalf of the company submitting this bid/proposal, that as Contractor, I am familiar with the requirements of City of San Diego Municipal Code § 22.3004 regarding Contractor Standards as outlined in the WHITEBOOK, Section 7-13.4, ("Contractor Standards"), of the project specifications, and that Contractor has complied with those requirements.

I further certify that each of the Contractor's subcontractors has completed a Pledge of Compliance attesting under penalty of perjury of having complied with City of San Diego Municipal Code § 22.3004.

.

CONTRACTOR CERTIFICATION

EQUAL BENEFITS ORDINANCE CERTIFICATION

I declare under penalty of perjury that I am familiar with the requirements of and in compliance with the City of San Diego Municipal Code § 22.4300 regarding Equal Benefits Ordinance.

CONTRACTOR CERTIFICATION

Equal Pay Ordinance Certification

Contractor shall comply with the Equal Pay Ordinance (EPO) codified in the San Diego Municipal Code (SDMC) at section 22.4801 through 22.4809, unless compliance is not required based on an exception listed in SDMC section 22.4804.

Contractor shall require all of its subcontractors to certify compliance with the EPO in their written subcontracts.

Contractor must post a notice informing its employees of their rights under the EPO in the workplace or job site.

By signing this Contract with the City of San Diego, Contractor acknowledges the EPO requirements and pledges ongoing compliance with the requirements of SDMC Division 48, section 22.4801 et seq., throughout the duration of this Contract.

AFFIDAVIT OF DISPOSAL

(To be submitted upon completion of Construction pursuant to the contracts Certificate of Completion)

WHEREAS, on the _____ DAY OF _____, 2_____ the undersigned entered into and executed a contract with the City of San Diego, a municipal corporation, for:

Morena Pump Station
(Project Title)

as particularly described in said contract and identified as Bid No. **K-21-1801-DBB-3-A**; SAP No. (WBS)**, B-15141** and **WHEREAS**, the specification of said contract requires the Contractor to affirm that "all brush, trash, debris, and surplus materials resulting from this project have been disposed of in a legal manner"; and **WHEREAS**, said contract has been completed and all surplus materials disposed of:

_____

_____

NOW, THEREFORE, in consideration of the final payment by the City of San Diego to said Contractor under the terms of said contract, the undersigned Contractor, does hereby affirm that all surplus materials as described in said contract have been disposed of at the following location(s)

_____

_____

and that they have been disposed of according to all applicable laws and regulations.

Dated this _____ DAY OF _____, _____.

By:_____
Contractor

ATTEST:

State of _____ County of _____

On this_____ DAY OF _____, 2_____, before the undersigned, a Notary Public in and for said County and State, duly commissioned and sworn, personally appeared_____ known to me to be the _____ Contractor named in the foregoing Release, and whose name is subscribed thereto, and acknowledged to me that said Contractor executed the said Release.

Notary Public in and for said County and State

LIST OF SUBCONTRACTORS

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *** TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY *** SEE INSTRUCTIONS TO BIDDERS FOR FURTHER INFORMATION**

In accordance with the requirements of the "Subletting and Subcontracting Fair Practices Act", Section 4100, of the California Public Contract Code (PCC), the Bidder is to list below the name, address and license number of each Subcontractor who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement, in an amount of or in excess of 0.5% of the Contractor's total Bid. Failure to comply with this requirement may result in the Bid being rejected as non-responsive. The Contractor is to list only one Subcontractor for each portion of the Work. The Bidder's attention is directed to the Special Provisions - General; Paragraph 2-3 Subcontracts, which stipulates the percentage of the Work to be performed with the Bidder's own forces. The Bidder is to also list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which the Bidders are seeking recognition towards achieving any mandatory, voluntary, or both subcontracting participation percentages.

NAME, ADDRESS AND TELEPHONE NUMBER OF SUBCONTRACTOR	DIR Registration Number	CONSTRUCTOR OR DESIGNER	SUBCONTRACTOR LICENSE NUMBER	TYPE OF WORK	DOLLAR VALUE OF SUBCONTRACT	MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB①	WHERE CERTIFIED ②	CHECK IF JOINT VENTURE PARTNERSHIP
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____								
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____								

① As appropriate, Bidder shall identify Subcontractor as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

Certified Minority Business Enterprise	MBE	Certified Woman Business Enterprise	WBE
Certified Disadvantaged Business Enterprise	DBE	Certified Disabled Veteran Business Enterprise	DVBE
Other Business Enterprise	OBE	Certified Emerging Local Business Enterprise	ELBE
Certified Small Local Business Enterprise	SLBE	Small Disadvantaged Business	SDB
Woman-Owned Small Business	WoSB	HUBZone Business	HUBZone
Service-Disabled Veteran Owned Small Business	SDVOSB		

② As appropriate, Bidder shall indicate if Subcontractor is certified by:

City of San Diego	CITY	State of California Department of Transportation	CALTRANS
California Public Utilities Commission	CPUC		
State of California's Department of General Services	CADoGS	City of Los Angeles	LA
State of California	CA	U.S. Small Business Administration	SBA

The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.

NAMED EQUIPMENT/MATERIAL SUPPLIER LIST

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *** TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY *** SEE INSTRUCTIONS TO BIDDERS FOR FURTHER INFORMATION**

NAME, ADDRESS AND TELEPHONE NUMBER OF VENDOR/SUPPLIER	DIR Registration Number	MATERIALS OR SUPPLIES	DOLLAR VALUE OF MATERIAL OR SUPPLIES	SUPPLIER (Yes/No)	MANUFACTURER (Yes/No)	MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB①	WHERE CERTIFIED②
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____							
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____							

① As appropriate, Bidder shall identify Vendor/Supplier as one of the following and shall include a valid proof of certification (except for OBE,SLBE and ELBE):

Certified Minority Business Enterprise	MBE	Certified Woman Business Enterprise	WBE
Certified Disadvantaged Business Enterprise	DBE	Certified Disabled Veteran Business Enterprise	DVBE
Other Business Enterprise	OBE	Certified Emerging Local Business Enterprise	ELBE
Certified Small Local Business Enterprise	SLBE	Small Disadvantaged Business	SDB
Woman-Owned Small Business	WoSB	HUBZone Business	HUBZone
Service-Disabled Veteran Owned Small Business	SDVOSB		

② As appropriate, Bidder shall indicate if Vendor/Supplier is certified by:

City of San Diego	CITY	State of California Department of Transportation	CALTRANS
California Public Utilities Commission	CPUC		
State of California's Department of General Services	CADoGS	City of Los Angeles	LA
State of California	CA	U.S. Small Business Administration	SBA

The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.

City of San Diego
Pure Water Project OCIP
Notice of Subcontract Award

Today's Date _____

To:	**From:**
Email:	**Email:**
Phone #:	**Phone #:**
Fax #:	**Fax #:**

The subcontractor named below will be issued a contract to perform work on the following:

Project: _____

Contract Number: _____ Contract Value: $ _____

- ☐ Check here if the subcontractor is to be enrolled in the OCIP
- ☐ Check here if the subcontractor is to be excluded from the OCIP
- ☐ Check here if the subcontractor will be an excluded prime tier fabricator with eligible (enrolled) sub-tier erector/installer

1. Name of subcontractor:	
2. Prime sub or GC name:	
3. Subcontractor FEIN:	
4. Subcontractor contact person:	
5. Subcontractor phone number:	
6. Subcontractor address:	
7. Subcontractor email address:	
8. General description of work:	
9. Date of award:	
10. Anticipated on-site start date:	
11. Anticipated completion date:	

AON **Form-1**

INSURANCE COST WORKSHEET
(Fixed Price Type Contracts)
Numbers reference attached instructions

City of San Diego Pure Water OCIP
Project Name:

A. Contractor Information: Federal ID # or Soc. Sec. # **1**

☐ **Business Information** *(headquarters)* ☐ **Contact Information** *(address questions to)*

Company Name & dba: **2** **3**
Contact Name & Title:
Address:
City, State, Zip Code:
Telephone:
E-mail Address:

B. Bid Information: Bid Package No.: **1**

Description of Work: **2**
Proposed Contract Price $: **3** Are you submitting a bid to The City of San Diego ? **5** ☐ Yes ☐ No
Amount of Self Performed Work $: **4** If No, identify to whom: **6**

C. Workers Compensation Insurance Information for Work Described Above: [a] (attach a separate sheet, if necessary)

a State	b Class Code	c Description	d Rate *(per $100 payroll)*	e Work Hours	f Payroll	g WC Premium *(Payroll*Rate/100)*
1						
			Totals	**2**	**3**	**4**

Identify the Amount of Your Claim Retention **5** Your Company's Workers Compensation Experience Modifier: **6**
Modified Premium (line **C4 x C6**): **7**
Employers Liability Rate: **8** Employers Liability Premium: **9**

10 Modification & Discount Premium Factors		11 Rate	12 Amount
Mod 1:	+ or =		
Mod 2:	+ or =		
Mod 3:	+ or =		
Mod 4:	+ or =		
Mod 5:	+ or =		

Total Modification Amount *(Total of all amounts entered in column **C12**)*: **13**
Total Workers Compensation Premium *(line **C7 + C9 + C13**)*: **14**

D. General Liability: [a] Rate: **1** **2** Based On: ☐ Total Payroll **(C3)** ☐ Contract Price **(B3)** ☐ Other: **3** Rate factor: ☐ Per 100 ☐ Per 1,000 **4** Identify the Amount of Your Claim Retention: **5**
GL Premium ***(D2 x D1 ÷ D3)***:

Excess/Umb. Liab.: [a] Rate: **6** **7** Based On: ☐ Total Payroll **(C3)** ☐ Contract Price **(B3)** ☐ Other: **8** Rate factor: ☐ Per 100 ☐ Per 1,000
Excess/Umbrella Premium ***(D7 x D6 ÷ D8)***: **9**

E. Builder's Risk/ Installation Floater: [1] Rate: **1** **2** Rate Factor ☐ Per 100 ☐ Per 1,000
Builder's Risk/Installation Floater Premium ***(B3 x E1 ÷ E2)***: **3**

F. Other Insurance Premiums: [1] *(Enter total premium costs identified on page 2)* **1**

G. Totals
Total of all Insurance Premiums *(Total of lines **C14+D5+D9+E3+F1**)*: **1**
Overhead & Profit on Insurance Premium %: **2** O/H & Profit Amount ***(G1 x G2)***: **3**
Total Initial Insurance Cost *(Total of lines **G1 + G3**)*: **4**
Contractor's Initial Insurance Cost Rate *(Line **G4** divided by total payroll in line **C3 x 100**)*: **5**

H. Signature Block: I **verify** the information presented above and attachments are correct:

Name: *(please print)* **Date:**
Title: **Signature:**

Completion of this form is a required part of your bid and must accompany your bid documents. Complete a separate form for each contractor, known subcontractor(s) and trades not currently awarded to a subcontractor. Duplicate this form as needed.

(a) Please provide copies of the following documents to support your insurance cost calculations:

Policy rate pages must be submitted with this worksheet. THERE WILL BE NO EXCEPTIONS.

AON Form-1	**INSURANCE COST WORKSHEET (Fixed Price Type Contracts)** Numbers reference attached instructions	**City of San Diego Pure Water OCIP** Project Name:

Complete a separate form for each contractor, known subcontractor and trade not currently awarded to a subcontractor. Duplicate this form as needed. Completion of this form is a required part of your bid and must accompany your bid documents.

A. Contractor Information

1. Enter your company's Federal ID number. This number can be found on filings made to the federal government such as your tax return.
2. Enter your company's name, mailing address and phone/fax number for your company's main office location in the space provided below.
3. Enter the name of the person AON should contact if questions arise. Include the mailing address, phone/fax and e-mail address if different than A-2.

B. Bid Information

1. Enter the Bid Package Number, Contract Number or Purchase Order Number that was included in The City of San Diego originating documentation.
2. Provide a brief description of the work you will be performing at the project site.
3. Identify the total amount of your bid. Include both labor and material.
4. Identify the amount of work that you anticipate will be self-performed. Include both labor and material.
5. Check the appropriate box that identifies if you contract directly with The City of San Diego or are a subcontractor.
6. If you are a subcontractor identify the entity with whom you are under contract.

C. Workers Compensation Insurance Information

1 a. Enter the two letter abbreviation for the state in which the work will be performed.
b. Enter each Workers Compensation class code that applies to your work identified in B2. (Most states use a 4 digit Number).
c. Enter the Workers Compensation class code description that applies to each class code identified in C1b.
d. Enter the Workers Compensation rate that applies to the specified class code.
e. Enter the estimated Work Hours required to complete the described work for each Workers Compensation class code.
f. Enter the estimated Payroll required to complete your work. Use only unburdened payroll and exclude the premium portion of any overtime pay.
g. Calculate the WC Premium by multiplying the Payroll (C1f) by the Rate (C1d) and dividing the result by 100. Repeat this calculation for each WC class code.

2. Total the estimated Work Hours for each class code. Be sure to include information from additional pages if used.
3. Total the estimated Payroll for each class code. Be sure to include information from additional pages if used.
4. Total the Workers Compensation Premium for each class code. Be sure to include information from additional pages if used.
5. Enter the amount of the Claim Retention/ Deductible your company has on their existing Worker's Compensation.
6. Enter you WC experience Modifier. This information can be located on your Workers Compensation policy or on your NCCI Bureau Rating Sheet.
7. Calculate the Modified Premium by multiplying the WC Premium (C4) by the Experience Modifier (C6).
8. Enter your Employer's Liability Insurance Rate. This information can be found in your Workers Compensation Policy,
9. Calculate your Employer's Liability Premium by multiplying the Modified Premium (C7) by the Employer's Liab. Rate (C8).
10. Identify the Modifiers that apply to your Workers Compensation Premium. This information can be located on your Workers Compensation Policy.
11. Enter the rate for each identified Modifier. The information can be located on your Workers Compensation Policy.
12. Calculate the Modified Premium Factor Amount by multiplying the Modified Premium (C7) by the Modified Premium Rate (C11) and dividing by 100. Be sure to identify if the Modification factor is an addition or reduction to your premium.
13. Total the Modified Premium Amounts by adding the numbers in column C12.
14. Calculate the Total Workers Compensation Premium by adding the Modified Premium (C7) to the Employer's Liab Premium (C9) and adding the Premium Modifications (C12).

D. General Liability & Umbrella/Excess Liability Insurance

1. Enter the general liability Rate. This number can be found on your General Liability Policy.
2. Identify the base the General Liability Rate applies to. If the base is other than Payroll or Revenue, enter the amount and the description in the space provided.
3. Identify the General Liability Rate factor by marking the box.
4. Identify the amount of your Claim Retention.
5. Calculate the General Liability Premium by multiplying the Bases (D2) by the Rate and dividing by the factor (D3).
6. Enter the Excess/Umbr Liability Rate. This number can be found on your Excess/Umbr Liability Policy.
7. Identify the base the Excess/Umbr Liab. Rate applies to. If the base is other than Payroll or Revenue, enter the amount and description in the space provided.
8. Identify the Excess/Umbr Liability Rate factor by marking the box.
9. Calculate the Excess/Umbr Liability Premium by multiplying the Bases (D7) by the Rate (D6) and dividing by the factor (100 or 1,000).

E. Builder's Risk / Installation Floater

1. Enter the Builder's Risk / Installation Floater Rate. Locate this information on your Property Policy or Builder's Risk Policy.
2. Identify the base factor that it applies to (100 or 1,000).
3. Calculate the Premium by multiplying the Proposed Contract Price (B3) by the Rate (E1) and dividing it by the Factor (E2).

F. Other Insurance Premiums

1. For each of the Insurance Lines of Coverage identified below, identify the Rate, Base and Factor. Calculate the Premium by multiplying the Base x Rate ÷ Factor. Total the Other Insurance Premiums in the space provided and carry that amount to the front page.

Line of Coverage	Rate	Base	Factor	Premium	Total Premium

G. Totals

1. Calculate the Total of all Insurance Premium by adding Workers Compensation (C14), General Liability (D5), Excess/Umbr Liability (D9), Builder's Risk/Installation Floater (E3), and Other Insurance Premiums (F1).
2. Identify the Overhead & Profit Percentage that was applied to this project during the tabulation of the Proposed Contract Price.
3. Calculate the Overhead & Profit Amount by Multiplying the Total of all Insurance Costs (G1) by your Overhead & Profit Percentage (G2).
4. Calculate the Total Initial Insurance Cost by adding the Overhead & Profit Amount (G3) with the Total of all Insurance Premium (G1).
5. Calculate your rate by Dividing the Total Initial Insurance Cost (G4) by the Estimated Payroll (C3) and multiplying by 100.

H. Signature Block

Note: Please provide copies of the following documents as part of your submittal:

- ☐ Rate Pages
- ☐ Workers Compensation declaration and rate pages
- ☐ General Liability declaration and rate pages
- ☐ Umbrella / Excess Liability declaration and rate pages
- ☐ 5 years actual loss experience for each line of coverage in which Contractor retains more than $5,000

AON **Form-3**

Enrollment Application

Numbers reference attached instructions

City of San Diego Pure Water OCIP

Project Name:

This form is to be used by a Prime Contractor to summarize subcontract activity. This form may also be used by Subcontracts that must summarize sub subcontract activity of any tier. Submit this form with your Bid Documents.

A. Contractor Information — Federal ID # or Soc. Sec. # **1**

	Business Information *(headquarters)* **2**	**Contract Information** *(address questions to…)* **3**
Company Name & dba: Contract Name & Title:		
Address:		
City, State, Zip Code:		
Telephone:		
Fax:		
Email Address:		

Indicate your Organization's Structure: 4 ☐ Corporation ☐ Partnership ☐ S-Corporation ☐ Joint Venture ☐ Sole Proprietor ☐ Other

B. Contract Information:

Contract No.: 1

Date Contract Awarded: 2

Description of Work: 3

Proposed Contract Price: 4

Are you Submitting a bid to The City of San Diego? 6 ☐ Yes ☐ No

If No, identify to whom: 7

Amount of Self Performed Work $: 5 ☐ Actual ☐ Estimated

8 Start Date:

9 Completion Date: ☐ Actual ☐ Estimated

C. Contacts: *(Complete if Applicable)*

Position	1 Name & Title	2 Phone	3 Fax	4 Email Address
Project Manager:				
Resident Engineer:				
Insurance:				
Contract Administrator:				
Payroll:				
Claims:				
Safety Representative:				

Provide Location of payroll records if different than Corporate address: **5** Phone:

City, State, Zip Code: Fax:

D. Workers Compensation Insurance Information for Work Described Above: *(attach a separate sheet, if necessary)*

a State	b Class Code	c Description	d Work Hours	e Payroll
1				
		Totals:	2	3

E. Provide your current Off-Site Workers Compensation Information: *(for each state you will perform work in)*

Applicable State	Risk ID Number	Rating Bureau	Anniversary Rating Date
1	2	3	4

Your WC Insurance Carrier 5

Policy # 6 Effective Date 7 Expiration Date 8

1 Subcontractor	2 Subcontract $	3 Contact Person	4 Address	5 Phone & Fax No.	6 Estimated Start Date

F. Signature Block: *This form must be signed by a representative of your company knowledgeable of its accuracy.*

Name: _____ Date: _____

(please print)

Title: _____ Signature: _____

Email to:

Fax:

Email:

Form-3	**Enrollment Application (Instructions)**	**City of San Diego Pure Water OCIP** Project Name:

This form must be completed and submitted by each successful Contractor and Subcontractor of any tier prior to Site mobilization for each contract awarded. The Contractor and Subcontractor will submit the completed form to Aon Risk Services. Upon receipt of this form, Aon will issue to the Contractor or Subcontractor a Certificate of Insurance evidencing coverage in the Controlled Insurance Program. The completed Certificate of Insurance and Workers Compensation insurance policy will be mailed to the Enrolled party.

A. Contractor Information

1 Enter your company's Federal ID number. This number can be found on filings made to the federal government such as your tax return.
2 Enter your company's name, mailing address and phone/fax number for your company's primary office location.
3 Enter the name of the person Aon should contact if questions arise. Include mailing address, phone/fax and email address, if different than A2.
4 Identify your company's legal structure by checking the box that applies. If the correct legal structure is not specifically listed, please check the "Other" box and specify in the space provided.

B. Contract Information

1 Enter the Contract Number or Purchase Order Number that was included in The City of San Diego's originating documentation.
2 Supply the Date this Contract was awarded to your organization.
3 Provide a brief description of the work you will be performing at the project site.
4 Identify the total amount of your contract. Include both labor and material.
5 Identify the amount of work that you anticipate will be self-performed. Include both labor and material.
6 Check the appropriate box that identifies if you contract directly with The City of San Diego or are a Subcontractor.
7 If you are a Subcontractor, identify the entity with whom you are under contract.
8 Enter the Date you anticipate starting work and then mark whether the date provided is actual or estimated.
9 Enter the Date you anticipate completing the described work and then mark whether the date provided is actual or estimated.

C. Contacts *(Requested Contact information is for specific functions. It is possible to have a single person fulfill multiple responsibilities.)*

1 Identify the name of the person and their title for each function. These individuals should be located, if at all possible, on-site.
2 Provide the phone number for each person identified above.
3 Provide the fax number for each person identified above.
4 Provide the email address for each person identified above, if applicable.
5 Identify the physical location where your payroll records are retained. Provide the Address, City, State, Zip Code, Telephone, Fax Number and Email Address of the person responsible for maintaining the payroll information.

D. Workers Compensation Information (Duplicate or attach additional sheets if necessary. You may create an electronic version of this document if all requested information is included.):

1 a Enter the two letter abbreviation for the state in which the work will be performed.
b Enter each Workers Compensation class code that applies to the work identified in B2. (Most states use a 4 digit Number)
c Enter the Workers Compensation class code description that applies to the work identified in D1b.
d Enter the estimated Work Hours required to complete the described work by Workers Compensation class code.
e Enter the estimated Payroll required to complete the described work for each Workers Compensation class code. Use only unburdened payroll and exclude the premium portions of any overtime pay.
2 Total all estimated Work Hours for each class code. Be sure to include information from additional pages if used.
3 Total all estimated Payroll for each class code. Be sure to include information from additional pages if used.

E. Current Off-Site Workers Compensation Information (Information relates to your corporation's existing coverage; identify each modification factor that applies.)

1 Enter the State that the Modification Information applies to.
2 Enter your Bureau File Number also referred to as your Risk Identification Number. This number can also be found on your Modification worksheets.
3 Enter the Bureau Rating Agency. In most states this is NCCI.
4 Provide your Company's Anniversary Rating Date. Information can be located on your bureau's WC Experience Modification worksheets.
5 Identify your insurance carrier for Workers Compensation Coverage.
6 Provide your Workers Compensation Policy Number.
7 Provide the effective date of your Workers Compensation policy.
8 Provide the expiration date of your Workers Compensation policy.

F. Subcontractor Information (Provide the following information for each Subcontractor that will be performing work at the project site. Use additional sheets, if necessary.)

1 Identify the name of the Subcontracting firm.
2 Provide the estimated value of the subcontracted activity.
3 Provide a contact name, preferably the project manager, for the Subcontractor.
4 Provide the mailing address for the Subcontractor.
5 Provide the phone number for the Subcontractor.
6 Provide the date the Subcontractor is scheduled to begin work.

G. Enrollment Questions

1 Determine if you will have any locations, off-site, that will be 100% dedicated to this project. Include material/supply storage as a possible location. Mark the appropriate box (yes/no). If you answer yes – provide the address of each location you identified as 100% dedicated.
2 Mark the box or boxes that apply. Contemplate only work performed under this contract.
3 Mark the box or boxes that apply. Employee Leasing Firm are those firms that supply the labor force for your company (You direct the activities of the Leasing Company's employees). Temporary Labor Firms supplement your labor force.

H. Warranty Statements:

1-6 Read each Warranty statement thoroughly. If you have questions regarding any of these statements, contact the Aon administrator identified on page 2.

I. Signature Block: This form must be signed by a representative of your company knowledgeable of its accuracy.

Forward the completed Enrollment Application to the Aon administrator identified at the bottom of page 2 of this form. The administrator prior to the start of your work on-site must receive this form.

Insert Company Letterhead

Skilled and Trained Workforce Certification Form

Month:_____ Year: _____

In accordance with Public Utilities Code section 132354.7 and Public Contract Code sections 2600-2602, _____ (the "Prime Contractor") certifies that all the workers performing work in an

(Prime Contractor Name)

apprenticeable occupation utilized on the project known as _____ (the "Project") during this monthly reporting period are either skilled journeypersons or apprentices registered in an apprenticeship

(Project Name)

program approved by the Chief of the Division of Apprenticeship Standards of the California Department of Industrial Relations (the "Chief").

"Skilled journeyperson" means a worker who either:

(1) Graduated from an apprenticeship program for the applicable occupation that was approved by the Chief or apprenticeship program located outside California and approved for federal purposes, pursuant to the apprenticeship regulations adopted by the Federal Secretary of Labor.

(2) Has at least as many hours of on-the-job experience in the applicable occupation as would be required to graduate from an apprenticeship program that is approved by the Chief.

In addition, the Prime Contractor certifies that it has met the requirements of Public Contract Code 2601(d), subject to certain exceptions set forth therein, that the required percentage of the skilled journeypersons or skilled journeyperson hours employed to perform work on the Project by the Prime Contractor and all subcontractors are graduates of an apprenticeship program for the applicable apprenticeable occupation[1].

A graduate of an apprenticeship program means either of the following:

(1) An individual that has been issued a certificate of completion under the authority of the California Apprenticeship Council for completing an apprenticeship program approved by the Chief pursuant to Section 3075 of the Labor Code, or

(2) An individual that has completed an apprenticeship program located outside California and approved for federal purposes pursuant to the apprenticeship regulations adopted by the federal Secretary of Labor.

I declare, under penalty of perjury under the laws of the State of California, that the foregoing is true and correct. I certify that the attached Skilled and Trained Workforce Monthly Compliance Reports are complete and accurate.

Full Name: _____

Title: _____

Signature: _____ Date Signed: _____

Please upload the completed form to the Labor Compliance Monitoring System (LCMS) monthly.

Insert contractor name/letterhead here

Skilled and Trained Workforce Monthly Compliance Report

DIRECTIONS: This form is required to be submitted by the Prime for all contractors regardless of tier by the 15th of the following month for work performed corresponding to this reporting period. Items with a red asterisk (*) indicate a required field.

Project Title *	
Project Number *	
Prime Contractor *	
Subcontractor *	
Contact Name *	
Contact Number *	

	Month	Year
Work Month & Year *		

Exemptions *	The contractor or subcontractor need not meet the apprenticeship graduation requirements if either (1) is true, or (2)(A) and (2)(B) are both true:	Please select * (True/False)	Exempt or non-exempt?
	(1) The contractor or subcontractor employed skilled journeypersons to perform fewer than 10 hours of work on the project during this reporting period?		Exempt if (1) is "True".
	(2) (A) The subcontractor was not a listed subcontractor under Section 4104 or a substitute for a listed subcontractor.		Exempt if both (2)(A) and (2)(B) are "True".
	(2) (B) The subcontract does not exceed one-half of 1 percent of the price of the prime contract.		

Report * Please fill out the following report for all apprenticeable occupations utilized in this reporting period.

SKILLED JOURNEYPERSON (SJ) REPORT

Apprenticeable Occupation (use dropdown menu) *	Required minimum SJ: Apprentice Graduate percentage (see 2nd page attachment) *	Number of Skilled Journeypersons (SJ) employed by the contractor to perform work on the project		SJ ratio between the number of SJ: Apprentice Graduates to SJ: On-The-Job Experience workers	Number of hours worked by SJ employed by the contractor to perform work on the project		SJ ratio of hours worked by SJ: Apprentice Graduates compared with SJ: On-The-Job Experience workers
		SJ: Apprentice Graduate *	SJ: On-The-Job Experience *		SJ: Apprentice Graduate *	SJ: On-The-Job Experience *	
EXAMPLE Laborer	40%	7	3	70%	30	70	30%

Terms	Definitions
Apprentice	Defined in Labor Code 3077
Skilled Journeyperson: Apprentice Graduate	Defined in Public Contracts Code 2601 (e) (1)
Skilled Journeyperson: On-The-Job Experience	Defined in Public Contracts Code 2601 (e) (2)

Apprenticeable Occupations (San Diego County)	Annual Apprenticeship Graduation Rate Minimum Requirements for Employed Skilled Journeypersons (%)		
	January 1 2018	January 1 2019	January 1 2020
Asbestos Worker, Heat and Frost Insulator	40	50	60
Boilermaker - Blacksmith	40	50	60
Bricklayer	30	30	30
Bricktender	40	50	60
Bridge Carpenter	30	30	30
Building Construction Inspector and Field Soils and Material Tester	30	30	30
Carpenter	30	30	30
Carpet, Linoleum and Resilient Floor Layer	40	50	60
Cement Mason	30	30	30
Drywall Finisher	40	50	60
Drywall Installer/Lather (Carpenter)	30	30	30
Electrician: Inside Wireman	40	50	60
Electrician: Sound and Signal Technician	40	50	60
Electrical Utility Lineman	40	50	60
Elevator Constructor	40	50	60
Field Surveyor: Chainman/Rodman	30	30	30
Field Surveyor: Chief of Party	30	30	30
Glazier	40	50	60
Horizontal Directional Drilling (Laborer)	40	50	60
Ironworker	40	50	60
Laborer	40	50	60
Landscape/Irrigation Fitter	40	50	60
Landscape/Irrigation Laborer	40	50	60
Marble Finisher	30	30	30
Metal Roofing Systems Installer	40	50	60
Millwright	40	50	60
Modular Furniture Installer (Carpenter)	30	30	30
Operating Engineer	30	30	30
Operating Engineer: Dredger	30	30	30
Operating Engineer: Landscape Construction	30	30	30
Painter	40	50	60
Painter: Industrial Painter	40	50	60
Parking and Highway Improvement (Striper-Laborer)	40	50	60
Pile Driver (Carpenter)	30	30	30
Plasterer	30	30	30
Plaster Tender	40	50	60
Plumber, Pipefitter, Steamfitter	40	50	60
Roofer	30	30	30
Sheet Metal Worker	40	50	60
Sprinkler Fitter (Fire Protection/Fire Control Systems)	40	50	60
Stator Rewinder	40	50	60
Terrazzo Finisher (Carpenter)	30	30	30
Terrazzo Installer (Carpenter)	30	30	30
Terrazzo Finisher	30	30	30
Terrazzo Worker	30	30	30
Tile Finisher	30	30	30
Tile Layer	30	30	30

Please visit the California Legislative Information website for further information on Public Contracts Code (PCC) 2600-2602. (https://leginfo.legislature.ca.gov/)

ELECTRONICALLY SUBMITTED FORMS

FAILURE TO FULLY COMPLETE AND SUBMIT ANY OF THE FOLLOWING FORMS WILL DEEM YOUR BID NON-RESPONSIVE.

PLANETBIDS WILL NOT ALLOW FOR BID SUBMISSIONS WITHOUT THE ATTACHMENT OF THESE FORMS

The following forms are to be completed by the bidder and submitted (uploaded) electronically with the bid in PlanetBids.

A. BID BOND – See Instructions to Bidders, Bidders Guarantee of Good Faith (Bid Security) for further instructions

B. CONTRACTOR'S CERTIFICATION OF PENDING ACTIONS

C. MANDATORY DISCLOSURE OF BUSINESS INTERESTS FORM

D. DEBARMENT AND SUSPENSION CERTIFICATION (PRIME CONTRACTOR)

E. DEBARMENT AND SUSPENSION CERTIFICATION (SUBCONTRACTORS/SUPPLIERS/MANUFACTURERS)

F. DISCLOSURE OF LOBBYING ACTIVITIES

G. COMMITMENT TO COMPLY WITH SKILLED AND TRAINED WORKFORCE CERTIFICATION FORMS

H. FORM 4500-3: DBE SUBCONTRACTOR PERFORMANCE FORM

I. FORM 4500-4: DBE SUBCONTRACTOR UTILIZATION FORM

Bids will not be accepted until ALL the above-named forms are submitted as part of the bid submittal

BID BOND

See Instructions to Bidders, Bidder Guarantee of Good Faith
(Bid Security)

KNOW ALL MEN BY THESE PRESENTS,

That _____ as Principal, and _____ as Surety, are held and firmly bound unto The City of San Diego hereinafter called "OWNER," in the sum of **10% OF THE TOTAL BID AMOUNT** for the payment of which sum, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Principal has submitted a Bid to said OWNER to perform the WORK required under the bidding schedule(s) of the OWNER's Contract Documents entitled

_____

NOW THEREFORE, if said Principal is awarded a contract by said OWNER and, within the time and in the manner required in the "Notice Inviting Bids" enters into a written Agreement on the form of agreement bound with said Contract Documents, furnishes the required certificates of insurance, and furnishes the required Performance Bond and Payment Bond, then this obligation shall be null and void, otherwise it shall remain in full force and effect. In the event suit is brought upon this bond by said OWNER and OWNER prevails, said Surety shall pay all costs incurred by said OWNER in such suit, including a reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this _____ day of _____, 20_____

_____ (SEAL) _____ (SEAL)
(Principal) (Surety)

By: _____ By: _____
(Signature) (Signature)

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

CONTRACTOR'S CERTIFICATION OF PENDING ACTIONS

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of all instances within the past 10 years where a complaint was filed or pending against the Bidder in a legal or administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers, and a description of the status or resolution of that complaint, including any remedial action taken.

CHECK ONE BOX ONLY.

☐ The undersigned certifies that within the past 10 years the Bidder has NOT been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers.

☐ The undersigned certifies that within the past 10 years the Bidder has been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers. A description of the status or resolution of that complaint, including any remedial action taken and the applicable dates is as follows:

DATE OF CLAIM	LOCATION	DESCRIPTION OF CLAIM	LITIGATION (Y/N)	STATUS	RESOLUTION/REMEDIAL ACTION TAKEN

Contractor Name: _____

Certified By _____ Title _____
Name

_____ Date _____
Signature

USE ADDITIONAL FORMS AS NECESSARY

Mandatory Disclosure of Business Interests Form

BIDDER/PROPOSER INFORMATION

Legal Name		DBA	
Street Address	**City**	**State**	**Zip**
Contact Person, Title		**Phone**	**Fax**

Provide the name, identity, and precise nature of the interest* of all persons who are directly or indirectly involved** in this proposed transaction (SDMC § 21.0103).

* The precise nature of the interest includes:

- the percentage ownership interest in a party to the transaction,
- the percentage ownership interest in any firm, corporation, or partnership that will receive funds from the
- transaction, the value of any financial interest in the transaction,
- any contingent interest in the transaction and the value of such interest should the contingency be satisfied, and any
- philanthropic, scientific, artistic, or property interest in the transaction.

** Directly or indirectly involved means pursuing the transaction by:

- communicating or negotiating with City officers or employees,
- submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City,
- or directing or supervising the actions of persons engaged in the above activity.

Name	Title/Position
City and State of Residence	**Employer (if different than Bidder/Proposer)**
Interest in the transaction	

Name	Title/Position
City and State of Residence	**Employer (if different than Bidder/Proposer)**
Interest in the transaction	

* Use Additional Pages if Necessary *

Under penalty of perjury under the laws of the State of California, I certify that I am responsible for the completeness and accuracy of the responses contained herein, and that all information provided is true, full and complete to the best of my knowledge and belief. I agree to provide written notice to the Mayor or Designee within five (5) business days if, at any time, I learn that any portion of this Mandatory Disclosure of Business Interests Form requires an updated response. Failure to timely provide the Mayor or Designee with written notice is grounds for Contract termination.

Print Name, Title _____ Signature _____ Date _____

Failure to sign and submit this form with the bid/proposal shall make the bid/proposal non-responsive. In the case of an informal solicitation, the contract will not be awarded unless a signed and completed Mandatory Disclosure of Business Interests Form is submitted.

DEBARMENT AND SUSPENSION CERTIFICATION

PRIME CONTRACTOR

FAILURE TO COMPLETE AND SUBMIT AT TIME OF BID SHALL RENDER BID NON-RESPONSIVE

EFFECT OF DEBARMENT OR SUSPENSION
To promote integrity in the City's contracting processes and to protect the public interest, the City shall only enter into contracts with responsible- bidders and contractors. In accordance with San Diego Municipal Code §22.0814 (a): *Bidders* and *contractors* who have been *debarred* or *suspended* are excluded from submitting bids, submitting responses to requests for proposal or qualifications, receiving *contract* awards, executing *contracts*, participating as a *subcontractor*, employee, agent or representative of another *person* contracting with the City.

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of Names of the Principal Individual owner(s).

The names of all persons interested in the foregoing proposal as Principals are as follows:

NAME	TITLE

IMPORTANT NOTICE: If Bidder or other interested person is a corporation, state secretary, treasurer, and manager thereof; if a co-partnership, state true name of firm, also names of all individual co-partners composing firm; if Bidder or other interested person is an individual, state first and last names in full.

The Bidder, under penalty of perjury, certifies that, except as noted below, he/she or any person associated therewith in the capacity of owner, partner, director, officer, manager:

- Is not currently under suspension, debarment, voluntary exclusion, or determination of ineligibility by any Federal, State or local agency;
- has not been suspended, debarred, voluntarily excluded or determined ineligible by any Federal, State or local agency within the past 3 years;
- does not have a proposed debarment pending; and
- has not been indicted, convicted, or had a civil judgment rendered against it by a court of competent jurisdiction in any matter involving fraud or official misconduct within the past 3 years.

If there are any exceptions to this certification, insert the exceptions in the following space.

Exceptions will be considered in determining bidder responsibility. For any exception noted above, indicate below to whom it applies, initiating agency, and dates of action.

Contractor Name:_____

Certified By _____ Title _____

Name

_____ Date _____

Signature

NOTE: Providing false information may result in criminal prosecution or administrative sanctions.

DEBARMENT AND SUSPENSION CERTIFICATION

SUBCONTRACTORS, SUPPLIERS AND MANUFACTURERS

TO BE COMPLETED BY BIDDER

FAILURE TO COMPLETE AND SUBMIT AT TIME OF BID SHALL RENDER BID NON-RESPONSIVE

Names of the Principal individual owner(s)

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of Names of the Principal Individual owner(s) for their subcontractor/supplier/manufacturers.

Please indicate if principal owner is serving in the capacity of **subcontractor**, **supplier,** and/or **manufacturer**:

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

Contractor Name: _____

Certified By _____ Title _____

Name

_____ Date _____

Signature

USE ADDITIONAL FORMS AS NECESSARY*

INSTRUCTIONS FOR COMPLETION OF SF-LLL, DISCLOSURE OF LOBBYING ACTIVITIES

This disclosure form shall be completed by the reporting entity, whether subawardee or prime Federal recipient, at the initiation or receipt of a covered Federal action, or a material change to a previous filing, pursuant to title 31 U.S.C. section 1352. The filing of a form is required for each payment or agreement to make payment to any lobbying entity for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a covered Federal action. Use the SF-LLLA Continuation Sheet for additional information if the space on the form is inadequate. Complete all items that apply for both the initial filing and material change report. Refer to the implementing guidance published by the Office of Management and Budget for additional information.

1. Identify the type of covered Federal action for which lobbying activity is and/or has been secured to influence the outcome of a covered Federal action.
2. Identify the status of the covered Federal action.
3. Identify the appropriate classification of this report. If this is a follow up report caused by a material change to the information previously reported, enter the year and quarter in which the change occurred. Enter the date of the last previously submitted report by this reporting entity for this covered Federal action.
4. Enter the full name, address, city, State and zip code of the reporting entity. Include Congressional District, if known. Check the appropriate classification of the reporting entity that designates if it is, or expects to be, a prime or subaward recipient. Identify the tier of the subawardee, e.g., the first subawardee of the prime is the 1st tier. Subawards include but are not limited to subcontracts, subgrants and contract awards under grants.
5. If the organization filing there port in item 4 checks "Subawardee," then enter the full name, address, city, State and zip code of the prime Federal recipient. Include Congressional District, if known.
6. Enter the name of the Federal agency making the award or loan commitment. Include at least one organizational level below agency name, if known. For example, Department of Transportation, United States Coast Guard.
7. Enter the Federal program name or description for the covered Federal action (item1). If known, enter the full Catalog of Federal Domestic Assistance (CFDA) number for grants, cooperative agreements, loans, and loan commitments.
8. Enter the most appropriate Federal identifying number available for the Federal action identified in item 1 (e.g., Request for Proposal (RFP) number; Invitation for Bid (IFB) number; grant announcement number; the contract, grant, or loan award number; the application/proposal control number assigned by the Federal agency). Include prefixes, e.g., "RFP-DE-90-001."
9. For a covered Federal action where there has been an award or loan commitment by the Federal agency, enter the Federal amount of the award/loan commitment for the prime entity identified in item 4 or 5.
10. (a) Enter the full name, address, city, State and zip code of the lobbying entity engaged by the reporting entity identified in item 4 to influence the covered Federal action.

    (b) Enter the full names of the individual(s) performing services, and include full address if different from 10 (a). Enter Last Name, First Name, and Middle Initial (MI).
11. Enter the amount of compensation paid or reasonably expected to be paid by the reporting entity (item4) to the lobbying entity (item10). Indicate whether the payment has been made (actual) or will be made (planned). Check all boxes that apply. If this is a material change report, enter the cumulative amount of payment made or planned to be made.
12. Check the appropriate box(es). Check all boxes that apply. If payment is made through an in-kind contribution, specify the nature and value of the in-kind payment.
13. Check the appropriate box(es). Check all boxes that apply. If other, specify nature.
14. Provide a specific and detailed description of the services that the lobbyist has performed, or will be expected to perform, and the date(s) of any services rendered. Include all preparatory and related activity, not just time spent in actual contact with Federal officials. Identify the Federal official(s) or employee(s) contacted or the officer(s), employee(s), or Member(s) of Congress that were contacted.
15. Check whether or not a SF-LLLA Continuation Sheet(s) is attached.
16. The certifying official shall sign and date the form, print his/her name, title, and telephone number.

DISCLOSURE OF LOBBYING ACTIVITIES Approved by OMB

Complete this form to disclose lobbying activities pursuant to 31 U.S.C. 1352 0348-0046

(See reverse for public burden disclosure)

1. Type of Federal Action: ☐ a. Contract a. Grant b. Cooperative agreement c. Loan d. Loan guarantee e. Loan insurance	**2. Status of Federal Action:** ☐ a. bid/offer/application b. initial award c. post-award	**3. Report Type:** ☐ a. initial finding b. material change **For Material Change Only** year_____ quarter _____ date of last report_____

4. Name and Address of Reporting Entity: ☐ Prime ☐ Subawardee Tier _____, *if known:* Congressional District, *if known:*	**5. If Reporting Entity in No. 4 is a Subawardee, Enter Name and Address of Prime:** Congressional District, *if known:*
6. Federal Department/Agency:	**7. Federal Program Name/Description:** CFDA Number, *if applicable:* _____
8. Federal Action Number, if known:	**9. Award Amount,** if known: $
10. a. Name and Address of Lobbying Entity (if individual, last name, first name, M)	**b. Individuals Performing Services** (including address if different from No. 10a) (last name, first name, MI):

(attach Continuation Sheet(s) SF-LLL4, *if necessary*)

11. Amount of Payment (check all that apply) **$**_____ ☐ **actual** ☐ **planned**	**13. Type of Payment** (check all that apply) ☐ a. retainer ☐ b. one-time lee ☐ c. commission ☐ d. contingent fee ☐ e. deferral ☐ f. other: specify:_____
12. Form of Payment (check all that apply) ☐ a, cash ☐ b. in-kind: specify: nature _____ Value_____	

14. Brief Description of Services Performed or to be Performed and Date(s) of Service, Including officer(s), employee(s), or Member(s), contacted, for Payment indicated in item 11:

(attach Continuation Sheet(s) SF-LLLA, *if necessary*)

15. Continuation Sheet(s) SF-LLLA attached: ☐ Yes ☐ No

16.	Information requested through this for misauthorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when this transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less that $10,000 and not more than $100,000 for each such failure.	Signature: _____ Print Name: _____ Title:_____ Telephone No.: _____ Date: _____

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DISCLOSURE OF LOBBYING ACTIVITIES
CONTINUATION SHEET

Approved by
OMB0348-0046

Reporting Entity: _____ Page _____of_____

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Standard Form - LLL-A

COMMITMENT TO COMPLY WITH SKILLED AND TRAINED WORKFORCE REQUIREMENTS

Bidder, on behalf of itself and its subcontractor(s) at every tier, hereby commits that a skilled and trained workforce will be used to perform all work on the Project that falls within an apprenticeship occupation in the building or construction trades in accordance with Chapter 2.9 (commencing with Section 2600) of Part 1 of Division 2 of the Public Contract Code. Pursuant to Public Contract Code section 2601, as of January 1, 2018:

"Skilled and trained workforce" means a workforce that meets all of the following conditions: All the workers performing work in an apprenticeable occupation in the building and construction trades are either skilled journeypersons or apprentices registered in an apprenticeship program approved by the chief.

For work performed on or after January 1, 2018, at least 40 percent of the skilled journeypersons employed to perform work on the contract or project by every contractor and each of its subcontractors at every tier are graduates of an apprenticeship program for the applicable occupation. This requirement shall not apply to work performed in the following occupations: acoustical installer, bricklayer, carpenter, cement mason, drywall installer or lather, marble mason, finisher, or setter, modular furniture or systems installer, operating engineer, pile driver, plasterer, roofer or waterproofer, stone mason, surveyor, teamster, terrazzo worker or finisher, and tile layer, setter, or finisher.

For work performed on or after January 1, 2019, at least 50 percent of the skilled journeypersons employed to perform work on the contract or project by every contractor and each of its subcontractors at every tier are graduates of an apprenticeship program for the applicable occupation. This requirement shall not apply to work performed in the following occupations: acoustical installer, bricklayer, carpenter, cement mason, drywall installer or lather, marble mason, finisher, or setter, modular furniture or systems installer, operating engineer, pile driver, plasterer, roofer or waterproofer, stone mason, surveyor, teamster, terrazzo worker or finisher, and tile layer, setter, or finisher.

For work performed on or after January 1, 2020, at least 60 percent of the skilled journeypersons employed to perform work on the contract or project by every contractor and each of its subcontractors at every tier are graduates of an apprenticeship program for the applicable occupation. This requirement shall not apply to work performed in the following occupations: acoustical installer, bricklayer, carpenter, cement mason, drywall installer or lather, marble mason, finisher, or setter, modular furniture or systems installer, operating engineer, pile driver, plasterer, roofer or waterproofer, stone mason, surveyor, teamster, terrazzo worker or finisher, and tile layer, setter, or finisher.

NOTE: The above commitment is required by California Public Utilities Code section 132354.7 and must be submitted by Bidder in order for the Bid to be responsive to the IFB.

Name of Bidder: _____

Name and Title of Bidder's Authorized Representative: _____

Signature of Bidder's Representative: _____ Date: _____

(SIGN HERE)

Disadvantaged Business Enterprise (DBE) Program

DBE Subcontractor Performance Form

This form is intended to capture the DBE[1] subcontractor's[2] description of work to be performed and the price of the work submitted to the prime contractor. A Financial Assistance Agreement Recipient must require its prime contractor to have its DBE subcontractors complete this form and include all completed forms in the prime contractor's bid or proposal package.

Subcontractor Name	Project Name	
Bid / Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.	Email Address	
Prime Contractor Name	Issuing/Funding Entity	

Contract Item Number	Description of Work Submitted from the Prime Contractor Involving Construction, Services, Equipment or Supplies	Price of Work Submitted to the Prime Contractor
DBE Certified By: _ DOT _ SBA Other: _____	Meets/exceeds EPA certification standards? YES NO Unknown	

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.2015 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

FORM 4500-3 (DBE Subcontractor Performance Form)

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	Date

Subcontractor Signature	Print Name
Title	Date

The public reporting and record keeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Do not send the completed form to this address.

FORM 4500-3 (DBE Subcontractor Performance Form)

Disadvantaged Business Enterprise (DBE) Program

DBE Subcontractor Utilization Form

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE[1] subcontractor's[2] and the estimated dollar amount of each subcontract. A Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposal package. Prime contractors should also maintain a copy of this form on file.

Prime Contractor Name		Project Name
Bid / Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.		Email Address
Issuing/Funding Entity		

I have identified potential DBE certified subcontractors. YES NO

If *yes*, please complete the table below. If *no*, please explain:

Subcontractor Name/ Company Name	**Company Address / Phone / Email**	**Estimated Dollar Amount**	**Currently DBE Certified?**

--Continue on back if needed--

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.2015 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

FORM 4500-4 (DBE Subcontractor Utilization Form)

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	Date

The public reporting and record keeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Do not send the completed form to this address.

FORM 4500-4 (DBE Subcontractor Utilization Form)

City of San Diego

CITY CONTACT: Stephen Samara, Principal Contract Specialist, Email: SSamara@sandiego.gov
Phone No. (619) 533-3619

ADDENDUM A

e - Bidding

FOR

MORENA PUMP STATION

BID NO.: K-21-1801-DBB-3-A
SAP NO. (WBS/IO/CC): B-15141
CLIENT DEPARTMENT: 2000
COUNCIL DISTRICT: 2, 7
PROJECT TYPE: KA, BP

BID DUE DATE:

2:00 PM
DECEMBER 17, 2020

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

http://www.sandiego.gov/cip/bidopps/index.shtml

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:

Shapiro, Alan — Digitally signed by Shapiro, Alan DN: cn=Shapiro, Alan, ou=USSDG1 Reason: I have reviewed this document Date: 2020.11.24 09:10:18 -08'00'

1) Registered Engineer (Morena Pump Station) — 11/24/2020 Date — Seal:

2) For City Engineer (Morena Pump Station) — 11/24/2020 Date — Seal:

A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

B. BIDDER's QUESTIONS

Q1. Due to the size and complexity of the project an 8 week procurement schedule that includes the week of Thanksgiving is not enough time for Contractors to bid the project. We are requesting that the project bid date be extended until mid-January 2021.

A1. No extension on the project bid due date.

Q2. I am emailing you with regards to the Morena Pump Station Project in San Diego, Ideal Electric Company would like to propose that we be considered and equal or alternative to the three manufacturer's that are currently listed as approved manufacturer's under MV Motor Specification (Section 16 19 00) Part 2 ss. 2.1a. Ideal Electric is a US Based Manufacturer of industrial and commercial motors for application such as your project since 1903. I am attaching copies of our SOQ and our Company history and current Status for your review. Your consideration to be included as an acceptable manufacturer would be greatly appreciated. Please review the attached documentation and feel free to contact me at your earliest opportunity.

A2. Refer to section 4-1.6 " Trade Names or Equals" of the Supplementary Special Provisions for submittal of approved equal products. If the contractor intends to use an approved equal product, he or she will need to submit for review and approval to the City of San Diego. The use of the approved equal product needs prior approval from the City.

Q3. Manufacturing the pipe to specification:

SECTION 33 05 10 REINFORCED CONCRETE PIPE (RCP), RUBBER GASKET JOINT WITH PVC LINING
Part 2 2.2 E

Is not possible since T-Lock is no longer a product and there are no other approved PVC liners on the City of San Diego approved product lists.

E. **PVC-Liner:** PVC-liner shall conform to SSPWC Subsection 207.3 and shall be Amerplate T-Lock as manufactured by Northwest Pipe Company, Brea, California, or equal. The liner shall cover 330 degrees of the pipe interior surface, leaving an open arc of 30 degrees at the bottom of the pipe for observation of cracks that may occur during D- Load tests.

2.3 JOINTS

A. Joint assembly design shall be Carnegie bell and spigot steel joint or reinforced concrete raised or flush bell concrete joint incorporating a fully retained single rubber gasket in accordance with ASTM C 361 and as shown. For locations where pipelines will be installed below the water table, the CONTRACTOR shall provide double rubber gaskets.

One product that will perform better than PVC lined RCP is Meyer polymer concrete pipe. Meyer is approved on the City of San Diego wastewater approved products. It is non corrosive, it will handle curves, and is also a rigid product like RCP. Because the pipe is inherently corrosion resistant there is no welding required at the joints.

I've attached the city of San Diego approved products list and the meyer pipe guide.

We would like to propose Meyer as an equal to the City for consideration and approval before the project bid date.

A3. Refer to Section 4-1.6 "Trade Names or Equals" of the Supplementary Provisions for submittal of approved or equal product. If the contractor intends to use an approved equal product, he or she will need to submit for review and approval to the City of San Diego.

The use of the approved equal product needs prior approval from the City.

Q4. Specification Section 31 71 19 2.1.A states: "Sewer jacking pipe shall consist of plastic lined reinforced concrete pipe (PLRCP), as required to provide a safe, stable tunnel excavation and acceptable in-place pipe. Pipe materials shall be in accordance with the Contract Documents and specifications." Specification Section 33 05 10 1.1 A states: "RCP for use in trenchless construction shall be provided as identified in the section for Microtunneling." Please clarify if microtunneling pipe (sewer jacking pipe) must conform to Specification Section 33 05 10.

A4. Specification 33 05 10 is for Open Cut pipe and does not have to confirm to Jacking Pipe standards. Microtunneling Pipe specified in Section 31 71 19 does not have to conform to specification 33 05 10

Q5. Specification Section 33 05 10 2.2.E states: "PVC-liner shall confirm to SSPWC Subsection 207.3 and shall be Amerplate T-Lock as manufactured by Northwest Pipe Company, Brea, California, or equal."

T-Lock PVC liner is no longer manufactured by Northwest Pipe, and no equal is identified in the City's Approved Materials List. Please identify a commercially available PVC liner product meeting the intent of the specifications or identify an alternate microtunnel/jacking pipe material that will be acceptable for use on this project.

A5. PVC or HDPE pipe lining material not identified on the City's approved 2018 material list for wastewater will be considered in lieu of the no longer produced T-Lock PVC liner. HDPE lined pipe products such as Northwest's Perfect Pipe will e considered as "equal" if the manufacturer can show the proposed lining material is equivalent or better than T-lock lined pipe to te City's satisfaction. Please refer to Section 4-1.6 "Trade Names or Equals".

Q6. I have the following question about the Morena Pump Station Project.

9. Linings: Fittings shall be interior lined same as specified for the piping connected to the fitting. Refer to AWWA C205.
10. Manufacturer: Provide wall and floor pipe as manufactured by one of the following:
    a. Thompson Pipe Group.
    b. Northwest Pipe Company.
    c. Or equal.

B. Pipe Sleeves Through Walls or Floor Slabs (New Concrete Below Grade): Sleeves shall be cast into the wall as shown on the Contract Drawings.

1. Material: Steel with welded-on waterstop.
2. Dimensions: As recommended by manufacturer and link-seal manufacturer. Length as required.
3. Pipe Sizes: Greater than 22-inch diameters.
4. Product and Manufacturer: Provide one of the following:
    a. Steel Wall Sleeve, Model WS, Thunderline Corporation.
    b. Or equal.

C. Link Seals: Provide link type mechanical seals suitable for 20 psi working pressure, accessible from one side.

1. Sizes: As recommended by manufacturer and pipe sleeve manufacturer.
2. Seal Element: EPDM black.
3. Pressure Plates: Composites.
4. Bolts and Nuts:
    a. 316 stainless steel for all applications.
5. Product and Manufacturer: Provide one of the following:
    a. Link-Seal, Model C, Thunderline Corporation, for above grade applications.
    b. Link-Seal, Model S. Thunderline Corporation for below grade applications.
    c. Or equal.

D. Escutcheon Plates:

1. Bare pipes passing through walls and ceilings in finished rooms: Provide escutcheon plates of cast brass or cast iron nickel plated, clevis or split ring and hinged with set screws.
2. Insulated pipes passing through walls and ceilings in finished rooms: Provide plated escutcheon plates of 18 gage steel.

The Wall & Floor spools are called out to be manufactured by specific companies and or equal. Can Western Waterworks Supply be an approved equal?

A6. Any submittal of or "Equal" item – should be referred to Section 4-1.6 "Trade Names or Equals". If the Contractor intends to use or "Equal" item, he or she will need to submit and cannot use it without prior approval from the City.

Q7. Sht E-50 is not included in electronic file for this project. Please provide this drawing.

A7. See Sheet E-50, page 87, added in this Addendum.

Q8. In accordance with Notice Inviting Bids section 16, please respond to the following prebid questions:

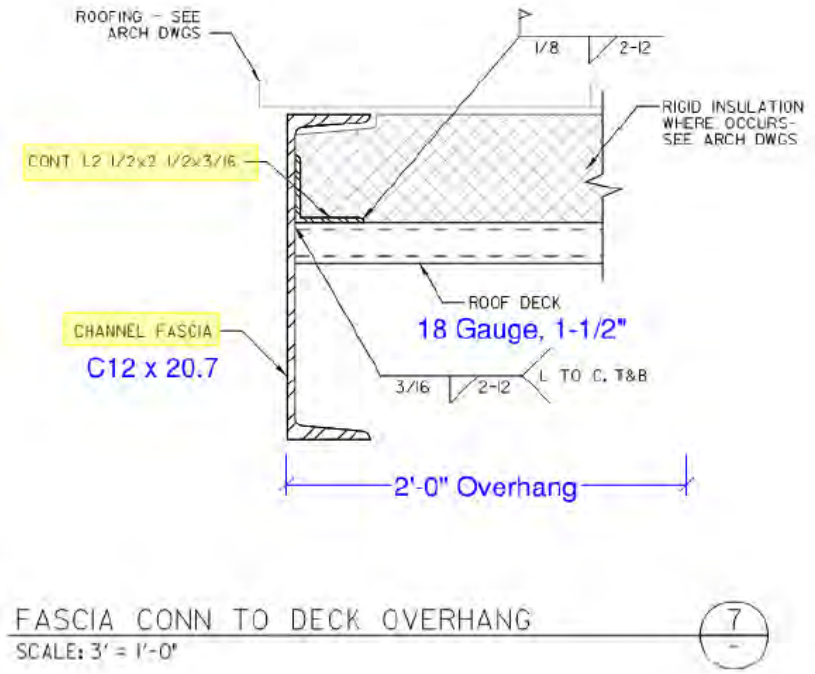
1. Reference Attachment E, section 6.2.2.1 calling for flagged vehicle access to the MTS Trolley overflow lot located on Friars Road during trolley operational hours. Is flagging required to stop public traffic in the event construction vehicles enter or leave this lot? Is flagging required to escort public traffic in and out of this lot when construction activities are nearby? Please clarify.

2. Reference drawing M-04 (40421-167-D) and note 3 calling for "10-0" X 10'-0" DOUBLE LEAF MOTORIZED ALUMINUM EQUIPMENT HATCH WITH HANDRAIL." Architectural drawings (A-07, A-38) do not mention these hatches being motorized. Specification section 08 31 13 ACCESS DOORS AND HATCHES would appear to apply here, yet there is no mention of motorized hatches. Electrical drawings fo not appear to indicate that power or controls are required at the locations of these hatches. Are these hatches actually manually operated? Please clarify.

A8. 1. Response: An excavation shaft within the parking lot is shown on drawing C-16, Section 6.2.2.1 is applicable.

2. Response: The hatches shall be motorized per specification Section 08 31 13.

Q9. After speaking with a metal deck supplier/installer, it is their opinion that this detail (Detail 7/S-59) does not work. The 1/8: weld, 2" long @ 12", will burn through the 18-gauge deck and not support the angle/fascia as detailed. Please advise.



A9. See revised detail on Drawing Sheet 40421-156-D provided in this Addendum.

Q10. On Sheet S-51, there is a monorail crane beam and support beam shown in the Maintenance Building. While the size and weight of the monorail beam is provided (S10 x 25.4) the support beam size is missing the weight information (W10 x ?). Please provide missing information.

A10. The Support Beam size is W10 X 19.

Q11. Sht. E-33, (Conduit & Cable Schedule) calls out "A" conduits numbering up to A-98.

Sht. E-27, (Duct Bank Sections) calls out "A" conduits in Duct Bank 1 and 3 which exceed the numbers called out in the Conduit Schedule… IE: A-104, 107, 119, 127, 128, 131 147, 148, 149.

Please Clarify!

We intend to exclude these conduits from our scope unless directed Otherwise.

A11. Additional conduits will be used for security wiring described as Bid Item 34 Security Systems (EOC Type I).

Q12. On Sheets S-09 note 8, S-10 note 5, S-11 note 19, S-27 note 15, it states "Waterproofing – Apply to all external wall surfaces below grade – see specification section 07 16 16." This section does not exist. Please confirm the note should reference specification section 07 13 26.

A12. Keynote 8 on S-09, keynote 5 on S-10, and keynote 19 on S-11 should reference Specification Section 07 13 26. Delete keynote 15 on S-27.

Q13. The stainless steel in the Process Piping spec 40 27 00 2.7 section calls out A-312 Pipe & A-815 Fittings. These are dissimilar materials. Is there a specific reason for this or can the Pipe and Fittings be the same material?

A13. Stainless Steel process pipe shall be A-312 as specified. Fittings maybe manufactured from same material or as recommended by the pipe manufacturer.

Q14. Drawing D-01, Note 6, indicates it is the contractor's responsibility for draining/ handling/ disposing of all water/ wastewater/ other media in piping and equipment found on site or connected to site and existing structures and buildings. Please provide quantities and types for all of this material to be disposed of.

A14. Disposal quantities are not determinable at this time. The quantity of disposal must be field evaluated and measured by the contractor and agreed to by the Construction Manager. Costs for disposal will be paid from a field order allowance.

Q15. Drawing S-31 indicates 10' square access hatches in Keynote 4. There does not appear to be a specification for these roof hatches. Please provide.

A15. Refer to Specification Section 07 72 33 for roof hatches shown on Drawing S-31.

Q16. Drawing M-01, Note 1, indicates the use of 316 SS hardware to be used inside the Screening Facility. Does this note extend to all hardware to be used in the Roof Structure? This is the same question for the Pump Station Building, too.

A16. Drawing M-01 Note 1 applies to the Mechanical drawings only. Roof Hardware shall be as shown on Structural and/or Architectural drawings.

Q17. Reference drawing C-16: At Sta. 2+00 of the 48" casing/36" Brine sewer, a Rip Rap Excavation Shaft is shown. Is the intent of the excavation to remove the toe of the rip rap in Friars Rd North Levee that is in conflict with the proposed 48" casing pipe and then rebuild the toe above the casing pipe? If so, at what distance above the top of the proposed 48" casing should the rip rap terminate? How far on either side of the proposed 48" casing pipe should the rip rap be removed?

A17. The Contractor should figure out the limits of the rip rap by probing as indicated in Note 2 of Dwg C-16. The Contractor will need to remove enough rip rap to be able to build the pipeline and then replace rip rap to meet the limits the rip rap exists now above and next to the pipe.

Q18. On Drawing C-21, Note No. 4 states that Stone Columns shall be installed at 9-ft on center with a 3-ft diameter, unless shown by the test section to allow different spacing and diameter and still achieve ground improvement objectives. Note No. 5 states that a 40-ft by 40-ft test section shall be performed and verified in the field by advancing Cone Penetrometer Test Soundings (CPTs). Additional Stone Columns may be required if the ground improvement goals are not met. Note No. 6 states that the means and methods, including final design, shall be developed by the selected Contractor.

Question: These statements contradict each other. Note 4 provides a design (depth, spacing, and diameter), while Note 5 and 6 states Design of the stone columns is the responsibility of the contractor. Please clarify if the stone columns installation scope is a prescriptive specification bid or design build performance specification bid.

A18. Note 4 was provided to provide a specification to bid to and have a baseline condition. If the Contractor can show during the test section or during production, that the spacing is different, this provides for either a cost savings for the Contractor or a change order for the ground conditions.

Q19. On Drawing C-22, Detail B, the details show the jet grouting limits along with a minimum wall thickness of 2-ft. This is also stated in Note No. 2. Note No. 8 states that the contractor may select to use jet grouting to assist with excavation shoring, groundwater control, and break in/out sections.

Question: Can the jet grouting extend beyond the limit of the ground improvement shown, in order to achieve the required primary objective and secondary functions?

A19. Yes, as long as the jet grouting does not damage existing improvements.

Q20. Are there Restoration limits for the Contract work in the Right of Way?

A20. Contractor is required to restore area to original condition, including replace in-kind any and all plantings/irrigation and hardscape damaged during construction.

Q21. Per contract specification section 31 71 19 - 1.04.F.3 Settlement monitoring points need to be monitored on a daily bases along the tunnel alignment. Can the City define the spacing between monitoring points along the tunnel alignments?

A21. The Contractor shall provide a monitoring plan and spacing to be approved or commented on by the City. Changes to the monitoring requirements per comments from the City may equate to changes in the compensation for monitoring.

Q22. Section 43 23 15, para. Item 1.6.A. states “Furnish for each of the five (5) sets of pumps” further described in subitems A.1 through A.8 with each line stating “…for 5 pumps”. Is each line item requiring a total of 25 sets of spares or a total of 5 sets of spares?

A22. A total of 5 sets of spares is required.

Q23. Section 43 42 56.04 has no pump material specification but in M26 & 27 fs 4 and 2, respectively, 316SS material for Submersible Pump is stated. Is the 316SS material a requirement for all the components such; motor casing, pump casing, impeller and base elbow?

A23. Yes, all pump components including motor casing, pump casing, impeller and base elbow shall be manufactured from 316 SS.

Q24. Does the City plan on pushing the bid of the project from the current date of December 17, 2020 – 2PM?

A24. No extension on the Bid Due Date.

Q25. Please confirm that concrete embedded and encased conduits are PVC Sch-40.

A25. Per Specification 26 05 33 – 3.03G concrete encased conduits shall be either rigid galvanized steel, intermediate metal, PVC Schedule 40 or PVC Schedule 80.

Q26. Please confirm that direct buried conduits are PVC Sch-80.

A26. Per Specification 26 05 33 – 3.03F direct buried conduits shall be either PVC Schedule 40, PVC Schedule 80, or PVC-coated rigid galvanized steel.

Q27. The Contract Drawings references Contract 40067-D in multiple drawings. Contract 40067-D has work on Custer & Sherman Street that will impede into the Morena Pump Station easement potentially affecting access to the project site. Please confirm when the scope of Contract 40067-D is complete or address how the coordination between the Contracts will ensue.

A27. 40067-D drawings are included in the following three contracts; Morena Conveyance North, South and Middle Projects. MPS Contractor will only interface/coordinate with the Morena Conveyance South Contractor as shown in Appendix F. The MPS contractor will be required to coordinate with the Morena Conveyance South per Supplementary Special Provision Section 2-14.3.

Q28. BG Waterproofing – section 07 13 26. There is a not on the drawings requesting an obscure batten stripe anchored on 6" centers but this accessory is not listed in section 07 13 26. Is this an error on the drawings?

A28. The referenced termination bars are applicable to the structure. Refer to Specification 07 13 26, Section 2.3 part F.

Q29. Room Finish Schedule. There is none other than what is listed in 09 90 00 Section 3.7 and 3.8. Are we to rely solely on these 2 sections? If so,

please review and confirm that this is an exhaustive list of the surfaces requiring field painting, coating or lining.

A29. The room finished schedule is provided in Specification 09 90 00, Section 3.8.

Q30. Reference Plan Sheet C-29. Please provide as-built drawings and flow rates for the existing sewer lines that show locations of adjacent manholes, cleanouts, etc., that can be utilized for bypass pump estimating. Specifically, for the as-builts, we are looking for more information on the following:

a. At MH1, the is an existing 8" VCP coming from the NW curb. Is this line coming from the property? (Google maps' street view shows this property is a Sears building). Please identify the nearest manholes upstream and downstream of the required sewer line improvements.

b. At MH2, there is an existing 10" VCP coming from the north along Grant Street. Please identify the nearest manholes upstream and downstream of the required sewer line improvements.

c. Upstream of MH3 there are two laterals that are part of the sewer improvements. Are these laterals to be 4"? Please identify the nearest upstream bypass access point locations for each of these (i.e. cleanout, or other). Are there any shut down restrictions for these laterals?

A30. The sewer entering MH1 indicated on C-29 is a lateral from the adjacent property. The existing 10-inch diameter VCP sewer coming from the north along Grant Street has an upstream MH located approximately 230-feet north of MH2 and a downstream MH south of MH3 approximately 320 feet. The two laterals located east of MH3 are to be 4-inch laterals. CONTRACTOR shall coordinate with the ENGINEER for the timing of cross over. CONTACTOR to assume no more than 24-hours of none sewer use for the properties. Connection points will need to occur in R/W. Record drawings are provided in the following link:

https://drive.google.com/drive/folders/1fvDMuQly1M5qlD4LZhHEcyDyxuSVQs3z?usp=sharing

Q31. Per specification 03 3 00.2.5A: The maximum temperature limit for mass concrete is specified to be 135 °F. Even if we use a concrete that contains 600 lbs/cuyd of cementitious where 50% is fly ash, the temperature rise will be 65 °F which means the concrete can't be warmer than 70 °F at the time of placement. This is not practical. The 135 °F limit is essentially not achievable without extreme (expensive) measures such as cooling pipes or liquid nitrogen precooling. The industry standard limit for mass concrete (reference ACI 301 and Caltrans) is 160 °F. Can the maximum temperature limit be increased from 135 °F to 160 °F?

A31. Maximum concrete temperature can be increased to 160°F. Cooling pipes are required by Specification Section 03 30 00 Part 1.04.C.

Q32. Per specification 03 3 00.3.1.G1: "Minimum curing period shall be 14 days. Unless otherwise permitted, preserve moisture by maintaining forms in place." Standard curing requirements for all concrete, including mass concrete is 7 days. Please confirm if our Thermal Control Plan allows us to remove the forms before 14 days we can finish the curing period using methods described in specification 03 39 00.3.1B Concrete Curing. We understand temperature control is different than curing (moisture retention).

A32. Forms may be removed after 7 days provided that curing is provided for a total of at least 14 days. Curing using methods described in Specification 03 39 00.3.01B, “Concrete Curing”.

Q33. Note 16 on Drawing S-11 identifies "T-Lock PVC Liner" on Junction & Diversion Cast in Place Concrete structures with no Technical Specifications provided. Please note that "T-Lock PVC Liner" is no longer in production or available to purchase per the manufacture. Please provide alternate product and Technical Specification for areas requiring "T-Lock PVC Liner".

A33. Refer to Section 4-6 "Trade Names” of the 2018 Supplementary Standard Specifications, “Whitebook” for submittal of an approved or equal product. As indicated in the “Whitebook”, the use of an equal product needs prior approval from the City.

Q34. Please confirm Permits that will be covered in Bid Item #19 Permits and Fees Allowance.

A34. Bldg Permit, PCD, SDG&E, Fire Department and other permits as required.

Q35. Please confirm Groundwater Dewatering Discharge to Sewer Fees will be paid in Bid Item #27 Dewatering permit and Discharge Fees Allowance.

A35. Confirmed.

Q36. Please confirm acceptance period of 90 calendar days for this project.

A36. Refer to Section 01 91 14 Testing, Integration, & Start Up and also Refer to Section 6-8.1 "Completion" and Section 6-8.2 "Acceptance" of the Supplementary Special Provisions and Technical Specifications Section 01 77 00 "Closeout Procedures" for requirements on project acceptance.

Q37. Please confirm performance and payment bonds shall be valid for one year after final acceptance.

A37. Refer to Greenbook Section 2-4 Contract Bonds.

Q38. Please confirm that builders risk policy covering contractor and subcontractors under OCIP includes off-site and in-transit coverage. Please confirm sub-limits of such coverage.

A38. Confirmed, $10M sub-limit.

Q39. Please confirm that builders risk policy covering contractor and subcontractors under OCIP provides for replacement cost coverage.

A39. Confirmed.

Q40. Please confirm that builders risk policy covering contractor and subcontractors under OCIP provides for terrorism coverage.

A40. Builders Risk Policy does not cover terrorism.

Q41. Attachment E, section 7-4.9 OCIP Builder's Risk Insurance – states that the builders risk policy under the OCIP does not provide for earthquake coverage. Please confirm that Owner is responsible for all losses as related to earthquake.

A41. Builders Risk Policy does not cover earthquakes. Owner is not responsible for all losses as they relate to earthquakes

Q42. Would Owner furnish contractor with a builders risk policy for review?

A42. Yes, Owner will furnish Contractor with a Builders Risk Policy for review.

Q43. Please confirm that OCIP builder's risk policy is DE5 or LEG3 level of coverage?

A43. LEG3 coverage.

Q44. With reference to The Whitebook section 6-5.5 relating to loss of project funding please confirm that Contractor will be entitled to receive payment for the value of the work completed to the date of termination not previously covered by monthly payments, including G&A and profit on such work incurred by Contractor to implement such termination.

A44. Contractor will be compensated per Whitebook Section 6-5.1 Termination Cost.

Q45. Please confirm that Contractor retains the right to suspend work in the event of Owner non-payment.

A45. Refer to Whitebook Section 3-5.1 Claims.

Q46. In an effort to adequately quantify risk would the Owner consider a total limit of liability for Contractor?

A46. No.

Q47. In an effort to provide the best possible price to the Owner and adequately quantify risk would the Owner consider a mutual waiver of consequential damages on this project.

A47. No.

Q48. With reference to Greenbook section 6-10 Use of Improvement During Construction – please confirm that Owner will pay any impact costs associated with such partial occupancy and will not impact contractor's work.

A48. No changes will be made to Greenbook Section 6-10.

Q49. Will the owner furnish the contractor with the Workers Compensation, General Liability, and Excess Liability Insurance for review?

A49. Yes.

Q50. Please confirm that the General Liability policy covering the ontractor and subcontractors under the OCIP will amend Damage to Your Work Exclusion will be deleted in its entirety or amended to clarify that the exclusion only applies to that particular part of your work which must be restored, repaired or replaced.

A50. The OCIP CGL Policy is endorsed with Resulting Damage To Your Work - Form 2 HS CG AM 1088 10 18.

Q51. Please confirm that the General Liability policy covering the contractor and subcontractors under the OCIP the Damage to your Product exclusion will be deleted in its entirety.

A51. The OCIP CGL Policy does not have a Damage to Your Product Exclusion.

Q52. Please confirm that the General Liability policy covering the contractor and subcontractors under the OCIP will be endorsed to modify the professional liability exclusion to the Contractors Professional Liability Limited Exclusion coverage provided by ISO endorsement CG 22 80.

A52. The OCIP CGL Policy is endorsed with Contractors Professional Liability Exclusion CG 22 79 04 13.

Q53. Please confirm that builders risk policy covering contractor and subcontractors under OCIP will not exclude resultant property damage caused by wind driven precipitation.

A53. Confirmed.

Q54. Please confirm that builders risk policy covering contractor and subcontractors under OCIP will not exclude resultant water damage to property that is not enclosed by a building envelope (i.e, Blue Tarp).

A54. The OCIP Builders Risk Policy does not define or exclude for coverage for property not enclosed by building envelope.

Q55. Please confirm that builders risk policy covering contractor and subcontractors under OCIP will provide for limits in an equal amount to

the full contract value plus any additional soft costs or delay in startup values as it relates to Water Damage.

A55. OCIP Builders Risk coverage for contract value for water damage - $250,000 sublimit for Blanket Undeclared Soft Costs.

Q56. Please confirm that builders risk policy covering contractor and subcontractors under OCIP will provide for limits in an equal amount to the full contract value plus any additional soft costs or delay in startup values for the perils of Flood and Named Windstorm.

A56. OCIP Builders Risk Flood coverage - $200M, except for property located in Flood Zone A, limit is $25M. $250,000 Blanketed Undeclared Soft Costs - Named Storm - Included.

Q57. Section 7-4.17 (3) – requires ISO form CG 00 01 10 01 or its equivalent, with no exclusion endorsements. Our policy uses ISO form CG 00 01 04 13 and have exclusion endorsements for coverages such as Pollution, Asbestos, Nuclear Energy Liability, Aircraft, Employment Related Practices, Professional Liability, etc. These exclusions are common exclusions on CGL policies for these coverages are covered separately via separate policies if required. Please advise if CG 00 01 04 13 and the general exclusions applicable to CGL policies will be acceptable.

A57. Bidders shall provide endorsements as identified in the OCIP contract specifications; no changes or modifications.

Q58. Section 7-4.17 (4) – Automobile Liability coverage at least as broad as ISO form CA 00 01 10 01. Please advise if ISO form CA 00 01 10 13 is acceptable.

A58. Bidders shall provide endorsements as identified in the OCIP contract specifications; no changes or modifications.

Q59. Section 7-4.17 (8a) – The additional insured endorsement shall provide coverage at least as broad as ISO form CG 20 10 11 01 and CG 20 37 10 01. Please advise if CG 20 10 04 13 and CG 20 27 04 13 are acceptable.

A59. Bidders shall provide endorsements as identified in the OCIP contract specifications; no changes or modifications

Q60. Reference is made to Attachment E, section 7-8.6.6.9 "Payment", item 3. Per the reference, the payment for dewatering includes any and all required equipment to treat hazardous groundwater. No groundwater contaminate study has been provided to enable us to quantify the treatment costs. Please provide the data needed to determine what treatment would be anticipated for each location. If a study cannot be provided, please add an allowance item for the treatment of contaminated groundwater.

A60. See Section 2.1.3 Ground Water Sampling & Appendix C, Geotechnical Report Morena Pump Station by AECOM dated January 5, 2018. Link provided in Supplementary Special Provisions 2.7.4.5.

Q61. Note 14 on Sheet S-28 calls out door 101E to be an FRP sound door and references the Door Schedule on A-24. Assuming we are to use the door schedule on A-37, door 101E is listed as HM not FRP. Please clarify which is correct

A61. The subject door should be Hollow Metal (HM).

Q62. Specification 26 05 33, section 2.11 C state that Raceway coatings will be per 09 90 00. Please provide coating system for exposed Rigid Galvanized Steel Conduit and PVC Coated conduit, if any

A62. There is no need to coat the subject galvanized steel or PVC conduits.

Q63. Please provide Payment Procedures for new bid items 9-14, 24-26 & 38 per Specification 01 29 00.1.14 Bid Items.

A63. Payment procedures are identified in the corresponding section of the Greenbook (GB), Whitebook (WB) or Supplementary Special Provision (SSP) next to the bid item.

Q64. Spec 01 50 25-3.13.L, first paragraph indicates complete redundant bypass pumping system. Please confirm this means 100% redundancy for flow capabilities produced by the bypass pumps. Additionally, please confirm this means 100% redundancy for discharge piping as well.

A64. Refer to redundancy of pumps and suction. Discharge piping can be sized for the PWWF's identified in Section 01 50 25.

Q65. Please refer to Specification Section 01 50 25 Sewer Bypass Pumping and the Potential Construction Sequencing Plan. Diversion Scenario 3 indicates to divert the 78" NMVI to the existing NMI Junction Structure. The drawing shows a green diversion line form the existing 78" NMVI pipe to the NMI structure. This is not realistic. Water isolation and bypass pumping needs to be diverted from an upstream manhole. The as-builts show a manhole near the YMCA. However, a few key pieces of information needs to be known:

a. Manhole depth from grade level to water level needs to be known in order to properly size pumps. Please provide the elevations or as-builts.

b. Assuming a 100% redundant system, the PWWF at 73.5 MGD means 147MGD bypass system will need to be in place. This amount of flow equates to approximately 15 pumps with suction sizes at 24"in diameter each. The amount of suction pipes will not fit in one manhole. Additional manholes and/or other means of diverting flow needs to be clarified in order to properly plan and price this scope of work. Please clarify how the bypass operation will be accomplished.

c. For the discharge piping to the NMI structure, please provide as-builts of the NMI structure.

d. To divert flow from the YMCA parking lot manhole to the NMI junction structure, discharge pipe will need to be routed through the Mission Valley Preserve and underneath the trolley bridge. Please clarify if any restrictions are associated in doing this.

A65. To divert flow from the YMCA parking lot manhole to the NMI junction structure, discharge pipe will need to be routed through the Mission Valley Preserve and underneath the trolley bridge. Please clarify if any restrictions are associated in doing this.

a. See Record Drawings 27256-D provided in this link. https://drive.google.com/drive/folders/1Z1flFEfdDYNajA5gYUxxkkh7CeX7TeBq?usp=sharing

b. See response above.

c. See Record Drawings 27152-D provided in this link. https://drive.google.com/drive/folders/1Z1flFEfdDYNajA5gYUxxkkh7CeX7TeBq?usp=sharing

d. Routing pipes through the preserve will not be allowed.

Q66. Reference drawing A-25, Control Room 303, Key Note 8 states in part "raised computer floor per details A-915, A-916 and A-917 on Sheet A-39." The floor elevation is missing in the drawings - the details have a 30" range. Please provide a specification for this flooring system.

A66. Raised floor to be flush with concrete landing pad at exterior; details A-915, A-916 & A-197 on Dwg A-39 call out for Concore All Steel Access Panel System. Recommend Concore 1000 series with high pressure laminate finish or equal.

Q67. Can you please provide the following information related to the bypass of the 78" NMVI pipeline:

a. What is the diameter of the manhole located in the YMCA parking lot (MH-1)?

b. Can the 78" NMVI pipeline be surcharged above the top of the 78" pipe?

c. Can you please provide as-builts of the existing NMI Junction structure, including the diameters of the manholes.

d. Are there any other sewer lines that dump into the 78" NMVI pipeline between MH-1 (in the YMCA parking lot) and the existing NMI Junction Structure?

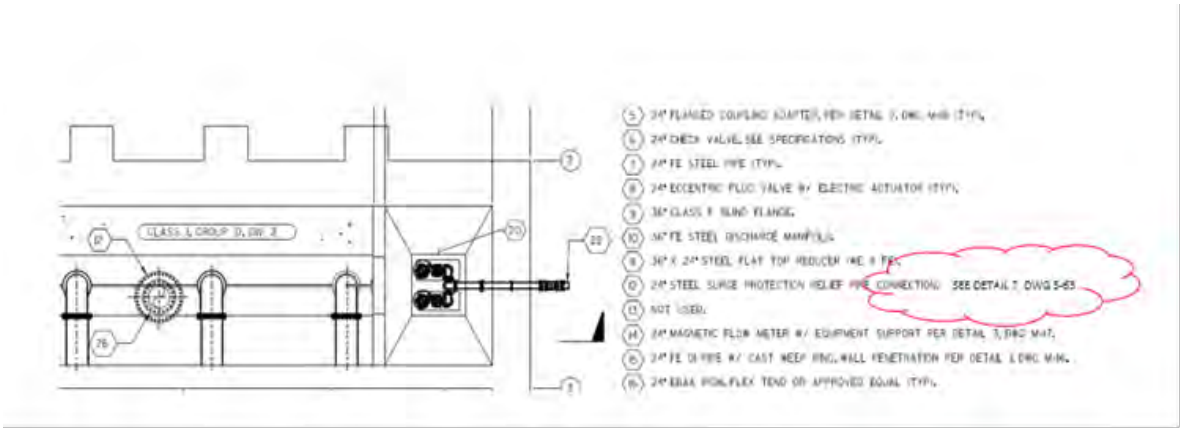
A67. It is understood that bypass pumping operation will not fit in a manhole. Due to the constraints of limited property at the upstream manhole and the adjacency to the Mission Valley Preserve it is anticipated that the NMVI will be exposed between NMI Junction Structure and the trolley tracks where bypass pumping can occur. The CONTRACTOR shall develop a plan for approval by the ENGINEER to open top of the NMVI and provide bypass pumping and repair upon completion. Routing pipes through the preserve will not be allowed. Record drawings 27256-D and 27152-D links have been provided via this Addendum.

Q68. Key note 5 on drawing M-07 calls out for a Flanged coupling adapter that is depicted on detail 2 on page M-18. Keynote 5 on page M-11 calls out for a Romac ECF400 which is an equipment connection fitting different of what is depicted on detail 2 page M-18. Please specify which fitting is the correct one.

A68. Provide Equipment Connection Fittings, Romac ECF-400 or approved equal, at all locations shown as such on Drawing M-11.

Q69. On page M-07 Key note 12 calls out for a Surge protection relief pipe connection on detail 5 of pg M-20. There is no detail 5 on page M-20. Can you please provide this detail?

A69. Connection detail is shown on Detail 7 of Drawing S-63. The reference on Drawing M-07 to Detail 5 on M-20 will be changed to Detail 7 on Drawing S-63. See revised Drawing M-07 provided in this Addendum.



C. NOTICE INVITING BIDS

1. To Item 12, SUBCONTRACTING PARTICIPATION PERCENTAGES, sub-item 12.7, page 10, **DELETE** in its entirety and **SUBSTITUTE** with the following:

12.7 Bid **shall** be declared non-responsive if the Bidder fails any of the following conditions:

12.7.1 Submission of GFE documentation, as specified in the Special Provisions.

12.7.1.1 Bidder's submission of Good Faith Effort documentation, saved in searchable portable

Document Format (PDF) and stored on Universal Serial Bus (USB) Type-A, Compact Disc (CD) or Digital Video Disc (DVD), demonstrating the Bidder made a good faith effort to outreach to and include DBE Subcontractors shall be submitted by 5 PM, 4 Working Days after the Bid opening.

12.7.1.2 Due to circumstances related to Covid-19, until further notice, all submittals in searchable PDF shall be submitted electronically within the prescribed time identified in the contract documents via a File Cloud link provided by the Contract Specialist to all bidders.

Upon circumstances returning to normal business as usual, the GFE shall once again be submitted to:

Engineering & Capital Projects Department,
Contracts Division
525 B Street, Suite 750 (7th Floor)
San Diego, California, 92101
Attention: Stephen Samara

12.7.2 Attending the Pre-Bid Meeting.

2. To Item 18, OWNER CONTROLLED INSURANCE PROGRAM (OCIP), page 12, **DELETE** in its entirety and **SUBSTITUTE** with the following:

18. OWNER CONTROLLED INSURANCE PROGRAM (OCIP): The City has implemented an Owner-Controlled Insurance Program (OCIP) for its Pure Water Projects. In this OCIP, the City furnishes Workers' Compensation, General, Excess, Pollution Liability and Builder's Risk insurance associated with construction of the Work, as detailed in Section 7- Responsibilities of the Contractor. Bidders, as well as all of their subcontractors, with a subcontract amount of greater than one half of one percent of the Contractors bid amount shall complete OCIP credit worksheets. Bidders shall submit, as well as OCIP credit worksheets obtained

from all their subcontractors, the OCIP credit worksheets two business days after bid opening. Compliance with the OCIP requirements will be a condition for award.

D. ATTACHMENTS

1. To Attachment D, FUNDING AGENCY PROVISIONS, (CASRF), (EPA), (CWSRF), (DWSRF), (WIFIA) PROP 68 and (BOR), item 10, DAVIS-BACON WAGE RATES AND PROVISIONS, Wage Rates, pages 54 through 81, **DELETE** in its entirety and **SUBSTITUTE** with pages 28 through 57 of this Addendum.

2. To Attachment D, FUNDING AGENCY PROVISIONS, (CASRF), (EPA), (CWSRF), (DWSRF), (WIFIA) PROP 68 and (BOR), item 12, DBE POTENTIAL RESOURCES CENTERS, sub-item 12.8, page 92, **DELETE** in their entirety and **SUBSTITUTE** with the following:

   12.8 Federal Agencies (must be contacted and solicitations posted on their websites):

Name and Address	Telephone and Web Site
U.S. Small Business Administration	(415) 744-6820 Extension 0
455 Market Street, Suite 600	Dynamic Small Business Search: https://catalog.data.gov/dataset/dynamic-small-business-search-dsbs-025a1
San Francisco, CA 94105	Bid Notification: https://catalog.data.gov/dataset/subcontracting-network-subnet-system
RE: Minority Enterprise Development Offices	
U.S. Department of Commerce	909-315-3339
Minority Business Development Agency	Website:
177 East Colorado Blvd. Suite 200 Space 2054	https://www.mbda.gov/business-center/pasadena-mbda-business-center
Pasadena, CA 91105	RE: Business Development Centers

E. SUPPLEMENTARY SPECIAL PROVISIONS

1. To **SECTION 2 – SCOPE AND CONTROL OF WORK**, page 113, **ADD** the following:

2-9.2 Surveying. To the "GREENBOOK" and "WHITEBOOK", **DELETE** in its entirety and **SUBSTITUTE** with the following:

2-9.2 Surveying (DESIGN-BID-BUILD).

2-9.2.1 General.

1. You shall provide all required site layout and general grade checking work not specified in 3-10.2, "Survey Services Provided by City".

2. Notify the City, in writing, at least 2 Working Days prior to requesting survey services provided by the City.

2-9.2.2 Survey Services Provided by City.

1. Monument Perpetuation, including mark-outs. You are responsible for requesting the coordination of these services.

   a) If at any time a monument will be destroyed or covered, such monument shall be perpetuated in accordance with state law. Inform the City Engineering Support & Technical Services Division's Land Survey Section (LSS), via project Resident Engineer, if any monument will be destroyed or covered during any construction activity.

2. The following surveying services (including construction staking), as defined in California Business & Professions Code §8726, shall be provided by the City:

   a) Locating or establishing alignment or elevations of all features or structures shown on project Plans.

b) Locating or establishing geodetic control points for all site feature or structure locations.

c) Produce topographic as-built data.

d) Locating, establishing, or re-establishing monuments, property lines, right-of-way lines, or easement lines.

e) Verifying structure finish grade elevations.

3. All construction survey stakes, control points, and other survey related marks provided by the City shall be preserved for the duration of the Project. If any construction survey stakes, control points, or other survey related marks are lost or disturbed and need to be replaced, such replacement shall be performed at your expense.

2-9.2.3 Payment.

1. The payment for site layout and general grade checking Work, coordination, and preservation of all survey related marks shall be included in the Contract Price.

2. To **SECTION 7, RESPONSIBILITIES OF THE CONTRACTOR**, Subsection 7-2, **LABOR**, Item 7-2.5, **Project Labor Agreement,** page 139, **DELETE** in its entirety and **SUBSTITUTE** with the following:

7-2.5 Project Labor Agreement. The Contractor and all subcontractors agree to be bound by the Project Labor Agreement (which is attached as Attachment I and incorporated by this reference) by submitting a Letter of Assent to the City's Labor Coordinator. The Contractor shall submit its Letter of Consent as a condition of award and all subcontractors shall submit their Letter of Assent before commencing any Work on the Project.

3. To Technicals, **SECTION 31 71 19**, **MICROTUNNELING**, pages 1281 through 1301, **DELETE** in its entirety and **SUBSTITUTE** with pages 58 through 79 of this Addendum.

F. PLANS

1. To Drawing Sheet Numbers 40421-01-D, 40421-22-D, 40421-92-D, 40421-103-D, 40421-155-D, 40421-156-D, and 40421-170-D, **DELETE** in their entirety and **REPLACE** with pages 80 through 86 of this Addendum.

2. To Drawing Plans, **ADD** Drawing Sheet Number 40421-261-D, E-50, page 87 of this Addendum.

James Nagelvoort, Director
Engineering & Capital Projects Department

Dated: *November 24, 2020*
San Diego, California

JN/AJ/lir

10. WAGE RATES This contract shall be subject to the following Davis-Bacon Wage Decisions:

"General Decision Number: CA20200001 10/30/2020

Superseded General Decision Number: CA20190001

State: California

Construction Types: Building, Heavy (Heavy and Dredging), Highway and Residential

County: San Diego County in California.

BUILDING CONSTRUCTION PROJECTS; DREDGING PROJECTS (does not include hopper dredge work); HEAVY CONSTRUCTION PROJECTS (does not include water well drilling); HIGHWAY CONSTRUCTION PROJECTS; RESIDENTIAL CONSTRUCTION PROJECTS (consisting of single family homes and apartments up to and including 4 stories)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.80 for calendar year 2020 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.80 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2020. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate,if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2020
1	01/10/2020

Modification Number	Publication Date
2	01/31/2020
3	03/06/2020
4	04/17/2020
5	05/29/2020
6	06/05/2020
7	07/03/2020
8	07/17/2020
9	07/24/2020
1	07/31/2020
11	08/07/2020
12	08/14/2020
13	08/21/2020
14	08/28/2020
15	09/04/2020
16	09/25/2020
17	10/02/2020
18	10/09/2020
19	10/16/2020
20	10/23/2020
21	10/30/2020

ASBE0005-002 07/06/2020

	Rates	Fringes
Asbestos Workers/Insulator (Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems)..	$ 45.39	23.74
Fire Stop Technician (Application of Firestopping Materials for wall openings and penetrations in walls, floors, ceilings and curtain walls).....	$ 28.92	18.73

ASBE0005-004 07/01/2019

Asbestos Removal worker/hazardous material handler (Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing of all

	Rates	Fringes
insulation materials from mechanical systems, whether they contain asbestos or not)……...$	20.63	12.17

BOIL0092-003 03/01/2018

	Rates	Fringes
BOILERMAKER.....$	44.07	33.52

BRCA0004-008 11/01/2018

	Rates	Fringes
BRICKLAYER; MARBLE SETTER..$	38.21	17.44

BRCA0018-004 06/01/2019

	Rates	Fringes
MARBLE FINISHER.....$	33.43	14.11
TILE FINISHER.....$	28.23	12.65
TILE LAYER.....$	40.07	18.36

BRCA0018-010 09/01/2020

	Rates	Fringes
TERRAZZO FINISHER.....$	33.66	14.20
TERRAZZO WORKER/SETTER.....$	41.60	14.73

CARP0409-002 07/01/2016

	Rates	Fringes
Diver		
(1) Wet.....$	712.48	17.03
(2) Standby.....$	356.24	17.03
(3) Tender.....$	348.24	17.03
(4) Assistant Tender....$	324.24	17.03

Amounts in ""Rates' column are per day

CARP0409-008 08/01/2010

	Rates	Fringes
Modular Furniture Installer...	$ 17.00	7.41

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* CARP0547-001 07/01/2018

	Rates	Fringes
CARPENTER		
(1) Bridge.....	$ 42.34	19.17
(2) Commercial Building.	$ 37.11	19.17
(3) Heavy & Highway.....	$ 42.21	19.17
(4) Residential Carpenter..	$ 29.69	19.17
(5) Residential Insulation Installer....	$ 18.00	8.16
MILLWRIGHT.....	$ 42.71	19.17
PILEDRIVERMAN.....	$ 42.34	19.17

CARP0547-002 07/01/2017

	Rates	Fringes
Drywall		
(1) Work on wood framed construction of single family residences, apartments or condominiums under four stories		
Drywall Installer/Lather.	$ 22.95	18.85
Drywall Stocker/Scrapper.	$ 12.50	12.27
(2) All other work		
Drywall Installer/Lather.	$ 32.00	17.63
Drywall Stocker/Scrapper.	$ 12.50	12.27

ELEC0569-001 06/01/2020

	Rates	Fringes
Electricians (Tunnel Work)		
Cable Splicer.....	$ 51.38	3%+14.88

	Rates	Fringes
Electrician.....	$ 50.63	3%+14.88
Electricians: (All Other Work, Including 4 Stories Residential)		
Cable Splicer.....	$ 45.75	3%+14.88
Electrician.....	$ 45.00	3%+14.88

ELEC0569-004 06/01/2020

	Rates	Fringes
ELECTRICIAN (Sound & Communications Sound Technician).....	$ 33.95	13.55

SCOPE OF WORK Assembly, installation, operation, service and maintenance of components or systems as used in closed circuit television, amplified master television distribution, CATV on private property, intercommunication, burglar alarm, fire alarm, life support and all security alarms, private and public telephone and related telephone interconnect, public address, paging, audio, language, electronic, background music system less than line voltage or any system acceptable for class two wiring for private, commercial, or industrial use furnished by leased wire, freuency modulation or other recording devices, electrical apparatus by means of which electricity is applied to the amplification, transmission, transference, recording or reproduction of voice, music, sound, impulses and video. Excluded from this Scope of Work - transmission, service and maintenance of background music. All of the above shall include the installation and transmission over fiber optics.

ELEC0569-005 06/01/2020

	Rates	Fringes
Sound & Communications		
Sound Technician.....	$ 33.95	13.55

SCOPE OF WORK Assembly, installation, operation, service and maintenance of components or systems as used in closed circuit television, amplified master television distribution, CATV on private property, intercommunication, burglar alarm, fire alarm, life support and all security alarms, private and public telephone and related telephone interconnect, public address, paging, audio, language, electronic, background music system less than line voltage or any system acceptable for class two wiring for private, commercial, or industrial use furnished by leased wire, freuency modulation or other recording devices, electrical apparatus by means of which electricity is applied to the amplification, transmission, transference, recording or reproduction of voice, music, sound, impulses and video. Excluded from this Scope of Work - transmission, service and maintenance of background music.

All of the above shall include the installation and transmission over fiber optics.

SOUND TECHNICIAN: Terminating, operating and performing final check-out

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ELEC0569-006 10/01/2018

Work on street lighting; traffic signals; and underground systems and/or established easements outside of buildings
Traffic signal, street light and underground work

	Rates	Fringes
Utility Technician #1..	$ 32.44	8.67
Utility Technician #2..	$ 27.05	8.51

STREET LIGHT & TRAFFIC SIGNAL WORK:

UTILITY TECHNICIAN #1: Installation of street lights and traffic signals, including electrical circuitry, programmable controller, pedestal-mounted electrical meter enclosures and laying of pre-assembled cable in ducts. The layout of electrical systems and communication installation including proper position of trench depths, and radius at duct banks, location for manholes, street lights and traffic signals.

UTILITY TECHNICIAN #2: Distribution of material at jobsite, installation of underground ducts for electrical, telephone, cable TV land communication systems. The setting, leveling, grounding and racking of precast manholes, handholes and transformer pads.

ELEC0569-008 08/31/2020

	Rates	Fringes
ELECTRICIAN (Residential, 1-3 Stories).....	$ 35.74	7.68

ELEC1245-001 06/01/2020

	Rates	Fringes
LINE CONSTRUCTION		
(1) Lineman; Cable splicer..	$ 59.14	20.78
(2) Equipment specialist (operates crawler tractors, commercial motor vehicles, backhoes, trenchers, cranes (50 tons and below), overhead &		

	Rates	Fringes
underground distribution line equipment).....	$ 47.24	19.59
(3) Groundman.....	$ 36.12	19.19
(4) Powderman.....	$ 51.87	18.79

HOLIDAYS: New Year's Day, M.L. King Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day and day after Thanksgiving, Christmas Day

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ELEV0018-001 01/01/2020

	Rates	Fringes
ELEVATOR MECHANIC.....	$ 57.40	34.765+a+b

FOOTNOTE:
a. PAID VACATION: Employer contributes 8% of regular hourly rate as vacation pay credit for employees with more than 5 years of service, and 6% for 6 months to 5 years of service.
b. PAID HOLIDAYS: New Years Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Friday after Thanksgiving, and Christmas Day.

ENGI0012-003 07/01/2020

	Rates	Fringes
OPERATOR: Power Equipment (All Other Work)		
GROUP 1.....	$ 48.25	27.20
GROUP 2.....	$ 49.03	27.20
GROUP 3.....	$ 49.32	27.20
GROUP 4.....	$ 50.81	27.20
GROUP 5.....	$ 48.96	25.25
GROUP 6.....	$ 51.03	27.20
GROUP 8.....	$ 51.14	27.20
GROUP 9.....	$ 49.29	25.25
GROUP 10.....	$ 51.26	27.20
GROUP 11.....	$ 49.41	25.25
GROUP 12.....	$ 51.43	27.20
GROUP 13.....	$ 51.53	27.20
GROUP 14.....	$ 51.56	27.20
GROUP 15.....	$ 51.64	27.20
GROUP 16.....	$ 51.76	27.20
GROUP 17.....	$ 51.93	27.20
GROUP 18.....	$ 52.03	27.20
GROUP 19.....	$ 52.14	27.20
GROUP 20.....	$ 52.26	27.20
GROUP 21.....	$ 52.43	27.20
GROUP 22.....	$ 52.53	27.20

	Rates	Fringes
GROUP 23.....	$ 52.64	27.20
GROUP 24.....	$ 52.76	27.20
GROUP 25.....	$ 52.93	27.20
OPERATOR: Power Equipment (Cranes, Piledriving & Hoisting)		
GROUP 1.....	$ 49.60	27.20
GROUP 2.....	$ 50.38	27.20
GROUP 3.....	$ 50.67	27.20
GROUP 4.....	$ 50.81	27.20
GROUP 5.....	$ 51.03	27.20
GROUP 6.....	$ 51.14	27.20
GROUP 7.....	$ 51.26	27.20
GROUP 8.....	$ 51.43	27.20
GROUP 9.....	$ 51.60	27.20
GROUP 10.....	$ 52.60	27.20
GROUP 11.....	$ 53.60	27.20
GROUP 12.....	$ 54.60	27.20
GROUP 13.....	$ 55.60	27.20
OPERATOR: Power Equipment (Tunnel Work)		
GROUP 1.....	$ 50.10	27.20
GROUP 2.....	$ 50.88	27.20
GROUP 3.....	$ 51.17	27.20
GROUP 4.....	$ 51.31	27.20
GROUP 5.....	$ 51.53	27.20
GROUP 6.....	$ 51.64	27.20
GROUP 7.....	$ 51.76	27.20

PREMIUM PAY:
$3.75 per hour shall be paid on all Power Equipment Operator work on the followng Military Bases: China Lake Naval Reserve, Vandenberg AFB, Point Arguello, Seely Naval Base, Fort Irwin, Nebo Annex Marine Base, Marine Corp Logistics Base Yermo, Edwards AFB, 29 Palms Marine Base and Camp Pendleton
Workers required to suit up and work in a hazardous material environment: $2.00 per hour additional. Combination mixer and compressor operator on gunite work shall be classified as a concrete mobile mixer operator.

SEE ZONE DEFINITIONS AFTER CLASSIFICATIONS

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Bargeman; Brakeman; Compressor operator; Ditch Witch, with seat or similar type equipment; Elevator operator-inside; Engineer Oiler; Forklift operator (includes loed, lull or similar types under 5 tons; Generator operator; Generator, pump or compressor plant operator; Pump operator; Signalman; Switchman

GROUP 2: Asphalt-rubber plant operator (nurse tank operator); Concrete mixer operator-skip type; Conveyor operator; Fireman; Forklift operator (includes loed, lull or similar types over 5 tons; Hydrostatic pump operator; oiler crusher (asphalt or concrete plant); Petromat laydown machine; PJU

side dum jack; Screening and conveyor machine operator (or similar types); Skiploader (wheel type up to 3/4 yd. without attachment); Tar pot fireman; Temporary heating plant operator; Trenching machine oiler
GROUP 3: Asphalt-rubber blend operator; Bobcat or similar type (Skid steer); Equipment greaser (rack); Ford Ferguson (with dragtype attachments); Helicopter radioman (ground); Stationary pipe wrapping and cleaning machine operator

GROUP 4: Asphalt plant fireman; Backhoe operator (mini-max or similar type); Boring machine operator; Boxman or mixerman (asphalt or concrete); Chip spreading machine operator; Concrete cleaning decontamination machine operator; Concrete Pump Operator (small portable); Drilling machine operator, small auger types (Texoma super economatic or similar types - Hughes 100 or 200 or similar types - drilling depth of 30' maximum); Equipment greaser (grease truck); Guard rail post driver operator; Highline cableway signalman; Hydra-hammer-aero stomper; Micro Tunneling (above ground tunnel); Power concrete curing machine operator; Power concrete saw operator; Power-driven jumbo form setter operator; Power sweeper operator; Rock Wheel Saw/Trencher; Roller operator (compacting); Screed operator (asphalt or concrete); Trenching machine operator (up to 6 ft.); Vacuum or much truck

GROUP 5: Equipment Greaser (Grease Truck/Multi Shift).

GROUP 6: Articulating material hauler; Asphalt plant engineer; Batch plant operator; Bit sharpener; Concrete joint machine operator (canal and similar type); Concrete planer operator; Dandy digger; Deck engine operator; Derrickman (oilfield type); Drilling machine operator, bucket or auger types (Calweld 100 bucket or similar types - Watson 1000 auger or similar types - Texoma 330, 500 or 600 auger or similar types - drilling depth of 45' maximum); Drilling machine operator; Hydrographic seeder machine operator (straw, pulp or seed), Jackson track maintainer, or similar type; Kalamazoo Switch tamper, or similar type; Machine tool operator; Maginnis internal full slab vibrator, Mechanical berm, curb or gutter(concrete or asphalt); Mechanical finisher operator (concrete, Clary-Johnson-Bidwell or similar); Micro tunnel system (below ground); Pavement breaker operator (truck mounted); Road oil mixing machine operator; Roller operator (asphalt or finish), rubber-tired earth moving equipment (single engine, up to and including 25 yds. struck); Self-propelled tar pipelining machine operator; Skiploader operator (crawler and wheel type, over 3/4 yd. and up to and including 1-1/2 yds.); Slip form pump operator (power driven hydraulic lifting device for concrete forms); Tractor operator-bulldozer, tamper-scraper (single engine, up to 100 h.p. flywheel and similar types, up to and including D-5 and similar types); Tugger hoist operator (1 drum); Ultra high pressure waterjet cutting tool system operator; Vacuum blasting machine operator

GROUP 8: Asphalt or concrete spreading operator (tamping or finishing); Asphalt paving machine operator (Barber Greene or similar type); Asphalt-rubber distribution operator; Backhoe operator (up to and including 3/4 yd.), small ford, Case or similar; Cast-in-place pipe laying machine operator; Combination mixer and compressor operator (gunite work); Compactor operator (self-propelled); Concrete mixer operator (paving); Crushing plant operator; Drill Doctor; Drilling machine operator, Bucket or auger types (Calweld 150 bucket or similar types - Watson 1500, 2000 2500 auger or similar types - Texoma 700, 800 auger or similar types - drilling depth of 60' maximum); Elevating grader operator; Grade checker; Gradall operator; Grouting machine operator; Heavy-duty repairman; Heavy equipment robotics operator; Kalamazoo balliste regulator or similar type; Kolman belt loader and similar type; Le Tourneau blob compactor or similar type; Loader operator (Athey, Euclid, Sierra and similar types); Mobark Chipper or similar; Ozzie padder or similar types; P.C. slot saw; Pneumatic concrete placing machine operator (Hackley-Presswell or similar type); Pumpcrete gun operator; Rock Drill or similar types; Rotary drill operator (excluding caisson type); Rubber-tired earth-moving equipment operator (single engine, caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. up to and including 50 cu. yds. struck); Rubber-tired earth-moving equipment operator (multiple engine up to and including 25 yds. struck); Rubber-tired scraper operator (self-loading paddle wheel type-John Deere, 1040 and similar single unit); Self-propelled curb and gutter machine operator; Shuttle buggy; Skiploader operator (crawler and wheel type over 1-1/2 yds. up to and including 6-1/2 yds.); Soil remediation plant operator; Surface heaters and planer operator; Tractor compressor drill combination operator; Tractor operator (any type larger than D-5 - 100 flywheel h.p. and over, or similar-bulldozer, tamper, scraper and push tractor single engine); Tractor operator (boom attachments), Traveling pipe wrapping, cleaning and bendng machine operator; Trenching machine operator (over 6 ft. depth capacity, manufacturer's rating); trenching Machine with Road Miner attachment (over 6 ft depth capacity): Ultra high pressure waterjet cutting tool system mechanic; Water pull (compaction) operator

GROUP 9: Heavy Duty Repairman

GROUP 10: Drilling machine operator, Bucket or auger types (Calweld 200 B bucket or similar types-Watson 3000 or 5000 auger or similar types-Texoma 900 auger or similar types-drilling depth of 105' maximum); Dual drum mixer, dynamic compactor LDC350 (or similar types); Monorail locomotive operator (diesel, gas or electric); Motor patrol-blade operator (single engine); Multiple engine tractor operator (Euclid and similar type-except Quad 9 cat.); Rubber-tired earth-moving equipment operator (single engine, over 50 yds. struck); Pneumatic pipe ramming tool and similar types; Prestressed wrapping machine operator;

Rubber-tired earth-moving equipment operator (single engine, over 50 yds. struck); Rubber tired earth moving equipment operator (multiple engine, Euclid, caterpillar and similar over 25 yds. and up to 50 yds. struck), Tower crane repairman; Tractor loader operator (crawler and wheel type over 6-1/2 yds.); Woods mixer operator (and similar Pugmill equipment)

GROUP 11: Heavy Duty Repairman - Welder Combination, Welder - Certified.

GROUP 12: Auto grader operator; Automatic slip form operator; Drilling machine operator, bucket or auger types (Calweld, auger 200 CA or similar types - Watson, auger 6000 or similar types - Hughes Super Duty, auger 200 or similar types - drilling depth of 175' maximum); Hoe ram or similar with compressor; Mass excavator operator less tha 750 cu. yards; Mechanical finishing machine operator; Mobile form traveler operator; Motor patrol operator (multi-engine); Pipe mobile machine operator; Rubber-tired earth- moving equipment operator (multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck); Rubber-tired self- loading scraper operator (paddle-wheel-auger type self-loading - two (2) or more units)

GROUP 13: Rubber-tired earth-moving equipment operator operating equipment with push-pull system (single engine, up to and including 25 yds. struck)

GROUP 14: Canal liner operator; Canal trimmer operator; Remote- control earth-moving equipment operator (operating a second piece of equipment: $1.00 per hour additional); Wheel excavator operator (over 750 cu. yds.)

GROUP 15: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. and up to and including 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine-up to and including 25 yds. struck)

GROUP 16: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 17: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine, Euclid, Caterpillar and similar, over 50 cu. yds. struck); Tandem tractor operator (operating crawler type tractors in tandem - Quad 9 and similar type)

GROUP 18: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, up to and including 25 yds. struck)

GROUP 19: Rotex concrete belt operator (or similar types); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds.and up to and including 50 cu. yds. struck); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - multiple engine, up to and including 25 yds. struck)

GROUP 20: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps, and similar types in any combination, excluding compaction units - multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 21: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck)

GROUP 22: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, up to and including 25 yds. struck)

GROUP 23: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. and up to and including 50 yds. struck); Rubber-tired earth-moving equipment operator, operating with the tandem push-pull system (multiple engine, up to and including 25 yds. struck)

GROUP 24: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 25: Concrete pump operator-truck mounted; Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck)

CRANES, PILEDRIVING AND HOISTING EQUIPMENT CLASSIFICATIONS

GROUP 1: Engineer oiler; Fork lift operator (includes loed, lull or similar types)

GROUP 2: Truck crane oiler

GROUP 3: A-frame or winch truck operator; Ross carrier operator (jobsite)

GROUP 4: Bridge-type unloader and turntable operator; Helicopter hoist operator

GROUP 5: Hydraulic boom truck; Stinger crane (Austin-Western or similar type); Tugger hoist operator (1 drum)

GROUP 6: Bridge crane operator; Cretor crane operator; Hoist operator (Chicago boom and similar type); Lift mobile operator; Lift slab machine operator (Vagtborg and similar types); Material hoist and/or manlift operator; Polar gantry crane operator; Self Climbing scaffold (or similar type); Shovel, backhoe, dragline, clamshell operator (over 3/4 yd. and up to 5 cu. yds. mrc); Tugger hoist operator

GROUP 7: Pedestal crane operator; Shovel, backhoe, dragline, clamshell operator (over 5 cu. yds. mrc); Tower crane repair; Tugger hoist operator (3 drum)

GROUP 8: Crane operator (up to and including 25 ton capacity); Crawler transporter operator; Derrick barge operator (up to and including 25 ton capacity); Hoist operator, stiff legs, Guy derrick or similar type (up to and including 25 ton capacity); Shovel, backhoe, dragline, clamshell operator (over 7 cu. yds., M.R.C.)

GROUP 9: Crane operator (over 25 tons and up to and including 50 tons mrc); Derrick barge operator (over 25 tons up to and including 50 tons mrc); Highline cableway operator; Hoist operator, stiff legs, Guy derrick or similar type (over 25 tons up to and including 50 tons mrc); K-crane operator; Polar crane operator; Self erecting tower crane operator maximum lifting capacity ten tons

GROUP 10: Crane operator (over 50 tons and up to and including 100 tons mrc); Derrick barge operator (over 50 tons up to and including 100 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 50 tons up to and including 100 tons mrc), Mobile tower crane operator (over 50 tons, up to and including 100 tons M.R.C.); Tower crane operator and tower gantry

GROUP 11: Crane operator (over 100 tons and up to and including 200 tons mrc); Derrick barge operator (over 100 tons up to and including 200 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 100 tons up to and including 200 tons mrc); Mobile tower crane operator (over 100 tons up to and including 200 tons mrc)

GROUP 12: Crane operator (over 200 tons up to and including 300 tons mrc); Derrick barge operator (over 200 tons up to and including 300 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 200 tons, up to and including 300 tons mrc); Mobile tower crane operator (over 200 tons, up to and including 300 tons mrc)
GROUP 13: Crane operator (over 300 tons); Derrick barge operator (over 300 tons); Helicopter pilot; Hoist operator, stiff legs, Guy derrick or similar type (over 300 tons); Mobile tower crane operator (over 300 tons)

TUNNEL CLASSIFICATIONS

GROUP 1: Skiploader (wheel type up to 3/4 yd. without attachment)

GROUP 2: Power-driven jumbo form setter operator

GROUP 3: Dinkey locomotive or motorperson (up to and including 10 tons)

GROUP 4: Bit sharpener; Equipment greaser (grease truck); Slip form pump operator (power-driven hydraulic lifting device for concrete forms); Tugger hoist operator (1 drum); Tunnel locomotive operator (over 10 and up to and including 30 tons)

GROUP 5: Backhoe operator (up to and including 3/4 yd.); Small Ford, Case or similar; Drill doctor; Grouting machine operator; Heading shield operator; Heavy-duty repairperson; Loader operator (Athey, Euclid, Sierra and similar types); Mucking machine operator (1/4 yd., rubber-tired, rail or track type); Pneumatic concrete placing machine operator (Hackley-Presswell or similar type); Pneumatic heading shield (tunnel); Pumpcrete gun operator; Tractor compressor drill combination operator; Tugger hoist operator (2 drum); Tunnel locomotive operator (over 30 tons)

GROUP 6: Heavy Duty Repairman

GROUP 7: Tunnel mole boring machine operator

ENGINEERS ZONES

$1.00 additional per hour for all of IMPERIAL County and the portions of KERN, RIVERSIDE & SAN BERNARDINO Counties as defined below:

That area within the following Boundary: Begin in San Bernardino County, approximately 3 miles NE of the intersection of I-15 and the California State line at that point which is the NW corner of Section 1, T17N,m R14E, San Bernardino Meridian. Continue W in a straight line to that point which is the SW corner of the northwest quarter of Section 6, T27S, R42E, Mt. Diablo Meridian. Continue North to the intersection with the Inyo County Boundary at that point which is the NE

corner of the western half of the northern quarter of Section 6, T25S, R42E, MDM. Continue W along the Inyo and San Bernardino County boundary until the intersection with Kern County, as that point which is the SE corner of Section 34, T24S, R40E, MDM. Continue W along the Inyo and Kern County boundary until the intersection with Tulare County, at that point which is the SW corner of the SE quarter of Section 32, T24S, R37E, MDM. Continue W along the Kern and Tulare County boundary, until that point which is the NW corner of T25S, R32E, MDM. Continue S following R32E lines to the NW corner of T31S, R32E, MDM. Continue W to the NW corner of T31S, R31E, MDM. Continue S to the SW corner of T32S, R31E, MDM. Continue W to SW corner of SE quarter of Section 34, T32S, R30E, MDM. Continue S to SW corner of T11N, R17W, SBM. Continue E along south boundary of T11N, SBM to SW corner of T11N, R7W, SBM. Continue S to SW corner of T9N, R7W, SBM. Continue E along south boundary of T9N, SBM to SW corner of T9N, R1E, SBM. Continue S along west boundary of R1E, SMB to Riverside County line at the SW corner of T1S, R1E, SBM. Continue E along south boundary of T1s, SBM (Riverside County Line) to SW corner of T1S, R10E, SBM. Continue S along west boundary of R10E, SBM to Imperial County line at the SW corner of T8S, R10E, SBM. Continue W along Imperial and Riverside county line to NW corner of T9S, R9E, SBM. Continue S along the boundary between Imperial and San Diego Counties, along the west edge of R9E, SBM to the south boundary of Imperial County/California state line. Follow the California state line west to Arizona state line, then north to Nevada state line, then continuing NW back to start at the point which is the NW corner of Section 1, T17N, R14E, SBM

$1.00 additional per hour for portions of SAN LUIS OBISPO, KERN, SANTA BARBARA & VENTURA as defined below:

That area within the following Boundary: Begin approximately 5 miles north of the community of Cholame, on the Monterey County and San Luis Obispo County boundary at the NW corner of T25S, R16E, Mt. Diablo Meridian. Continue south along the west side of R16E to the SW corner of T30S, R16E, MDM. Continue E to SW corner of T30S, R17E, MDM. Continue S to SW corner of T31S, R17E, MDM. Continue E to SW corner of T31S, R18E, MDM. Continue S along West side of R18E, MDM as it crosses into San Bernardino Meridian numbering area and becomes R30W. Follow the west side of R30W, SBM to the SW corner of T9N, R30W, SBM. Continue E along the south edge of T9N, SBM to the Santa Barbara County and Ventura County boundary at that point whch is the SW corner of Section 34.T9N, R24W, SBM, continue S along the Ventura County line to that point which is the SW corner of the SE quarter of Section 32, T7N, R24W, SBM. Continue E along the south edge of T7N, SBM to the SE corner to T7N, R21W, SBM. Continue N along East side of R21W, SBM to Ventura County and Kern County boundary at the NE corner of T8N, R21W. Continue W along the Ventura County and Kern County boundary to the SE corner of T9N, R21W. Continue North along the East edge of R21W, SBM to the NE corner of T12N, R21W, SBM. Continue West along the north edge of T12N, SBM to the SE corner of T32S, R21E, MDM. [T12N SBM is a think strip between T11N SBM

and T32S MDM]. Continue North along the East side of R21E, MDM to the Kings County and Kern County border at the NE corner of T25S, R21E, MDM, continue West along the Kings County and Kern County Boundary until the intersection of San Luis Obispo County. Continue west along the Kings County and San Luis Obispo County boundary until the intersection with Monterey County. Continue West along the Monterey County and San Luis Obispo County boundary to the beginning point at the NW corner of T25S, R16E, MDM.

$2.00 additional per hour for INYO and MONO Counties and the Northern portion of SAN BERNARDINO County as defined below:

That area within the following Boundary: Begin at the intersection of the northern boundary of Mono County and the California state line at the point which is the center of Section 17, T10N, R22E, Mt. Diablo Meridian. Continue S then SE along the entire western boundary of Mono County, until it reaches Inyo County at the point which is the NE corner of the Western half of the NW quarter of Section 2, T8S, R29E, MDM. Continue SSE along the entire western boundary of Inyo County, until the intersection with Kern County at the point which is the SW corner of the SE 1/4 of Section 32, T24S, R37E, MDM. Continue E along the Inyo and Kern County boundary until the intersection with San Bernardino County at that point which is the SE corner of section 34, T24S, R40E, MDM. Continue E along the Inyo and San Bernardino County boundary until the point which is the NE corner of the Western half of the NW quarter of Section 6, T25S, R42E, MDM. Continue S to that point which is the SW corner of the NW quarter of Section 6, T27S, R42E, MDM. Continue E in a straight line to the California and Nevada state border at the point which is the NW corner of Section 1, T17N, R14E, San Bernardino Meridian. Then continue NW along the state line to the starting point, which is the center of Section 18, T10N, R22E, MDM.

REMAINING AREA NOT DEFINED ABOVE RECIEVES BASE RATE

ENGI0012-004 08/01/2020

	Rates	Fringes
OPERATOR: Power Equipment (DREDGING)		
(1) Leverman	$ 56.40	30.00
(2) Dredge dozer	$ 50.43	30.00
(3) Deckmate	$ 50.32	30.00
(4) Winch operator (stern winch on dredge)	$ 49.77	30.00
(5) Fireman-Oiler, Deckhand, Bargeman, Leveehand	$ 49.23	30.00
(6) Barge Mate	$ 49.84	30.00

IRON0433-006 07/01/2020

	Rates	Fringes
IRONWORKER		
Fence Erector.....	$ 34.58	24.81
Ornamental, Reinforcing and Structural.....	$ 41.00	33.45

PREMIUM PAY:

$6.00 additional per hour at the following locations:

China Lake Naval Test Station, Chocolate Mountains Naval Reserve-Niland,
Edwards AFB, Fort Irwin Military Station, Fort Irwin Training Center-Goldstone, San Clemente Island, San Nicholas Island, Susanville Federal Prison, 29 Palms - Marine Corps, U.S. Marine Base - Barstow, U.S. Naval Air Facility - Sealey, Vandenberg AFB

$4.00 additional per hour at the following locations:

Army Defense Language Institute - Monterey, Fallon Air Base, Naval Post Graduate School - Monterey, Yermo Marine Corps Logistics Center
$2.00 additional per hour at the following locations:

Port Hueneme, Port Mugu, U.S. Coast Guard Station - Two Rock

LABO0089-001 07/01/2020

	Rates	Fringes
LABORER (BUILDING and all other Residential Construction)		
Group 1.....	$ 34.18	20.48
Group 2.....	$ 34.86	20.48
Group 3.....	$ 35.57	20.48
Group 4.....	$ 36.37	20.48
Group 5.....	$ 38.30	20.48
LABORER (RESIDENTIAL CONSTRUCTION - See definition below)		
(1) Laborer.....	$ 30.82	18.80
(2) Cleanup, Landscape, Fencing (Chain Link & Wood).	$ 29.53	18.80

RESIDENTIAL DEFINITION: Wood or metal frame construction of single family residences, apartments and condominums - excluding (a) projects that exceed three stories over a garage level, (b) any utility work such as telephone, gas, water, sewer and other utilities and (c) any fine grading work, utility work or paving work in the future street and

public right-of-way; but including all rough grading work at the job site behind the existing right of way

LABORER CLASSIFICATIONS

GROUP 1: Cleaning and handling of panel forms; Concrete Screeding for Rought Strike-off; Concrete, water curing; Demolition laborer; Flagman; Gas, oil and/or water pipeline laborer; General Laborer; General clean-up laborer; Landscape laborer; Jetting laborer; Temporary water and and decks); air lines laborer; Material hoseman (walls, slabs, floors Plugging, filling of Shee-bolt holes; Dry packing of concrete ; Railroad maintenance, Repair Trackman and road beds, Streetcar and railroad construction trac laborers; Slip form raisers; Slurry seal crews (mixer operator, applicator operator, squeegee man, Shuttle man, top man), filling of cracks by any method on any surface; Tarman and mortar man; Tool crib or tool house laborer; Window cleaner; Wire Mesh puling-all concrete pouring operations

GROUP 2: Asphalt Shoveler; Cement Dumper (on 1 yard or larger mixer and handling bulk cement); Cesspool digger and installer; Chucktender; Chute man, pouring concrete, the handling of the cute from ready mix trucks, such as walls, slabs, decks, floors, foundations, footings, curbs, gutters and sidewalks; Concrete curer-impervious membrane and form oiler; Cutting torch operator (demoliton); Guinea chaser; Headboard man-asphlt; Laborer,
packing rod steel and pans; membrane vapor barrier installer; Power broom sweepers (small); Riiprap, stonepaver, placing stone or wet sacked concrete; Roto scraper and tiller; Tank sealer and cleaner; Tree climber, faller, chain saw operator, Pittsburgh Chipper and similar type brush shredders; Underground laborers, including caisson bellower

GROUP 3: Buggymobile; Concrete cutting torch; Concrete cutting torch; Concrete pile cutter; Driller, jackhammer, 2 1/2 feet drill steel or longer; Dri Pak-it machine; High sealer (including drilling of same); Hydro seeder and similar type; Impact wrench, mult-plate; Kettlemen, potmen and mean applying asphalt, lay-kold, creosote, line caustic and similar type materials (applying means applying, dipping, brushing or handling of such materials for pipe wrapping and waterproofing); Operators of pneumatic, gas, electric tools, vibratring machines, pavement breakers, air blasting, come-along, and similar mechanical tools not separately classified herein; Pipelayers back up man coating, grouting, making of joints, sealing, caulking, diapering and inclduing rubber gasket joints, pointing and any and all other services; Rotary Scarifier or multiple head concrete chipping scaarifier; Steel header board man and guideline setter; Tampers, Barko, Wacker and similar type; Trenching machine, handpropelled

GROUP 4: Asphalt raker, luterman, ironer, apshalt dumpman and asphalt spreader boxes (all types); Concrete core cutter

(walls, floors or ceilings), Grinder or sander; Concrete saw man; cutting walls or flat work, scoring old or new concrete; Cribber, shorer, lagging, sheeting and trench bracing, hand-guided lagging hammer; Laser beam in connection with laborer's work; Oversize concrete vibrator operator 70 pounds and over; Pipelayer performing all services in the laying, installation and all forms of connection of pipe from the point of receiving pipe in the ditch until completion of oepration, including any and all forms of tubular material, whether pipe, metallic or non-metallic, conduit, and any other stationary type of tubular device used for the conveying of any substance or element, whether water, sewage, solid, gas, air or other product whatsoever and without regard to the nature of material from which the tubular material is fabricated; No joint pipe and stripping of same; Prefabricated manhole installer; Sandblaster (nozzleman), Porta shot-blast, water blasting

GROUP 5: Blasters Powderman-All work of loading holes, placing and blasting of all pwder and explosives of whatever type, regardless of method used for such loading and placing; Driller-all power drills, excluding jackhammer, whether core, diamond, wagon, track, multiple unit, and any and all other types of mechanical drills without regard to the form of motive power.

LABO0089-002 11/01/2019

	Rates	Fringes
LABORER (MASON TENDER)....	$ 32.00	18.28

LABO0089-004 07/01/2020

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
Laborers:		
Group 1.....	$ 35.30	20.48
	Rates	Fringes
Group 2.....	$ 35.76	20.48
Group 3.....	$ 36.17	20.48
Group 4.....	$ 37.01	20.48
Group 5.....	$ 40.28	20.48

LABORER CLASSIFICATIONS

GROUP 1: Laborer: General or Construction Laborer, Landscape Laborer. Asphalt Rubber Material Loader. Boring Machine Tender (outside), Carpenter Laborer (cleaning, handling, oiling & blowing of panel forms and lumber), Concrete

Laborer, Concrete Screeding for rough strike-off, Concrete water curing. Concrete Curb & Gutter laborer, Certified Confined Space Laborer, Demolition laborer & Cleaning of Brick and lumber,Expansion Joint Caulking; Environmental Remediation, Monitoring Well, Toxic waste and Geotechnical Drill tender, Fine Grader, Fire Watcher, Limbers, Brush Loader, Pilers and Debris Handlers. flagman. Gas Oil and Water Pipeline Laborer. Material Hoseman (slabs, walls, floors, decks); Plugging, filling of shee bolt holes; Dry packing of concrete and patching; Post Holer Digger (manual); Railroad maintenance, repair trackman, road beds; Rigging & signaling; Scaler, Slip-Form Raisers, Filling cracks on any surface, tool Crib or Tool House Laborer, Traffic control (signs, barriers, barricades, delineator, cones etc.), Window Cleaner

GROUP 2: Asphalt abatement; Buggymobile; Cement dumper (on 1 yd. or larger mixers and handling bulk cement); Concrete curer, impervious membrane and form oiler; Chute man, pouring concrete; Concrete cutting torch; Concrete pile cutter; driller/Jackhammer, with drill steel 2 1/'2 feet or longer; Dry pak-it machine; Fence erector; Pipeline wrapper, gas, oil, water, pot tender & form man; Grout man; Installation of all asphalt overlay fabric and materials used for reinforcing asphalt; Irrigation laborer; Kettleman-Potman hot mop, includes applying asphalt, lay-klold, creosote, lime caustic and similar tyhpes of materials (dipping, brushing, handling) and waterproofing; Membrane vapor barrier installer; Pipelayer backup man (coating, grouting, making of joints, sealing caulkiing, diapering including rubber basket joints, pointing); Rotary scarifier, multiple head concrete chipper; Rock slinger; Roto scraper & tiller; Sandblaster pot tender; Septic tank digger/installer; Tamper/wacker operator; Tank scaler & cleaner; Tar man & mortar man; Tree climber/faller, chainb saw operator, Pittsburgh chipper & similar type brush shredders.

GROUP 3: Asphalt, installation of all frabrics; Buggy Mobile Man, Bushing hammer; Compactor (all types), Concrete Curer - Impervious membrane, Form Oiler, Concrete Cutting Torch, Concrete Pile Cutter,Driller/Jackhammer with drill steel 2 1/2 ft or longer, Dry Pak-it machine, Fence erector including manual post hole digging, Gas oil or water Pipeline Wrapper - 6 ft pipe and over, Guradrail erector, Hydro seeder, Impact Wrench man (multi plate), kettleman-Potman Hot Mop includes applying Asphalt, Lay-Kold, Creosote, lime caustic and similar types of materials (dipping, brushing or handling) and waterproofing. Laser Beam in connection with Laborer work. High Scaler, Operators of Pneumatic Gas or Electric Tools, Vibrating Machines, Pavement Breakers, Air Blasting, Come-Alongs and similar mechanical tools, Remote-Controlled Robotic Tools in connection with Laborers work. Pipelayer Backup Man (Coating, grouting,m makeing of joints, sealing, caulking, diapering including rubber gasket joints, pointing and other services). Power Post Hole Digger,

Rotary Scarifier (multiple head concrete chipper scarifier), Rock Slinger, Shot Blast equipment (8 to 48 inches), Steel Headerboard Man and Guideline Setter, Tamper/Wacker operator and similar types, Trenching Machine hand propelled.

GROUP 4: Any worker exposed to raw sewage. Asphalt Raker, Luteman, Asphalt Dumpman, Asphalt Spreader Boxes, Concrete Core Cutter, Concrete Saw Man, Cribber, Shorer, Head Rock Slinger. Installation of subsurface instrumentation, monitoring wells or points, remediation system installer; Laborer, asphalt-rubber distributor bootman; Oversize concrete vibrator operators, 70 pounds or over. Pipelayer, Prfefabricated Manhole Installer, Sandblast Nozzleman (Water Balsting-Porta Shot Blast), Traffic Lane Closure.

GROUP 5: Blasters Powderman-All work of loading holes, placing and blasting of all powder and explosives of whatever type, regardless of method used for such loading and placing; Horizontal directional driller, Boring system, Electronic traking, Driller: all power drills excluding jackhammer, whether core, diamond, wagon, track, multiple unit, and all other types of mechanical drills without regard to form of motive power. Environmental remediation, Monitoring well, Toxic waste and Geotechnical driller, Toxic waste removal. Welding in connection with Laborer's work.

LABO0300-005 01/01/2018

	Rates	Fringes
Asbestos Removal Laborer...	$ 33.19	17.78

SCOPE OF WORK: Includes site mobilization, initial site cleanup, site preparation, removal of asbestos-containing material and toxic waste, encapsulation, enclosure and disposal of asbestos- containing materials and toxic waste by hand or with equipment or machinery; scaffolding, fabrication of temporary wooden barriers and assembly of decontamination stations.

LABO0345-001 07/01/2020

	Rates	Fringes
LABORER (GUNITE)		
GROUP 1.....	$ 45.05	19.62
GROUP 2.....	$ 44.10	19.62
GROUP 3.....	$ 40.56	19.62

FOOTNOTE: GUNITE PREMIUM PAY: Workers working from a Bosn'n's Chair or suspended from a rope or cable shall receive 40 cents per hour above the foregoing applicable classification rates. Workers doing gunite and/or shotcrete work in a tunnel shall receive 35 cents per hour above the foregoing applicable classification rates, paid on a portal -to-portal basis. Any work performed on, in or above any smoke stack, silo, storage elevator or similar type of structure, when such structure is in excess of75'-0"" above base level and which work must be performed in whole or in part more than 75'-0"" above base level, that work performed above the 75'-0"" level shall be compensated for at 35 cents per hour above the applicable classification wage rate.

GUNITE LABORER CLASSIFICATIONS

GROUP 1: Rodmen, Nozzlemen

GROUP 2: Gunmen

GROUP 3: Reboundmen

LABO1184-001 07/01/2020

Laborers: (HORIZONTAL DIRECTIONAL DRILLING)

	Rates	Fringes
(1) Drilling Crew Laborer...	$ 37.85	15.99
(2) Vehicle Operator/Hauler.	$ 38.02	15.99
(3) Horizontal Directional Drill Operator.....	$ 39.87	15.99
(4) Electronic Tracking Locator.....	$ 41.87	15.99
Laborers: (STRIPING/SLURRY SEAL)		
GROUP 1.....	$ 39.06	19.01
GROUP 2.....	$ 40.36	19.01
GROUP 3.....	$ 42.37	19.01
GROUP 4.....	$ 44.11	19.01

LABORERS - STRIPING CLASSIFICATIONS

GROUP 1: Protective coating, pavement sealing, including repair and filling of cracks by any method on any surface in parking lots, game courts and playgrounds; carstops; operation of all related machinery and equipment; equipment repair technician
GROUP 2: Traffic surface abrasive blaster; pot tender - removal of all traffic lines and markings by any method (sandblasting, waterblasting, grinding, etc.) and preparation of surface for coatings. Traffic control person: controlling and directing traffic through both

conventional and moving lane closures; operation of all related machinery and equipment

GROUP 3: Traffic delineating device applicator: Layout and application of pavement markers, delineating signs, rumble and traffic bars, adhesives, guide markers, other traffic delineating devices including traffic control. This category includes all traffic related surface preparation (sandblasting, waterblasting, grinding) as part of the application process. Traffic protective delineating system installer: removes, relocates, installs, permanently affixed roadside and parking delineation barricades, fencing, cable anchor, guard rail, reference signs, monument markers; operation of all related machinery and equipment; power broom sweeper

GROUP 4: Striper: layout and application of traffic stripes and markings; hot thermo plastic; tape traffic stripes and markings, including traffic control; operation of all related machinery and equipment

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LABO1414-003 08/05/2020

	Rates	Fringes
LABORER		
PLASTER CLEAN-UP LABORER....	$ 36.03	21.01
PLASTER TENDER.....	$ 38.58	21.01

Work on a swing stage scaffold: $1.00 per hour additional.

Work at Military Bases - $3.00 additional per hour:
Coronado Naval Amphibious Base, Fort Irwin, Marine Corps Air Station-29 Palms, Imperial Beach Naval Air Station, Marine Corps Logistics Supply Base, Marine Corps Pickle Meadows, Mountain Warfare Training Center, Naval Air Facility-Seeley, North Island Naval Air Station, Vandenberg AFB.

PAIN0036-001 07/01/2020

	Rates	Fringes
Painters: (Including Lead Abatement)		
(1) Repaint (excludes San Diego County).....	$ 29.59	17.12
(2) All Other Work.....	$ 33.12	17.24

REPAINT of any previously painted structure. Exceptions: work involving the aerospace industry, breweries, commercial recreational facilities, hotels which operate commercial establishments as part of hotel service, and sports facilities.

PAIN0036-010 10/01/2020

	Rates	Fringes
DRYWALL FINISHER/TAPER		
(1) Building & Heavy Construction	$ 36.69	18.90
(2) Residential Construction (Wood frame apartments, single family homes and multi-duplexes up to and including four stories)	$ 27.11	17.51

PAIN0036-012 10/01/2020

	Rates	Fringes
GLAZIER	$ 45.55	18.06

PAIN0036-019 06/01/2020

	Rates	Fringes
SOFT FLOOR LAYER	$ 32.27	17.24

PLAS0200-005 08/07/2019

	Rates	Fringes
PLASTERER	$ 43.73	16.03

NORTH ISLAND NAVAL AIR STATION, COLORADO NAVAL AMPHIBIOUS BASE, IMPERIAL BEACH NAVAL AIR STATION: $3.00 additional per hour.

CEMENT MASON/CONCRETE FINISHER		
GROUP 1	$ 26.34	21.12
GROUP 2	$ 27.99	21.12
GROUP 3	$ 30.07	21.12

CEMENT MASONS - work inside the building line, meeting the following criteria:

GROUP 1: Residential wood frame project of any size; work classified as Type III, IV or Type V construction; interior tenant improvement work regardless the size of the project; any wood frame project of four stories or less.

GROUP 2: Work classified as type I and II construction

GROUP 3: All other work

PLUM0016-006 09/01/2020

	Rates	Fringes
PLUMBER, PIPEFITTER, STEAMFITTER		
Camp Pendleton; Vandenberg Air Force Base.....	$ 55.88	23.66
	Rates	Fringes
Work ONLY on new additions and remodeling of commercial buildings, bars, restaurants, and stores not to exceed 5,000 sq. ft. of floor space.....	$ 50.70	23.73
Work ONLY on strip malls, light commercial, tenant improvement and remodel work.....	$ 38.73	22.06
All other work except work on new additions and remodeling of bars, restaurant, stores and commercial buildings not to exceed 5,000 sq. ft. of floor space and work on strip malls, light commercial, tenant improvement and remodel work.....	$ 52.28	24.71

PLUM0016-011 09/01/2020

	Rates	Fringes
PLUMBER/PIPEFITTER		
Residential.....	$ 41.62	20.63

PLUM0345-001 09/01/2020

	Rates	Fringes
PLUMBER		
Landscape/Irrigation Fitter.	$ 35.30	24.10
Sewer & Storm Drain Work....	$ 39.39	21.48

ROOF0045-001 07/01/2020

	Rates	Fringes
ROOFER.....	$ 36.25	9.24

SFCA0669-001 04/01/2020

	Rates	Fringes
SPRINKLER FITTER.....	$ 41.57	24.10

SHEE0206-001 07/01/2020

	Rates	Fringes
SHEET METAL WORKER		
Camp Pendleton.....	$ 42.62	29.55
Except Camp Pendleton.....	$ 40.62	29.55
Sheet Metal Technician.....	$ 30.51	9.49

SHEET METAL TECHNICIAN - SCOPE:
a. Existing residential buildings, both single and multi-family, where each unit is heated and/or cooled by a separate system b. New single family residential buildings including tracts. c. New multi-family residential buildings, not exceeding five stories of living space in height, provided each unit is heated or cooled by a separate system. Hotels and motels are excluded. d. LIGHT COMMERCIAL WORK: Any sheet metal, heating and air conditioning work performed on a project where the total construction cost, excluding land, is under $1,000,000 e. TENANT IMPROVEMENT WORK: Any work necessary to finish interior spaces to conform to the occupants of commercial buildings, after completion of the building shell

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TEAM0166-001 09/01/2019

	Rates	Fringes
Truck drivers:		
GROUP 1.....	$ 18.90	34.69
GROUP 2.....	$ 26.49	34.69
GROUP 3.....	$ 26.69	34.69
GROUP 4.....	$ 26.89	34.69
GROUP 5.....	$ 27.09	34.69
GROUP 6.....	$ 27.59	34.69
GROUP 7.....	$ 29.09	34.69

FOOTNOTE: HAZMAT PAY: Work on a hazmat job, where hazmat certification is required, shall be paid, in addition to the classification working in, as follows: Levels A, B and C - +$1.00 per hour. Workers shall be paid hazmat pay in increments of four (4) and eight (8) hours.

TRUCK DRIVER CLASSIFICATIONS

GROUP 1: Fuel Man, Swamper

GROUP 2: 2-axle Dump Truck, 2-axle Flat Bed, Concrete Pumping Truck, Industrial Lift Truck, Motorized Traffic Control, Pickup Truck on Jobsite

GROUP 3: 2-axle Water Truck, 3-axle Dump Truck, 3-axle Flat Bed, Erosion Control Nozzleman, Dump Crete Truck under 6.5 yd, Forklift 15,000 lbs and over, Prell Truck, Pipeline Work Truck Driver, Road Oil Spreader, Cement Distributor or Slurry Driver, Bootman, Ross Carrier

GROUP 4: Off-road Dump Truck under 35 tons 4-axles but less than 7-axles, Low-Bed Truck & Trailer, Transit Mix Trucks under 8 yd, 3-axle Water Truck, Erosion Control Driver, Grout Mixer Truck, Dump Crete 6.5yd and over, Dumpster Trucks, DW 10, DW 20 and over, Fuel Truck and Dynamite, Truck Greaser, Truck Mounted Mobile Sweeper 2-axle Winch Truck

GROUP 5: Off-road Dump Truck 35 tons and over, 7-axles or more, Transit Mix Trucks 8 yd and over, A-Frame Truck, Swedish Cranes

GROUP 6: Off-Road Special Equipment (including but not limited to Water Pull Tankers, Athey Wagons, DJB, B70 Wuclids or like Equipment)

GROUP 7: Repairman

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).
Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage

payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

SECTION 31 71 19
MICROTUNNELING

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. The Work specified in this Section consists of installing plastic lined reinforced concrete (PLRCP) pipe along the alignment shown in the Contract Drawings and documents by Microtunneling. The soil material and hydrological conditions are described in the Geotechnical Data Report (GDR) and Geotechnical Baseline Report (GBR). "Geotechnical Report, Pump Station Portion, Morena Pump Station, WW Force Main, and Brine/Centrate Conveyance Predesign (NC01), San Diego, California," prepared by AECOM, dated January 5, 2018. Curved and straight microtunneling are specified the CONTRACTOR may adjust the shown curved alignment within the project easement boundary subject to OWNER's approval. CONTRACTOR shall furnish all labor, tools, and equipment, and perform operations necessary or incidental for the excavation and support of microtunneling operations including construction of the launching and receiving shafts and supply of suitable jacking pipes.

B. The support of excavation for shafts shall be in accordance with the Contract Documents, except as modified herein for microtunneling operations. This specification describes the additional measures that shall be provided by CONTRACTOR for each of the launching and receiving shafts used with the microtunneling method.

C. The shafts used for launching and receiving shall be made fully adequate for the microtunneling work and for any permanent structures situated within the shafts. CONTRACTOR shall be responsible for providing each launching shaft and each receiving shaft with the provisions necessary to perform the microtunneling operations. Furnish labor, equipment, material, and additional design, as necessary, to meet the minimum requirements as contained herein.

D. CONTRACTOR shall hire a California licensed Professional Engineer meeting the requirements as contained herein. CONTRACTOR is responsible for the work produced by this engineer.

E. CONTRACTOR shall provide each launch shaft with thrust blocks, entrance seals, base slabs, pumping and drainage systems, ventilation systems, electrical systems, and lighting systems. CONTRACTOR's licensed engineer shall design the shaft support (SOE), thrust blocks, entrance seals, and base slabs including necessary modifications to the shoring. CONTRACTOR shall also be responsible for developing a Fluid Control Plan to be implemented by CONTRACTOR at each of the shaft sites in accordance with the requirements as contained herein.

F. CONTRACTOR shall provide each receiving shaft with exit seals, base slabs, and, as necessary, a pumping and drainage system to maintain dry working conditions. CONTRACTOR's licensed engineer shall design the exit seals including necessary modifications to the shoring.

G. CONTRACTOR shall prevent the inflow of ground and/or groundwater into the shafts during the microtunneling operations including but not limited to exit and entry of the shaft during the launching and receiving processes of the MTBM. The ground shall be improved, as necessary, to prevent any inflow of ground and/or groundwater in excess of specified tolerances as contained herein.

H. CONTRACTOR shall prevent the machine from veering off of the design alignment during the launching, jacking, and/or receiving process in excess of the specified tolerances as contained herein. CONTRACTOR shall redesign pipeline and associated structures at no additional cost to the OWNER, if and when necessary due to exceedance of the specified tolerances.

I. CONTRACTOR shall be responsible for ensuring that each of the shafts, including modifications, used with the microtunneling is fully adequate for installation of the permanent structures as shown on the Contract Documents. CONTRACTOR shall modify these shafts as necessary to accommodate the construction of these structures. Furthermore, CONTRACTOR's licensed engineer shall provide additional design necessary for completing this work.

J. The CONTRACTOR shall provide a microtunnel boring machine (MTBM) capable of excavating through the ground and any material as described in the GBR, furnishing and installing jacking pipe complete and operational as specified in the documents to the specified line and grade. Furnish and attempt to replace lubricant with grout behind the jacking pipes to completely fill any annular void between the pipe extrados and the excavated surface through grout holes in the pipes.

K. CONTRACTOR shall store, process, properly transport, and legally dispose of muck and/or excavated material in accordance with the Contract Documents.

L. Microtunneling operations will be carried out to minimize settlements to within limits established in the Contract Documents. CONTRACTOR shall be responsible for damage caused by construction activities to include damage by subcontractors, and conducting restoration of existing facilities for damages due to shaft construction and microtunneling related ground movement.

M. CONTRACTOR's engineer shall develop a Survey Plan in accordance with the requirements as contained herein. The Licensed surveyor shall perform survey readings associated with this plan.

N. The 60in PLRCP microtunnel drive between Junction Structure 1 jacking shaft and the pump station passes under a levee and buried levee RipRap as indicated in the GBR and on the drawings. Contractor is advised that pieces of RipRap may be found in the tunnel alignment. Contractor will carry out at least 3 pilot bores of at least 150ft long from the jacking shaft to probe for obstructions in the crown of the tunnel alignment. Contractor will submit means and methods to complete the pipeline as per the drawings.

O. The 48in steel casing microtunnel drive from Custer Street to the 66in Overflow Pipe on Friars road passes under the Trolley tracks and a levee and as indicated on the drawings and GBR will pass through the bottom levee rip rap. Contractor must submit means and methods to remove or pass through the rip rap and complete the casing installation without causing movement to the trolley tracks.

P. All tunneling construction work and services, including layout and excavation locations, shall be responsibility of the Contractor. All consultant service activities operating under the jurisdiction of a regulating professional state board or federal agency shall be duly certified and registered under the regulating body. The Contractor will be responsible for protecting and preserving all project survey reports. The City will provide QA/QC surveys on project settlement monitoring survey reports".

1.1 REFERENCES:

A. American Association of State Highway and Transportation Officials (AASHTO).

B. American Society of Civil Engineers (ASCE).

C. California Occupational Safety and Health Administration (CAL-OSHA) – Particular attention is called to Sub-part S, Underground Construction, and Sub-part K, Electrical, of the Standards and Guidelines 29 CFR Part 1926,

D. Guidelines 2007 and ASCE 36 Standard Construction Guidelines for Microtunneling

1.2 DEFINITIONS:

A. Microtunneling: A continuously supported trenchless installation of a pipe by jacking the pipe directly behind a closed face, remotely controlled, steerable, guided, microtunnel boring machine (MTBM) which provides a continuous pressure on the face of the excavation to balance groundwater and earth pressures.

B. Microtunneling Boring Machine (MTBM) :The total system of the mechanized excavating equipment, consisting of a boring and articulated steering head, trailing shield segment(s), auxiliary and support equipment, and other items necessary for the sustained excavation operations of the microtunnel.

C. Jacking Pipe: pipe specifically designed to withstand jacking loads as defined herein, that serves as initial construction lining and tunnel support, and as the final carrier or casing pipe.

D. Hydraulic pipe joint : Specialty pipe joint system for jacking pipe through a curved drive to spread the jacking force or reduce force concentration over the pipe perimeter. It consists of a hose mounted in the pipe joint with controllable deformation and fluid pressure, which can be translated into forces acting on the pipe.

E. Ground Conditioning Agents: Used during microtunneling operations to control settlement, reduce cutting head torque, and prevent excessive wear on cutting tools and other MTBM components. These may include 1) foam (both simple surfactant/air/ water foam and polymer/surfactant/air/water foam); 2) polymers; 3) bentonite slurry.

F. Lubrication: Bentonite and/or polymer lubricant injected in the annular space between the pipe and surrounding ground during microtunneling to support the annular space and reduce friction between the pipe and soil.

G. Muck: Material excavated from shafts or tunnel including any ground treatment, lubrication, or slurry. Also referred to as spoils.

H. Spoil Transport System: A system of piping, pumps, valves, screw conveyors, or other equipment which transports the muck from the tunnel face to the surface. This includes the slurry treatment plant if a slurry based system is utilized.

I. Jacking Shaft: Excavation from which the MTBM is launched, which incorporates a thrust block to spread reaction loads to the ground. Also referred to as launching shaft.

J. Receiving Shaft: Excavation to which the MTBM is launched towards. A shaft can be used as both a jacking shaft and receiving shaft for adjacent microtunnel drives but is not required.

K. Jacking System: A system of hydraulic jacks installed inside the jacking shaft that provides thrust for the string of pipe in the ground and the MTBM. Capacity of jacks and extension rate is synchronized with excavation rate of the MTBM.

L. Intermediate Jacking Station (IJS): A fabricated steel cylinder fitted with hydraulic jacks installed at intermediate locations in the pipe string to allow selective shoving of discrete segments of the total pipe string and MTBM.

M. Laser: An optical system projecting a beam to a target to provide guidance for and location of the MTBM.

N. Guidance system : A system that may be based on a laser for straight drives or a Gyro or an automated or manual system based on surveyors total stations and prisms to provide position information for curved drives

O. Controls: The system which provides operational control to the MTBM including steering and synchronizes excavation, removal of the excavated material, and jacking of pipe to maintain overall balance to provide complete and adequate ground support at all times. The controls are generally containerized and located on the surface adjacent to the Jacking shaft.

P. Face Access: Provision of an opening in the MTBM pressure wall to give man access to the muck chamber behind the cutter wheel to allow cutter tool changes in stable ground

Q. AirLock: A system that allows access to the muck chamber behind the cutter head under pressure to change cutter tools if required

R. Contact Grouting: Grout used to fill the annular space between the pipe and the soil due to MTBM overcut upon completion of a microtunnel drive.

S. Dewatering: System of wells or excavations and pumps used for lowering the groundwater and/or removing groundwater from the microtunnel shafts.

T. Entrance Seal: A mechanism incorporated into the launching shaft, including any necessary ground improvement, to prevent the inflow of ground and/or groundwater into the shaft while launching the MTBM and jacking subsequent pipes.

U. Exit Seal: A mechanism incorporated into the receiving shaft, including any necessary ground improvement, to prevent the inflow of ground and/or groundwater into the shaft while in the process of recovering the MTBM at the receiving shaft.

V. Grade: Vertical alignment.

W. Launching: The machine is in the process of being launched at the beginning of a drive when passing through the entrance seal along the alignment beyond the outside edge of the launching shaft

X. Line: Horizontal alignment.

Y. Receiving: The machine is in the process of being received at the end of a drive when passing through the exit seal along the alignment beyond the outside edge of the receiving shaft.

Z. Shoring: Scheme of the shaft for supporting the excavation and controlling the groundwater.

AA. Thrust Block: A thrust block, including necessary ground improvement, is used to evenly distribute the jacking loads to the ground as part of the pipe installation process without excess movement or misalignment of the equipment.

BB. Pilot Bore: A small diameter test bore to be used to probe the ground on the tunnel alignment for obstructions.

1.3 SUBMITTALS:

A. Submit the following in accordance with the Contract Documents.

1. Coordination and Implementation Plans to demonstrate that applicable requirements from the Contract Documents as well as the requirements as contained herein, have been reviewed and coordinated by CONTRACTOR. Each of the subcontractors, if any, shall sign these plans.

2. Fluid Control Plan to ensure that the equipment operator maintains full control over fluid volumes and fluid pressures during microtunneling operations including slurries and/or lubricants. CONTRACTOR shall determine the construction activities at each launch shaft site location and describe these in detail. CONTRACTOR's engineer shall evaluate these activities and develop a plan including recommendations to ensure that fluid control is not impeded to any degree by any construction activity occurring at the site including but not limited to backfilling operations, leakage in the shoring, dewatering activities, and induced flow of groundwater. Consideration shall be given to the ground and groundwater conditions as defined in the GBR. CONTRACTOR's engineer shall sign this plan.

3. Shaft Layout and Details: For each microtunneling shaft and drive from it, provide complete details, drawings, and schematics, as applicable. Show layout of shaft, including equipment, drawn to scale. Demonstrate that proposed layout of shafts is adequate for sequence of construction, equipment operations, and means and methods of pipe installation including required acceptance testing. Describe in detail provisions for the working slab, invert treatment, and pump and drainage systems. Include details of lighting, ventilation, hydraulic, and electrical systems.

4. Structures Shown on Contract Documents: Evaluate each microtunneling shaft and demonstrate that each shaft is adequate for installation of the permanent structures as shown on the Contract Documents including each stage of construction and backfilling. Provide detailed descriptions, procedures, shop drawings, schematics, and explanations. Furthermore for design modifications to accommodate these structures, provide fully

developed design details, material requirements, standards, calculations, shop drawings, procedures, construction stages, and explanations signed and sealed by CONTRACTOR's engineer. Evaluate ground improvement schemes and contingency measures to be implemented as part of the design.

5. Contractor will submit means and methods to carry out pilot tube probing under the levee on the drive between Junction structure 1 jacking shaft and the pump station, and if obstructions are found in the tunnel alignment a method for completing the drive as per the contract drawings.

6. Contractor will submit specific means and methods to complete the 48in casing drive through the levee riprap and under the trolley tracks between custer street and the 66in Overflow pipe.

7. Survey Techniques: Provide complete details that fully describe the survey techniques to be used for transfer of line and grade.

8. Provide details of site monitoring plan including provision of measuring ground movements at shafts and along the tunnel alighnment and the monitoring of any existing structures within 100ft of the centerline of the excavation and tunnel alignment. Submit a plan for actions to be taken in the case of ground movements or movements of structures exceeding the allowable movement limits (Unless otherwise submitted 1/2in movement requires action to be taken as per the plan)

9. Qualifications of key personnel to include CONTRACTOR's California licensed engineer, project superintendent, MTBM operators, shift supervisors, and licensed surveyor.

10. Field Inspections, not less than once per week, in accordance with requirements as contained herein.

B. Shop Drawings (Minimum of 60 days before microtunneling is scheduled to begin):

1. Calculations and working drawings signed and sealed by a Professional Engineer registered in the State of California, showing jacking and reception shafts support, including shaft exit cut outs and thrust blocks designed to resist maximum jacking loads.

2. Working drawings indicating limits of jacking and reception shafts showing layout of tunneling and ancillary equipment.

3. MTBM shop drawings including:

    a. Configuration of cutterhead and over cut.

b. Ventilation system details for personnel entry to the MTBM.
c. Provision for cutter tool replacement during a drive
d. If an Airlock is supplied the Airlock operational manual
e. Jacking pipe lubrication system details.
f. Grade and alignment control system details.
g. MTBM emergency groundwater control provisions.
h. Details of slurry pumping and separation control if applicable.

4. Jacking pipe calculations and details as required by the Contract Documents.

5. Calculations and working drawings signed and sealed by a Professional Engineer registered in the State of California for methods of controlling groundwater, in accordance with the Contract Documents, during microtunneling.

6. Show pertinent dimensions, spacing, and layout of Microtunneling components. Indicate sizes, shapes, material specifications, and elevations, as related to depth of excavation. Include plan, elevations, sections, and details showing the arrangement and method of installation during intermediate construction stages in addition to providing the final stages.

C. Design calculations:

1. Include design assumptions, and for computer software, provide the program input.

2. Demonstrate the integrity of the pipe design and conformance to applicable design standards. Account for loads, sequences, and conditions during the various construction stages.

3. Provide analyses to determine impacts with existing site improvements including but not limited to structures and utilities.

4. For backfilling of shafts after microtunneling operations, provide analyses for end bearing capacity, skin friction/down-drag, and settlement.

D. Show existing structures, utilities, trees, and other site improvements located within each of these shaft areas.

E. Product Data (Minimum of 60 days before microtunneling is scheduled to begin):

1. Submit details of muck or slurry conditioning additives used to reduce machine applied torque and maintain muck flow and pressure holding capability.

F. Examples of Shift reports & Data Recording printouts (Minimum of 60 days before microtunneling is scheduled to begin):

1. A sample of the Data log printout or manual log of the jacking operation to be used, which will include the following items and be provided every 24hrs:

    a. Position of the MTBM in relation to the design line and grade.
    b. Jacking forces exerted on the pipe and at each intermediate jacking station if applicable.
    c. Date, starting time, and finish time of each pipe joint.
    d. Instantaneous jacking rate and total distance jacked.
    e. Position of the steering jacks.
    f. Pitch and roll of the MTBM.
    g. Cutterhead RPM & torque.
    h. Details of problems, obstructions, or delays: including the conjectured cause.
    i. Rotational speed of screw conveyor if applicable.
    j. For slurry based system: The volume of slurry in both the supply and return side of the slurry loop, indication of slurry bypass valve position, and indication of pressure in face support chamber.
    k. Face water jet use .

    l. For slurry based system the viscosity and density of the slurry supply fluid to the MTBM
    m. Shift report identifying the operating crew, weather , any downtime and reasons, description of the ground being excavated,

2. A sample of the visual inspection form to be used.

3. Settlement monitoring report showing ground movements for each monitoring point and for each monitored structure. Monitoring survey will be carried out daily for all monitoring points within 100ft of the MTBM during excavation.

G. Special Equipment and Repair (Minimum of 60 days before microtunneling is scheduled to begin):

1. Certification by the original MTBM manufacturer of the thrust, torque, condition, and operational characteristics of equipment to be used for installing the specified pipe. The microtunneling equipment shall employ a spoil removal system with a pressure balance system that is capable of equalizing pressures between the tunnel face and the microtunneling machine head to positively and continuously support the face of the excavation to balance groundwater and earth pressures.

2. Manufacturer's literature describing in detail the microtunneling system to be used. If the contract documents specify curved microtunneling , provide a detailed description of at least one similarly sized microtunnel project on which this system or similar has been successfully used in a curved drive application. Provide the names, addresses and telephone numbers of owner's representatives for these projects as well as the length, diameter, curve properties, and pipe material used. Indicate whether the machine proposed for this contract currently exists, or will be newly manufactured.

3. Details of special precautions required and the inspection procedures to be taken when stopping the machine for repair, weekends, holidays etc. to ensure that the pipe string does not become "locked" by soil pressure and face stability is not compromised during the shutdown including contingency measures to be implemented if problems arise or in groundwater control if power is lost.

H. Installation and inspection data (Minimum of 45 days before microtunneling is scheduled to begin.):

1. A detailed technical description of the microtunneling procedure, and construction techniques to provide the access required to install the specified pipe in conformance with the Contract Documents to include:

    a. Intended machine parameters to achieve pressure balance at the tunnel face, including cutterhead rotation speed, torque, thrust, pump or screw conveyor speeds, and discharge rates, rate of advance, and volumetric control.
    b. Details of muck handling system, rock crushing and spoil separation methods if required, including proposed additive formulations and calculations of the system capacity to handle flows at all distances and changes of elevation to and from the MTBM.
    c. Details of conditioning agents to be used, including concentration, injection rate, injection point, and ratios of these conditioning agents.
    d. Details of main jacking system, intermediate jacking stations, hydraulic joints (if proposed) and their proposed spacing, method of operation and thrust capacity. Include calculations of anticipated jacking forces required to advance the pipe and calculations of maximum jacking force permissible on straight and curved sections for the selected jacking pipe material. Include details and supporting compression calculations for joints used with intermediate jacking stations and hydraulic joints. Describe controls to prevent the maximum jacking force from being exceeded during the curved drive including use of hydraulic joints and/or other measures to prevent pipe overstress.
    e. Description of guidance system and procedures for maintaining line and grade.

f. Method of spoil disposal conforming to the Contract Documents.
g. A startup plan for the MTBM and the method of launching through the launching shaft wall into the ground, and the plan for exiting the drive at the reception shaft.
h. A plan for contact grouting after the pipe has been installed. The details shall include injection pressure, method of controlling grout pressures, and method for verifying complete filling of the void space between the pipe and the surrounding ground.
i. Complete information on CONTRACTOR's safety plan for personnel conducting the tunneling or jacking operations and appurtenance installation in accordance with OSHA and local regulations. The plan shall include provisions for lighting, ventilation, and electrical safety.
j. Contingency Plan, detailing measures to be taken when surface settlement exceeds the maximum values as described herein and in the Contract Documents.
k. A procedure (method statement) for remedial grouting to reduce infiltration rates to specified levels, if applicable.

I. Performance reports and test data (daily when MTBM is operating):

1. Jacking operation data log containing the data detailed in this Specification taken at intervals no more than 1 minute apart and a minimum of 10 times per pipe section. If the data is collected digitally it shall be submitted in both hard copy and digital format on an appropriate storage media.

2. If the electronic data log is not submitted or available in a digital format then a CD video recording of the operator's console shall be required. Video shall show a real- time clock that matches the time scale used in the manual log, and information used by the operator in machine operation, guidance, and control. Indicators for the MTBM being viewed by the CD recorder shall indicate when the MTBM is excavating and the number of the pipe joint that is being pushed. (The video disk shall be submitted to the OWNER each week and a complete video recording at the end of each drive)

3. Separate log tracking pipe lubricant used in gallons, its measured viscosity, and pumping pressure,

4. Separate log tracking the volume of muck removed from the tunnel excavation for each pipe section and from the site each day.

J. Survey Plan:

1. This plan shall be developed by CONTRACTOR's engineer to transfer line and grade from the surface to the working floor of the shaft and to complete the as-built survey of the pipe installed by microtunneling.

2. In pipes over 48in inside diameter Include the survey techniques to be used for acquiring the as-built line and grade. The surveyed points along the installed pipe shall be spaced at a distance not to exceed 10 feet but not less than one survey reading shall be taken per pipe. Additionally, survey low or high points will be indicated.

3. Provide interpretation of this data; compare with specified tolerances for line and grade as contained herein as well as in the Contract Documents. Whichever are more restrictive.

4. Submit as-built survey data to OWNER at the end of each drive.

1.4 QUALITY ASSURANCE:

A. Experience Requirements:

1. Microtunnel construction is deemed specialty contractor work. The specialty subcontractor or CONTRACTOR, if the CONTRACTOR elects to self-perform this work, shall have experience using MTBMs of the types specified for this project.

2. CONTRACTOR's engineer shall be licensed by the State of California with experience designing microtunneling and shafts in similar ground conditions. This engineer shall meet applicable regulatory criteria for each system design. Experience and education shall be documented in a resume with a detailed description of the work actually performed on each of the reference projects. Include contact details for each of the reference projects to include the current phone number, e-mail address, and title of a senior project representative familiar with his/her work. Descriptions of reference project shall include the number of shafts designed, dimensions, shoring methods, modifications to shoring, base slab details, ground and groundwater conditions, and thrust block details. Also indicate method of analyses, standards, computer programs, and materials used for constructing the shafts to include the entrance and exit seal. Provide sample design documents.

3. The Licensed surveyor shall be registered in the State of California.

4. Provide a project superintendent with tunneling experience who has worked on microtunneling/pipe jacking projects in similar ground conditions and curved alignment using equipment similar to the equipment selected for this project.

5. Provide a MTBM operator and a shift supervisor for each shift with tunneling experience who has worked on microtunneling/pipe jacking projects using equipment similar to the equipment selected for this project,

in similar ground conditions, and if proposed, curved alignment experience.

B. CONTRACTOR Design Responsibilities:

1. Design and details of jacking unit thrust collar to be used for symmetric and uniform transfer of jacking forces to the pipe.

2. Design and arrangement of shafts, including dimensions, capacity and location of the jacking reaction thrust block, frame alignment and interface with the pipe, support system for shaft walls, and provisions for control of groundwater. The excavation and excavation support shall be coordinated with construction of the permanent structure, tunnel access and manhole facilities.

3. Design and arrangement of microtunneling system including:

    a. An MTBM specifically designed for excavating and installing pipe from the jacking shaft through the geological materials as described in the GDR and GBR, for the soil and rock types, density, strength, abrasivity and maximum hydrostatic, and earth pressures. The MTBM shall also be designed to cut through boulders or obstructions as described in the GBR. The excavated diameters shall be suitable for the installed pipe diameters along the alignment specified in the Contract Documents.
    b. A spoil transport system specifically designed for matching the excavation advance rate to the spoil removal rate while conveying the tunnel muck from the face for geologic materials as described herein and in the GBR. Including a surface separation plant if a recycled slurry based microtunneling system is selected, and additives, such as foams, or other muck conditioners.
    c. A jacking system specifically designed for maintaining microtunnel advance as prescribed in the Contract Documents through the geologic materials as described in the GBR.
    d. Design and arrangement of intermediate jacking stations, including jacking and reaction plates and their interface with the pipe, external shield, and jack capacity and location.
    e. A laser, theodolite or gyro guidance control system specifically designed for maintaining tunnel tolerances as it is advanced along the required alignment as prescribed in the Contract Documents through the subsurface environment as described in the GDR and GBR.

4. Methods of excavation at the face, and details of cutting head tooling.

5. For MTBM over 60in outside diameter, provision of entry to the cutter / muck chamber for changes of cutter tools or removal of obstructions.

6. Locations where pipe lubricant is to be used and lubrication procedure.

7. Requirements for ports in pipe wall, for introduction of lubricant and contact grouting.

8. Procedure for operation of the MTBM to maintain tunnel face stability and minimize surface settlements at all times and under all conditions indicated during both excavation operations and periods of MTBM shutdown.

9. For personnel entry provide provisions for adequate ventilation in tunnels and shafts.

10. Provision for gas monitoring in the MTBM and shafts

11. Provisions for adequate lighting to facilitate as required the work in tunnels and shafts. Power and lighting circuits shall be separate as per regulations.

C. Design Criteria:

1. The geotechnical conditions including groundwater elevations to be encountered during microtunneling as detailed in the GBR.

2. Minimum shaft design loadings as provided in the GBR, plus additional construction loads such as erection, handling, storage and jacking forces necessary for installation of the pipe and other structures. Truck loading shall be minimum HS-20 vehicle loading distributions in accordance with AASHTO.

3. At Friars Rd jacking shaft take into account the multiple drives to be undertaken from a single shaft and the shaft wall MTBM launch cut outs required to ensure shaft structural stability is not compromised.

4. Internal pipe diameter, alignment, and invert location and elevations shall conform to those shown in the Contract Documents.

5. All electrical equipment should be suitable for CAL OSHA Potentially Gassy Conditions in the MTBM with an automatic power shut down to the MTBM if elevated LEL is detected. Ventilation fans will require continuous power and, if located within the tunnel, be designed for M1 operation for Class 1 Zone 1. Ventilation systems will be operated as required by CAL OSHA at no additional cost to the Owner.

6. The MTBM shall meet the following minimum requirements:

    a. Providing continuous positive face support in excess of the in-situ pressure during all phases of tunnel excavation and shutdown.

b. Articulated to enable controlled steering in both the vertical and horizontal directions to the tolerances indicated in the Contract Documents.
c. All functions shall be controlled remotely from the surface under normal operation.
d. Capable of controlling shield rotation of the MTBM in the ground.
e. Capable of injecting lubricant from the back of the MTBM and around the exterior of the pipes being jacked. Lubricant shall be refined, processed natural high swelling montmorillonite clay or other product as approved by the OWNER as necessary to produce satisfactory lubrication and earth support.
f. Capable of controlling heave and settlement to the acceptable tolerances as specified in the Contract Documents.
g. Provide access to the rear of the cutter wheel via an access door on MTBM that are over 60in outside diameter and on MTBM with an outside diameter over 72in with the provision of compressed air and an air lock if required.
h. Capable of boring through the anticipated geotechnical conditions and any obstruction as described in the GBR.

7. The main and intermediate jacking system shall each consist of an even number of thrust cylinders arranged symmetrically. Each cylinder of the main jacking system shall have individual activation, synchronized activation and individual thrust control. Cylinders shall not exert force when idle but shall resist displacement. The installed thrust capacity shall be at least 20 percent greater than the maximum theoretical combined reactions from the hydrostatic pressure, pipe friction, earth pressure, and cutter forces of the proposed drive.

1.5 COORDINATION DOCUMENTATION:

A. CONTRACTOR's engineer shall inspect, to the extent necessary, and certify that construction operations were performed in accordance with the approved design submittals. Deficiencies shall be immediately corrected by CONTRACTOR and reported to OWNER.

1.6 CONDITIONS:

A. The entire length of tunnel is classified as "Potentially Gassy." Perform work as specified herein, in accordance with the Contract Documents, and with current applicable CAL OSHA regulations for potentially gassy conditions and codes of Federal, State, and local agencies. Comply with applicable provisions of 29 CFR Part 1926, Subpart S, "Underground Construction" Standard Number 1926.800 by OSHA and Subpart P, "Excavations", latest revision. Should there be conflict between these specifications and OSHA requirements, the more restrictive will apply.

B. CONTRACTOR shall comply with applicable codes, standards, and regulations.

C. CONTRACTOR shall assess existing conditions, including property rights of adjacent properties whether private or public. Be responsible for the proposed temporary works and construction methods.

D. CONTRACTOR shall provide access to OWNER at all times during construction operations to perform inspections.

1.7 TOLERANCES:

A. Inflow of Ground and Groundwater: Not more than a total of one (1) cubic foot of ground shall enter into the shaft. Not more than one (1) gallon per minute of groundwater shall enter into the shaft during the course of the drive. If the groundwater is mixed with slurry and/or lubricant, it shall be prevented from entering the shaft in accordance with Fluid Control Plan.

B. Line and Grade during the Launching and Receiving Operations: During launching and receiving operations, line shall be maintained within ± 3 inches and grade shall be maintained within ± 1.5in

C. Maximum variation from lines and grades shown on the Contract Documents: +/-3inches in lateral alignment and +/-1.5infor vertical grade, providing that the final grade of flowline shall be in the direction shown. In the case of variation outside the required tolerance correction of the line and grade will not exceed 1inch in 25ft.

D. Maximum ground settlements and/or differential settlements shall not exceed the limits provided in the ground movement monitoring plan.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Sewer jacking pipe shall consist of plastic lined reinforced concrete pipe (PLRCP), as required to provide a safe, stable tunnel excavation and acceptable in-place pipe. Pipe materials shall be in accordance with the Contract Documents and specifications.

B. CONTRACTOR shall be responsible for selecting and designing appropriate pipes and pipe joints to safely carry the loads imposed during construction, including jacking forces. Pipe joints shall be flush with the inside and outside of the pipe surface when pipes are assembled. Special consideration shall be given for a " jack control" system using hydraulic joints and/or other means on the curved segment of the alignment.

2.2 EQUIPMENT:

A. Microtunnel Boring Machine (MTBM)

1. The Microtunneling Boring Machine (MTBM) shall have a closed face capable of providing positive supporting pressure to the full excavated area (face) at all times and must have the capability of controlling and measuring the pressure at the face. The balancing of earth and groundwater pressures shall be achieved by the use of slurry pressure, auger earth pressure balance system, or a combination of the two. The system shall be capable of any adjustment required to maintain face stability for anticipated ground conditions. For equipment that uses a slurry spoil transportation system the earth and groundwater pressure at the face shall be controlled by the use of a variable flow slurry pumping system, pressure control valves and a minimum of two flow meters, one on the supply side and one on the return side. For equipment that uses an auger spoil transportation system the earth and groundwater pressures at the face shall be managed by controlling the volume of spoil removal relative to the advance rate (Earth Pressure Balance) and shall be augmented by the application of compressed air or soil conditioning agents if conditions require.

2. The MTBM shall be capable of controlling rotation or roll by means of bi-directional drive on the cutter head and/or by use of fins or grippers.

3. The MTBM cutter head shall be electro or hydro mechanically powered and shall provide sufficient torque to cut the face, crush material as required and feed the excavated material to the spoil transportation system.

4. The MTBM shall be articulated and fully steerable, both vertically and horizontally.

5. Automated Spoil Transportation

   a. The MTBM system shall include an automated spoil transportation system that has the capability of matching the excavation rate to the rate of spoil removal such that settlement tolerances can be maintained.
   b. A separation process shall be provided when using a slurry spoil transportation system. The separation process shall be designed to provide adequate and efficient separation of solids from the slurry so that clean slurry can be returned to the cutting face for reuse and the solids can be disposed of in an efficient manner.

B. Control Systems

1. A remote control system shall be provided that allows for the operation of the system without the need for personnel to enter the tunnel for routine operation of the system. The control equipment shall integrate the system of excavation, removal of spoil and its simultaneous replacement by a pipe. As each pipe section is jacked forward, the control system shall synchronize all of the operational functions of the system. The system shall provide complete and adequate ground support at all times.

2. Line and grade shall be controlled by a guidance system that relates the actual position of the MTBM to a design reference established by a surveying system. Typically in straight drives by a laser beam transmitted from the jacking shaft to a target mounted in the MTBM. The laser shall be mounted in the jacking shaft independent of the jacking frame and thrust block. For long or curved drives Laser guided tachimetry or theodolite or gyroscope is also acceptable and in any case shall be used for guidance through the curved portions of the alignment. The guidance system shall be checked and calibrated at least every 50ft of pipe jacking or once every day whichever is the sooner. The active steering information shall be monitored and transmitted to the operation console. The minimum information available to the operator at the control console shall include the position of the MTBM relative to the reference, roll, inclination, attitude, rate of advance, installed length, thrust force, and cutter head torque.

C. Jacking Equipment

1. Each pipe section shall be jacked forward as the excavation progresses in such a way as to provide complete and adequate ground support at all times. A jacking frame shall be provided for developing a uniform distribution of jacking forces around the perimeter of the pipe.

2. The thrust reaction block shall be properly designed and constructed and shall be perpendicular to the jacked pipe alignment. The thrust reaction block shall be designed to support the maximum estimated jacking force with a factor of safety of at least two.

3. Intermediate jacking stations shall be provided to maintain total jacking forces within the capacity of the main jacking system and the thrust reaction block. Intermediate jacking stations shall be provided of sufficient numbers and spacing to ensure completion of the drive and be of individual capacity compatible with the maximum safe jacking capacity of the pipe including through the curve.

PART 3 - EXECUTION

3.1 CONSTRUCTION:

A. General Requirements:

1. Do not begin work on the microtunneling and shafts until relevant submittals have been approved.

2. All permits have been issued by the relevant authorities

3. Construction techniques required to provide access for microtunneling shall be such as to ensure the safety of the work, at all times and during all stages of the work.

4. Support excavations and control movement of the ground, pavement, utilities or structures outside of the excavation. Ensure support of excavation conforms to applicable Local Safety Standards, OSHA Standards, trenching, and shoring standards.

5. If, at any time, the method being used by the CONTRACTOR for supporting any material or structure adjacent to excavation is not safe in the opinion of the OWNER or applicable Federal, State, or local inspection authorities, provide additional bracing and support necessary to furnish the added degree of safety required by the OWNER. Provide such added bracing and support by such method approved by the OWNER as the CONTRACTOR may elect to use but the taking of such added precautions shall in no way relieve the CONTRACTOR of their sole final responsibility for the safety of lives, work, and structures. The use of such additional bracing and support shall be at no additional cost to the OWNER. The absence of an order for additional bracing shall in no way relieve the CONTRACTOR of the sole and final responsibility.

6. Ventilation and air quality monitoring shall conform to the requirements of OSHA 3115-06R 2003 Underground Construction regulations for Gassy or Potentially Gassy Operations. The ventilation design shall be determined by the CONTRACTOR.

7. Furnish necessary labor, material, equipment, power, water, and utilities to complete the work. Additionally:

    a. Select the means and methods for performing the work.
    b. Select, design, and install the thrust blocks. The thrust blocks shall be sufficiently reinforced, isolated, and otherwise anchored, to include necessary ground improvement measures, to prevent movement from occurring within the launching shaft and/or misalignment of the jacking frame.
    c. Select, design, and install the entrance seals, including necessary modifications to the shoring, for the launching shafts.
    d. Select, design, and install the base slabs, including necessary modifications to the shoring, for the launching shafts.

e. Select, design, and install the exit / entry seals, including necessary modifications to the shoring, for the receiving shafts.

8. Construct the shafts to accommodate the installation of the pipe, MTBM, and jacking device. Execute microtunneling such that settlement is maintained below maximum levels detailed in this Section of the specification, such that the in-place pipe shall have full bearing against earth, and such that voids shall be fully filled with grout.

9. Damaged and/or deficient materials shall be repaired and/or replaced as directed by OWNER.

10. Provide surface drainage during the period of construction to protect the work.

11. Control of Line and Grade:

a. The OWNER will establish the baselines and benchmarks indicated on the plans. The CONTRACTOR shall check these baselines and benchmarks at the beginning of the contract period and report errors or discrepancies to the OWNER. Use these baselines and benchmarks to furnish and maintain reference lines and grades for microtunnel construction. Use these lines and grades to establish the starting location of the microtunnel.
b. Mount guidance system in a manner than isolates it from effects of movement by the jacking forces.
c. When the excavation is off line or grade, return to the plan line and/or grade at a rate of no more than 1 inch per 25 feet.

12. Grouting:

a. A uniform mixture of 1:6 maximum (cement:sand) cement grout shall be placed to fill voids, which exist between the pipe and the ground in accordance with the requirements of this Section and the Contract Documents. Grout shall have a minimum 28-day compressive strength of 500 psi.

13. Protect the existing improvements at the site from damage including but not limited to structures, utilities, and culverts.

3.2 INSTALLATION:

A. Perform work in accordance with the approved submittals.

B. The licensed surveyor shall be responsible for verifying control points identified in the Contract Documents. CONTRACTOR's surveyor shall check baseline

and/or benchmarks shown prior to starting and report errors or discrepancies to OWNER.

C. Notify OWNER immediately upon detecting larger than predicted deformation, distress, or damage to the excavation support system.

D. Notify OWNER immediately of any structural element that is not in accordance with the approved design submittals.

E. Do not resume construction activities until corrective measures have been fully implemented.

F. Microtunnel each pipe section as the excavation progresses in such a way to provide complete and adequate ground support at all times. Utilize a jacking frame that develops a uniform distribution of jacking forces around the periphery of the pipe. Design and construct the thrust block to sustain jacking reactions and construction forces. The thrust block shall be normal (square) with the proposed pipe alignment and designed to support the maximum obtainable jacking pressure with a factor of safety of at least 2.0. The jacking system, including intermediate jacks used, shall be capable of continuously monitoring the jacking pressure and rate of advancement.

G. On drives over 500ft utilize an automated (ABIS) lubrication system that injects a lubricant from the rear of the MTBM and at intervals along the pipeline to the external surface of the pipe, which lowers the friction developed on the outside of the pipe during jacking. Spacing of lubricant points along the pipe train shall be at the CONTRACTOR's option. Modify this system as required to prevent pipe binding or stoppage at no additional cost to the OWNER.

H. Utilize a spoil transportation method capable of handling and removing the expected excavated materials as indicated herein and in the GBR.

I. Limit the overcut on the tunnel shield to no more than ½ inch on radius for pipe 48in or less in diameter and ¾ inch on radius for pipes over 48in in diameter unless approved by the OWNER. The annular space created by the overcut shall be filled with a lubricant that has been proven suitable for the particular ground conditions to be tunneled.

J. After completion of microtunneling, attempt to replace lubricant between the pipe exterior and surrounding ground with a cement grout. Control the pressure and the amount of grout to prevent damage and displacement of the pipe.

K. Use additive as required in muck conditioning system to reduce machine applied torque and maintain muck flow and pressure holding capability.

L. If a slurry system is used then a slurry separation plant shall be used. The plant

shall clean the excavated spoil from the slurry for disposal and return the slurry back to the MTBM face for reuse. The type of separation plant used shall be designed by the CONTRACTOR.

M. Dispose of excavated material off-site in accordance with applicable permit and regulatory requirements and in accordance with the Contract Documents.

3.3 FIELD INSPECTION:

A. CONTRACTOR's engineer shall conduct visual inspections to verify:

1. Shafts and modifications to the shoring were constructed in accordance with the approved design submittals.

2. Entrance/exit seals were constructed in accordance with the approved design submittals.

3. Thrust Blocks were constructed in accordance with the approved design submittals.

4. Base slabs were constructed in accordance with the approved design submittals.

5. Layout of shaft is generally in accordance with approved submittals.

B. Details of these visual inspections shall be written into a field inspection report and submitted to OWNER.

C. Submit to the OWNER copies of field notes used to establish lines and grades; however, the CONTRACTOR remains fully responsible for the accuracy of the work and the correction of it, as required.

D. Record locations where the jacking pipe has deflected more than 3in off line or 1in off grade

END OF SECTION

NC MORENA BLVD PUMP STATION AND PIPELINES

PACKAGE A

CONTRACTOR'S RESPONSIBILITIES

1. PURSUANT TO SECTION 4216 OF THE GOVERNMENT CODE, AT LEAST 2 WORKING DAYS PRIOR TO EXCAVATION, YOU MUST CONTACT THE REGIONAL NOTIFICATION CENTER (E.G. UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA) AND OBTAIN AN INQUIRY IDENTIFICATION NUMBER.
2. NOTIFY SDG&E AT LEAST 10 WORKING DAYS PRIOR TO EXCAVATING WITHIN 10' OF SDG&E UNDERGROUND HIGH VOLTAGE TRANSMISSION POWER LINES. (I.E., 69 KV & HIGHER)
3. LOCATE AND RECONNECT ALL SEWER LATERALS. LOCATIONS AS SHOWN ON THE PLANS ARE APPROXIMATE ONLY. LATERAL RECORDS ARE AVAILABLE TO THE CONTRACTOR AT THE WATER DEPARTMENT, 2797 CAMINITO CHOLLAS. LOCATE THE IMPROVEMENTS THAT WILL BE AFFECTED BY LATERAL REPLACEMENTS.
4. EXCAVATE AROUND WATER METER BOX (CITY PROPERTY SIDE) TO DETERMINE IN ADVANCE, THE SIZE OF EACH SERVICE BEFORE TAPPING MAIN.
5. CITY FORCES, WHEN SPECIFIED OR SHOWN ON THE PLANS, WILL MAKE PERMANENT CUTS & PLUGS AND CONNECTIONS.
6. KEEP EXISTING MAINS IN SERVICE IN LIEU OF HIGH-LINING, UNLESS OTHERWISE SPECIFIED SHOWN ON PLANS.
7. THE LOCATIONS OF EXISTING BUILDINGS AS SHOWN ON THE PLAN ARE APPROXIMATE.
8. STORM DRAIN INLETS SHALL REMAIN FUNCTIONAL AT ALL TIMES DURING CONSTRUCTION.
9. UNLESS OTHERWISE NOTED AS PREVIOUSLY POTHOLED (PH), ELEVATIONS SHOWN ON THE PROFILE FOR EXISTING UTILITIES ARE BASED ON A SEARCH OF THE AVAILABLE RECORD INFORMATION ONLY AND ARE SOLELY FOR THE CONTRACTOR'S CONVENIENCE. THE CITY DOES NOT GUARANTEE THAT IT HAS REVIEWED ALL AVAILABLE DATA. THE CONTRACTOR SHALL POTHOLE ALL EXISTING UTILITIES EITHER SHOWN ON THE PLANS OR MARKED IN THE FIELD IN ACCORDANCE WITH THE SPECIFICATIONS SECTION 33-UTILITIES.
10. EXISTING UTILITY CROSSING AS SHOWN ON THE PLANS ARE APPROXIMATE AND ARE NOT REPRESENTATIVE OF ACTUAL LENGTH AND LOCATION OF CONFLICT AREAS. SEE PLAN VIEW.
11. CONTRACTOR SHALL ATTEND PRECONSTRUCTION MEETING AS REQUIRED BY THE MITIGATION MONITORING AND REPORTING PROGRAM PER THE ENVIRONMENTAL IMPACT REPORT.

CONSTRUCTION STORM WATER PROTECTION NOTES

1. TOTAL SITE DISTURBANCE AREA (ACRES) 1.50
   HYDROLOGIC UNIT/ WATERSHED SAN DIEGO/SAN DIEGO RIVER (A)
   HYDROLOGIC SUBAREA NAME & NO. MISSION SAN DIEGO/907.11
2. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF THE
   - ☐ WPCP
     THE PROJECT IS SUBJECT TO MUNICIPAL STORM WATER PERMIT NO. R9-2013-0001 AS AMENDED BY R9-2015-0001 AND R9-2015-0100
   - ☒ SWPPP
     THE PROJECT IS SUBJECT TO MUNICIPAL STORM WATER PERMIT NO. R9-2013-0001 AS AMENDED BY R9-2015-0001 AND R9-2015-0100 AND CONSTRUCTION GENERAL PERMIT ORDER 2009-0009-DWQ AS AMENDED BY ORDER 2010-0014-DWQ AND 2012-0006-DWQ
     TRADITIONAL: RISK LEVEL 1☐ 2☒ 3☐
     LUP: RISK TYPE 1☐ 2☐ 3☐
3. CONSTRUCTION SITE PRIORITY
   ☐ ASBS ☒ HIGH ☐ MEDIUM ☐ LOW

ABBREVIATIONS

ABAND	ABANDON
ABAND'D	ABANDONED
AC	ASBESTOS CEMENT PIPE, ASPHALTIC CONCRETE
AHD	AHEAD
ASSY	ASSEMBLY
BFV	BUTTERFLY VALVE
BK	BACK
BTWN	BETWEEN
CATV	CABLE TV
CI	CAST IRON PIPE
CJP	COMPLETE JOINT PENETRATION
CML&C	CEMENT MORTAR LINED & COATED
CML&TCMC	CEMENT MORTAR LINED & TAPE, CEMENT MORTAR COATED
℄	CENTER LINE
COND	CONDUIT
CONT	CONTINUED, CONTINUATION
CONTR	CONTRACTOR
DB	DIRECT BURIED
DI	DUCTILE IRON
DWG	DRAWING
DS	DIVERSION STRUCTURE
E/O	EAST OF
EB	ENCASED BURIED
EL, ELEV	ELEVATION
ELEC	ELECTRIC
ETC	ETCETERA
ETWU	ESTIMATED TOTAL WATER USE
EX, EXIST	EXISTING
F, FLG	FLANGE
FE	FLANGED END
FF	FINISHED FLOOR
FH	FIRE HYDRANT
FO	FIBER OPTIC
FRP	FIBER REINFORCED PLASTIC
FS	FIRE SERVICE
GV	GATE VALVE
HDPE	HIGH-DENSITY POLYETHYLENE
HGL	HYDRAULIC GRADE LINE
HP	HIGH PRESSURE
HPI	HORIZONTAL POINT OF INTERSECTION
IE, INV EL	INVERT ELEVATION
JT	JOINT
LT	LEFT
MAWA	MAXIMUM APPLIED WATER ALLOWANCE
MAX	MAXIMUM
MCTC	MID-COAST TRANSIT CORRIDOR
MH	MANHOLE
MIN	MINIMUM
MJ	MECHANICAL JOINT
MPS	MORENA PUMP STATION
MTS	SAN DIEGO METROPOLITAN TRANSIT SYSTEM
MTD	MULTIPLE TELEPHONE DUCT
N/O	NORTH OF
NE	NORTH EAST
NO	NUMBER
NW	NORTH WEST
OC	ON CENTER
OHE	OVER HEAD ELECTRIC
OVHD	OVER HEAD
PCC	PORTLAND CEMENT CONCRETE
PCO	PRESSURE CLEANOUT
PLRCP	PLASTIC LINED REINFORCED CONCRETE PIPE
PROP	PROPOSED
PS	PUMP STATION
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
R, RAD	RADIUS
R/W	RIGHT OF WAY
RED	REDUCER
RP	REDUCED BACKFLOW PREVENTER
RT	RIGHT
℄	SURVEY LINE
SANDAG	SAN DIEGO ASSOCIATION OF GOVERNMENTS
SCH	SCHEDULE
SD	STORM DRAIN
SD&IV	SAN DIEGO & IMPERIAL VALLEY RAILROAD
SDA&E	SAN DIEGO ARIZONA & EASTERN RAILROAD
SDG&E	SAN DIEGO GAS & ELECTRIC
SDRSD	SAN DIEGO REGIONAL STANDARD DRAWING
SDSD	SAN DIEGO STANDARD DRAWING
SDTI	SAN DIEGO TROLLEY INC.
SE	SOUTH EAST
SO	STUB OUT
S/O	SOUTH OF
SQ	SQUARE
SS, SST	STAINLESS STEEL
SSPWC	STANDARD SPECIFICATION FOR PUBLIC WORKS CONSTRUCTION
SW	SOUTH WEST
SWQMP	STORMWATER QUALITY MANAGEMENT PLAN
SWR	SEWER
TEL	TELEPHONE
TOC	TOP OF CONCRETE
TW,TOW	TOP OF WALL
TYP	TYPICAL
UNK	UNKNOWN
VC	VITRIFIED CLAY PIPE
WM	WATER METER
WSP	WELDED STEEL PIPE
WTR	WATER
W/	WITH
W/O	WEST OF

EXISTING STRUCTURES

EX WATER MAIN & VALVES		EX TRAFFIC SIGNAL	TS
EX WATER METER		EX STREET LIGHT	SL.
EX FIRE HYDRANT		EX UTILITY POLE	
EX SEWER MAIN & MANHOLES		GAS MAIN	
EX DRAINS		ELEC. COND., OVERHEAD ELEC., TEL. COND., CATV	E OHE T C
EX PAVEMENT (PROFILE)		RAILROAD, TROLLEY TRACKS	
EX GROUND LINE (PROFILE)			

WORK TO BE DONE

THE PROJECT CONSISTS OF THE DEMOLITION OF EXISTING FACILITIES AT THE PROPOSED MORENA PUMP STATION SITE, THE CONSTRUCTION OF A NEW 37.7 MGD MORENA WASTEWATER PUMP STATION FACILITY, INCLUDING ODOR CONTROL SYSTEMS, ELECTRICAL BUILDING, SCREENING FACILITY, HIGH PURITY OXYGEN SYSTEM, MAINTENANCE BUILDING, ASSOCIATED CIVIL SITE WORK INCLUDING STORM DRAINAGE, YARD PIPING, PERIMETER WALLS, ACCESS GATES, PAVEMENT, AND LANDSCAPING.

THE PROJECT ALSO INCLUDES THE CONSTRUCTION OF 48-INCH, 60-INCH & 66-INCH DIVERSION AND OVERFLOW SEWERS, THREE DIVERSION STRUCTURES WITH SLIDE GATES AND JUNCTION STRUCTURE NO. 1.

SITE ADDRESS

887 SHERMAN STREET
SAN DIEGO, CA 92110

LEGAL DESCRIPTION

SEE DWG G-01A

ASSESSOR'S NUMBER

436-451-06-00, 436-451-05-00 & 436-660-47-00

SECURITY PLANS

SECURITY PLANS WILL BE FURNISHED TO THE CONTRACTOR UPON AWARD OF CONSTRUCTION CONTRACT. A BID ALLOWANCE ITEM HAS BEEN IDENTIFIED IN THE BID SCHEDULE.

VICINITY MAP
NOT TO SCALE

PROJECT TEAM

AECOM ENGINEERING - (619) 610.7700
KEH & ASSOCIATES - (760) 891.4180
AIR-X UTILITY SURVEYORS - (760) 480.2347
GMK CONSULTING INC. - (760) 975.3680
MATALON ARCHITECTURE - (858) 483.6587
MICHAEL BAKER INTERNATIONAL - (858) 614.5000

FIELD DATA

BENCHMARK:
THE BASIS OF ELEVATIONS FOR THIS PLAN IN THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29) PER CITY OF SAN DIEGO VERTICAL CONTROL NETWORK BENCHMARK: NBP (NORTH BRASS PLUG) LOCATED AT GAINES AND NAPA STREET.
ELEVATION: 21.742 (FEET)

BASIS OF BEARINGS / COORDINATES:
THE BASIS OF BEARINGS FOR THIS PLAN IS THE CALIFORNIA STATE PLANE COORDINATE SYSTEM OF 1983 (NAD83), EPOCH 1991.35, BASED ON THE LINE BETWEEN CITY OF SAN DIEGO HORIZONTAL CONTROL POINTS 1037 & 1040 PER ROS 14492. I.E. S 75°17'56" E

DATUM: MEAN SEA LEVEL

REFERENCES:
MAP NO. 569 & DRAWING NO. 40421

TOPOGRAPHY SOURCE:
CITY OF SAN DIEGO, GROUND SURVEY AND UTILITIES BY MBI. AERIAL MAPPING BY AEROTEK MAPPING, FLIGHT DATE 1/30/17

OWNER

SAN DIEGO PUBLIC UTILITIES DEPARTMENT
9192 TOPAZ WAY
SAN DIEGO CA. 92123
PHONE NUMBER (858) 292-6300
PROJECT MANAGER NABIL BATTA

ZONING

ZONE:	IL-3-1
CONSTRUCTION TYPE:	V-B
BUILDING CODE YEAR:	2016
EXISTING USE OF BUILDING:	LIGHT INDUSTRIAL
PROPOSED USE OF BUILDING:	MUNICIPAL

LEGEND

IMPROVEMENTS	STANDARD DRAWINGS	SYMBOL
SEWER MAIN	SDS-101, SDS-110 (TYPE C), SDW-161	
SEWER VAULT		
WATER MAIN & APPURTENANCES	SDM-105, SDW-110 SDW-151, SDW-161, SDW-162	
TEMPORARY WATER PIPE	SDM-105, SDW-110 SDW-151, SDW-161	
PROPOSED WATER BEND	SDM-105, SDW-110 SDW-151, SDW-161	
VALVES WITH CAPS AND WELLS	SDW-109, SDW-152, SDW-153, WV-05	
FIRE SERVICE CONNECTION ASSEMBLY & BACKFLOW PREVENTER (WHERE APPLICABLE)	SDW-109, SDW-118, SDW-152, SDW-153, SDW-105	PROPOSED RP IF NEEDED, P.L., RP, FS
6" FIRE HYDRANT ASSEMBLY & MARKER 2-PORT UNLESS SPECIFIED AS 3-PORT	SDW-104, SDW-109, SDW-152, SDW-153	PROPOSED WATER
1" WATER SERVICE UNLESS OTHERWISE SPECIFIED	SDW-107, SDW-134, SDW-136, SDW-137, SDW-138, SDW-150, WS-03	PROPOSED WATER, WM, P.L., W
BLOW-OFF ASSEMBLY	SDW-106, SDW-143, SDW-144, SDW-145, SDW-146, WB-05,	B.O., PROPOSED WATER
AIR & VACUUM VALVE	SDW-117, SDW-158, SDW-159, SDW-160	A.V.
ABANDONED WATER MAIN	WP-03	
CUTTING AND PLUGGING ABANDONED WATER MAIN	WP-03	
TRANSITION / REPAIR COUPLING	SEE APPROVED MATERIALS LIST	E
FLOOD ZONE BOUNDARY		PROPOSED WTR, EX WTR
PROPOSED WATER W/HOSE BIBB		
PROPOSED BACKFLOW PREVENTER ASSEMBLY	SDW-155	
PROPOSED WATER METER	SDW-113, SDW-149	
MANHOLE PIPE CONNECTORS	SDG-108	
SURVEY MONUMENT	M-10, M-10A, M-10B	△
TRENCH RESURFACING	SDG-107	

FOR LANDSCAPING LEGEND SEE SHEET L-01.

FOR IRRIGATION LEGEND SEE SHEET L-02.

FOR ADDITIONAL SYMBOLS SEE CURB RAMP AND TRAFFIC CONTROL SHEETS.

DECLARATION OF RESPONSIBLE CHARGE

* I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THE PROJECT AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE AND THAT THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS. I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE CITY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.

ALAN SHAPIRO — 10/07/20 DATE

MONUMENTATION/SURVEY NOTES

THE CONTRACTOR SHALL BE RESPONSIBLE FOR SURVEY MONUMENTS AND/OR VERTICAL CONTROL BENCHMARKS WHICH ARE DISTURBED OR DESTROYED BY CONSTRUCTION. A LICENSED LAND SURVEYOR OR LICENSED CIVIL ENGINEER AUTHORIZED TO PRACTICE LAND SURVEYING IN THE STATE OF CALIFORNIA SHALL FIELD LOCATE, REFERENCE, AND/OR PRESERVE ALL HISTORICAL OR CONTROLLING MONUMENTS PRIOR TO ANY EARTHWORK, DEMOLITION OR SURFACE IMPROVEMENTS. IF DESTROYED, A LICENSED LAND SURVEYOR SHALL REPLACE SUCH MONUMENT(S) WITH APPROPRIATE MONUMENTS. WHEN SETTING SURVEY MONUMENTS USED FOR RE-ESTABLISHMENT OF THE DISTURBED CONTROLLING SURVEY MONUMENTS AS REQUIRED BY SECTIONS 6730.2 AND 8771 OF THE BUSINESS AND PROFESSIONS CODE OF THE STATE OF CALIFORNIA, A CORNER RECORD OR RECORD OF SURVEY, AS APPROPRIATE, SHALL BE FILED WITH THE COUNTY SURVEYOR. IF ANY VERTICAL CONTROL IS TO BE DISTURBED OR DESTROYED, THE CITY OF SAN DIEGO FIELD SURVEY SECTION SHALL BE NOTIFIED IN WRITING AT LEAST 7 DAYS PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COST OF REPLACING AND VERTICAL CONTROL BENCHMARKS DESTROYED BY THE CONSTRUCTION.

AS-BUILT INFORMATION

MATERIALS	MANUFACTURER
PIPE CL 235 (WATER)	-
PIPE SDR 35 (SEWER)	-
GATE VALVES	-
FIRE HYDRANTS	-
SEWER MANHOLES	-
REHABILITATE SEWER MANHOLES	-
REHABILITATE SEWER MAIN	-

CONSTRUCTION CHANGE / ADDENDUM

CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.
A	11/12/20	1, 22, 92, 103, 155, 156, 170 & (261 New Sheet)	

WARNING
0 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

The City of SAN DIEGO Public Utilities

REGISTERED PROFESSIONAL ENGINEER ALAN B. SHAPIRO Exp. CIVIL STATE OF CALIFORNIA
10/07/20

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 01 OF 274 SHEETS

SPEC. NO.

APPROVED: Nabil Batta FOR CITY ENGINEER — 10/08/2020 DATE
NABIL BATTA PRINT DCE NAME — C63631 RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
△A ADDENDUM A	CITY	Nabil Batta	11/23/20	

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

SEWER WBS B-15141
SUBMITTED BY: NABIL BATTA PROJECT MANAGER
CHECKED BY: J. BERMUDO PROJECT ENGINEER
SEE SHEETS CCS27 COORDINATE
SEE SHEETS CCS83 COORDINATE
40421-01-D

G-01

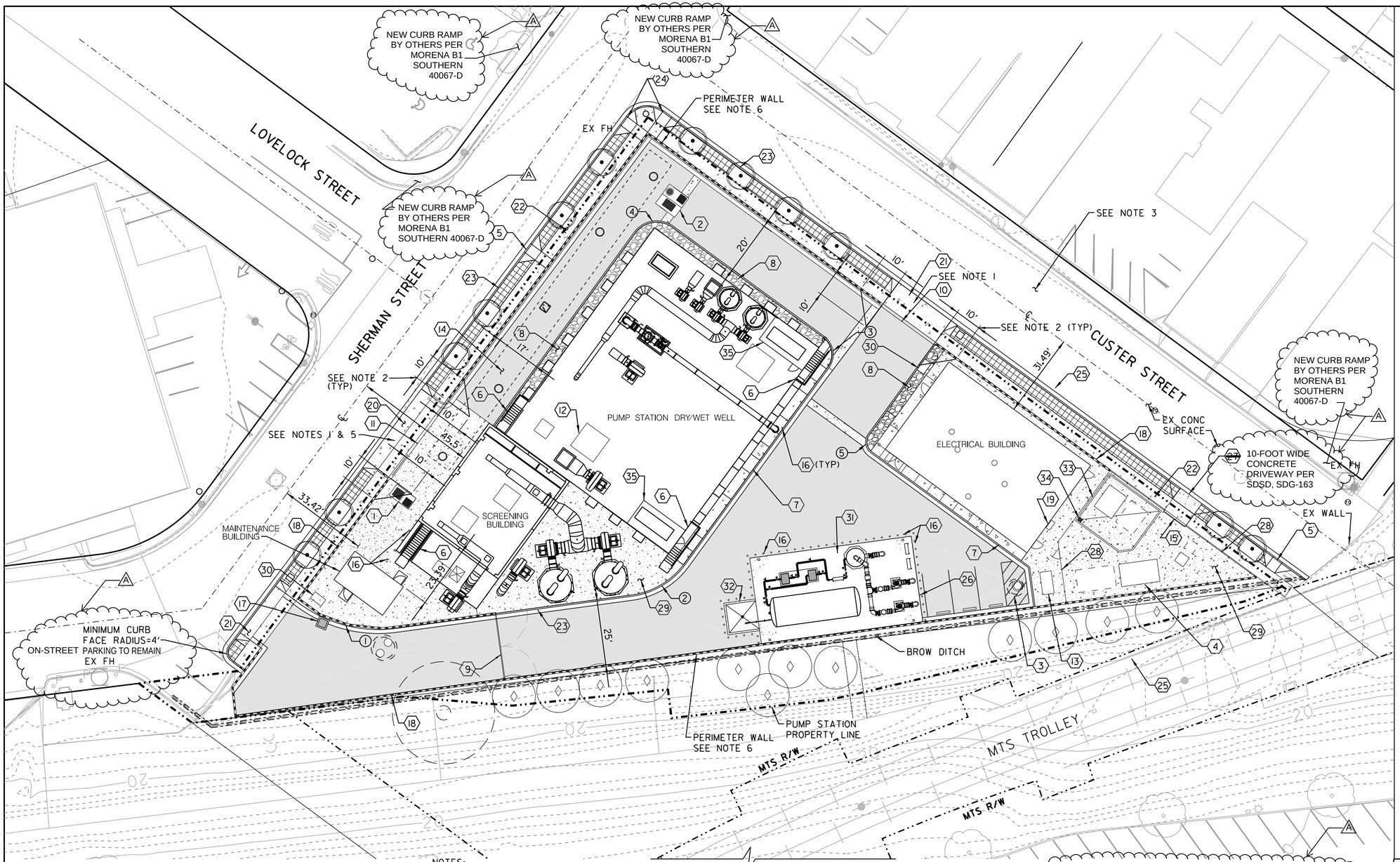
NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A

COVER SHEET

△A REVISE WATERSHED NAME.

ADDENDUM A

CONVEYANCE SYSTEM
MORENA PUMP STATION & CO



CURB FACE CURVE DATA			
NO.	DELTA	RADIUS	LENGTH
(1)	43° 51'58"	50.0'	38.28'
(2)	46° 56'37"	30.0'	24.58'
(3)	90° 00'00"	8.5'	13.35'
(4)	90° 00'00"	10.5'	16.49'
(5)	90° 00'00"	5.0'	7.85'

KEYNOTES

1. MODULAR WETLAND SYSTEM, PER MW-01, DWG C-24
2. MODULAR WETLAND SYSTEM, PER MW-02, DWG C-24
3. 5' DIA, 10' DEEP CONTAINMENT MANHOLE WITH T-LOCK LINER, PER SDSD SDS-106
4. SDG&E EQUIPMENT, SEE DWG E-03
5. CURB RAMP, PER SDSD ~~SDG-138~~ SDG-133
6. STAIRS AND GUARDRAIL PER STRUCTURAL PLANS, SEE DWG S-05 & S-06
7. 4-FOOT WIDE CONCRETE WALKWAY PER SDSD SDG-155 (TYP)
8. 3/4-INCH CRUSHED ROCK PER SSPWC SEC. 200-1.2, 3-INCH DEEP, COMPACT AFTER PLACEMENT FOR FINAL DEPTH (TYP.)
9. 25-FOOT DOUBLE LEAF ENTRANCE ONLY ACCESS GATE, SEE DETAIL 1, DWG C-28
10. 25-FOOT WIDE 8-FOOT HIGH ROLLING GATE FOR EXIT ONLY, SEE DETAIL 2, DWG C-28
11. 35-FOOT WIDE, 8-FOOT HIGH ROLLING GATE, SEE DETAIL 2, DWG C-28
12. DOUBLE LEAF EQUIPMENT HATCH, PER DWG M-08 (TYP OF 2)
13. ELECTRICAL BLDG CONDENSING UNIT, SEE H DWGS
14. HYDROMODIFICATION TANK, PER DWG C-06
15. 10-FOOT WIDE ROLLING GATE, PER DETAIL 2, DWG C-28
16. 4-INCH BOLLARD PROTECTION POST, PER SDRSD, WM-04 "TYPE B" SPACED AT 3'-0" O.C. ON 3 SIDES OF CONCRETE PAD AS SHOWN
17. CONCRETE CATCH BASIN - TYPE I PER SDSD D-29
18. 8-FOOT MASONRY BLOCK WALL, SEE DWG S-26
19. MOTOR CONTROL ROOM CONDENSING UNIT, SEE H DWGS
20. 35-FOOT WIDE CONCRETE DRIVEWAY, PER SDSD, SDG-163
21. 25-FOOT WIDE CONCRETE DRIVEWAY PER SDSD, SDG-163
22. 5-FOOT WIDE CONCRETE SIDEWALK PER SDSD SDG-155 (TYP)
23. 6-INCH CURB AND GUTTER PER SDSD, SDG-151
24. DUAL CURB RAMPS PER SDSD, SDG-134
25. PROPOSED LANDSCAPING, SEE DWG L-01
26. 12-INCH REINFORCED CONCRETE SLAB ON GRADE PER DETAIL 2, DWG S-06
27. 10-FOOT WIDE CONC SIDEWALK, PER SDSD SDG-155
28. 9'-6" H FENCE PER STRUCTURAL DWGS
29. 6-INCH PCC SURFACE PER SDSD, G-18
30. BACKFLOW PREVENTER, PER DWG C-03
31. HIGH PURITY OXYGENATION FACILITY, SEE DWG M-13
32. 12'-0" X 12'-0" LIQUID OXYGEN FILL CONCRETE APRON
33. 6-INCH CONTAINMENT CURB, PER SDSD, SDG-150
34. 18" X 18" X 18" CONTAINMENT SUMP W/GRATING, DRAINS TO 5' CONTAINMENT MH VIA 4-INCH SCH 80 PVC PIPE
35. DRYWELL ACCESS STRUCTURES, SEE DWG S-39

NOTES:

1. FOR THE 25 FOOT AND 35 FOOT ACCESS GATES ON SHERMAN AND CUSTER STREETS. A MINIMUM OF 10 FEET OF WROUGHT IRON FENCING SHALL BE PROVIDED ON BOTH SIDES OF GATES. TO MEET THE VISIBILITY REQUIREMENTS OF CITY OF SAN DIEGO AT THOSE LOCATIONS, THE HEIGHT OF THE MASONRY BLOCK WALL SHALL BE LIMITED TO 3 FEET WHILE THE REMAINING 6'-6" HEIGHT WILL BE WROUGHT IRON FENCING.
2. NO OBSTRUCTION INCLUDING SOLID WALLS IN VISIBILITY AREAS ADJACENT TO ACCESS GATES SHALL EXCEED 3 FEET IN HEIGHT. PLANT MATERIAL, OTHER THAN TREES, WITHIN THE PUBLIC RIGHT-OF-WAY THAT IS LOCATED WITHIN VISIBILITY AREAS SHALL NOT EXCEED 24 INCHES IN HEIGHT, MEASURED FROM THE TOP OF THE ADJACENT CURB.
3. EXISTING UTILITIES AND PROPOSED UTILITIES ARE NOT SHOWN HERE FOR CLARITY. SEE DWG C-03 FOR EXISTING & PROPOSED UTILITIES.
4. FOR DRAINAGE PLAN SEE DWG C-02A.
5. DRIVEWAY IN SHERMAN STREET IN FRONT OF SCREENING BUILDING SHALL BE USED FOR EXIT ONLY AND FOR LOADING AND UNLOADING SCREENING BUILDING ROLL-OFF BINS.
6. SEE DWG S-26 FOR PERIMETER WALL PROFILES.
7. CONTRACTOR SHALL FURNISH AND INSTALL SIGNS FOR PARKING IN ACCORDANCE WITH THE CBC TO READ AS SUCH: "PARKING FOR AUTHORIZED VEHICLES ONLY".

NOTES (CONT.):
8. MORENA PUMP STATION IS EXEMPT FROM ACCESSIBILITY STANDARDS WITHIN PROPERTY LINES.

N W E S

0 20 40 60

SCALE 1" = 20'

KEH & ASSOCIATES
A Business Group of Gannett Fleming
570 RANCHEROS DRIVE
STE. 200
SAN MARCOS, CA 92069
760.891.4180
WWW.GANNETTFLEMING.COM

SITE PLAN

C-01

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A
SITE PLAN

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 22 OF 286 SHEETS

SEWER WBS B-15141

APPROVED: FOR CITY ENGINEER — DATE 10/08/2020
NABIL BATTA, PRINT NAME — CE36631, RCE#

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
APPROVED BY: DARIN SANCHEZ, PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XX/XX			
A ADDENDUM A	CITY		11/23/20	

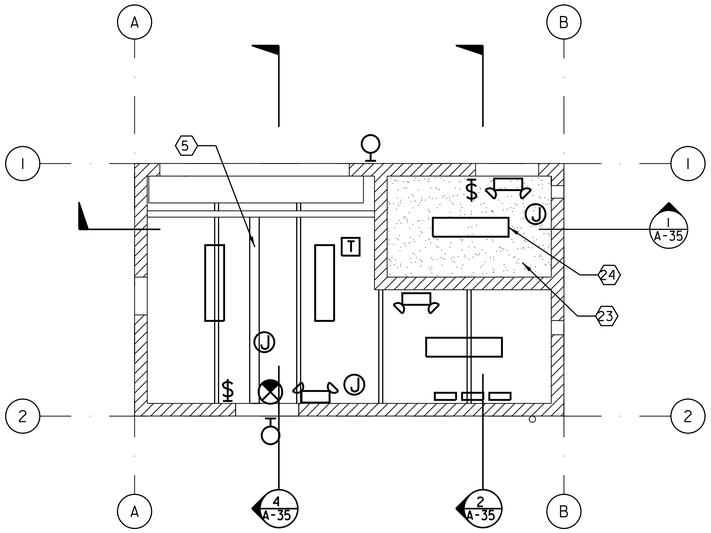
218-1707 CCS27 COORDINATE
6268407-1858444 CCS83 COORDINATE
40421-22-D

REGISTERED PROFESSIONAL ENGINEER — No. 49036 Exp. — CIVIL — STATE OF CALIFORNIA
01/17/19

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

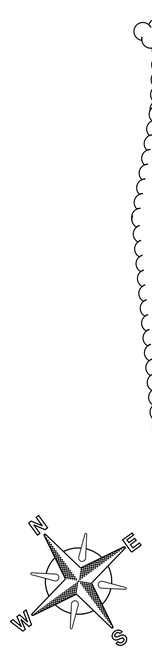
A CORRECT NOTE FOR DRIVEWAY AND PROVIDE DETAILS RAMPS BY OTHERS.

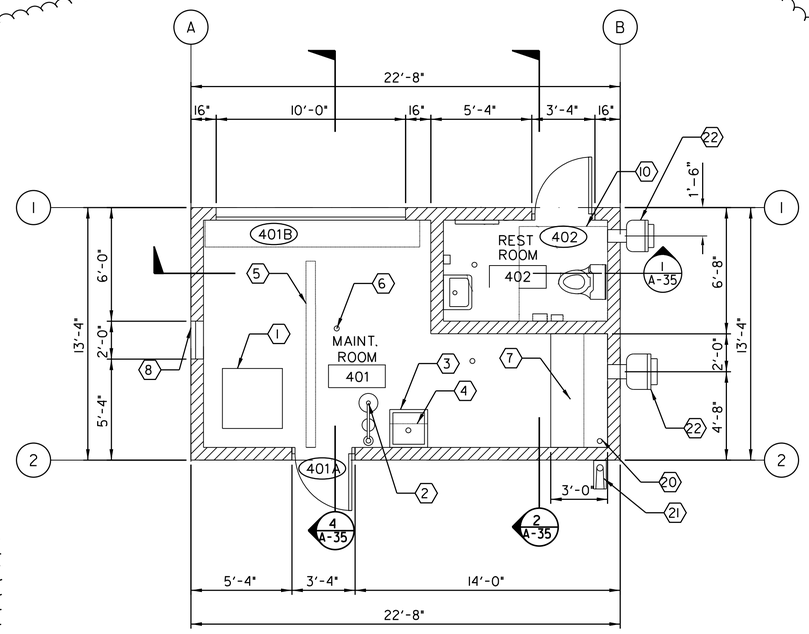
ADDENDUM A



CEILING PLAN

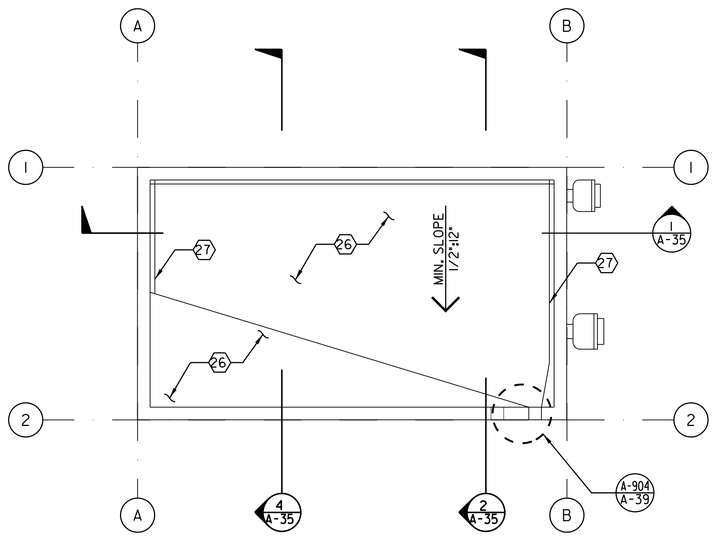
SCALE : 1/4" = 1'-0"





FLOOR PLAN

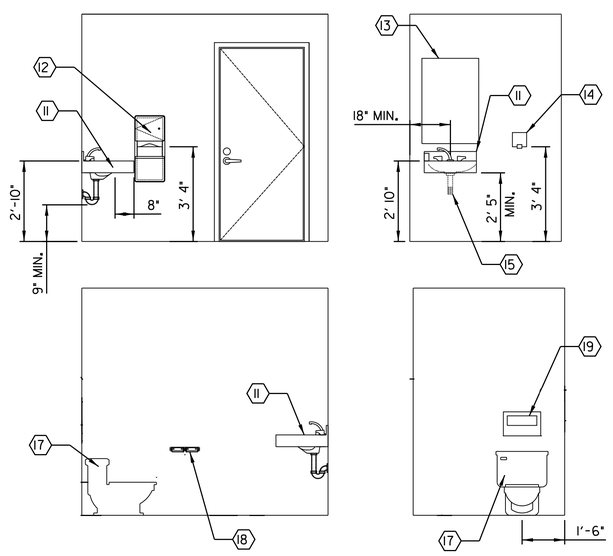
SCALE : 1/4" = 1'-0"



ROOF PLAN

SCALE : 1/4" = 1'-0"

NOTE: ACCESSIBLE RESTROOM REQUIREMENTS DO NOT APPLY.



INTERIOR ELEVATIONS

3/8" = 1' - 0"

1 A-34

KEY NOTES

1. 38" X 38" PAD FOR INGERSOLL RAND 7.5 HP, 80 GALLON TWO STAGER VERTICAL AIR COMPRSSOR
2. EMERGENCY EYEWASH
3. INDUSTRIAL SINGLE BASIN SINK
4. ABOVE-SINK CABINETS
5. 2-TON MONORAIL BEAM
6. 4" FLOOR DRAIN, TYPICAL OF 3
7. WORKBENCH, 3'-0" WIDE X 6'-0" LONG WITH 18" DEEP CABINETS ABOVE. SEE DETAIL 3 ON SHEET A-35.
8. LOUVER PER MECHANICAL PLANS.
9. ~~60" DIAMETER TURNING RADIUS~~
10. 54" X 60" CLEAR SPACE
11. WALL HUNG LAVATORY AND FAUCETS PER PLUMBING PLANS
12. PAPER TOWEL DISPENSER AND WASTE RECEPTACLE; BOBRICK B-3907 OR EQUAL
13. MIRROR; BOBRICK B-165 24 X 36 OR EQUAL
14. WALL MOUNTED SOAP DISPENSER; BOBRICK B-42 24 X 36 OR EQUAL
15. INSULATION JACKET
16.
17. WATER CLOSET PER PLUMBING PLANS.
18. TOILET PAPER DISPENSER; BOBRICK B-2740 OR EQUAL.
19. SEAT COVER DISPENSER; BOBRICK B-221 OR EQUAL.
20. DOWNSPOUT. ROUTE TO EXTERIOR ABOVE CABINETS.
21. CONCRETE SPLASH BLOCK.
22. EXHAUST FAN PER MECHANICAL PLANS.
23. 5/8" GYP. BOARD CEILING, PAINT.
24. LIGHT FIXTURE PER ELECTRICAL DWGS, TYPICAL OF FOUR.
25. 4-PLY BUILT-UP ROOFING WITH MINERAL SURFACED CAP SHEET (CBC CHAPTER 15 AND UBC STANDARD 15-2 FOR CLASS "A" FIRE RETARDANT ROOFING. ICBO #ESR-1388)
26. ROOF CRICKET PER DETAIL A-902/A-39.
27. CANT STRIP PER DETAIL A-903/A-39.

A

A

A

MAINTENANCE BUILDING PLANS

A-34

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A

MAINTENANCE BUILDING PLANS

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 92 OF 286 SHEETS

SEWER WBS B-15141

APPROVED: FOR CITY ENGINEER — DATE 10/08/2020
NABIL BATTA, PRINT NAME — C63631, RCE#

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
APPROVED BY: DARIN SANCHEZ, PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
A ADDENDUM A	CITY		11/23/20	

218-1707 CCS27 COORDINATE
6268407-1858444 CCS83 COORDINATE
40421-92-D

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

A REMOVE ACCESSIBILITY REQUIREMENTS

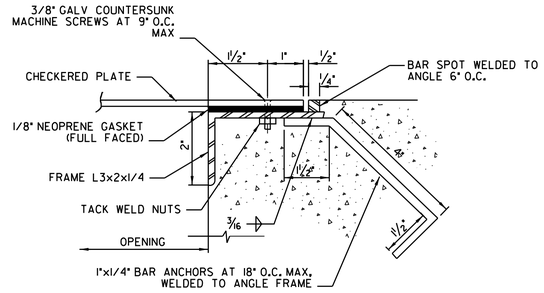
ADDENDUM A

matalon architecture & planning

Q:\DCS\Projects\WTR\60530732_SDPureWate\900-CAD-GIS\910-CAD\20-SHEETS\Pkg_A\A\SHEETS\60530732-SHT-ARCH_A-34_Maintenance Building Plans.dgn

4/22/2019 rothr1

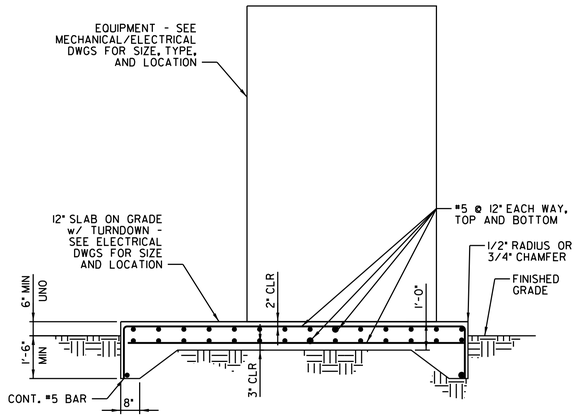
November 24, 2020 Morena Pump Station



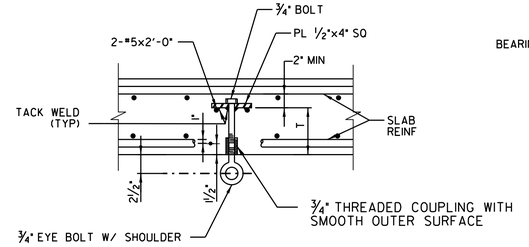
NOTES:

1. GALVANIZE FRAME AFTER FABRICATION
2. FOR ALUMINUM OR STAINLESS STEEL PLATES USE MATCHING MATERIAL FOR FRAME AND FASTENERS.

TYPICAL PLATED COVERED OPENING — 1 / -
SCALE: NTS



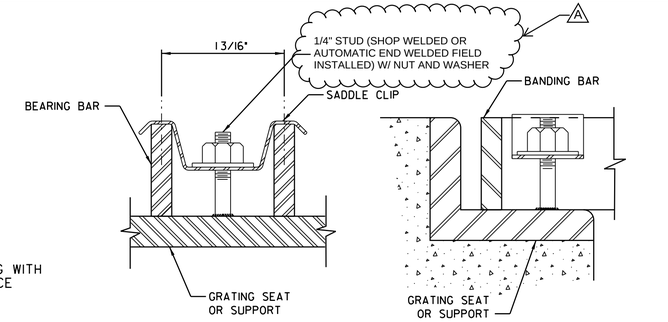
SLAB ON GRADE EQUIPMENT PAD — 2 / -
SCALE: NTS



NOTES:

1. ALL METAL PARTS SHALL BE 316 SST
2. LOAD CAPACITY T=4" 2000 LB
   T=5" 3000 LB
   T=6" 4000 LB
3. CONCRETE SHALL COVER REINF BARS 2" MIN

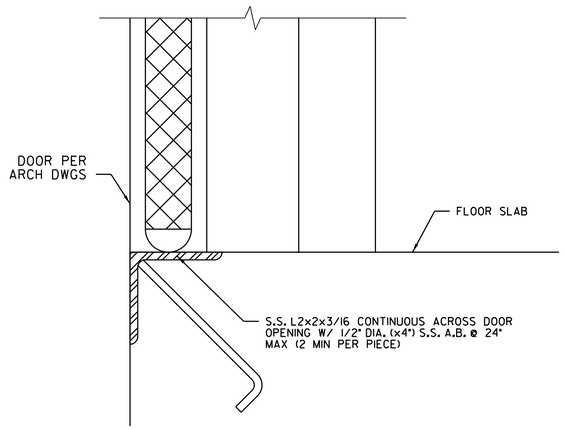
LIFTING EYE — 3 / -
SCALE: NTS



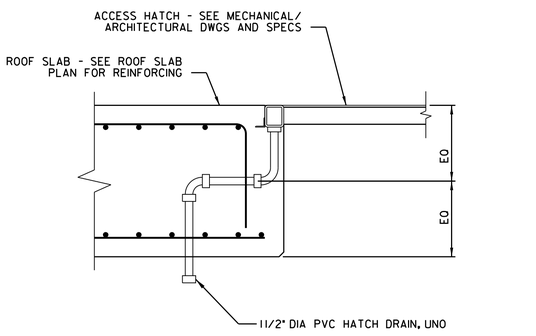
NOTES:

1. PROVIDE A MINIMUM OF 4 CLIPS PER GRATING PANEL, APPROX 4" FROM PANEL CORNERS. MAXIMUM CLIP SPACING AT 36" O.C.
2. STUD, NUT, WASHER AND CLIP TO BE OF SAME MATERIAL AS GRATING SEAT OR SUPPORT
3. AT GRATING SUPPORTED BY BEAMS. ALTERNATIVE CLIPS THAT FASTEN ONTO THE BEAM FLANGE MAY BE USED IN LIEU OF WELDED STUDS.

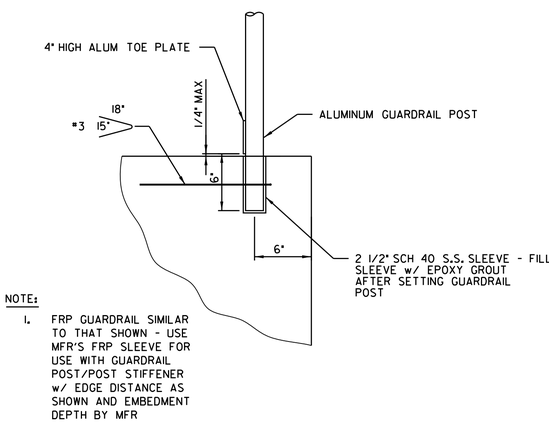
GRATING ANCHOR DETAIL — 4 / -
SCALE: NTS



DOOR THRESHOLD REINFORCEMENT — 5 / -
SCALE: NTS



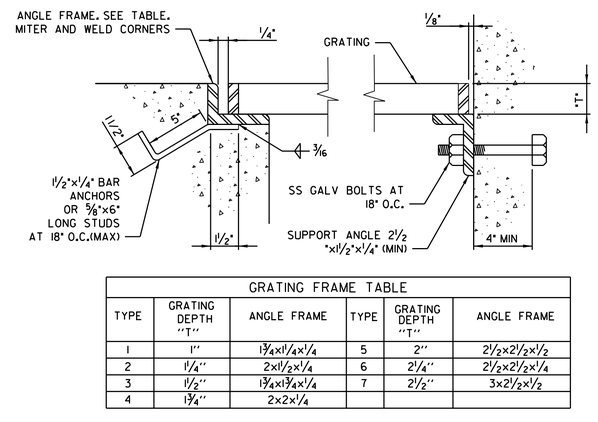
FLUSH ACCESS HATCH DRAIN — 6 / -
SCALE: NTS



NOTE:

1. FRP GUARDRAIL SIMILAR TO THAT SHOWN - USE MFR'S FRP SLEEVE FOR USE WITH GUARDRAIL POST/POST STIFFENER w/ EDGE DISTANCE AS SHOWN AND EMBEDMENT DEPTH BY MFR

GUARDRAIL POST CONNECTION TO CONC. — 7 / -
SCALE: NTS

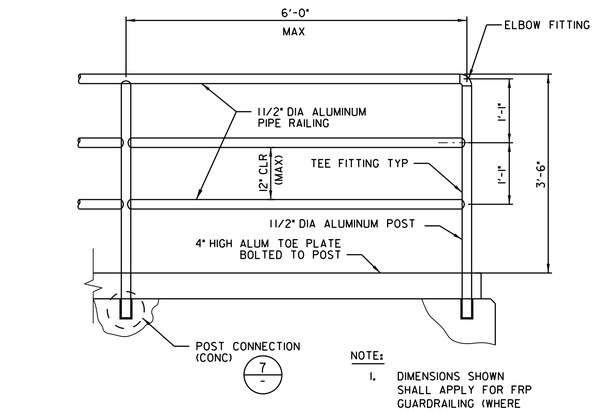


GRATING FRAME TABLE					
TYPE	GRATING DEPTH "T"	ANGLE FRAME	TYPE	GRATING DEPTH "T"	ANGLE FRAME
1	1"	1 3/4x1 1/4x1/4	5	2"	2 1/2x2 1/2x1/2
2	1 1/4"	2x1 1/2x1/4	6	2 1/4"	2 1/2x2 1/2x1/4
3	1 1/2"	1 3/4x1 3/4x1/4	7	2 1/2"	3x2 1/2x1/2
4	1 3/4"	2x2x1/4			

NOTES:

1. BEARING BARS: "T"x3/16" AT 1 3/16" O.C.
   CROSS BARS: SAME SIZE AT 4" O.C.
2. ANGLE FRAME AND SUPPORT ANGLE SHALL BE OF SAME MATERIAL AS GRATING, EXCEPT FOR FRP GRATING THEY SHALL BE STAINLESS STEEL
3. FOR GRATING DEPTH "T" SEE DRAWINGS
4. ALL ENDS AND OPENINGS OF GRATING SHALL BE BANDED
5. SEE DETAIL 4 ON THIS DRAWING FOR GRATING ANCHORS
6. WEIGHT OF GRATING SECTION SHALL NOT EXCEED 80 LBS

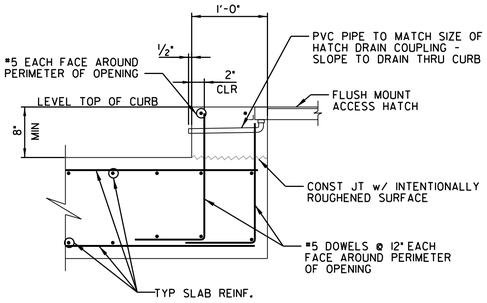
GRATING DETAILS — 8 / -
SCALE: NTS



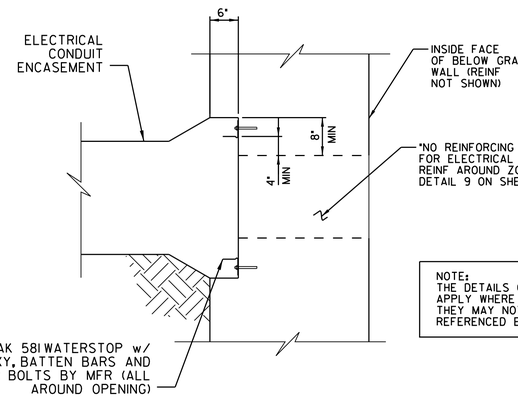
NOTE:

1. DIMENSIONS SHOWN SHALL APPLY FOR FRP GUARDRAILING (WHERE SPECIFIED)

GUARDRAIL SYSTEM — 9 / -
SCALE: NTS



ACCESS HATCH CURB — 10 / -
SCALE: 1"=1'-0"



ELEC. CONDUIT THRU SUBGRADE WALL — 11 / -
SCALE: NTS

NOTE:
THE DETAILS ON THIS DRAWING SHALL APPLY WHERE APPLICABLE EVEN THOUGH THEY MAY NOT BE SPECIFICALLY REFERENCED ELSEWHERE.

TYPICAL STRUCTURAL DETAILS 3

S-06

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A
TYPICAL STRUCTURAL DETAILS 3

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 103 OF 286 SHEETS

SEWER WBS B-15141

APPROVED: FOR CITY ENGINEER — DATE 10/08/2020
NABIL BATTA, PRINT NAME — C63631 RCE#

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
APPROVED BY: DARIN SANCHEZ, PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
A ADDENDUM A	CITY		11/23/20	

SEE SHEETS CCS27 COORDINATE
SEE SHEETS CCS83 COORDINATE

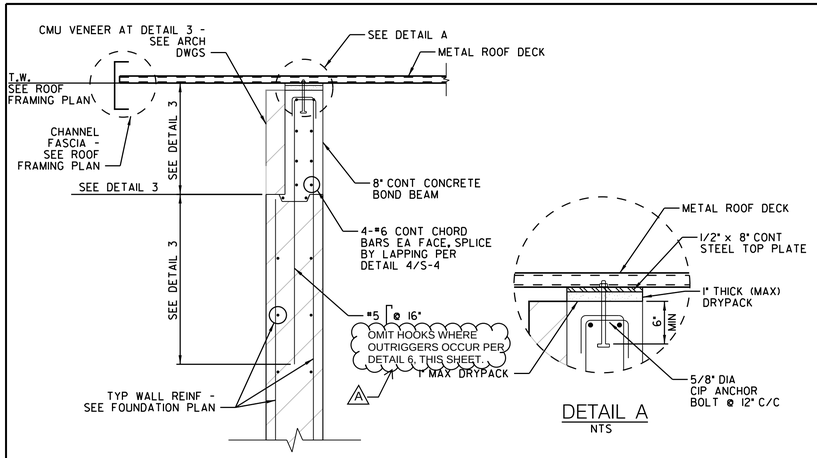
REGISTERED PROFESSIONAL ENGINEER — DALE E. MAH — No. 2582 — STRUCTURAL — STATE OF CALIFORNIA — 3/9/19

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

40421-103 -D

A EDITS TO DETAIL 4

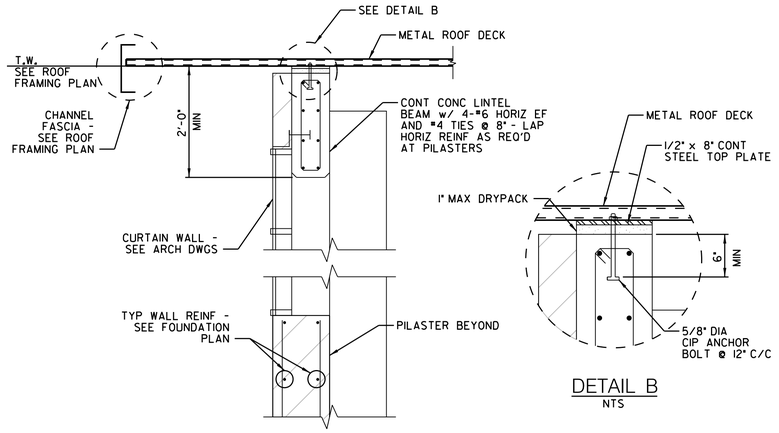
ADDENDUM A



DETAIL A
NTS

END WALL SECTION
SCALE: 3/4" = 1'-0"

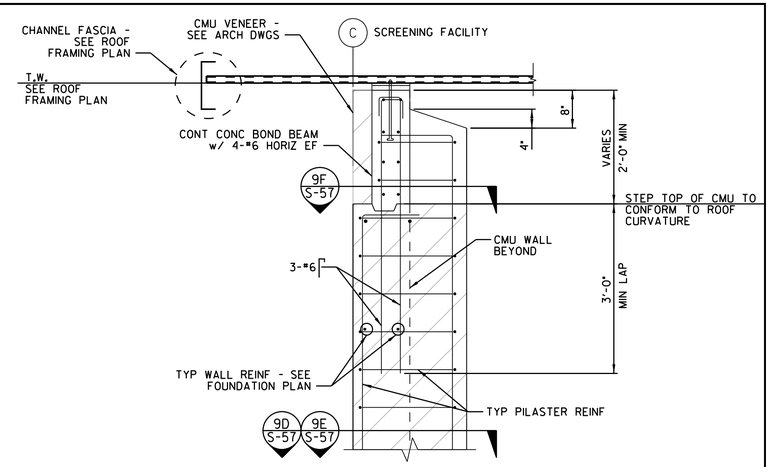
1 / -



DETAIL B
NTS

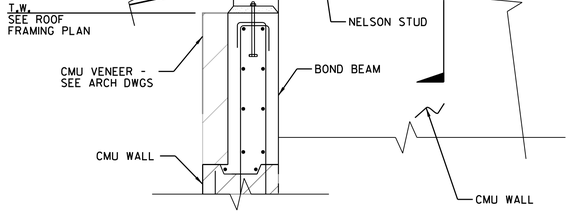
END WALL SECTION AT WINDOW
SCALE: 3/4" = 1'-0"

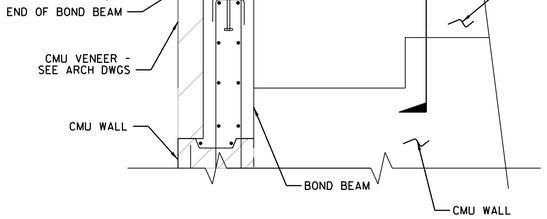
2 / -

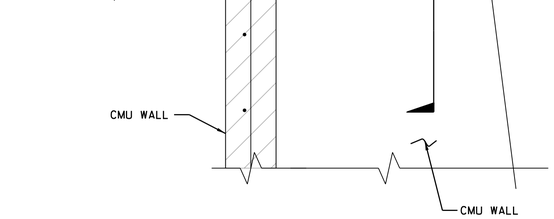


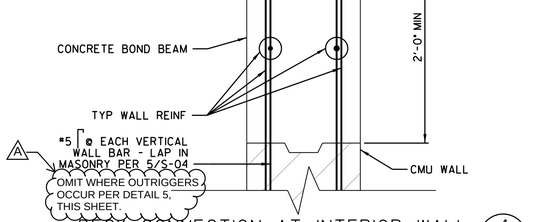
PILASTER SECTION AT END WALL
SCALE: 3/4" = 1'-0"

3 / -



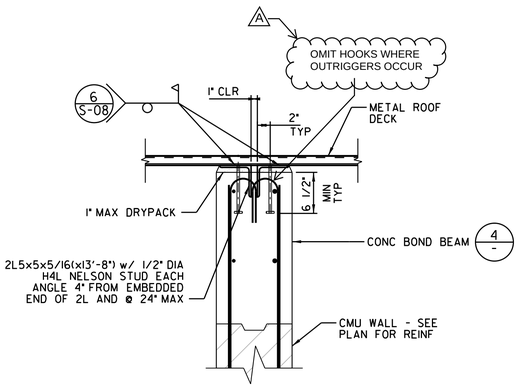




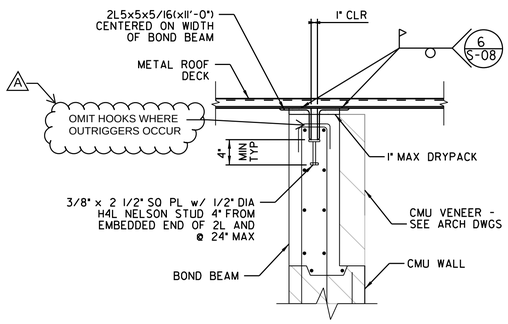


DECK CONNECTION AT INTERIOR WALL
SCALE: 11/2" = 1'-0"

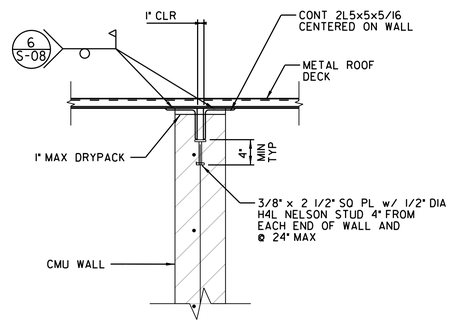
4 / -



SECTION A



SECTION B



SECTION C

OUTRIGGER AT INTERIOR WALL
SCALE: 1" = 1'-0"

5 / -

OUTRIGGER AT END WALL
SCALE: 1" = 1'-0"

6 / -

OUTRIGGER AT STAIR ENCLOSURE
SCALE: 1" = 1'-0"

7 / -

STRUCTURAL DETAILS 6

S-58

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A
STRUCTURAL DETAILS 6

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 155 OF 286 SHEETS

SEWER WBS B-15141

APPROVED: FOR CITY ENGINEER — DATE 10/08/2020
NABIL BATTA, PRINT NAME — C63631, RCE#

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ, PROJECT ENGINEER

REGISTERED PROFESSIONAL ENGINEER DALE E. WAH No. 2582 STRUCTURAL STATE OF CALIFORNIA 11/9/19

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
A ADDENDUM A	CITY		11/23/20	

SEE SHEETS, CCS27 COORDINATE
SEE SHEETS, CCS83 COORDINATE

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

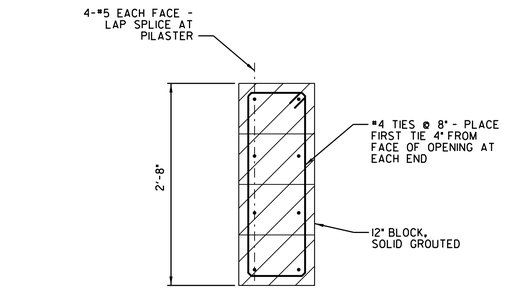
40421- 155-D

A EDITS TO DETAILS 1, 4, 5 & 6

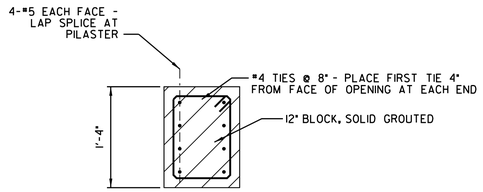
ADDENDUM A

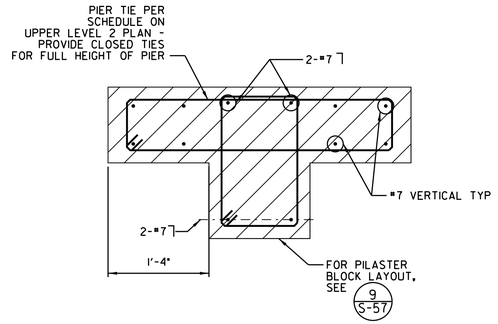
Q:\DCS\Projects\WTR\60530732_SDPureWate\900-CAD-GIS\910-CAD\20-SHEETS\Pkg_A\S\60530732-SHT-STRUCT_S-58.dgn

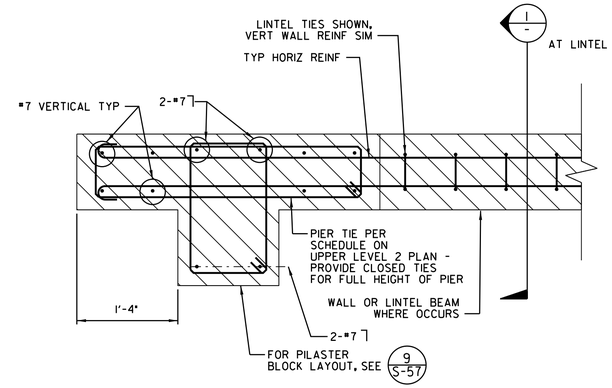
4/22/2019 rothr1
November 24, 2020 Morena Pump Station



NOTE: SPLICE TOP BARS BY LAPPING BETWEEN WALL PILASTERS AND BOTTOM BARS AT PILASTERS. SPLICE HORIZONTAL BARS BETWEEN TOP AND BOTTOM BARS BETWEEN PILASTERS.

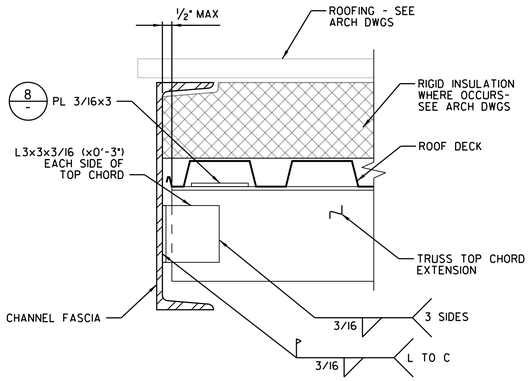






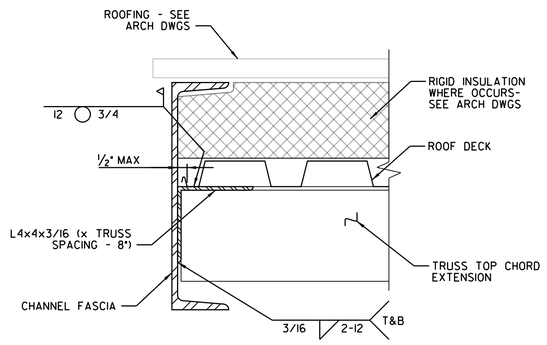
LINTEL SECTION (SCREENING FACILITY BLDG) 1 -

SCALE: 11/2" = 1'-0"



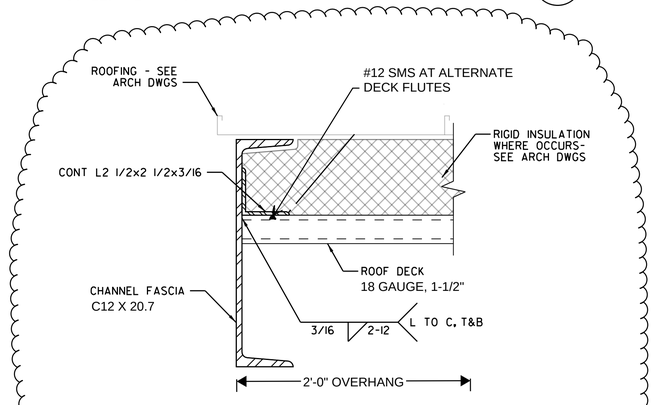
LINTEL SECTION (ELECTRICAL BLDG) 2 -

SCALE: 3" = 1'-0"



PILASTER-PIER SECTION 3 -

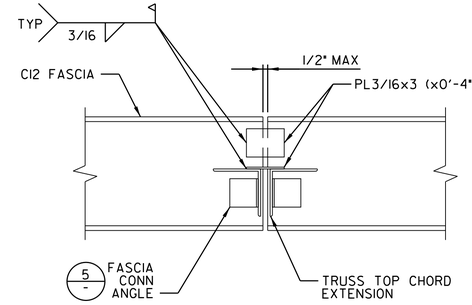
SCALE: 11/2" = 1'-0"



DETAIL APPLIES TO ELECTRICAL BUILDING AS WELL.

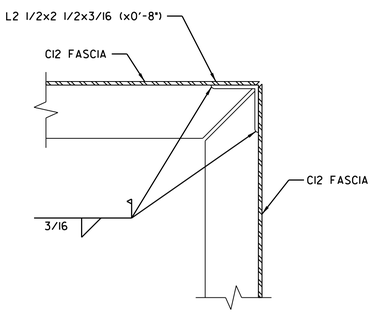
PILASTER-WALL SECTION 4 -

SCALE: 1" = 1'-0"



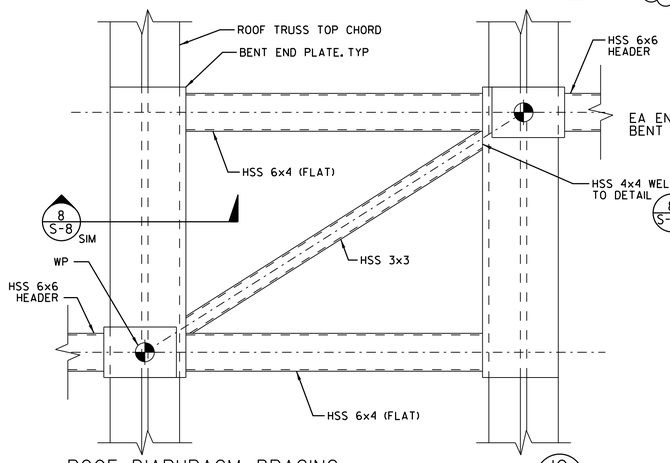
FASCIA CONN TO TRUSS/OUTRIGGER 5 -

SCALE: 3' = 1'-0"



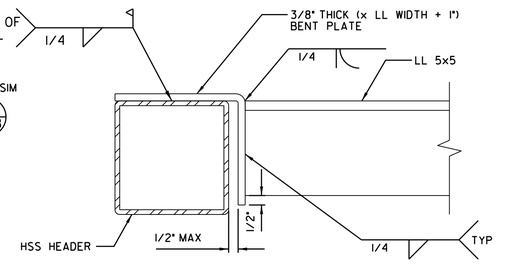
DECK CONN TO FASCIA BETWEEN TRUSSES 6 -

SCALE: 3' = 1'-0"



FASCIA CONN TO DECK OVERHANG 7 -

SCALE: 3' = 1'-0"



CHANNEL FASCIA SPLICE 8 -

SCALE: 11/2" = 1'-0"

CHANNEL FASCIA CONN 9 -

SCALE: 3' = 1'-0"

ROOF DIAPHRAGM BRACING 10 -

SCALE: 1" = 1'-0"

OUTRIGGER TO HEADER CONNECTION 11 -

SCALE: 3" = 1'-0"

STRUCTURAL DETAILS 7

S-59

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A
STRUCTURAL DETAILS 7

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 156 OF 286 SHEETS

SEWER WBS B-15141

APPROVED: FOR CITY ENGINEER — DATE 10/08/2020
NABIL BATTA, PRINT NAME — RCE# 63631

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ, PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
A ADDENDUM A	CITY		11/23/20	

SEE SHEETS CCS27 COORDINATE
SEE SHEETS CCS83 COORDINATE

REGISTERED PROFESSIONAL ENGINEER — DALE E. WAH — No. 2582 — CIVIL — STATE OF CALIFORNIA — 3/19/19

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

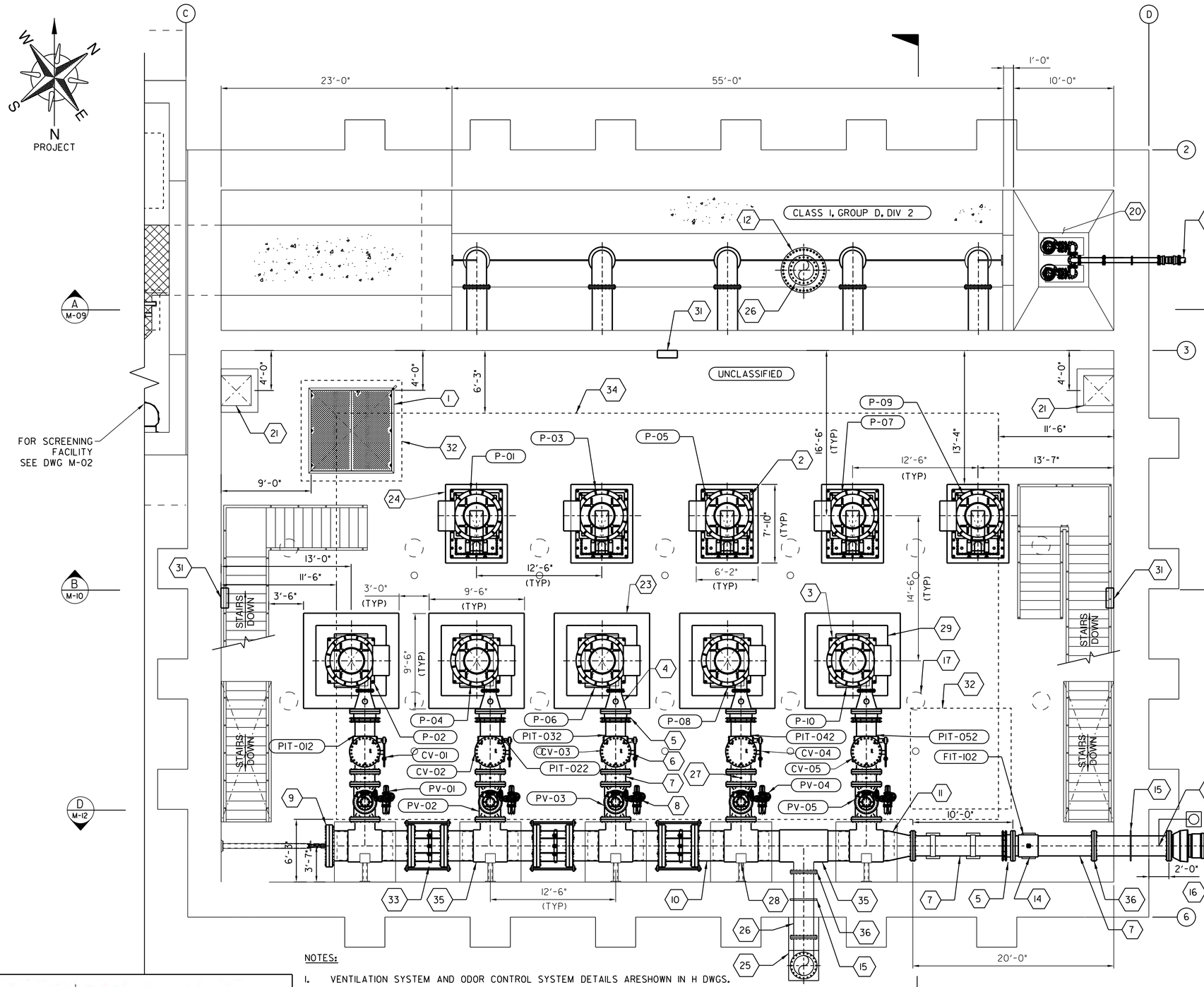
40421-156-D

A UPDATE DETAIL 7

ADDENDUM A

Q:\DCS\Projects\WTR\60530732_SDPureWate\900-CAD-GIS\910-CAD\20-SHEETS\Pkg_A\S\60530732-SHT-STRUCT_S-59.dgn

4/22/2019 rothr1



KEYNOTES

1. 8'-0" x 8'-0" DOUBLE LEAF FLOOR ACCESS HATCH (FLUSH MOUNTED).
2. STAGE 1 MOTOR AND FLYWHEEL (TYP).
3. STAGE 2 PUMP, MOTOR AND FLYWHEEL (TYP).
4. 14" X 24" FE STEEL REDUCER, RATED FOR 300-PSI PRESSURE (TYP).
5. 24" FLANGED COUPLING ADAPTER, PER DETAIL 2, DWG M-18 (TYP).
6. 24" CHECK VALVE, SEE SPECIFICATIONS (TYP).
7. 24" FE STEEL PIPE (TYP).
8. 24" ECCENTRIC PLUG VALVE W/ ELECTRIC ACTUATOR (TYP).
9. 36" CLASS F BLIND FLANGE.
10. 36" FE STEEL DISCHARGE MANIFOLD.
11. 36" X 24" STEEL FLAT TOP REDUCER (WE X FE).
12. 24" STEEL SURGE PROTECTION RELIEF PIPE CONNECTION, SEE DETAIL 7, DWG. S-63
13. NOT USED.
14. 24" MAGNETIC FLOW METER W/ EQUIPMENT SUPPORT PER DETAIL 3, DWG M-17.
15. 24" FE DI PIPE W/ CAST WEEP RING, WALL PENETRATION PER DETAIL 1, DWG M-16.
16. 24" EBAA IRON, FLEX TEND OR APPROVED EQUAL (TYP).
17. LOWER LEVEL CONCRETE SUPPORT COLUMN (TYP), SEE STRUCTURAL DWGS
18. 24" X 48" FE CML&TCMC FLAT BOTTOM REDUCER (96" LENGTH).
19. 48" CML&TCMC STEEL PIPE PRESSURE CLASS 300 PSI.
20. SCUM REMOVAL SUMP W/ DUPLEX SUBMERSIBLE PUMPS, PER DETAIL 1, DWG M-27
21. 36" SQ. VENTILATION DUCT FLOOR PENETRATION, SEE H DWGS.
22. 6" TYPE 316L SS SCUM DISCHARGE PIPE, SEE DWG C-03
23. PUMP CONCRETE SUPPORT PAD PER STRUCTURAL DWGS. PUMP CONCRETE EQUIPMENT ANCHOR & LEVELING, PER DETAIL 1, DWG M-24
24. PUMP CONCRETE SUPPORT PAD PER STRUCTURAL DWGS. SHAFT HANDING SYSTEM PER DETAIL 3, DWG M-24. PUMP CONCRETE EQUIPMENT ANCHOR & LEVELING, PER DETAIL 1, DWG M-24
25. 6" CONCRETE ENCASEMENT PER DETAIL 3, DWG S-55
26. 24" STEEL SURGE PROTECTION RELIEF PIPE, SEE DWG M-08.
27. PRESSURE INDICATOR GAUGE & TRANSMITTER PER DETAILS 3 & 4, DWG M-19 (TYP)
28. REINFORCED SUPPORT ANCHOR TEE, PER SPECIFICATIONS (TYP OF 5).
29. FABRICATED STEEL MOTOR AND FLYWHEEL SUPPORT FRAME BY PUMP MANUFACTURER.
30. 2-WIRE TEST STATION WITH 2 ANODES. SEE DETAIL 1, DWG CP-01
31. 3/4" WALL MOUNTED HOSE BIB & RACK PER DETAIL 3, DWG M-20
32. ROOF LEVEL ACCESS HATCH (ABOVE)
33. RESTRAINED FLEXIBLE COUPLING, PER DETAIL 2, DWG M-18 (TYP OF 3)
34. BRIDGE CRANE SERVICE AREA
35. 36" X 24" X 36" WELDED STEEL TEE
36. INSULATING FLANGE KIT, SEE DETAIL 3, DWG CP-03

NOTES:

1. VENTILATION SYSTEM AND ODOR CONTROL SYSTEM DETAILS ARESHOWN IN H DWGS.
2. ALL STEEL PIPING, FITTINGS, COUPLINGS, ETC. FOLLOWING STAGE 2 PUMPS, SHALL BE RATED FOR 300-PSI PRESSURE.
3. ALL PIPE SUPPORTS, BRACKETS, HANGERS, ANCHOR BOLTS, NUTS WASHERS, ETC. LOCATED IN THE PUMP STATION DRY WELL AND WET WELL SHALL BE TYPE 316 SS.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN, INSTALLATION, AND TESTING OF ALL ANCHORAGE, THRUST RESTRAIN, AND BRACING SYSTEMS IN ACCORDANCE WITH SPECIFICATIONS SECTION 01 88 15.

INTERMEDIATE LEVEL PLAN

SCALE: 3/16"=1'-0"

KEH & ASSOCIATES
A Business Group of Gannett Fleming
570 RANCHEROS DRIVE
STE. 200
SAN MARCOS, CA 92069
760.891.4180
WWW.GANNETTFLEMING.COM

PUMP STATION INTERMEDIATE LEVEL PLAN

M-07

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A

PUMP STATION
INTERMEDIATE LEVEL PLAN

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 170 OF 286 SHEETS

SEWER WBS B-15141

REGISTERED PROFESSIONAL ENGINEER — RAFAEL FAJARDO SANCHEZ — No. 49036 Exp. — CIVIL — STATE OF CALIFORNIA — 01/17/19

APPROVED	DATE
FOR CITY ENGINEER	10/08/2020
NABIL BATTA PRINT NAME	C63631 RCE#

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ, PROJECT ENGINEER

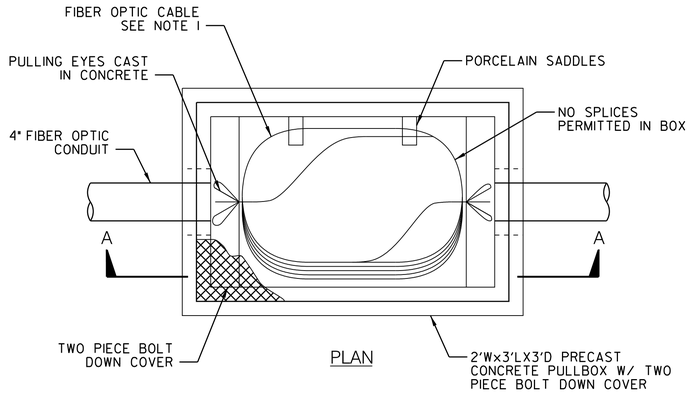
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XX/XX			
A ADDENDUM A	CITY		11/23/20	

218-1707 CCS27 COORDINATE
6268407-1858444 CCS83 COORDINATE
40421-170-D

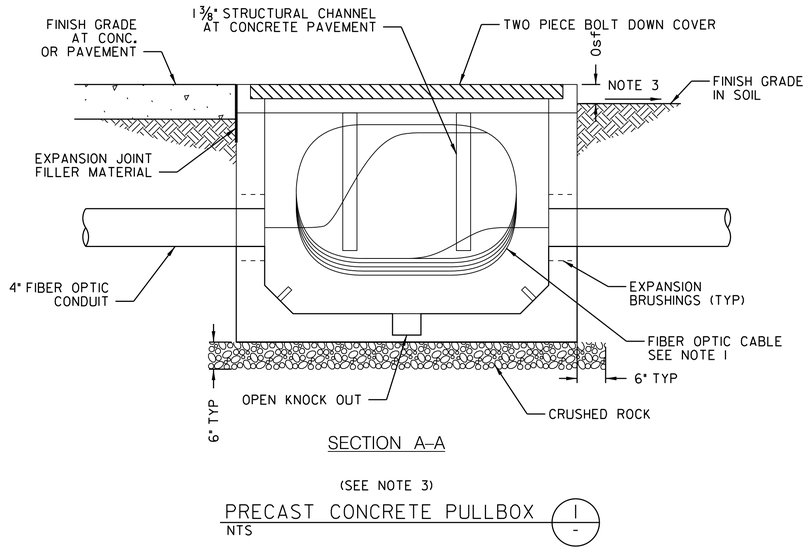
CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

A REVISED KEYNOTE 12

ADDENDUM A



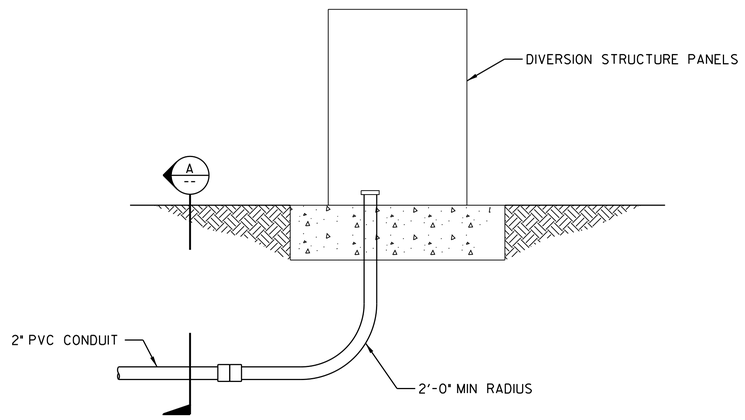
PLAN



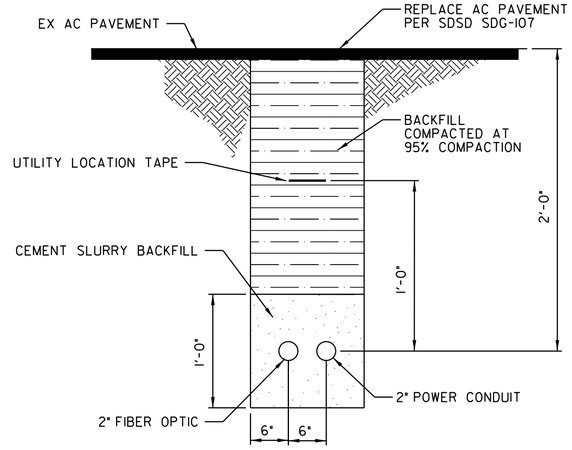
SECTION A–A

(SEE NOTE 3)

PRECAST CONCRETE PULLBOX (1 / -)
NTS



FIBER OPTIC CABLE CONNECTION
AT PANELS (2 / -)
NTS



NOTE: SEE SDRSD SDW-126 FOR DIRECT BURY OF CABLE OR CONDUIT

TYPICAL CONDUIT TRENCH SECTION (A / -)
NTS

NOTES:

1. ATTACH FIBER OPTIC CABLE TO PORCELAIN SADDLES WITH CABLE TIES. PROVIDE A MINIMUM OF 50 FEET OF CONTINOUS CABLE IN EVERY PULLBOX UNLESS OTHERWISE SHOWN ON PLANS.
2. PROVIDE FINISHED GRADE TO DRAIN AWAY FROM PULLBOX.
3. POWER PULLBOX SHALL BE IDENTICAL TO FIBER OPTIC PULLBOX EXCEPT CABLES MAY BE SPLICED WITH COMPRESSION SPLICES AND HEAT OR COLD SHRINK INSULATION.

DIVERSION/JUNCTION STRUCTURE PULLBOX DETAILS

E–50

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A

DIVERSION/JUNCTION STRUCTURE
PULLBOX DETAILS

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 261 OF 286 SHEETS

SEWER WBS B-15141

REGISTERED PROFESSIONAL ENGINEER
ALLEN J. RANDALL
No. E9206
ELECTRICAL
STATE OF CALIFORNIA
04/22/19

APPROVED: FOR CITY ENGINEER — DATE 04-22-19
NABIL BATTA, PRINT NAME — C63631 RCE#

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ, PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
A ADDENDUM A	CITY		11/19/20	

218-1707 CCS27 COORDINATE
6268407-1858444 CCS83 COORDINATE

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

40421– 261 –D

Q:\DCS\Projects\WTR\60530732_SDPureWate\900–CAD–GIS\910–CAD\20–SHEETS\Pkg_A\E\60530732–SHT–E–50_PULLBOX DETAILS.dgn
November 24, 2020 Morena Pump Station
4/24/2019 rothr1

A NEW SHEET

ADDENDUM A

City of San Diego

CITY CONTACT: Stephen Samara, Principal Contract Specialist, Email: SSamara@sandiego.gov
Phone No. (619) 533-3619

ADDENDUM B

e - Bidding

FOR

MORENA PUMP STATION

BID NO.:	**K-21-1801-DBB-3-A**
SAP NO. (WBS/IO/CC):	**B-15141**
CLIENT DEPARTMENT:	**2000**
COUNCIL DISTRICT:	**2, 7**
PROJECT TYPE:	**KA, BP**

BID DUE DATE:

2:00 PM
JANUARY 6, 2021

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

http://www.sandiego.gov/cip/bidopps/index.shtml

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:

Shapiro, Alan — Digitally signed by Shapiro, Alan DN: cn=Shapiro, Alan, ou=USSDG1 Reason: I have reviewed this document Date: 2020.12.04 10:09:24 -08'00'

1) Registered Engineer (Morena Pump Station) — 12/4/2020 Date — Seal:

2) For City Engineer (Morena Pump Station) — 12/7/2020 Date — Seal:

A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

B. BIDDER's QUESTIONS

Q1. Detail 4 / S-06 shows a Stud config for Grating attachment. In our past projects, this config has been difficult to shop weld to ensure the studs will be centered between the Grating Bars. They often need to be cut off in the field for re-welding or shipped loose for field welding. Is it acceptable to use Self-drilling screws? If not, Struct-Fast (www.structfast.com) offers alternative types of grating clips that eliminate the need for field welding. If either of these alternative config is acceptable, it will save the cost for field welding of studs in between bars.

A1. Refer to revised Detail 4 on Drawing 40421-103-D, Sheet S-06, provided in Addendum A.

Q2. Section 43 23 15, para. Item 1.6.A. states "Furnish for **each** of the five (5) sets of pumps" further described in subitems A.1 through A.8 with each line stating "…for 5 pumps". Is each line item requiring a total of 25 sets of spares or a total of 5 sets of spares?

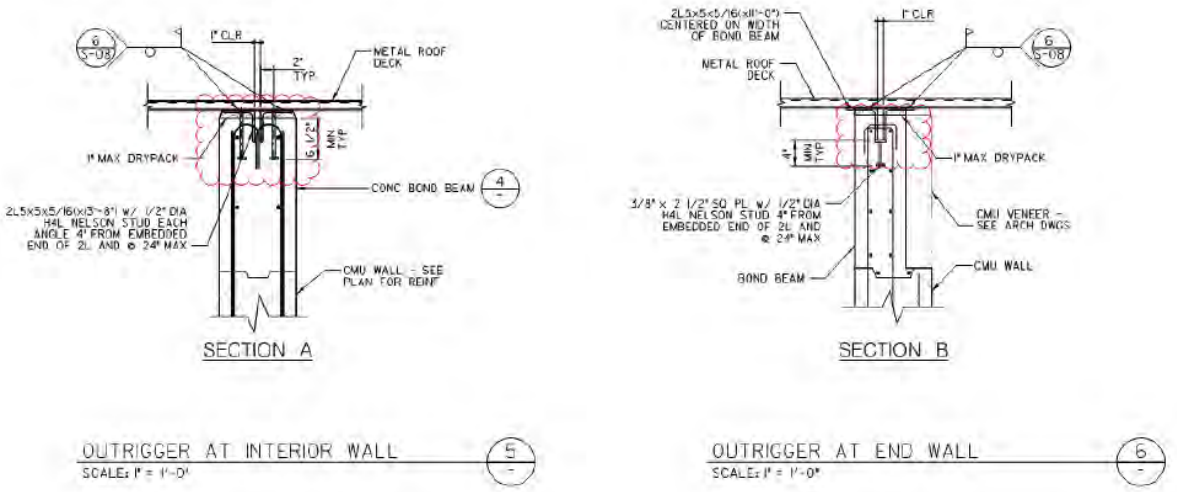
A2. A total of 5 sets of spares is required.

Q3. Section 43 42 56.04 has no pump material specification but in M26 & 27 Keynotes 4 and 2, respectively, 316SS material for Submersible Pump is stated. Is the 316SS material a requirement for all the components such; motor casing, pump casing, impeller and base elbow?

A3. Yes, all pump components including motor casing, impeller and base elbow shall be manufactured from 316SS.

Q4. There are outriggers detailed for both the Screenings Building and Electrical Building. They will cantilever either 4' or 3' depending on whether it is front or back of the structure. That will require 7' or 8' embedded into the beam for Detail 6 or 9'-8" or 10'- 8" embedded into the beam for Detail 5. Detail 6 is for both structures. Detail 5 is Electrical Building only. The outriggers are cast into the concrete beams on top of the block wall as shown. However,

the rebar shown cannot be installed through the continuous angles as shown. Either the rebar needs to be changed or the embed needs to be changed in order to install. Please advise.



A4. See revised Details 5 and 6 in Drawing 40421-155-D, Sheet S-58, provided in Addendum A.

Q5. Regarding the subject project request for bid and the following two bid items:

24- Testing, Sampling, Site Storage, and Handling of Transportation, and Disposal of Containerized RCRA Hazardous Waste – One 55-gallon drum

25- Testing, Sampling, Site Storage, and Handling of Transportation, and Disposal of Containerized RCRA Non-Hazardous Waste Non-RCRA Hazardous Waste – One 55-gallon drum

Do you have information regarding these hazardous waste or do we need to analyze the samples for everything that could characterize the waste as hazardous?

A5. These items are for hazardous waste left on-site by previous owner. See California Code of Regulations(CCR) Title 22, Division 4.5, Chapter 11, Articles 3 and 4 for classification and proper handling. These items have not been quantified but may consist of various hazardous chemicals, cleaners (Bleach and Ammonia), aerosols, among other things.

Q6. Reference is made to S-43/D and Note 33 at the Pump Station. Exterior concrete wall along Line '2' at the Pump Station requires #5 hairpins as shown in S-43/D. Rebar clearance between face of wall and main

reinforcement is 2" as shown. With the addition of #5 hairpins, rebar clearance to hairpin is reduced to approximately 1 ¼". Please confirm the Engineer's intention to keep the 2" rebar clearance is to hairpins.

A6. Refer to revised Drawing S-43 provided in this Addendum.

Q7. Reference is made to Screening Facility in S-32 Note 34, Grout Fill. Plans do not provide limits of Grout Fill from Inlet Pipe in Screening Facility to floor at EL: -16.00. Please provide plan view of Grout Fill limits.

A7. Refer to revised Drawing S-27 provided in this Addendum.

Q8. Are Liquidated Damages in Calendar Days or Working Days?

A8. Liquidated Damages are in Working Days.

Q9. Are liquidated Damages assessed adding on each milestone so that they may equal a total of $11,500 if delayed past the substantial completion or final completion? Or are you only assessed the $9,500 until completing that milestone and then the $1,000 LDS?

A9. Liquidated Damages will be applied to each working day after the milestone timeline until that milestone is complete. If Milestone 1 is not met Contractor will pay liquidated damages associated with Milestone 1 until that Milestone 1 is complete and accordingly with each Milestone

Q10. Reference is made to the GEOTECHNICAL REPORT PUMP STATION PORTION

MORENA PUMP STATION, WWFORCE MAIN, AND BRINE/CENTRATE CONVEYANCE PREDESIGN, dated January 5, 2018 prepared by AECOM.

Section 5.2.2 of the report provides an evaluation and estimate of groundwater discharge rates for construction dewatering to provide dry, firm working conditions as well as reduce hydrostatic uplift risk for the pump station excavation. The evaluation of groundwater pumping rate is based on stratigraphy and conductivity rates developed from boring PS-2 insitu silts and sands.

Even without taking into account the presence of the stone column grid the geotechnical evaluation provides dewatering flow rate a range variation of over 100% from 168,000 to 430,000 gpd.

Please provide a geotechnical evaluation of construction dewatering that takes into account the installation of the highly porous stone column grid

extending 30 feet below the pump station excavation subgrade into the pervious poorly graded sands.

Also, by installing the shallower 50 foot deep stone column grid throughout the site, will the upper permeable sand layer be hydraulically linked to the lower permeable sand layer? Should this also be incorporated into the modeling for dewatering flow nets for the pump station excavation?

A10. The dewatering rate will depend upon the stone columns, but also on the shoring system the contractor selects. The dewatering rate provided from the slug test is only information provide so that the contractor can make their own evaluation of the dewatering required based on the shoring, dewatering system, and construction method and schedule selected. No additional dewatering information will be provided.

Q11. Re Section 33 05 24 - Part 2.13.A.3 Tape Coat Rockshield System: Manufacturer Chase Tapecoat or Equal:

What AWWA standard the specified "Chase Tapecoat system" complies with?

A11. The "Chase Tape Coat System" complies with AWWA C209.

Q12. The Pump Station Section Drawings show walls pouring full height from top of SOG to bottom of upper deck with exception to Wet Well walls that have a CJ shown at EL -20.50. In an effort to reduce wall pour heights is it possible to install a horizontal Construction Joint in the Pump Station Walls.

A12. No.

Q13. Spec 01 50 25-3.1.L: Table 1 shows 60" EMBTS to have a PDWF of 12. Diversion Scenario plan shows the 60 EMBTS to have a PDWF of 19.6. Which one is correct?

A13. Interceptor and sewer diversion flows shown on Drawing G-8 depict anticipated post construction operation. Sewer bypass pumping flows for standby pumping capacity requirements during construction are detailed in Section 01 50 25 – 3.1.L Table 1. Flows have been updated to 2019 and are provided in the revised specification released as part of Addendum B. See revised Technicals, Section 01 50 25, Sewer Bypass Pumping, provided in this Addendum.

Q14. Spec 01 50 25-3.1.L: Table 1 shows MBTS & MBI to have a total PDWF of 34.2. Diversion Scenario plan shows MBTS & MBI to have a total PDWF of 44.9. Which one is correct?

A14. Interceptor and sewer diversion flows shown on Drawing G-8 depict anticipated post construction operation. Sewer bypass pumping flows for standby pumping capacity requirements during construction are detailed in Section 01 50 25 – 3.1.L Table 1. Flows have been updated to 2019 and are provided in the revised specification released as part of Addendum B. See revised Technicals, Section 01 50 25, Sewer Bypass Pumping, provided in this Addendum.

Q15. Reference Details 6 and 8 shown on Plan Sheet S-22. These details show wall rings where the 48", 60", and 66" PLRCP tie into structures and depict building the structure with wall rings complete before the pipe can be installed. Meanwhile, the pipe between structures will be driven via microtunneling. This will leave a small segment of PLRCP that will need to be tied in between the two fixed alignments. Realistically, these will not line up exactly in the field. We have the following questions:

a. Can we deviate from the wall detail and install a pipe stubbing out of the structure first, and then build the structure wall around the pipe stub? This would enable a more accurate pipe alignment from the structure to the microtunnel pipe.

b. Please provide a collar detail to tie the microtunnel pipe to the pipe coming out of the structure.

A15. A pipe stub cast into the wall with a retrofit waterstop per detail 7, sheet S-22 is acceptable in lieu of the cast-in-place wall ring provided a gasketed joint is installed within 4 feet of the exterior wall of the structure. A lined reinforced concrete closure structure using a cast-in-place wall ring on each end may be used to connect the adjoining fixed alignments. Contractor to submit, for approval, the closure structure location and detail to fit the selected pipeline lay schedule.

Gravity conveyance pipelines 48-inches in diameter and larger can be inspected visually with manned entry and do not require CCTV inspection.

Q16. With regard to the upcoming Morena PS bid, will there be any additional drawings being made available on Planetbids as there are currently insufficient drawings detailing the screens and gates with regard to channel dimensions and elevations?

A16. For screening channel dimensions and elevations, refer to existing drawings particularly Drawings S-27 and S-31. Additional design drawings are not necessary and will not be provided at this time.

Q17. Specifically, with regard to the FRP gates, the specs seem to indicate that they will need to hold back about 10ft of water differential however the spec isn't super clear on whether we are working with water differential and head pressure but generally stop plates hold back water. The spec seems to indicate they are actually "Stop Logs" and not "Stop Plates," please can this be clarified together with additional drawings if they are available of all the gate/stop log locations?

A17. FRP stop plates are required where shown in the screening building influent channels. There are no Stop logs for this project. For stop plate locations, refer to the Gate Schedule provided in Specification Section 35 20 16.25, which identifies stop plate locations, number required, materials of construction and differential head.

Q18. Additionally, would it be possible to name Huber as an acceptable screen manufacturer? Their RakeMax screen fully meets and exceeds the performance requirements of the specification including being able to exceed the required flow rate, have an improved capture rate and provide a more rugged and reliable design with simpler maintenance that can be completed without removing the screen from the channel as specified.

A18. As required by Specification Section 46 21 17 Mechanical Bar Screens shall be Parkson Aqua Guard Model ag-s-t 85 or approved equal. Evaluation of equal equipment and formal approval for equal equipment can be requested after bid award if the alternative screening equipment can fully meet the requirements of the specs and is very similar to the specified screening equipment.

Q19. Note-9 on Drawing E-03 references the "B.1 Contractor". Would you please clarify who the "B.1 Contractor" is?

A19. B1 Contractor is the Contractor selected to perform the Construction of the Morena B1 Southern Pipelines Project. Work identified for the B.1 Contractor is out of scope for this contract.

Q20. What are the elevations top of the invert slab and top of the roof of the angle structure on S-23?

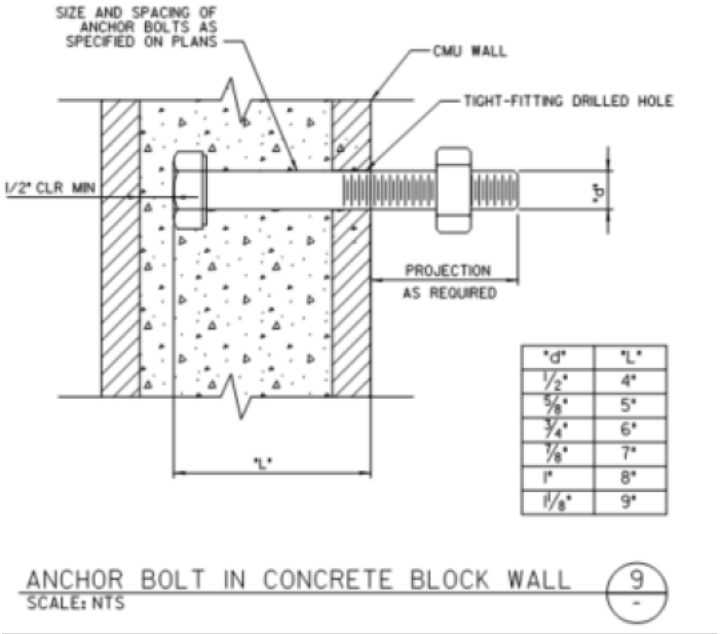
A20. Per S-24 grout fill above invert slab is 12 inches minimum below pipe invert at -10.73; hence Top of Invert slab elevation is -11.73. Per S-23 and S-24, provide 8′ minimum head space above top of bench (which is at the pipe OD elevation). Use -10.73 as pipe invert + 48″ pipe diameter + 6″ wall thickness + 8′ head space = elevation +1.77 at soffit of roof slab. Top of roof slab is 1.67 above at elevation +3.44.

Q21. Re Section 33 05 24 - Part 2.13.A.3 Tape Coat Rockshield System: Manufacturer Chase Tapecoat or Equal:

What AWWA standard the specified "Chase Tapecoat system" complies with?

A21. The Chase Corporation claims their tape coat system complies with AWWA C209.

Q22. Reference is made to Detail 9 on Sheet S-07, anchor bolt in concrete block wall. The detail shows a headed bolt being used within a block cell. While the drawing infers that the bolt can be installed with the parameters shown, this detail cannot be constructed as shown. A bolt having any projection out of the block would not be able to fit in the block cell and maintain the ½" clear shown. The detail also requires the drilled hole to be tight, which would not allow the bolt head to be installed from the outside of the block. Please revise detail to allow constructability.



A22. Detail 9 will be revised on Sheet S-07. Replacement Sheet S-07 is provided in this Addendum.

Q23. I'm with Flow N Control and we're working to bid the submersible and scum pumps on the Morena pump station project per spec section 43 42 56.04. We plan to bid ABS-Sulzer model XFP submersibles for which I've attached a brochure. We'd like to better understand a comment in the addendum recently published.

The published addendum states, "all pump components including motor casing, pump casing, impeller and base elbow shall be manufactured from 316 SS". However, in our experience with submersible pumps, the motor casing, pump casing and base elbow are typically not available in 316SS. This will significantly increase the cost and lead time of the pumps which will most likely need to be custom engineered to meet this requirement. Also, it seems to be in contradiction with spec 43 42 56.04 paragraph 2.6.B which calls for epoxy paint which is typically not applicable to stainless steel.

We'd like to understand where this requirement is coming from and if you've got a specific pump in mind.

A23. Submersible Sump and Scum Pumps supplied under Spec 43 42 56.04 shall be provided with stainless steel shafts, impellers, wear plate, and inlet extensions (grade 316 SS or better.) Pump casing, motor casing and base elbow shall be cast iron and epoxy coated per Specification Section 43 42 56.04 Paragraph 2.07.

Q24. After reviewing the Geotechnical Documents, it appears that the dewatering analysis done did not consider the presence of stone columns or a gravel layer. There is a large potential for the stone columns to interconnect a bunch of more permeable materials and greatly increase the vertical hydraulic conductivity of the soil mass. As a result of this the dewatering flow rates could be considerably higher than the 860,000 gpd that we are directed to assume in Specification Section 7-8.6.6.9.6. Please confirm that if the dewatering flow rates exceed 860,000 gpd that all the additional costs resulting from this will be paid as Extra Work.

A24. The estimate of 860,000 gpd potential dewatering flow identified in the GBR is a conservative estimate. Depending on the shoring system selected by the contractor during excavation, the amount of dewatering wells, the depth of groundwater drawdown below the excavation bottom, and other construction methods, the dewatering flow will vary. For example the use of secant piles will likely reduce the dewatering flow from the site. The

contractor can submit their selected shoring system for approval by the engineer and other construction methods. This will determine the assumed amount of dewatering in gpd. The 860,000 gpd was provided as a guideline only for the contractor assuming soldier beam and lagging excavation shoring. The Stone Columns installation may contribute more water volume to the dewatering due to the stone columns intersecting the deep gravel layer, but the additional water volume was accounted for in the 860,000 gpd estimate provided.

Q25. In the AECOM Geotechnical Report dated January 5, 2018 under Section 5.1 they discuss several methods of liquification mitigation and recommend utilizing vibro-replacement (stone columns). They note that cost considerations is one of the reasons for selection, however it does not appear they took into account that the stone columns terminate at a gravel layer and that there is a large potential for the stone columns to interconnect a bunch of more permeable materials, which in turn will greatly increase the dewatering costs. In addition to the direct costs there is the risk of settlement to adjacent structures resulting from the dewatering as it does not appear it can be limited to within the shoring. The Geotechnical Report discusses using a water-tight shoring/cut-off wall to limit the dewatering to the interior, however due to the gravel layer at the bottom of the stone columns and the deepest boring of 90 feet still within the gravel layer, it is not known where a less permeable zone is that the shoring will need to terminate in in order to cut-off the groundwater. Based on the above items it could be more cost effective and you would mitigate the risk of settlement to adjacent structures by utilizing the compaction grouting method also considered in the Geotechnical Report. Please consider revising the ground improvement within the zone of 80-foot stone columns to compaction grouting.

A25. Compaction grouting methods can be submitted for approval during the construction as a value engineering alternative. Please do not deviate from the current design documents for bidding purposes. An alternative can be discussed, but should not be included in the pricing for bidding purposes.

Q26. In Specification Section 7-8.6.6.9.3 it states the payment for dewatering hazardous contaminated water shall be included in the lump sum Bid item for "Shoring, Bracing and Dewatering of Non-Hazardous and Hazardous Contaminated Groundwater." Please confirm that we are to utilize the analytical test results provided in the Geotechnical Report under Section 5.2.2 as our basis of bid and that all additional costs resulting from

additional contaminants or contaminants above the limits stated will be paid as Extra Work.

A26. Section 2.1.3 Ground Water Sampling & Appendix C of the Geotechnical Report Morena Pump Station by AECOM dated January 5, 2018 provides anticipated pollutants to design treatment system for. If additional contaminants or increased concentration of contaminants that require additional treatment measures to be implemented, the Contractor can negotiate a changed condition per Greenbook Section 3-4 Changed Condition. If additional contaminants or increased concentration of contaminants are found and do not require additional treatment measures to be implemented, no additional compensation will be allowed.

Q27. In the AECOM Geotechnical Report dated January 5, 2018 under Section 3.4 it states groundwater (and soil) contamination may be present along West Morena Boulevard associated with former leaking underground storage tanks. As monitoring well PS-2 from which the analytical test results were provided is not in this area please provide a basis for bid for the potential groundwater (and soil) contamination on Friars Road or consider adding an allowance bid item for this work since it is an unknown.

A27. Contractor shall use the same information provided for the Pump Station for work in Friars Road. No allowance bid item will be provided.

Q28. In Specification Section 7-8.6.6.9.3 it states the payment for dewatering hazardous contaminated water shall be included in the lump sum Bid item for "Shoring, Bracing and Dewatering of Non-Hazardous and Hazardous Contaminated Groundwater," however in Specification Section 7-8.6.6.9.4 it states the payment for the handling and disposal of hazardous contamination shall be in accordance with F7-22.20, "Payment". Please clarify how payment is to be made for contaminated water and soil.

A28. Specification Section 7-8.6.6.9.4 defines the handling and disposal of pollutants collected in the process of treatment of dewatering.

Q29. As instructed by the City of San Diego "White book" page 97, I am submitting to the engineer a substitution proposal prior to Bid due date for Morena Pump Station. It is my understanding we have a three(3) working days period for the engineer of record to reply to our substitution prior to bid. Please let me know if the attached substitution proposal is satisfactory

for Section 43 23 15 Custom Engineered Vertical Non-Clog Variable Speed Pumps.

A29. Information provided with request is insufficient for review. Evaluation of equal pumps and formal approval for equal pumps can be requested after bid award if the alternative pumping equipment can fully meet the requirements of the specs and is very similar to the pumps specified. Comply with Supplementary Special Provisions Section 4-1.6, Trade Names or Equals for substitution requirements.

Q30. I am working on a quote for VFDs on this project and wanted to clarify the spares requirement.

The spec states to provide spares for each MVD. We typically see one set of spares for "each size" VFD as these are all identical (especially lift/hoisting mechanisms these are expensive and you probably do not want 5 of them).

One thing to note about Eaton as well we can include in our clarification: Eaton builds their VFDs with less components and more robust designs. Other competitors use lower rated modules (480V, etc) but use a lot of them to achieve medium voltage. Eaton uses medium voltage rated components. So you would be buying very large spares, and a lot of them, of an item that has an industry low failure rate.

I propose we quote one set of spares and make note of the details above in the letter proposal.

A30. Spare parts listed are total required, not per VFD. See revisions to Technicals, Section 26 19 23, Medium-Voltage Adjustable Frequency Drive System, sub-section 1.4, Extra Materials, provided in this Addendum.

Q31. Reference is made to S-16 Note 5, which states "Maintain level elevation around entire perimeter of structure during backfill operations. Do not backfill until top slab is in place." In Diversion Structure 3, there is a mezzanine deck at Elev: +7.00' and top slab is at Elev: +17.00'. Please confirm it is acceptable to backfill walls after mezzanine slab is in place.

A31. For Diversion Structure No. 3, it is acceptable to backfill up to elevation +5.00 once the mezzanine slab is in place.

Q32. In S-Drawings for Diversion Structures and Angle Structures, there is a note where top slab must be in place before backfilling of walls. See Note 5 in S-12, S-14, S-16 and Note 2 in S-23. However, there is no similar note for the Junction Structure 1 (see S-11). Please confirm walls may be backfilled in Junction Structure 1 without requirement of top slab in place as specified in 033000-3.6-A.

A32. For JS 1, Top Slab shall be in place before backfilling or loading of the walls. Refer to General Note 4 on Sheet S-01 of the drawings.

Q33. Bidding Documents, Certifications and Forms - List of Subcontractors and Named Equipment/Material Supplier List (pages 2193 & 2194): It is understood that the Contractor shall list all Subcontractors that will perform work in excess of one half of one percent in electronic format on PlanetBids. However, how are we to submit the Named Equipment/Material Supplier List? There is no way to electronically submit on PlanetBids. Please advise.

A33. Named Equipment/Material Supplier List is to be submitted by the awarded contractor at the preconstruction meeting.

Q34. Bidding Documents, Certifications and Forms – Debarment and Suspension Certification

- Prime Contractor and Debarment and Suspension Certification – Subcontractors, Suppliers, and Manufacturers (pages 2207 & 2208): These forms state that they must be completed and submitted at time of bid. This will be difficult to accomplish in view of all the other documentation that will need to be submitted at bid time (i.e., EPA forms 4500-3 and 4500-4). Would the City consider revising this requirement to completing and submitting these forms by 5 PM, 2 working days after bid opening? Also, is the Debarment and Suspension Certification for Subcontractors, Suppliers, and Manufacturers required of all Subcontractors and Suppliers or just those at ½ of 1 percent of the total amount bid?

A34. Please submit at bid time as specified in the solicitation. The Debarment and Suspension Certification for Subcontractors, Suppliers, and Manufacturers is required of all Subcontractors and Suppliers not just those at ½ of 1 percent.

Q35. Is the city providing water for testing?

A35. Contractor pays for the water for testing by connecting to a fire hydrant via a water meter for construction provided by the City, refer to Appendix B – Fire Hydrant Meter.

Q36. Is the city paying for the initial fill and testing of chemicals through extra work, or does the contractor need to cover this?

A36. The Contractor covers the cost. Refer to Appendix B – Fire Hydrant Meter.

Q37. Per Attachment E – Supplementary Special Provisions: Section 7-4.9(1), earthquake coverage is not included in the OCIP Builder's Risk. Are other types of earth movement (landslide, subsidence, et. Al) covered by this policy?

A37. No.

Q38. Will the General Liability and Excess Liability insurance coverage provided under the OCIP contain any exclusions for work within 50' of railroad property? Will MTS be allowed to be added as an Additional Insured on these policies if/when required by written contract/agreement?

A38. Yes. The OCIP CGL policy is endorsed with Contractual Liability - Railroads CG 24 17 10 01 on a blanket basis.

Q39. Please confirm the time period when the Builder's Risk insurance provided by the OCIP will cease. Would it be when any portion of the work is put to its intended use or after Intermediate, Substantial, or Final completion?

A39. Coverage shall cease the earlier of the time the Insured Property is taken over or taken into use by the owner or the expiration date stated in the Project Declaration Endorsement.

Q40. Will the micro tunneling work to be performed outside of the main footprint of the project be included as a covered location under the OCIP or will the contractor need to specifically request that this dedicated off-site location be insured, subject to the OCIP insurer's approval as required by Section 3, page 9 of the OCIP manual?

A40. Micro tunneling work included as part of the project work and covered under the OCIP.

Q41. Does the Builder's Risk insurance provided by the OCIP include tsunami/tidal wave in its definition of "Flood"? Please also provide the flood limit for this policy.

A41. No. Please also provide the flood limit for this policy. Flood - $200M per Occurrence and in the Annual Aggregate per project and for all projects combined except Flood for insured property in Flood Zone A - $25M.

Q42. Bidding Documents, Attachment E – Supplementary Special Provisions, 7-4.9.1 states the Owner provided Builder's Risk coverage has an applicable limit of $94 million per occurrence for this project; however, the OCIP Insurance Manual indicates the limit of liability for the Builder's Risk will be the Project Value which exceeds $94 million. Please confirm the applicable limit.

A42. The limit of liability for the Builder's Risk Insurance is the Contract Value.

Q43. The City charges from $0.005 - $0.015/gal (max) to discharge to the sewer system depending on water quality. Assuming twice the dewatering flow rate identified in the Geotechnical Report (168,000 to 430,000 GPD) x 2 = 860,000 GPD (max), the cost to discharge to the sewer could be up to $12,900/day. Please confirm that this cost is to be carried in Bid Item #15 Shoring, Bracing and Dewatering of Non- Hazardous and Hazardous Contaminated Groundwater" and not part of the allowance in Bid Item #27 "Dewatering Permit and Discharge Fees".

A43. The cost to discharge groundwater to the sewer system is a part of Bid Item #15 Shoring, Bracing and Dewatering of Non- Hazardous and Hazardous Contaminated Groundwater.

Q44. Supplementary Special Provisions, Section 4.16 "Trade Names or Equal" states that proposed substitutions for "equals" items shall be submitted no later than 5 working days after the determination of the Apparent Low Bidder. Section 4-6.3.a of the WHITEBOOK states, for review of substitutions prior to Bid, the engineer shall respond to substitutions at least 3 working days prior to the Bid date. Please clarify if the Engineer will be accepting and responding to "or Equal" substitution proposals before bid time, or if they must all be submitted 5 days after the determination of the Apparent Low Bidder.

A44. Please comply with the Supplementary Special Provisions, Section 4.16, Trade Names or Equal.

Q45. Paint spec section 09 90 00, Part 3.7B states that all buried and exposed above ground ductile iron piping, fittings, valves etc. shall be lined and coated with a fusion bonded epoxy system. However, section 33 05 19 Part 2.1F for Ductile Iron pipe states that pipe and fittings for clean water shall be cement mortar lined and asphaltic seal-coated. It then states that pipe and fittings are to be lined with 40 mil of ceramic epoxy. Please confirm whether the ductile iron pipe and fittings on the project are to be lined with fusion bonded epoxy system or with 40 mil of ceramic epoxy.

A45. All ductile iron pipe and fittings shall be fusion bonded epoxy lined and coated and conform to the requirements of 09900 Part 3.07 B.

C. ADDENDUM

1. To Addendum A, Section B, Bidders Questions, page 10, Q17 and A17, **DELETE** in its entirety and **SUBSTITUTE** with the following:

Q17. Reference drawing C-16: At Sta. 2+00 of the 48" casing/36" Brine sewer, a Rip Rap Excavation Shaft is shown. Is the intent of the excavation to remove the toe of the rip rap in Friars Rd North Levee that is in conflict with the proposed 48" casing pipe and then rebuild the toe above the casing pipe? If so, at what distance above the top of the proposed 48" casing should the rip rap terminate? How far on either side of the proposed 48" casing pipe should the rip rap be removed?

A17. Contractor to employ appropriate means and methods to remove existing rip rap as required to install the steel casing. Contractor to backfill rip rap excavation shaft with CLSM up to 18" above the steel casing, then refill with rip rap up to adjacent rip rap elevations (set first course of rip rap into wet CLSM), then backfill remainder of shaft with suitable soil material and re-pave asphalt.

2. To Addendum A, Section B, Bidders Questions, pages 20 and 21, Q65 and A65, **DELETE** in its entirety and **SUBSTITUTE** with the following:

Q65. Please refer to Specification Section 01 50 25 Sewer Bypass Pumping and the Potential Construction Sequencing Plan. Diversion Scenario 3 indicates to divert the 78" NMVI to the existing NMI Junction Structure. The drawing shows a green diversion line form the existing 78" NMVI pipe to the NMI structure. This is not realistic. Water isolation and bypass pumping needs to be diverted

from an upstream manhole. The as-builts show a manhole near the YMCA. However, a few key pieces of information needs to be known:

1. Manhole depth from grade level to water level needs to be known in order to properly size pumps. Please provide the elevations or as-builts.
2. Assuming a 100% redundant system, the PWWF at 73.5 MGD means 147MGD bypass system will need to be in place. This amount of flow equates to approximately 15 pumps with suction sizes at 24"in diameter each. The amount of suction pipes will not fit in one manhole. Additional manholes and/or other means of diverting flow needs to be clarified in order to properly plan and price this scope of work. Please clarify how the bypass operation will be accomplished.
3. For the discharge piping to the NMI structure, please provide as-builts of the NMI structure.
4. To divert flow from the YMCA parking lot manhole to the NMI junction structure, discharge pipe will need to be routed through the Mission Valley Preserve and underneath the trolley bridge. Please clarify if any restrictions are associated in doing this.

A65. It is understood that bypass pumping operation will not fit in a manhole. Due to the constraints of limited property at the upstream manhole and the adjacency to the Mission Valley Preserve it is anticipated that the NMVI will be exposed between NMI Junction Structure and the trolley tracks where bypass pumping can occur. The CONTRACTOR shall develop a plan for approval by the ENGINEER to open top of the NMVI and provide bypass pumping and repair upon completion.

1. See Record Drawings 27256-D provided in this link. https://drive.google.com/drive/folders/1Z1flFEfdDYNajA5gYUxxkkh7CeX7TeBq?usp=sharing
2. See response above.
3. See Record Drawings 27152-D provided in this link. https://drive.google.com/drive/folders/1Z1flFEfdDYNajA5gYUxxkkh7CeX7TeBq?usp=sharing
4. Routing pipes through the preserve will not be allowed

3. To Addendum A, Section E - Supplementary Special Provisions, Item 1, page 25**,** **DELETE** in its entirety and **SUBSTITUTE** with the following:

2-9.2 Surveying. To the "GREENBOOK" and "WHITEBOOK", **DELETE** in its entirety and **SUBSTITUTE** with the following:

2-9.2 Surveying (DESIGN-BID-BUILD).

2-9.2.1 General.

1. You shall provide all required site layout and general grade checking work not specified in 3-10.2, "Survey Services Provided by City".

2. Notify the City, in writing, at least 2 Working Days prior to requesting survey services provided by the City.

3. You shall provide all required traffic control in support of the City's survey work.

2-9.2.2 Survey Services Provided by City.

1. Monument Perpetuation, including mark-outs. You are responsible for requesting the coordination of these services.

    a) If at any time a monument will be destroyed or covered, such monument shall be perpetuated in accordance with state law. Inform the City Engineering Support & Technical Services Division's Land Survey Section (LSS), via project Resident Engineer, if any monument will be destroyed or covered during any construction activity.

2. The following surveying services (including construction staking), as defined in California Business & Professions Code §8726, shall be provided by the City:

    a) Locating or establishing alignment or elevations of all features or structures shown on project Plans.

    b) Locating or establishing geodetic control points for all site feature or structure locations.

    c) Produce topographic as-built data.

d) Locating, establishing, or re-establishing monuments, property lines, right-of-way lines, or easement lines.

e) Verifying structure finish grade elevations.

3. All construction survey stakes, control points, and other survey related marks provided by the City shall be preserved for the duration of the Project. If any construction survey stakes, control points, or other survey related marks are lost or disturbed and need to be replaced, such replacement shall be performed at your expense.

2-9.2.3 Payment.

1. The payment for site layout and general grade checking Work, coordination, and preservation of all survey related marks shall be included in the Contract Price.

D. SUPPLEMENTARY SPECIAL PROVISIONS

1. To Section 7, Responsibilities of the Contractor, sub-section 7-4, Owner-Controlled Insurance Program, Item 7-4.9, OCIP Builder's Risk Insurance, sub-item 1, page 145, **DELETE** in its entirety and **SUBSTITUTE** with the following:

    1. OCIP Coverage for builder's risk will provide coverage on an all-risk basis, including coverage against fire, flood, lightning, wind damage, hail, explosion, collapse, offsite storage and in-transit, and installation risks of equipment to be installed as part of the work. Earthquake coverage is not included. The policies for such insurance will be secured and maintained by the City in a form and amount consistent with such coverage commonly purchased for large construction projects. The Contractor's coverage for Builder's Risk shall be the Contract value per occurrence with no aggregate.

2. To Technicals, SECTION 26 19 23, MEDIUM -VOLTAGE ADJUSTABLE FREQUENCY DRIVE SYSTEM**,** sub-section 1.4, Part 1 General, Extra Materials**,** page 1106, **DELETE** in its entirety and **SUBSTITUTE** with the following:

    1.4 EXTRA MATERIALS

        A. Spare Parts: Furnish the following spare parts.

            1. Two power modules (Cells) with accompanying printed circuit boards.

2. Five spare LEDs of each type used.

3. Three spare fuses of each type used.

4. Two spare control relays of each type used.

5. Two spare sets of all replacement air filters.

6. One hoisting mechanism for removal and replacement of cells, if required.

3. To Technicals, Section 44 47 00, High Purity Oxygen System, pages 1951 through 1967, **DELETE** in their entirety and **SUBSTITUTE** with pages 22 through 37 of this Addendum.

4. To Technicals, Section 01 50 25, Sewer Bypass Pumping, pages 288 through 300, **DELETE** in their entirety and **SUBSTITUTE** with pages 38 through 51 of this Addendum.

E. PLANS

1. To Drawing Sheet Numbers 40421-01-D, 40421-104-D, 40421-124-D and 40421-140-D, **DELETE** in their entirety and **REPLACE** with Drawing Sheets provided in pages 52 through 55 of this Addendum.

James Nagelvoort, Director
Engineering & Capital Projects Department

Dated: *December 7, 2020*
San Diego, California

JN/AJ/mlw

SECTION 44 47 00
HIGH PURITY OXYGEN SYSTEM

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Division 26 – Electrical

B. Division 40 – Process Integration

C. Division 43 – Process Gas and Liquid handling, Purification, and Storage Equipment

1.02 REFERENCE STANDARDS

A. The following is a list of standards which may be referenced in this section:

1. Occupational Safety and Health Administration (OSHA)
2. National Fire Protection Association (NFPA) 53
3. Compressed Gas Association (CGA) G-4.1
4. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section VIII, Div. 1
5. ASME B16.1/B16.5 Pipe Flanges and Flanged Fittings.

1.03 SYSTEM DESCRIPTION

A. The Super Oxygenation System (System) shall be designed to elevate dissolved oxygen (D.O.) levels at the Morena force main to reduce dissolved sulfides and subsequent vapor phase hydrogen sulfide (H_2S) levels in the sewer collection system. The System will be designed to achieve a minimum oxygen transfer efficiency of greater than 90 percent. To achieve this goal, the System shall provide a large oxygen/water interface generated by an intense bubble swarm to achieve dissolution such that the gaseous oxygen is completely dissolved into the wastewater before being blended back into the force main flow.

B. The System shall contain no internal nozzles, mixers, or inner baffles that are prone to clogging and all openings shall be a minimum of 4 inches in diameter to pass raw wastewater. The SuperOxygenation System shall not be pressurized

above the operating discharge pressure of the force main being treated. No pure oxygen headspace shall be developed inside of the dissolution vessel. No devices may be placed within the force main to aid dissolution as said devices may become fouled and/or otherwise adversely affect force main flow characteristics.

C. The Supplier shall provide all labor, materials, equipment and incidentals as specified and indicated herein and as required to meet the specified performance requirements to furnish:

1. One complete SuperOxygenation System and appurtenances complete and operational. Components are to include:
   a. SuperOxygenation Cone (Speece Cone).
   b. PLC based Process Control Panel.
   c. Oxygen Control Panel.
   d. Two 40 HP Side stream pump.
2. All mechanical components shall be designed and constructed in accordance with the latest edition and revision of all applicable codes and regulations, including the following:
   a. ASTM
   b. ANSI
   c. ASME
3. Equipment Materials:
   a. All components of the System shall be compatible with the conditions and chemicals to which they will be subjected to during normal operation.
   b. Compounds with which the materials of construction must be compatible include, but are not limited to:
      1) Hydrogen sulfide.
      2) Sulfuric acid.

D. Unit Responsibility and Scope of Supply:

1. The products shall be the end product of one responsible System manufacturer or responsible System supplier.
2. The System manufacturer shall provide components suitable for the service conditions listed herein.
3. The Contractor shall be responsible for coordinating with System manufacturer for Contractor's Scope of Supply.

4. The Contractor shall be responsible to provide and install, but not limited to, the following:
    a. Interconnecting raw sewage piping including valves and accessories.
    b. Oxygen feed piping to the System, and accessories.
    c. Installation and assembly of all equipment and instrumentation components for a complete system including labor.
    d. Site preparation.
    e. Utility requirements, including main electrical service and field wiring.

1.04 SYSTEM SUPPLIER

A. The Super Oxygenation system shall be furnished by a single System Supplier. The System Supplier shall have experience in similar installations with permanently installed and operating systems adding a similar amount of oxygen to what are required per these specifications.

B. The System Supplier shall be ECO Oxygen Technologies, LLC of Indianapolis, IN.

1.05 SUBMITTALS

A. Action Submittals:

1. Detailed mechanical and electrical drawings showing equipment dimensions, system fabrication, arrangement, assembly, including locations and type of connections and weights of major equipment and components.
2. Power and control wiring diagrams, including terminals and numbers.
3. Factory finish system.
4. External utility requirements such as air, water, power, drains, etc., for each component.
5. Control panel elevation drawings showing panel face layout, construction, and placement of operator interface devices and other elements.
6. Complete set of engineered drawings for system I/O and Process control.
7. Make, model, weight, and horsepower of each pump assembly.
8. Complete pump and motor catalog information, descriptive literature, specifications, and identification of materials of construction.
9. Performance data curves at nominal pump speed showing head, capacity, horsepower demand, NPSH required, and pump efficiency over entire operating range of pump, from shutoff to maximum capacity.

10. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
11. Installation Manual.
12. Manufacturer shall have experience in the installation of HPO facilities in similar applications under similar circumstances and of similar size.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance.
2. Warranty Certificate,
3. Operation and Maintenance Manuals (3 hard copies, 1 electronic copy).
4. Manufacturer's Certificate of Proper Installation.
5. Equipment Testing and Field Startup Report.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. The manufacturer must be able to provide the Owner with training as specified herein.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed in such a manner as to not degrade quality, serviceability or appearance.

B. All exposed equipment openings shall be properly protected.

C. Appropriate measures shall be taken to prevent the entrance of moisture or water to equipment during shipment and storage onsite.

1. Control panels should be stored in an enclosed place, safe from the weather until installed.

1.08 PATENTS

A. The manufacturer shall warrant that the use of their system and its equipment, in the process for which the system has been expressly designed, will not infringe on

any U.S. or foreign patents or patents pending. In the event of any claim of infringement, the manufacturer shall defend and indemnify the Owner free from any liabilities associated with the use of the patented equipment or process.

B. The manufacturer hereby grants to the City, in perpetuity, a paid-up license to use any inventions covered by patent or patents pending owned, or controlled by the manufacturer in the operation of the facility being constructed in conjunction with the equipment supplied under this Contract, but without the right to grant sublicenses.

1.09 WARRANTY

A. The manufacturer shall guarantee that the SuperOxygenation system will perform in accordance with the specifications when operated within the specified design conditions.

B. The manufacturer shall guarantee all materials and equipment to be free from all defects due to faulty materials or workmanship for a period of one (1) year from the date of startup and shall be limited to the repair or replacement of the SuperOxygenation system.

1.10 PERFORMANCE GUARANTEE

A. SuperOxygenation System Supplier shall guarantee that the System shall provide a minimum oxygen transfer efficiency of 90% or greater.

1. One-time performance testing as described in the FIELD TESTING section shall be means of proving performance criteria is met.

1.11 PAYMENT

A. Payment for equipment shall be in accordance with System Supplier's payment terms.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

A. The SuperOxygenation System shall be designed to operate under the following operating conditions:

Process Parameter	Value
Diameter of Force Main (inches)	48
Length of Force Main to be Treated (ft)	56,760
Total Dynamic Head at Maximum Flow Conditions (ft)	494
Static Head	389
Force Main Pump Operation	Continuous
Daily Average Flow (gpm)	21,910
Maximum Flow Rate (gpm)	26,180
Minimum Flow Rate (gpm)	5,000
Max Hydraulic Retention Time (hrs)	15
Existing Dissolved Sulfides (mg/L)	3
Site Elevation Above Sea Level (ft)	16
Max Temperature of Sewage (°C)	25
Oxygen Uptake Rate (OUR) (mg/L/hr)	15
Daily Oxygen Addition Required Based on Above Parameters (lbs O_2/day)	20,205

2.02 PERFORMANCE CRITERIA

A. The SuperOxygenation System shall be designed to achieve an oxygen transfer efficiency of greater than 90%.

1. The System Supplier shall submit performance data from a minimum of 10 permanently installed and operational systems that prove a minimum oxygen transfer efficiency of greater than 90% under actual operating conditions. Data from factory tests with clean water or data from temporary pilot tests is not acceptable.
2. To achieve the high oxygen transfer efficiency, the system shall provide a large oxygen/water interface generated by an intense bubble swarm to achieve oxygen dissolution such that the gaseous oxygen is completely dissolved into the wastewater before being blended back into the main flow.
3. Systems with a pressurized pure oxygen headspace shall not be considered.
4. Systems which insert venturis, nozzles, diffusers, mixers, or other such devices into the force main will not be considered.
5. Discharge D.O. levels shall be measured upon system start-up to confirm transfer efficiency.

B. The SuperOxygenation System should run continuously with a minimum amount of maintenance to guarantee reliable D.O. control. Therefore, the system shall contain no internal nozzles, mixers or inner baffles that are prone to clogging, and all openings shall be a minimum of 4 inches to avoid scaling and clogging. Additionally, no device such as a venturi, nozzle, mixer or diffuser shall be installed within the force main.

C. The SuperOxygenation System shall be operated at or near the existing pressure in the force main line to prevent the potential for oversaturation of dissolved oxygen and pure oxygen gas off-gassing. The SuperOxygenation System shall not be pressurized above the operating pressure of the force main. The side stream pump shall not be used to maintain a pressure differential across nozzles or venturis.

2.03 INJECTION CONE

A. The SuperOxygenation Injection cone shall be constructed of Type 304 stainless steel and fabricated to ASME standards for 300 psig pressure rated vessels.

B. Features:

1. Self-cleaning bottom discharge design.
2. Sight glasses.
3. Manway.
4. 10 inch flanged inlet and discharge ports.
5. 1 inch female NPT threaded oxygen port.
6. System discharge instrumentation ports.
7. Bead blast finish.
8. Free standing vessel with lower mounting flange/feet for anchoring.

C. SuperOxygenation System Dimensions and Parameters:

1. Model Number: ECO2-7-12-PC
2. Cone Diameter: 7 feet.
3. Cone Nominal Height: 18 feet.
4. Total head loss shall not exceed 15 feet through the SuperOxygenation System at design conditions.
5. Side Stream Flow Rate: 4,200 gpm.
6. Side Stream Pump Duty Head: 28 feet.

2.04 SIDE STREAM PUMP

A. General:

1. Provide a complete, coordinated, and fully functional operating system.
2. Coordinate pump requirements with motor manufacturer and be responsible for pump and motor requirements.
3. Pumps supplied under this section to be a standard product of manufacturer and to have proven reliability.

B. Pump:

1. Furnish and install two vertical non-clog wastewater pump(s). Each pump shall be equipped with a 40 HP electric motor, connected for operation on 480 volts, 3 phase, and 60 hertz.

2. Each pump is vertical close-coupled dry-pit solids-handling angle-flow design with a 14" diameter suction and 12" diameter discharge. Each unit shall be furnished with a pump, driver, and motor high ring base with guard. Pumps are to be connected to drivers by suitably sized flexible coupling.

C. Performance Requirements:

1. Capacity: 4,200 gpm.
2. Total Dynamic Head: 28 feet of head.
3. Suction Pressure: 215 psi
4. Minimum Rated Pump Hydraulic Efficiency at Rated Capacity: 80 percent
5. Constant speed.
6. Motor Size: 40 Horsepower.
7. Motor Speed: 710 rpm (10 pole)

D. Manufacturers:

1. Pump(s) shall be the product of Fairbanks Nijhuis or approved equal.
2. Manufacturer shall have installations of like or similar application with a minimum of 5 years' service for this pump size.

E. Design:

1. Rotation:
   The pump will be clockwise rotation when viewed from the driver end looking at the pump.

2. Impeller:

   a. The impeller shall be cast corrosion resistant alloy conforming to ASTM A743 CA6NM and be of the 3-vane, enclosed mixed-flow design, single suction, solids-handling type designed to pass a minimum sphere size of a 4 inch diameter.
   b. The impeller is to be dynamically balanced and secured to the shaft by means of a key, and impeller capscrew, and matched to the volute/casing. The arrangement shall be such that the impeller cannot be loosened from torque in either forward or reverse rotation.
   c. Wiper vanes on the back impeller shroud are not allowed.

3. Volute/Casing:
    a. The volute shall be matched to the impeller and made of cast ductile iron conforming to ASTM A395 Gr 65-45-12. The volute is to be of one-piece design with smooth fluid passages large enough to pass any size solid that can pass through the impeller.
    b. The volute shall be side flanged tangential discharge and capable of rotation in 45 degree increments to accommodate piping orientation. The volute shall be designed to permit front or back impeller removal. Diffusion vanes are not permitted.
    c. The volute shall be furnished with a large contoured inspection and cleanout opening located at the cutwater, to allow access to the impeller. Discharge flange 250 lb. ANSI drilling.
    d. The volute shall be designed to permit front or back impeller removal and to permit the removal of the rotating assembly without disturbing the suction or discharge piping. The casing shall be hydrostatically tested to 1.3 times the maximum pressure (max suction pressure plus pump shutoff TDH).
4. Wear Rings:
    a. Axial-type removable wear ring is to be provided on the impeller and the volute for reduction of recirculation.
    b. Wear rings shall be stainless steel. The impeller wear ring shall be approximately 50 Brinell softer than the fronthead wear ring.
5. Fronthead:
    a. The fronthead shall be made of cast ductile iron conforming to ASTM A395, Gr. 65-45-12 and have the base integrally cast. It shall be cast separately of the volute. Fronthead suction flange shall be 250 lb. ANSI drilling.
    b. Fronthead shall incorporate a hand hole for inspection.
6. Backhead:
    a. A separately cast ductile iron backhead with large access openings and integral sealing box conforming to ASTM A395 Gr. 65-45-12 shall be provided. The sealing box shall be cast integrally with the backhead and be designed to accommodate either packing or mechanical seal without re-machining. The sealing box shall be drilled and tapped for external flushing with seal cage.

b. A ¾" minimum backhead drain tap shall be provided. Sealing box leakage will be collected by the backhead drain trough and piped directly to drain, eliminating any drippage to the floor.

c. Pumps shall be equipped with mechanical seals. There shall be no reduction in shaft size through the seal area. Provide silicon carbide seal, Type CURC manufactured by AES, or approved equal.

7. Bearing Frame Assembly:

a. The bearing housing shall be close-grained cast iron conforming to ASTM A48 CL30 and of heavy, rugged design for carrying the bearings and machined for accurate and permanent bearing alignment completely enclosing the shaft between the bearings. Bearing supports are to be of heavy-duty construction providing for self-centering fit with the casing for proper alignment. The bearing housing shall be of dust-proof design, incorporating lip-type grease seals in contact with the shaft to prevent the entrance of contaminants. Jacking bolts for external impeller adjustments are required. Zerk-type grease fittings for bearing lubrication shall be supplied at the bearing housing.

b. The pump shaft shall be made from type 4140 alloy steel, of sufficient diameter to carry the maximum loads imposed and to prevent vibration and fatigue. The shaft shall be accurately machined along its entire length. Keyways shall be provided at both ends.

c. A renewable shaft sleeve, positive adhesive sealed to prevent leakage between the shaft and the sleeve, shall protect the shaft through the sealing box area. The shaft sleeve shall be 316 stainless steel and shall extend beyond the stuffing box to accommodate seal outboard length.

d. Radial (inboard) bearings shall be grease-lubricated single-row deep-grooved ball type, self-aligning, designed to carry the hydraulic radial loads encountered in the service conditions. Thrust (outboard) bearings shall be angular contact, duplex mounted, designed to carry the pump hydraulic axial and dead load thrust.

e. Bearings shall be designed for an L10 life of 100,000 hours per AFBMA at best efficiency point. Grease relief ports with plugs shall be provided.

8. Fits and Hardware:
   The volute/casing, fronthead, backhead, and frame shall be manufactured with concentric shoulder fits to assure accurate alignment. All machined bolts, nuts, and capscrews shall be 316 stainless steel and of the hex-head type and will not require the use of any special tools.
9. High Ring Base:
   The motor high ring base shall be fabricated steel designed to support the weight of the motor and to assure accurate alignment of the pump and motor shaft and be of adequate height to permit access to the coupling and furnished with a shaft guard.
10. Vibration Limitations (Field):
    The limits of vibration as set forth in the standards of the Hydraulic Institute shall govern.
11. Testing:
    A certified factory hydrostatic and performance test shall be performed on each pumping unit in accordance with Hydraulic Institute Standards, latest edition. Tests shall be sufficient to determine the curves of head, input horsepower, and efficiency relative to capacity from shutoff to 130% of design flow. A minimum of six points, including shutoff, shall be taken for each test. At least one point of the six shall be taken as near as possible to each specified condition. Results of the performance tests shall be certified by a Registered Professional Engineer and submitted for approval before final shipment.

2.05 PIPING, VALVES, AND ACCESSORIES

A. By others as necessary and as shown on the drawings.

2.06 INSTRUMENTATION AND CONTROL

A. General:

1. Provide control panels, electrical components and wiring for a complete, functional system.
2. Provide all items not specifically specified which are required to implement the specified functions and the functions required for proper system operation.
3. Coordinate controls with existing SCADA system.

B. Process Control Panel: PLC driven automatic system control with sensing features. The system shall be designed for automatic flow control with full manual backup control of oxygen flow and side stream pump control. The oxygen feed rate shall be continuously adjusted to the actual process water flow rate. The control panel shall be rated for use on a 120 volt power supply and shall be housed in a NEMA Type 4X 304 stainless steel enclosure. The control panel shall contain an Allen-Bradley Programmable Logic Control (PLC), operator interface screen and have the capability to monitor system parameters for alarm indication and data logging and trending.

1. Instrumentation included with the system and controlled/monitored by the Process Control Panel:
   a. Oxygen mass flow controller.
   b. One (1) solenoid valve.
   c. One (1) actuated ball valve.
   d. Side stream flow meter.
   e. Side stream pressure sensor.
   f. Side stream temperature sensor.
2. PLC and I/O:
   a. Allen-Bradley MicroLogix Processor.
   b. Ethernet switch.
   c. MicroLogix fixed racks, power supplies, expansion analog and digital I/O.
   d. Trend recording: The PLC shall record the following data as a minimum:
      1) Oxygen addition, current day's total.
      2) Oxygen addition, previous day's total.
      3) Force main flow.
      4) Side stream flow.
      5) Side stream pressure.
      6) Side stream temperature.
3. Operator Interface:
   a. Panel Door-mounted HMI:
      1) Trending and logging.
      2) Ethernet communication capable (for remote connection).
4. Main Control Enclosure:
   a. Preassemble and wired, NEMA 4X 304 stainless steel construction.
   b. System Hand-Off-Auto switch.
   c. Interposing I/O relays as necessary.
   d. Disconnects and fusing for AC power distribution.
   e. DC power supply and fusing for DC power distribution.

f. All necessary wireways, wiring, labels, and miscellaneous hardware for a complete control panel.

C. Oxygen Control Panel: NEMA 4X 304 stainless steel panel complete with oxygen mass flow controller, rotameter, solenoid valve, check valves, isolation valves and stainless steel tubing and fittings as required. Panel will be powered, monitored and controlled by the Process Control Panel.

D. Additional Components: The following additional components will be provided for mounting on the Injection Cone for redundant control and system isolation of the oxygen delivery piping:

1. Isolation valve
2. Check valve.
3. Actuated ball valve.

E. Inputs to Process Control Panel:

1. Force main flow rate.
2. Side stream pump signal(s).
3. System enable/permission to run.

F. Description of Operation:

1. The Super Oxygenation System shall operate by redirecting a side stream of raw wastewater from the force main and pumping it through the Injection Cone. Gaseous oxygen is fed into the Injection Cone by the Oxygen Control Panel as controlled by the Process Control Panel. The Injection Cone shall provide a large oxygen/water interface as generated by an intense bubble swarm to achieve rapid oxygen dissolution such that the gaseous oxygen is completely dissolved before being blended back into the force main. The Super Oxygenation System shall not have a pure oxygen headspace inside of the vessel.
2. The Process Control Panel PLC shall monitor the force main flow rate, side stream water flow rate, and water temperature and system pressure. Based on this data, the PLC shall calculate the amount of oxygen required to meet the oxygen demand of the wastewater. The PLC shall be capable of adjusting the

oxygen feed rate into the Injection Cone by means of the mass flow controller to match the calculated oxygen demand.

3. The Super Oxygenation System shall be capable of automatically adding variable amounts of oxygen as required by varying force main flow rates.
4. The PLC shall also monitor the side stream pump operation, side stream water flow rate, oxygen flow rate, and water temperature and system pressure. These parameters shall be checked against design inputs to ensure optimal system performance and provide for system shutdown and/or alarm notification if the operation is out of tolerance.

G. Alarms shall be capable of being transmitted to the owner in accordance with their requirements, specified herein under specifications Division 40.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

A. Manufacturer shall provide written instructions for installation of equipment by Contractor.

B. Anchor Bolts: Contractor shall provide all necessary anchor bolts and field install after receipt of equipment. All anchor bolts, nuts, washers, etc. shall be type 316 stainless steel.

3.02 PUMP INSTALLATION

A. Provide pump manufacturer's written instructions for pump installation by Contractor.

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom as designated by Owner, for minimum person-days listed below, travel time excluded:

1. Function Testing, Performance Testing, Training of Owner's Staff, and Completion of Manufacturer's Certificate of Proper Installation: 3 days and two trip.

B. Schedule with Owner's manufacturer's services/Contractor to avoid conflict with other onsite testing or other onsite activities.

C. Furnish trained, articulate personnel to perform manufacturer's services.

D. Establish training schedule to ensure adequate training of appropriate personnel as deemed necessary by Owner.

E. Training Lesson Plan: Provide the following:

1. Title and objectives.
2. Course description and outline of course content.
3. Recommended attendees and time required.
4. Format (e.g. lecture, hands-on).

3.04 FIELD TESTING

A. Prior to acceptance by Owner, an operational test of the SuperOxygenation system shall be conducted to determine if the installed equipment meets the purpose and intent of the Specifications. Tests shall demonstrate that all equipment is electrically, mechanically, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

B. All equipment shall be tested to check for proper operation, proper alignment, faulty equipment, and for excessive vibration.

C. Any and all alterations, modifications, additions and/or work necessary to rectify defects or nonconformance with the Section of the Specifications shall be in such a manner as to provide for the satisfactory operation of the system, all at no additional cost to the Owner.

D. Upon completion of Field Testing, the Manufacturer shall provide a summary report documenting the results of the required field testing.

E. All labor, instruments, equipment, apparatus, fuel, temporary piping, water and electrical power required for testing shall be provided by the Contractor at no additional cost to the Owner.

END OF SECTION

SECTION 01 50 25
SEWER BYPASS PUMPING

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to provide temporary sewage bypass pumping throughout the construction phase of the project and until all project improvements are constructed and accepted by the City.

1. Contractor shall construct and maintain all temporary bypass sewers and be responsible for all bypass pumping of sewage that may be required to prevent backing up of sewage and allow appropriate conditions for proper inspection, rehabilitation, testing or drainage during force main rehabilitation, replacement of pumps, or reconnections to existing sewers. The Contractor shall immediately remove and dispose of all offensive matter spilled during the bypass pumping at his own expense. The Contractor shall also be responsible for paying any fines imposed as a result of spills or overflows that occur as a result of the bypass pumping operations.

2. Contractor shall provide a 100% redundant bypass pumping system, including intake and discharge conduit, and other equipment necessary to provide continuous wastewater flow and prevent the backing up of sewage in the case of emergencies at all times.

3. Noise levels shall not exceed 70 dBA measured at 30-feet from the engine.

4. Contractor shall provide all necessary equipment to provide odor control facilities during bypass pumping and to ensure that no odor complaints are received by the City from surrounding businesses and residents. The Contractor shall be responsible for obtaining and securing any required permits needed for odor control systems and standby generators with the San Diego APCD at no additional cost to the City.

1.2 SUBMITTALS

A. The design, installation, and operation of the temporary pumping system shall be the sole responsibility of the Contractor. The Contractor shall employ the services of a subcontractor who can demonstrate, to the Engineer extensive experience in design, installation, and operation of temporary bypass pumping systems.

B. The Contractor shall prepare a specific, detailed description of the proposed pumping system (Bypass Pumping Plan). The Bypass Pumping Plan shall be submitted for review and approval by the Engineer prior to the mobilization of any of the equipment included in the Bypass Pumping Plan. The Bypass Pumping Plan shall outline all provisions and precautions to be taken by the Contractor regarding handling of existing wastewater flows. The Bypass Pumping Plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials, and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of the access and bypass pumping locations for damage due to the discharge flows, and compliance with the requirements and permit conditions specified herein. No Construction shall begin until all provisions and requirements have been reviewed and accepted by the Engineer. The plan shall include but not limited to the following details:

1. Staging areas for pumps.

2. Sewer plugging method and types of plugs.

3. Size and location of manholes or access points for suction and discharge hose or piping.

4. Size of pipeline or conveyance system to be bypassed.

5. Number, size, material, location and method of installation of suction piping.

6. Number, size, material, location and method of installation of discharge piping.

7. Bypass pump sizes, capacities, and number of each size to be provided on- site including all primary, secondary, and spare pumping units.

8. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump, operating range shall be submitted).

9. Downstream discharge plan.

10. Method of protecting discharge manholes or structures from erosion and damage.

11. Thrust and restraint block sizes and locations. Provide the details necessary to demonstrate the integrity of all suction and discharge piping including piping and fittings associated with all primary and secondary pumping units.

12. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill.

13. Method of noise control for each pump and any additional equipment that is included in the Bypass Pumping Plan to maintain specified noise levels.

14. Any temporary pipe supports and anchoring requirements.

15. Access plans to all bypass pumping locations indicated on the drawings.

16. Calculations for selection of bypass pumping pipe size.

17. Schedule for installation of and maintenance of bypass pumping lines.

18. Plan indicating location of bypass pumping pipe locations.

19. A detailed Emergency Response Plan (ERP)for adverse weather and flooding for various phases of the Work. The ERP shall be prepared in collaboration with the City's O&M staff to ensure that the plan is acceptable to the City. The Contractor is responsible for conducting any workshops with City staff to complete the emergency response plan.

20. The Contractor shall provide continuous 24-hour monitoring of all equipment required for the bypass pumping operation, including motors, hoses, pipes, valves, generators, etc. The contractor shall provide continuous 24-hours a day qualified personnel in operation and maintenance of bypass pumping systems on site throughout the duration of any bypass work. The Contractor shall submit list of monitoring personnel and their qualifications for review and approval by the City. The Contractor shall maintain in good working condition all valves, gauges, meters associated with bypass system and shall replace any defective monitoring devices within 24 hours.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 BYPASS PUMPING

A. The Contractor shall supply pumps, conduits, power, and other equipment to divert the flow of sewage from existing gravity influent sewer to the existing force mains. The bypass system shall be of sufficient capacity to handle the wastewater flows in the table located at the end of this section. It is the intent of these Specifications to require the Contractor to establish adequate bypass pumping as required regardless of the flow condition.

B. All bypass pumping piping for force main materials, shall be HDPE and conform to the following requirements:

1. All polyethylene (HDPE) pipes shall meet the requirements of ASTM F714. DR rating of the pipe shall be sufficient to withstand the pressure and leakage test outlined below.

2. HDPE Pipe shall be furnished in standard laying lengths not exceeding 50 feet.

3. Joining system: The HDPE pipe shall be joined with butt, heat fusion joints. All joints shall be made in strict compliance with the manufacturer's recommendations and ASTM 2657. Where required, flange connections, mechanical joint connections and butt connections using bolted mechanical couplers shall be provided from a pipe stub with a polyethylene and steel stiffener. Flanged connections shall be provided from a pipe stub and a steel back-up flange. Back flanges shall be primed and painted in corrosion protected paint. Quick connect couplings will not be permitted on HDPE bypass piping.

4. HDPE fittings shall be fully pressure rated to match the pipe DR pressure rating. All fittings shall be molded or fabricated by the same manufacturer as the pipe. HDPE fittings shall be joined using butt, heat fusion and/or electro- fusion. Adhesives and solvent cements shall not be permitted.

C. The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to the actual operation. The pressure and leakage test shall be conducted at one-and-a-half times the maximum pressure the system will experience based on the approved Bypass Pumping Plan for a period of two hours. No leakage is permitted during this test. The Engineer will be given 72 hours' notice prior to testing. In addition, the Contractor shall demonstrate that the pumping system is in good working order and is sufficiently sized to successfully handle flows by performing a test run for a period of 72 hours prior to beginning the Work.

D. Each bypass pumping operation shall include the components and systems to accomplish the bypass in accordance with these Specifications.

E. The Contractor shall provide on-site manual oversight of all bypass pumping operations 24 hours per day, 7 days per week when the bypass pumping system is in operation.

F. The Contractor shall be required to repair, at his own expense, any damage to public or private property caused by his operations.

G. Should damage of any kind occur to the existing sewers, the Contractor shall, at his own expense make repairs to the satisfaction of the Engineer.

H. The Contractor shall immediately notify the governing authority should a sanitary sewer overflow (SSO) occur and take the necessary action to clean up and disinfect the spillage to the satisfaction of the Authority and/or other governmental agency. If sewage is spilled onto public or private property, the Contractor shall wash down, clean up, and disinfect the spillage to the satisfaction of the property owner, Authority, and/or other governmental agency.

I. The Contractor shall not be permitted to overflow, bypass, pump or by any other means convey drainage to any land, street, storm drain or water course.

J. The Contractor shall cease bypass pumping operations and return flows to the new and/or existing sewer when directed by the Owner. During bypassing, no wastewater shall be leaked, dumped, or spilled in or onto any area outside the existing wastewater system. When bypass operations are complete, all bypass piping shall be flushed with fresh water and drained into the wastewater system prior to disassembly.

K. Contractor must take care to prevent damage to existing structures. Discharge piping to gravity sewer systems shall be designed in such a manner as to prevent discharge from contacting manhole walls or benching and full discharge shall go into downstream pipe with as minimal turbulence as possible. Contractor is responsible for any damage to manholes. It may be necessary to remove the manhole cone to provide sufficient space for the bypass piping. If this is required, the Contractor shall be responsible for any damage to existing manhole components.

L. The Contractor shall establish adequate bypass pumping adherent to the conditions above and anticipate severe weather conditions and increases in peak flows during rain events. Available flow and capacity data for Contractor's use in sizing equipment is as follows. Bypass pumps shall be sized with an additional 1.5 safety factor applied to the peak dry weather flows (PDWF) listed below, or a complete redundant bypass pumping system shall be provided.

Table 1 presents the wastewater flows for the existing trunk sewers that were provided by the City based on recordings of existing flows during 2019. Contractor shall request from the City updated flow data prior to start of construction of the project and prior to conducting any bypass pumping.

Table 1 – Existing Influent

Table 1 – Existing Influent Sewer Wastewater Flows					
	(NMVI) 78-inch	(MBI) 72-inch	(MBTS) 33-inch (1)	(EMBTS) 60-inch	TOTAL
	Q, (mgd)	Q, (mgd)	Q, (mgd)	Q, (mgd)	Q, (mgd)
Per 2019 Flow Meter Data					
ADWF	29.8	28.8	1.8	9.2	69.6
PDWF	40.0	42	2.9	13.6	98.5
PWWF	73.5	78.2	6.2	26.5	184.4

(1) The existing 33-inch MBTS connects to the 72-inch MBI upstream of proposed Diversion Structures 1 and 2.

LEGEND:

NMVI – North Mission Valley Interceptor
MBI – Morena Blvd Interceptor
MBTS – Morena Blvd Trunk Sewer
EMBTS – East Mission Bay Trunk Sewer

Drawing C-05 provides an overview of the arrangement of the existing influent sewers along with their associated record drawings. It also shows the existing 66-inch Abandoned Sewer that extends from the rail road tracks on the west side of the proposed Morena Pump Station to the east where it connects to the City's 108-inch North Metro Interceptor (NMI).

The abandoned 66-inch sewer has diversion structures that enables diversion of sewer flows from the MBI and MBTS (See Record Drawings 30507 -D). The estimated maximum flow that can be diverted through the 66-inch is 50 mgd. If the Contractor intends to utilize the existing 66-inch sewer for any sewer diversion, then this needs to be coordinated with the City. If the Contractor plans on utilize the 66-inch for sewer diversion, then the Contractor needs to investigate the condition of the existing diversion and the 66-inch sewer. This will require visual inspection of structures, slide gates, and CCTV of the existing 66-inch sewer. The Contractor would be required to provide a report to the City documenting the inspection work. The report should indicate any repairs intended to be made by the Contractor to any of the existing facilities and the costs associated with these repairs. The cost for sewer bypass pumping should be included in the Contractor base bid and there should not be any additional costs to the City outside of the required repairs identified by the Contractor.

The Contractor should note that sections of the existing 66-inch sewer will need to be removed and abandoned in order to construct the new facilities including the pump station and the 30-inch brine line. The Contractor should take all of these

factors into consideration as part of his/hers construction sequencing plan for the project.

M. The 24-hour monitoring staff shall be properly trained, experienced, and mechanically qualified such that they can quickly and effectively address any potential emergency and non-emergency situations associated with the pumps and bypass pumping system that must remain in operation for an extended period.

3.2 SUPPLEMENTS

A. The supplements listed below, following “End of Section” are a part of this specification:

- Diversion Scenarios

END OF SECTION

Potential Construction Sequencing Plan

Pump Station Dewatering Activities

JS Shaft	**MT JS to DS2**	**MT JS to DS3 66" & 48"**	**MT JS to MPS**	**MT 30" Brine from Custer to Friars**	**JS1 & Angle Structures**

DS1	**DS2**	**DS3**	**Angle Structure Adjacent to DS3**

Diversion Scenario 1	**Diversion Scenario 2**	**Diversion Scenario 3**	**Diversion Scenario 4**	**Diversion Scenario 5**

Traffic Control Scenario 1	**Traffic Control Scenario 2**	**Traffic Control Scenario 3**	**Friars Road Open**

Abbreviations

DS – Diversion Structure

JS – Junction Structure

MT – Microtunnel

MPS – Morena Pump Station

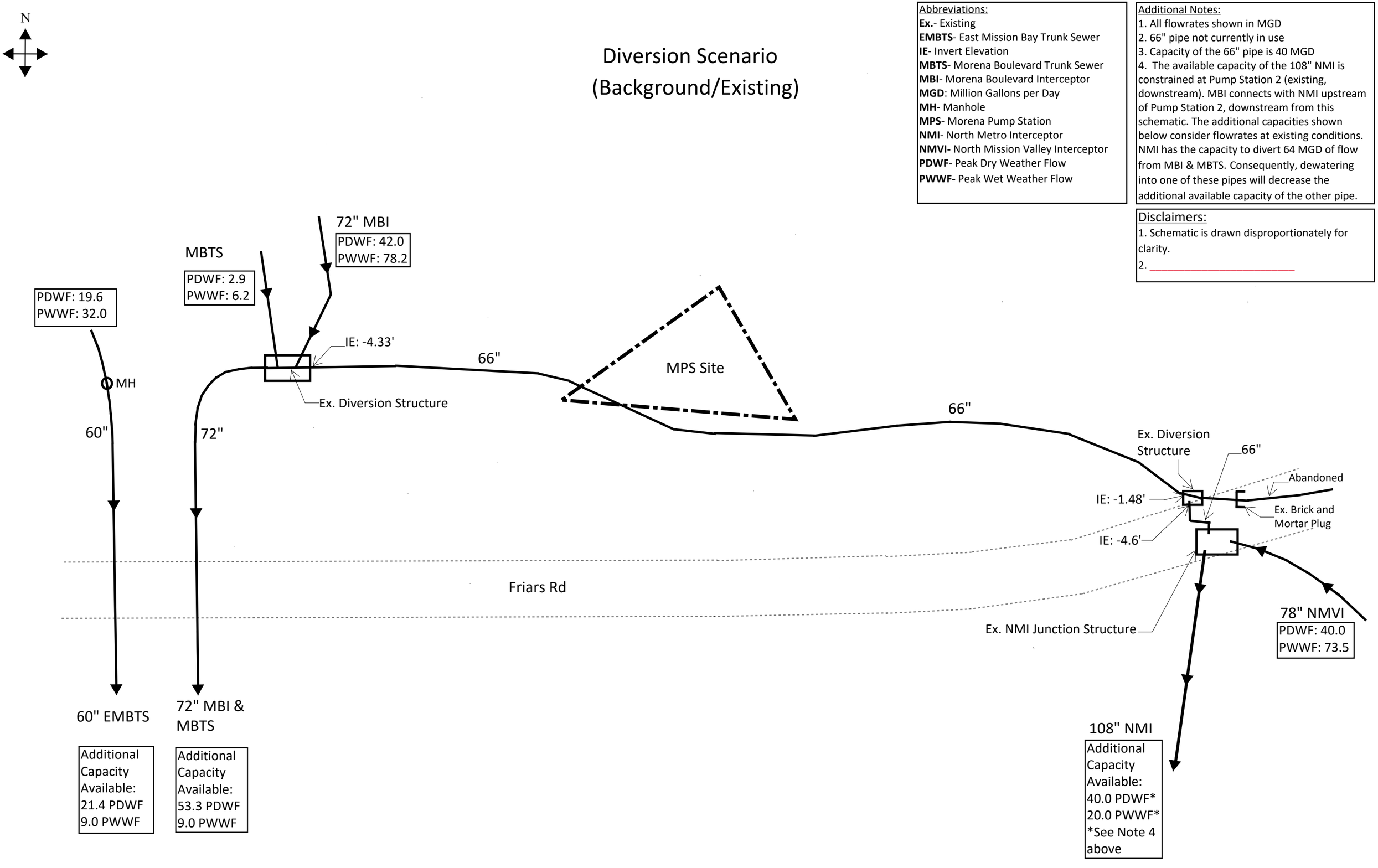
NMVI – North Mission Valley Interceptor

Diversion Scenario (Background/Existing)

Abbreviations:
Ex.- Existing
EMBTS- East Mission Bay Trunk Sewer
IE- Invert Elevation
MBTS- Morena Boulevard Trunk Sewer
MBI- Morena Boulevard Interceptor
MGD: Million Gallons per Day
MH- Manhole
MPS- Morena Pump Station
NMI- North Metro Interceptor
NMVI- North Mission Valley Interceptor
PDWF- Peak Dry Weather Flow
PWWF- Peak Wet Weather Flow

Additional Notes:
1. All flowrates shown in MGD
2. 66" pipe not currently in use
3. Capacity of the 66" pipe is 40 MGD
4. The available capacity of the 108" NMI is constrained at Pump Station 2 (existing, downstream). MBI connects with NMI upstream of Pump Station 2, downstream from this schematic. The additional capacities shown below consider flowrates at existing conditions. NMI has the capacity to divert 64 MGD of flow from MBI & MBTS. Consequently, dewatering into one of these pipes will decrease the additional available capacity of the other pipe.

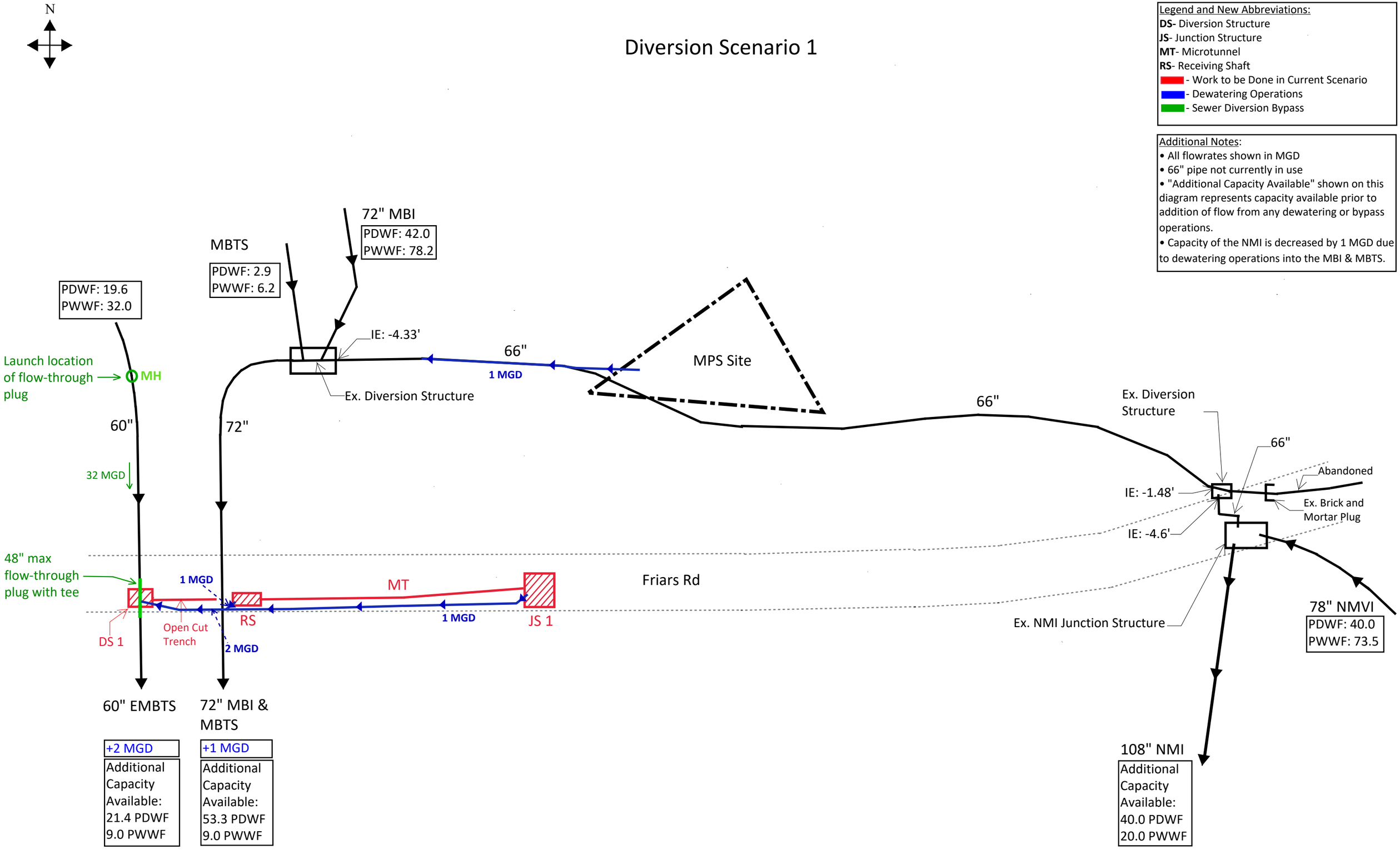
Disclaimers:
1. Schematic is drawn disproportionately for clarity.
2. _____



Diversion Scenario 1

Legend and New Abbreviations:
DS- Diversion Structure
JS- Junction Structure
MT- Microtunnel
RS- Receiving Shaft
- Work to be Done in Current Scenario
- Dewatering Operations
- Sewer Diversion Bypass

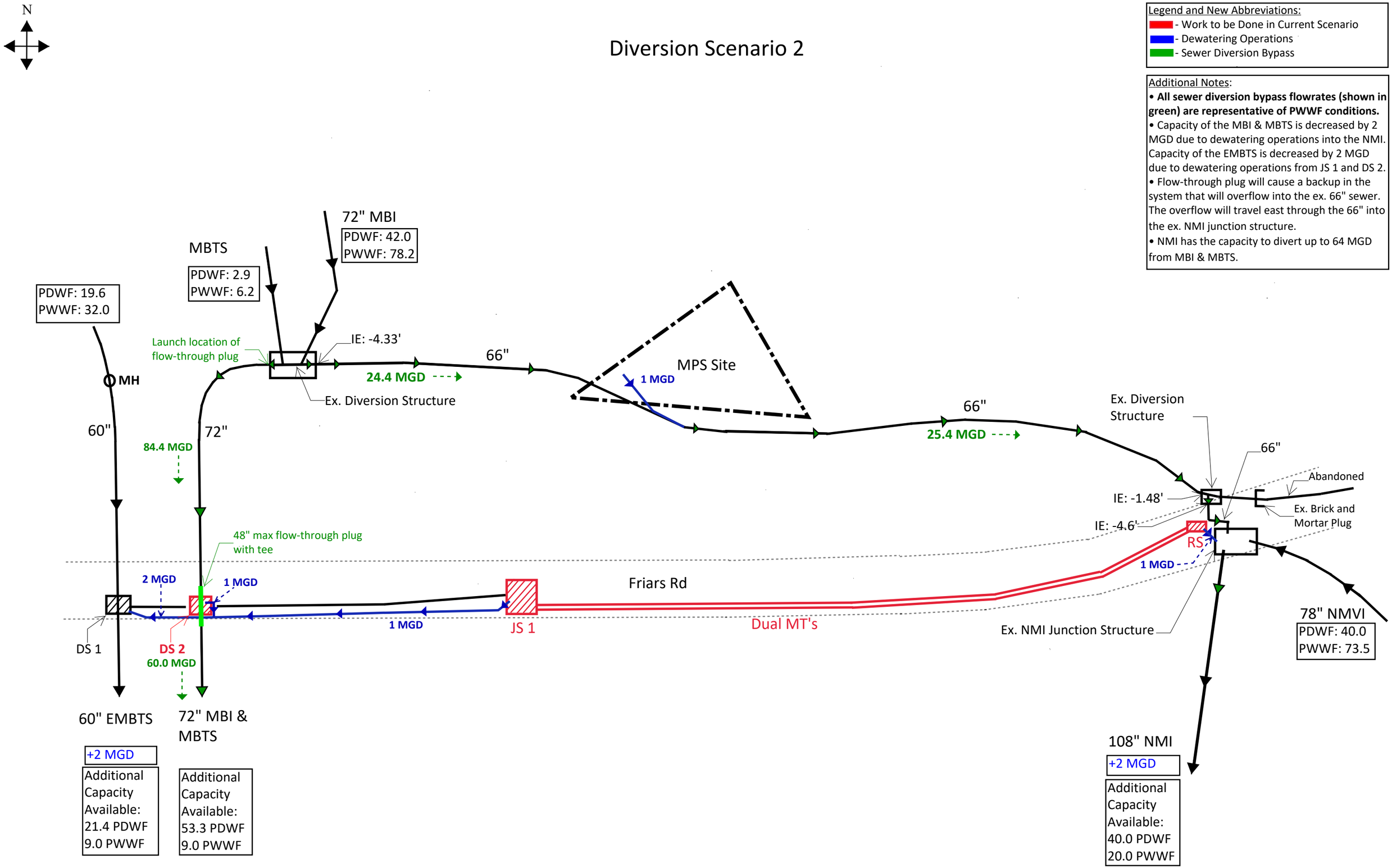
Additional Notes:
- All flowrates shown in MGD
- 66" pipe not currently in use
- "Additional Capacity Available" shown on this diagram represents capacity available prior to addition of flow from any dewatering or bypass operations.
- Capacity of the NMI is decreased by 1 MGD due to dewatering operations into the MBI & MBTS.



Diversion Scenario 2

Legend and New Abbreviations:
- Work to be Done in Current Scenario
- Dewatering Operations
- Sewer Diversion Bypass

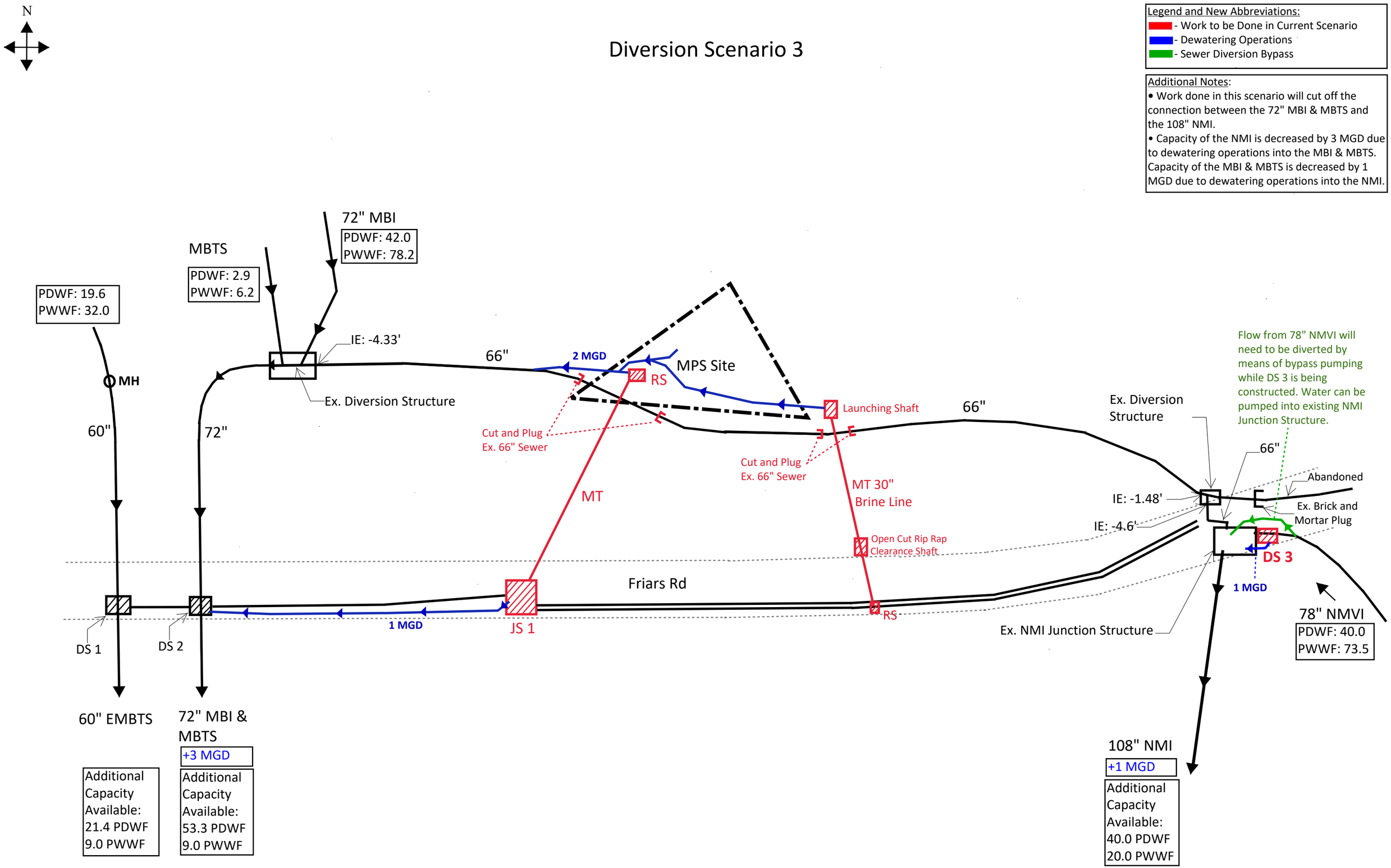
Additional Notes:
- **All sewer diversion bypass flowrates (shown in green) are representative of PWWF conditions.**
- Capacity of the MBI & MBTS is decreased by 2 MGD due to dewatering operations into the NMI. Capacity of the EMBTS is decreased by 2 MGD due to dewatering operations from JS 1 and DS 2.
- Flow-through plug will cause a backup in the system that will overflow into the ex. 66" sewer. The overflow will travel east through the 66" into the ex. NMI junction structure.
- NMI has the capacity to divert up to 64 MGD from MBI & MBTS.



Diversion Scenario 3

Legend and New Abbreviations:
- Work to be Done in Current Scenario
- Dewatering Operations
- Sewer Diversion Bypass

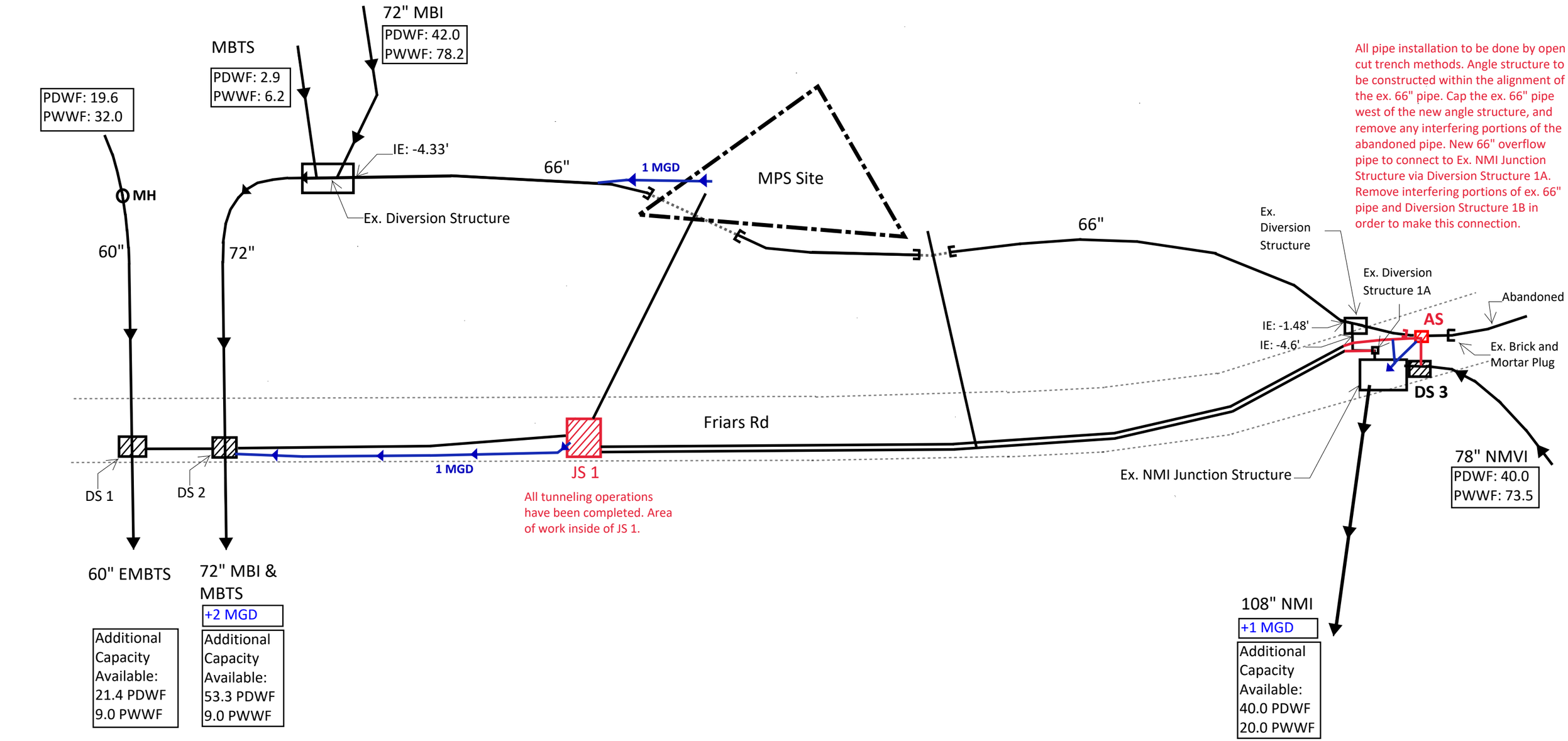
Additional Notes:
- Work done in this scenario will cut off the connection between the 72" MBI & MBTS and the 108" NMI.
- Capacity of the NMI is decreased by 3 MGD due to dewatering operations into the MBI & MBTS. Capacity of the MBI & MBTS is decreased by 1 MGD due to dewatering operations into the NMI.



Diversion Scenario 4

Legend and New Abbreviations:
- **AS** - Angle Structure
- Work to be Done in Current Scenario
- Dewatering Operations
- Sewer Diversion Bypass

Additional Notes:
- Capacity of the NMI is decreased by 2 MGD due to dewatering operations into the MBI & MBTS. Capacity of the MBI & MBTS is decreased by 1 MGD due to dewatering operations into the NMI.

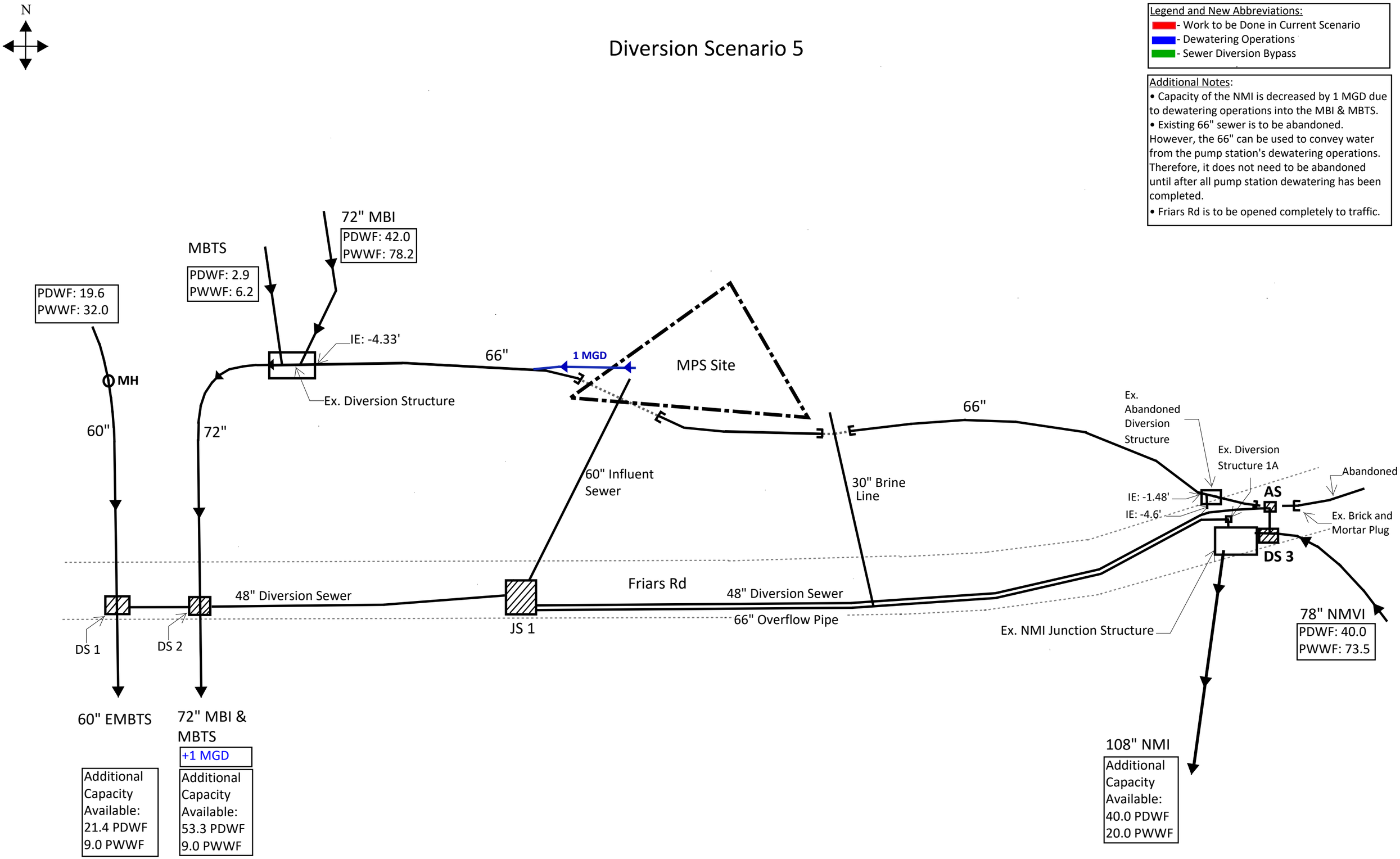


All pipe installation to be done by open cut trench methods. Angle structure to be constructed within the alignment of the ex. 66" pipe. Cap the ex. 66" pipe west of the new angle structure, and remove any interfering portions of the abandoned pipe. New 66" overflow pipe to connect to Ex. NMI Junction Structure via Diversion Structure 1A. Remove interfering portions of ex. 66" pipe and Diversion Structure 1B in order to make this connection.

Diversion Scenario 5

Legend and New Abbreviations:
- Work to be Done in Current Scenario
- Dewatering Operations
- Sewer Diversion Bypass

Additional Notes:
- Capacity of the NMI is decreased by 1 MGD due to dewatering operations into the MBI & MBTS.
- Existing 66" sewer is to be abandoned. However, the 66" can be used to convey water from the pump station's dewatering operations. Therefore, it does not need to be abandoned until after all pump station dewatering has been completed.
- Friars Rd is to be opened completely to traffic.



NC MORENA BLVD PUMP STATION AND PIPELINES

PACKAGE A

CONTRACTOR'S RESPONSIBILITIES

1. PURSUANT TO SECTION 4216 OF THE GOVERNMENT CODE, AT LEAST 2 WORKING DAYS PRIOR TO EXCAVATION, YOU MUST CONTACT THE REGIONAL NOTIFICATION CENTER (E.G. UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA) AND OBTAIN AN INQUIRY IDENTIFICATION NUMBER.
2. NOTIFY SDG&E AT LEAST 10 WORKING DAYS PRIOR TO EXCAVATING WITHIN 10' OF SDG&E UNDERGROUND HIGH VOLTAGE TRANSMISSION POWER LINES. (I.E., 69 KV & HIGHER)
3. LOCATE AND RECONNECT ALL SEWER LATERALS. LOCATIONS AS SHOWN ON THE PLANS ARE APPROXIMATE ONLY. LATERAL RECORDS ARE AVAILABLE TO THE CONTRACTOR AT THE WATER DEPARTMENT, 2797 CAMINITO CHOLLAS. LOCATE THE IMPROVEMENTS THAT WILL BE AFFECTED BY LATERAL REPLACEMENTS.
4. EXCAVATE AROUND WATER METER BOX (CITY PROPERTY SIDE) TO DETERMINE IN ADVANCE, THE SIZE OF EACH SERVICE BEFORE TAPPING MAIN.
5. CITY FORCES, WHEN SPECIFIED OR SHOWN ON THE PLANS, WILL MAKE PERMANENT CUTS & PLUGS AND CONNECTIONS.
6. KEEP EXISTING MAINS IN SERVICE IN LIEU OF HIGH-LINING, UNLESS OTHERWISE SPECIFIED SHOWN ON PLANS.
7. THE LOCATIONS OF EXISTING BUILDINGS AS SHOWN ON THE PLAN ARE APPROXIMATE.
8. STORM DRAIN INLETS SHALL REMAIN FUNCTIONAL AT ALL TIMES DURING CONSTRUCTION.
9. UNLESS OTHERWISE NOTED AS PREVIOUSLY POTHOLED (PH), ELEVATIONS SHOWN ON THE PROFILE FOR EXISTING UTILITIES ARE BASED ON A SEARCH OF THE AVAILABLE RECORD INFORMATION ONLY AND ARE SOLELY FOR THE CONTRACTOR'S CONVENIENCE. THE CITY DOES NOT GUARANTEE THAT IT HAS REVIEWED ALL AVAILABLE DATA. THE CONTRACTOR SHALL POTHOLE ALL EXISTING UTILITIES EITHER SHOWN ON THE PLANS OR MARKED IN THE FIELD IN ACCORDANCE WITH THE SPECIFICATIONS SECTION 33-UTILITIES.
10. EXISTING UTILITY CROSSING AS SHOWN ON THE PLANS ARE APPROXIMATE AND ARE NOT REPRESENTATIVE OF ACTUAL LENGTH AND LOCATION OF CONFLICT AREAS. SEE PLAN VIEW.
11. CONTRACTOR SHALL ATTEND PRECONSTRUCTION MEETING AS REQUIRED BY THE MITIGATION MONITORING AND REPORTING PROGRAM PER THE ENVIRONMENTAL IMPACT REPORT.

CONSTRUCTION STORM WATER PROTECTION NOTES

1. TOTAL SITE DISTURBANCE AREA (ACRES) 1.50
   HYDROLOGIC UNIT/ WATERSHED SAN DIEGO/SAN DIEGO RIVER (A)
   HYDROLOGIC SUBAREA NAME & NO. MISSION SAN DIEGO/907.11
2. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF THE
   - ☐ WPCP
     THE PROJECT IS SUBJECT TO MUNICIPAL STORM WATER PERMIT NO. R9-2013-0001 AS AMENDED BY R9-2015-0001 AND R9-2015-0100
   - ☒ SWPPP
     THE PROJECT IS SUBJECT TO MUNICIPAL STORM WATER PERMIT NO. R9-2013-0001 AS AMENDED BY R9-2015-0001 AND R9-2015-0100 AND CONSTRUCTION GENERAL PERMIT ORDER 2009-0009-DWQ AS AMENDED BY ORDER 2010-0014-DWQ AND 2012-0006-DWQ
     TRADITIONAL: RISK LEVEL 1☐ 2☒ 3☐
     LUP: RISK TYPE 1☐ 2☐ 3☐
3. CONSTRUCTION SITE PRIORITY
   ☐ ASBS ☒ HIGH ☐ MEDIUM ☐ LOW

ABBREVIATIONS

ABAND	ABANDON
ABAND'D	ABANDONED
AC	ASBESTOS CEMENT PIPE, ASPHALTIC CONCRETE
AHD	AHEAD
ASSY	ASSEMBLY
BFV	BUTTERFLY VALVE
BK	BACK
BTWN	BETWEEN
CATV	CABLE TV
CI	CAST IRON PIPE
CJP	COMPLETE JOINT PENETRATION
CML&C	CEMENT MORTAR LINED & COATED
CML&TCMC	CEMENT MORTAR LINED & TAPE, CEMENT MORTAR COATED
℄	CENTER LINE
COND	CONDUIT
CONT	CONTINUED, CONTINUATION
CONTR	CONTRACTOR
DB	DIRECT BURIED
DI	DUCTILE IRON
DWG	DRAWING
DS	DIVERSION STRUCTURE
E/O	EAST OF
EB	ENCASED BURIED
EL, ELEV	ELEVATION
ELEC	ELECTRIC
ETC	ETCETERA
ETWU	ESTIMATED TOTAL WATER USE
EX, EXIST	EXISTING
F, FLG	FLANGE
FE	FLANGED END
FF	FINISHED FLOOR
FH	FIRE HYDRANT
FO	FIBER OPTIC
FRP	FIBER REINFORCED PLASTIC
FS	FIRE SERVICE
GV	GATE VALVE
HDPE	HIGH-DENSITY POLYETHYLENE
HGL	HYDRAULIC GRADE LINE
HP	HIGH PRESSURE
HPI	HORIZONTAL POINT OF INTERSECTION
IE, INV EL	INVERT ELEVATION
JT	JOINT
LT	LEFT
MAWA	MAXIMUM APPLIED WATER ALLOWANCE
MAX	MAXIMUM
MCTC	MID-COAST TRANSIT CORRIDOR
MH	MANHOLE
MIN	MINIMUM
MJ	MECHANICAL JOINT
MPS	MORENA PUMP STATION
MTS	SAN DIEGO METROPOLITAN TRANSIT SYSTEM
MTD	MULTIPLE TELEPHONE DUCT
N/O	NORTH OF
NE	NORTH EAST
NO	NUMBER
NW	NORTH WEST
OC	ON CENTER
OHE	OVER HEAD ELECTRIC
OVHD	OVER HEAD
PCC	PORTLAND CEMENT CONCRETE
PCO	PRESSURE CLEANOUT
PLRCP	PLASTIC LINED REINFORCED CONCRETE PIPE
PROP	PROPOSED
PS	PUMP STATION
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
R, RAD	RADIUS
R/W	RIGHT OF WAY
RED	REDUCER
RP	REDUCED BACKFLOW PREVENTER
RT	RIGHT
℄	SURVEY LINE
SANDAG	SAN DIEGO ASSOCIATION OF GOVERNMENTS
SCH	SCHEDULE
SD	STORM DRAIN
SD&IV	SAN DIEGO & IMPERIAL VALLEY RAILROAD
SDA&E	SAN DIEGO ARIZONA & EASTERN RAILROAD
SDG&E	SAN DIEGO GAS & ELECTRIC
SDRSD	SAN DIEGO REGIONAL STANDARD DRAWING
SDSD	SAN DIEGO STANDARD DRAWING
SDTI	SAN DIEGO TROLLEY INC.
SE	SOUTH EAST
SO	STUB OUT
S/O	SOUTH OF
SQ	SQUARE
SS, SST	STAINLESS STEEL
SSPWC	STANDARD SPECIFICATION FOR PUBLIC WORKS CONSTRUCTION
SW	SOUTH WEST
SWQMP	STORMWATER QUALITY MANAGEMENT PLAN
SWR	SEWER
TEL	TELEPHONE
TOC	TOP OF CONCRETE
TW,TOW	TOP OF WALL
TYP	TYPICAL
UNK	UNKNOWN
VC	VITRIFIED CLAY PIPE
WM	WATER METER
WSP	WELDED STEEL PIPE
WTR	WATER
W/	WITH
W/O	WEST OF

EXISTING STRUCTURES

EX WATER MAIN & VALVES		EX TRAFFIC SIGNAL	TS
EX WATER METER		EX STREET LIGHT	SL.
EX FIRE HYDRANT		EX UTILITY POLE	
EX SEWER MAIN & MANHOLES		GAS MAIN	
EX DRAINS		ELEC. COND., OVERHEAD ELEC., TEL. COND., CATV	E OHE T C
EX PAVEMENT (PROFILE)		RAILROAD, TROLLEY TRACKS	
EX GROUND LINE (PROFILE)			

WORK TO BE DONE

THE PROJECT CONSISTS OF THE DEMOLITION OF EXISTING FACILITIES AT THE PROPOSED MORENA PUMP STATION SITE, THE CONSTRUCTION OF A NEW 37.7 MGD MORENA WASTEWATER PUMP STATION FACILITY, INCLUDING ODOR CONTROL SYSTEMS, ELECTRICAL BUILDING, SCREENING FACILITY, HIGH PURITY OXYGEN SYSTEM, MAINTENANCE BUILDING, ASSOCIATED CIVIL SITE WORK INCLUDING STORM DRAINAGE, YARD PIPING, PERIMETER WALLS, ACCESS GATES, PAVEMENT, AND LANDSCAPING.

THE PROJECT ALSO INCLUDES THE CONSTRUCTION OF 48-INCH, 60-INCH & 66-INCH DIVERSION AND OVERFLOW SEWERS, THREE DIVERSION STRUCTURES WITH SLIDE GATES AND JUNCTION STRUCTURE NO. 1.

SITE ADDRESS

887 SHERMAN STREET
SAN DIEGO, CA 92110

LEGAL DESCRIPTION

SEE DWG G-01A

ASSESSOR'S NUMBER

436-451-06-00, 436-451-05-00 & 436-660-47-00

SECURITY PLANS

SECURITY PLANS WILL BE FURNISHED TO THE CONTRACTOR UPON AWARD OF CONSTRUCTION CONTRACT. A BID ALLOWANCE ITEM HAS BEEN IDENTIFIED IN THE BID SCHEDULE.

VICINITY MAP
NOT TO SCALE

PROJECT TEAM

AECOM ENGINEERING - (619) 610.7700
KEH & ASSOCIATES - (760) 891.4180
AIR-X UTILITY SURVEYORS - (760) 480.2347
GMK CONSULTING INC. - (760) 975.3680
MATALON ARCHITECTURE - (858) 483.6587
MICHAEL BAKER INTERNATIONAL - (858) 614.5000

FIELD DATA

BENCHMARK:
THE BASIS OF ELEVATIONS FOR THIS PLAN IN THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29) PER CITY OF SAN DIEGO VERTICAL CONTROL NETWORK BENCHMARK: NBP (NORTH BRASS PLUG) LOCATED AT GAINES AND NAPA STREET.
ELEVATION: 21.742 (FEET)

BASIS OF BEARINGS / COORDINATES:
THE BASIS OF BEARINGS FOR THIS PLAN IS THE CALIFORNIA STATE PLANE COORDINATE SYSTEM OF 1983 (NAD83), EPOCH 1991.35, BASED ON THE LINE BETWEEN CITY OF SAN DIEGO HORIZONTAL CONTROL POINTS 1037 & 1040 PER ROS 14492. I.E. S 75°17'56" E

DATUM: MEAN SEA LEVEL

REFERENCES:
MAP NO. 569 & DRAWING NO. 40421

TOPOGRAPHY SOURCE:
CITY OF SAN DIEGO, GROUND SURVEY AND UTILITIES BY MBI. AERIAL MAPPING BY AEROTEK MAPPING, FLIGHT DATE 1/30/17

OWNER

SAN DIEGO PUBLIC UTILITIES DEPARTMENT
9192 TOPAZ WAY
SAN DIEGO CA. 92123
PHONE NUMBER (858) 292-6300
PROJECT MANAGER NABIL BATTA

ZONING

ZONE:	IL-3-1
CONSTRUCTION TYPE:	V-B
BUILDING CODE YEAR:	2016
EXISTING USE OF BUILDING:	LIGHT INDUSTRIAL
PROPOSED USE OF BUILDING:	MUNICIPAL

LEGEND

IMPROVEMENTS	STANDARD DRAWINGS	SYMBOL
SEWER MAIN	SDS-101, SDS-110 (TYPE C), SDW-161	
SEWER VAULT		
WATER MAIN & APPURTENANCES	SDM-105, SDW-110 SDW-151, SDW-161, SDW-162	
TEMPORARY WATER PIPE	SDM-105, SDW-110 SDW-151, SDW-161	
PROPOSED WATER BEND	SDM-105, SDW-110 SDW-151, SDW-161	
VALVES WITH CAPS AND WELLS	SDW-109, SDW-152, SDW-153, WV-05	
FIRE SERVICE CONNECTION ASSEMBLY & BACKFLOW PREVENTER (WHERE APPLICABLE)	SDW-109, SDW-118, SDW-152, SDW-153, SDW-105	PROPOSED RP IF NEEDED, P.L., RP, FS
6" FIRE HYDRANT ASSEMBLY & MARKER 2-PORT UNLESS SPECIFIED AS 3-PORT	SDW-104, SDW-109, SDW-152, SDW-153	PROPOSED WATER
1" WATER SERVICE UNLESS OTHERWISE SPECIFIED	SDW-107, SDW-134, SDW-136, SDW-137, SDW-138, SDW-150, WS-03	PROPOSED WATER, WM, P.L., W
BLOW-OFF ASSEMBLY	SDW-106, SDW-143, SDW-144, SDW-145, SDW-146, WB-05,	B.O., PROPOSED WATER
AIR & VACUUM VALVE	SDW-117, SDW-158, SDW-159, SDW-160	A.V.
ABANDONED WATER MAIN	WP-03	
CUTTING AND PLUGGING ABANDONED WATER MAIN	WP-03	
TRANSITION / REPAIR COUPLING	SEE APPROVED MATERIALS LIST	E
FLOOD ZONE BOUNDARY		PROPOSED WTR, EX WTR
PROPOSED WATER W/HOSE BIBB		
PROPOSED BACKFLOW PREVENTER ASSEMBLY	SDW-155	
PROPOSED WATER METER	SDW-113, SDW-149	
MANHOLE PIPE CONNECTORS	SDG-108	
SURVEY MONUMENT	M-10, M-10A, M-10B	△
TRENCH RESURFACING	SDG-107	

FOR LANDSCAPING LEGEND SEE SHEET L-01.

FOR IRRIGATION LEGEND SEE SHEET L-02.

FOR ADDITIONAL SYMBOLS SEE CURB RAMP AND TRAFFIC CONTROL SHEETS.

DECLARATION OF RESPONSIBLE CHARGE

* I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THE PROJECT AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE AND THAT THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS. I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE CITY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.

10/07/20
ALAN SHAPIRO — DATE

MONUMENTATION/SURVEY NOTES

THE CONTRACTOR SHALL BE RESPONSIBLE FOR SURVEY MONUMENTS AND/OR VERTICAL CONTROL BENCHMARKS WHICH ARE DISTURBED OR DESTROYED BY CONSTRUCTION. A LICENSED LAND SURVEYOR OR LICENSED CIVIL ENGINEER AUTHORIZED TO PRACTICE LAND SURVEYING IN THE STATE OF CALIFORNIA SHALL FIELD LOCATE, REFERENCE, AND/OR PRESERVE ALL HISTORICAL OR CONTROLLING MONUMENTS PRIOR TO ANY EARTHWORK, DEMOLITION OR SURFACE IMPROVEMENTS. IF DESTROYED, A LICENSED LAND SURVEYOR SHALL REPLACE SUCH MONUMENT(S) WITH APPROPRIATE MONUMENTS. WHEN SETTING SURVEY MONUMENTS USED FOR RE-ESTABLISHMENT OF THE DISTURBED CONTROLLING SURVEY MONUMENTS AS REQUIRED BY SECTIONS 6730.2 AND 8771 OF THE BUSINESS AND PROFESSIONS CODE OF THE STATE OF CALIFORNIA, A CORNER RECORD OR RECORD OF SURVEY, AS APPROPRIATE, SHALL BE FILED WITH THE COUNTY SURVEYOR. IF ANY VERTICAL CONTROL IS TO BE DISTURBED OR DESTROYED, THE CITY OF SAN DIEGO FIELD SURVEY SECTION SHALL BE NOTIFIED IN WRITING AT LEAST 7 DAYS PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COST OF REPLACING AND VERTICAL CONTROL BENCHMARKS DESTROYED BY THE CONSTRUCTION.

AS-BUILT INFORMATION

MATERIALS	MANUFACTURER
PIPE CL 235 (WATER)	-
PIPE SDR 35 (SEWER)	-
GATE VALVES	-
FIRE HYDRANTS	-
SEWER MANHOLES	-
REHABILITATE SEWER MANHOLES	-
REHABILITATE SEWER MAIN	-

CONSTRUCTION CHANGE / ADDENDUM

CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.
A	11/12/20	1, 22, 92, 103, 155, 156, 170 & (261 New Sheet)	
B	12/2/20	104, 124 & 140	

WARNING
0 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

The City of SAN DIEGO Public Utilities

REGISTERED PROFESSIONAL ENGINEER ALAN B. SHAPIRO Exp. CIVIL STATE OF CALIFORNIA
10/07/20

SPEC. NO.

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 01 OF 274 SHEETS

APPROVED N. L. Batta FOR CITY ENGINEER — 10/08/2020 DATE
NABIL BATTA PRINT DCE NAME — C63631 RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
△A ADDENDUM A	CITY	N. L. Batta	11/23/20	

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

SEWER WBS B-15141
SUBMITTED BY NABIL BATTA PROJECT MANAGER
CHECKED BY J. BERMUDO PROJECT ENGINEER
SEE SHEETS CCS27 COORDINATE
SEE SHEETS CCS83 COORDINATE
40421-01-D

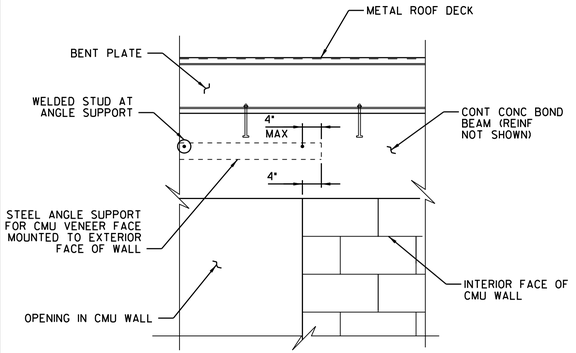
G-01

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A

COVER SHEET

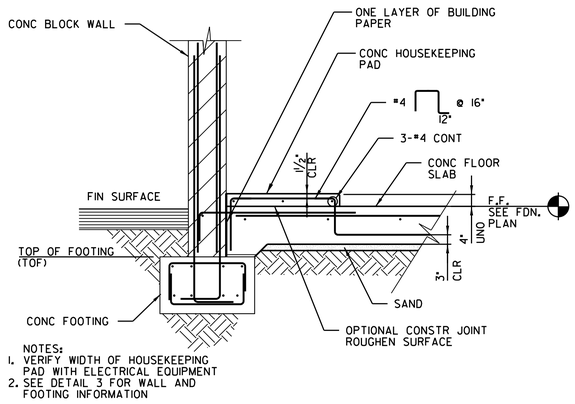
△A REVISE WATERSHED NAME.

CONVEYANCE SYSTEM
MORENA PUMP STATION & CO



CMU VENEER SUPPORT AT WALL OPENING (1)

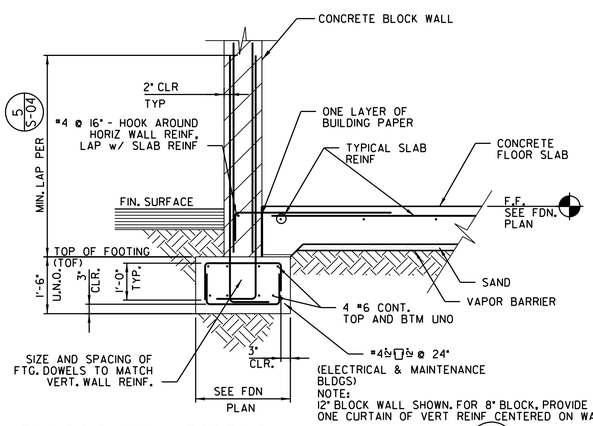
SCALE: 3/4"=1'-0"



NOTES:
1. VERIFY WIDTH OF HOUSEKEEPING PAD WITH ELECTRICAL EQUIPMENT
2. SEE DETAIL 3 FOR WALL AND FOOTING INFORMATION

WALL FOOTING AT HOUSEKEEPING PAD (2)

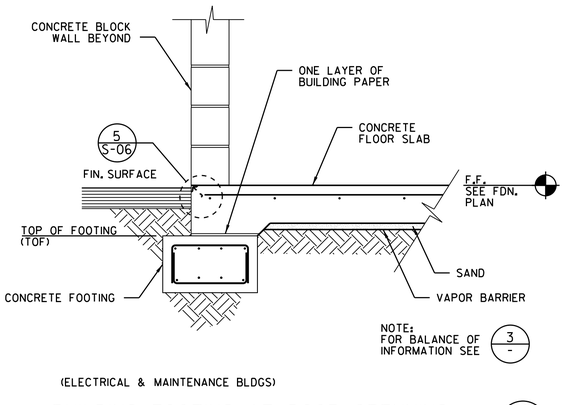
SCALE: NTS



NOTE:
12" BLOCK WALL SHOWN. FOR 8" BLOCK, PROVIDE ONE CURTAIN OF VERT REINF CENTERED ON WALL

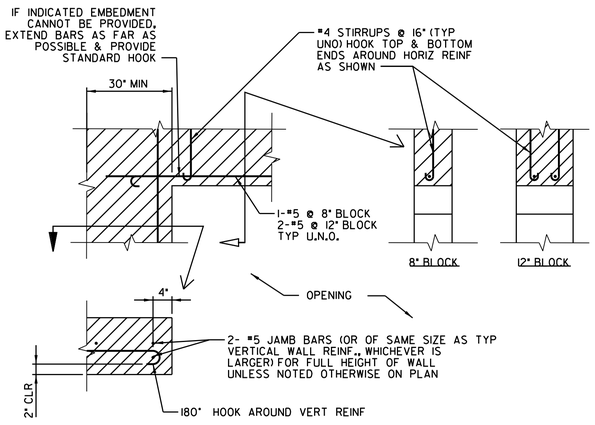
BUILDING WALL FOOTING (3)

SCALE: NTS



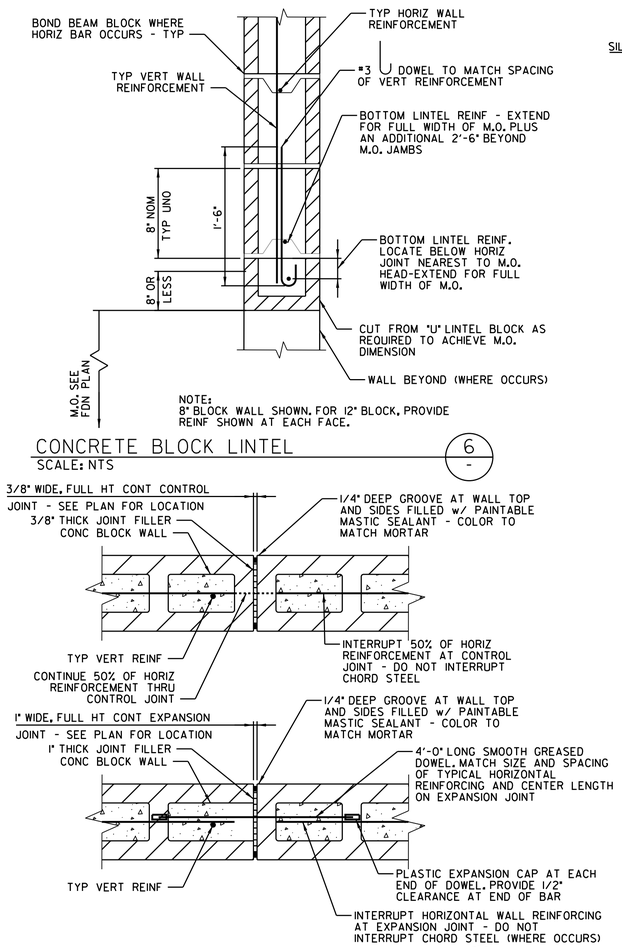
BUILDING FOOTING AT DOOR OPENNING (4)

SCALE: NTS



REINF. AT MASONRY WALL OPENING (5)

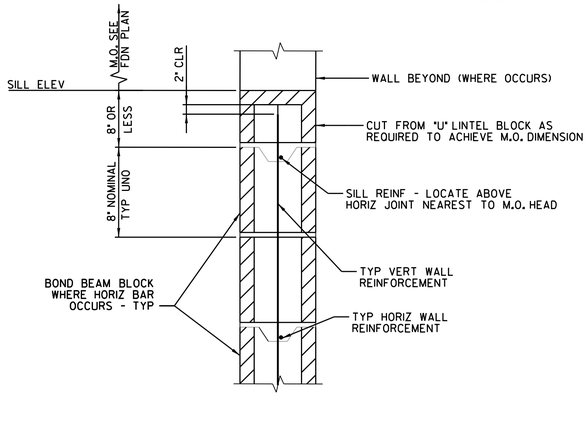
SCALE: NTS



NOTE:
8" BLOCK WALL SHOWN. FOR 12" BLOCK, PROVIDE REINF SHOWN AT EACH FACE.

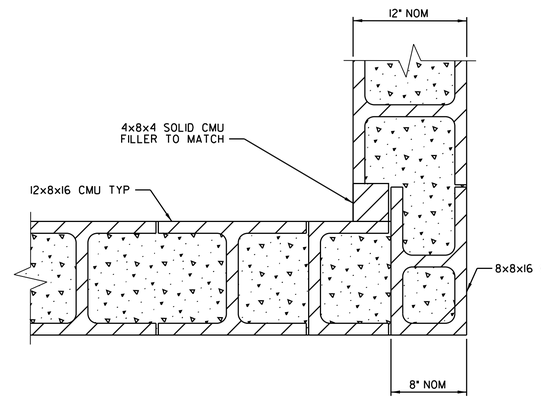
CONCRETE BLOCK LINTEL (6)

SCALE: NTS



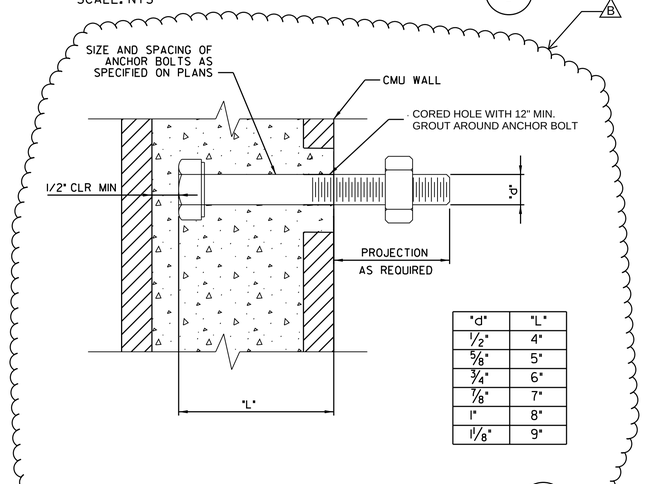
CONCRETE BLOCK SILL (7)

SCALE: NTS



EXTERIOR CMU CORNER (12" BLOCK) (8)

SCALE: NTS (SIMILAR AT ALTERNATE COURSES ABOVE AND BELOW)



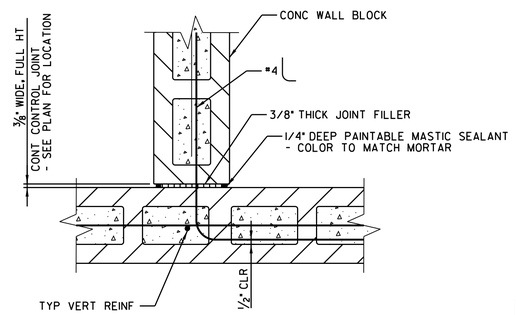
"d"	"L"
½"	4"
⅝"	5"
¾"	6"
⅞"	7"
1"	8"
1⅛"	9"

ANCHOR BOLT IN CONCRETE BLOCK WALL (9)

SCALE: NTS

CMU CONTROL/EXPANSION JOINT (10)

SCALE: NTS



CMU CONTROL JOINT AT INTERSECTION (11)

SCALE: NTS

NOTE:
THE DETAILS ON THIS DRAWING SHALL APPLY WHERE APPLICABLE EVEN THOUGH THEY MAY NOT BE SPECIFICALLY REFERENCED ELSEWHERE.

S-07

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A
TYPICAL STRUCTURAL DETAILS 4

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 104 OF 286 SHEETS

SEWER WBS B-15141

REGISTERED PROFESSIONAL ENGINEER DALE E. WAH No. 2582 STRUCTURAL STATE OF CALIFORNIA 3/19/19

APPROVED: N.C.L. B.T.H. FOR CITY ENGINEER 10/08/2020 DATE
NABIL BATTA PRINT NAME C63631 RCE#

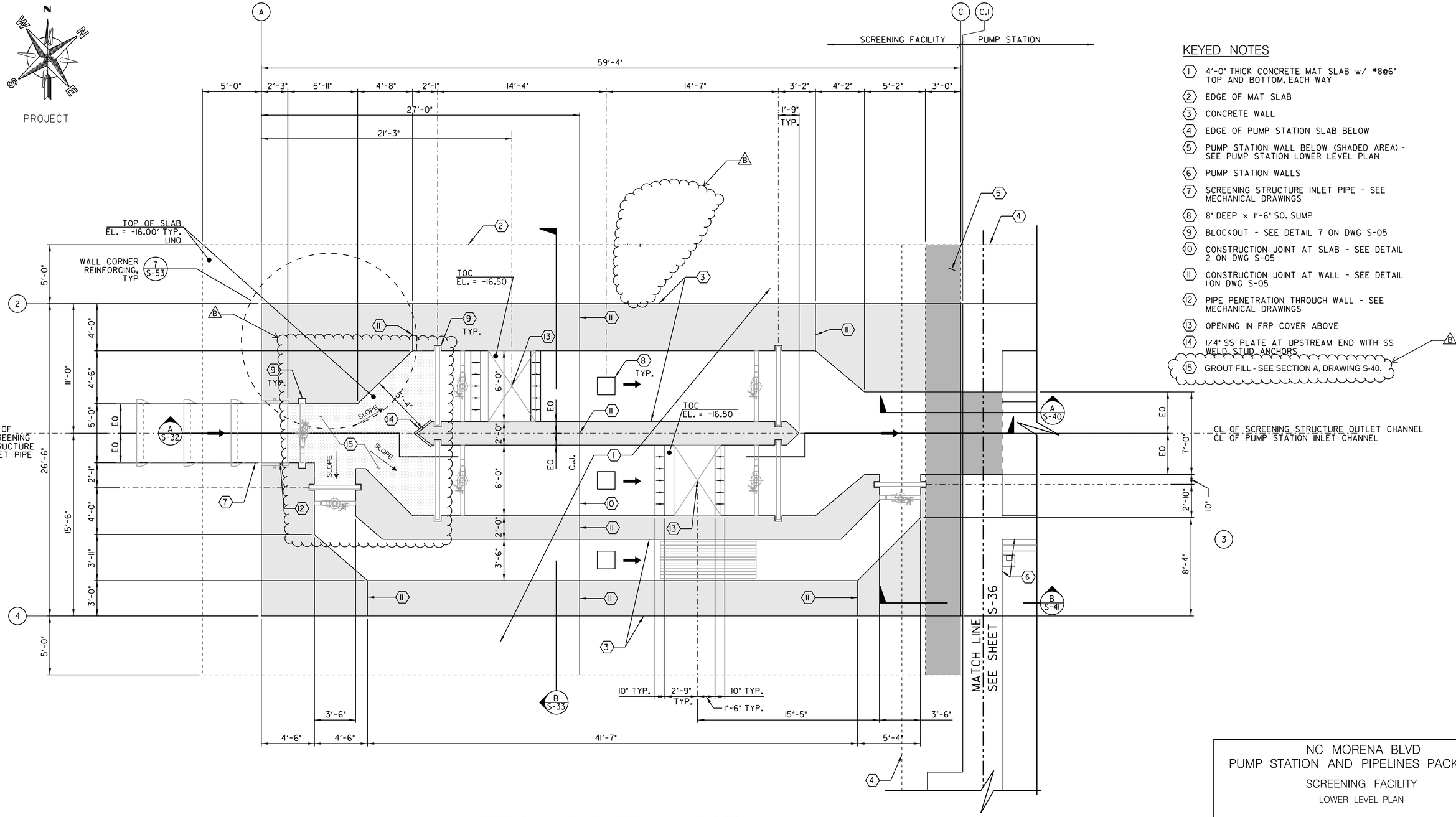
SUBMITTED BY: NABIL BATTA PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
B ADDENDUM B	CITY	N.C.L. B.T.H.	12/2/20	

SEE SHEETS CCS27 COORDINATE
SEE SHEETS CCS83 COORDINATE

CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED
40421-104-D

TYPICAL STRUCTURAL DETAILS 5



KEYED NOTES

1. 4'-0" THICK CONCRETE MAT SLAB w/ #8@6" TOP AND BOTTOM, EACH WAY
2. EDGE OF MAT SLAB
3. CONCRETE WALL
4. EDGE OF PUMP STATION SLAB BELOW
5. PUMP STATION WALL BELOW (SHADED AREA) - SEE PUMP STATION LOWER LEVEL PLAN
6. PUMP STATION WALLS
7. SCREENING STRUCTURE INLET PIPE - SEE MECHANICAL DRAWINGS
8. 8" DEEP x 1'-6" SQ. SUMP
9. BLOCKOUT - SEE DETAIL 7 ON DWG S-05
10. CONSTRUCTION JOINT AT SLAB - SEE DETAIL 2 ON DWG S-05
11. CONSTRUCTION JOINT AT WALL - SEE DETAIL 1 ON DWG S-05
12. PIPE PENETRATION THROUGH WALL - SEE MECHANICAL DRAWINGS
13. OPENING IN FRP COVER ABOVE
14. 1/4" SS PLATE AT UPSTREAM END WITH SS WELD STUD ANCHORS
15. GROUT FILL - SEE SECTION A, DRAWING S-40.

LOWER LEVEL PLAN (EL. = -16.00')

SCALE : 1/4" = 1'-0"

NOTE: ALL CHANNELS SHALL BE COATED WITH AN EPOXY COATING, RAVEN LINING SYSTEM 405 OR APPROVED EQUAL. THE EPOXY COATING SHALL COVER THE FLOOR AND EXTEND TO THE TOP OF THE CHANNEL WALLS. THE EPOXY COATING SHALL BE APPLIED AND QUALITY TESTED PER MANUFACTURER RECOMMENDATIONS.

SCREENING FACILITY LOWER LEVEL PLAN

S-27

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A

SCREENING FACILITY
LOWER LEVEL PLAN

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 124 OF 286 SHEETS

SEWER WBS B-15141

APPROVED: FOR CITY ENGINEER — DATE 10/08/2020
NABIL BATTA, PRINT NAME — RCE# C63631

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ, PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
B ADDENDUM B	CITY		12/2/20	

218-1707 CCS27 COORDINATE
6268407-1858444 CCS83 COORDINATE
40421-124-D

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

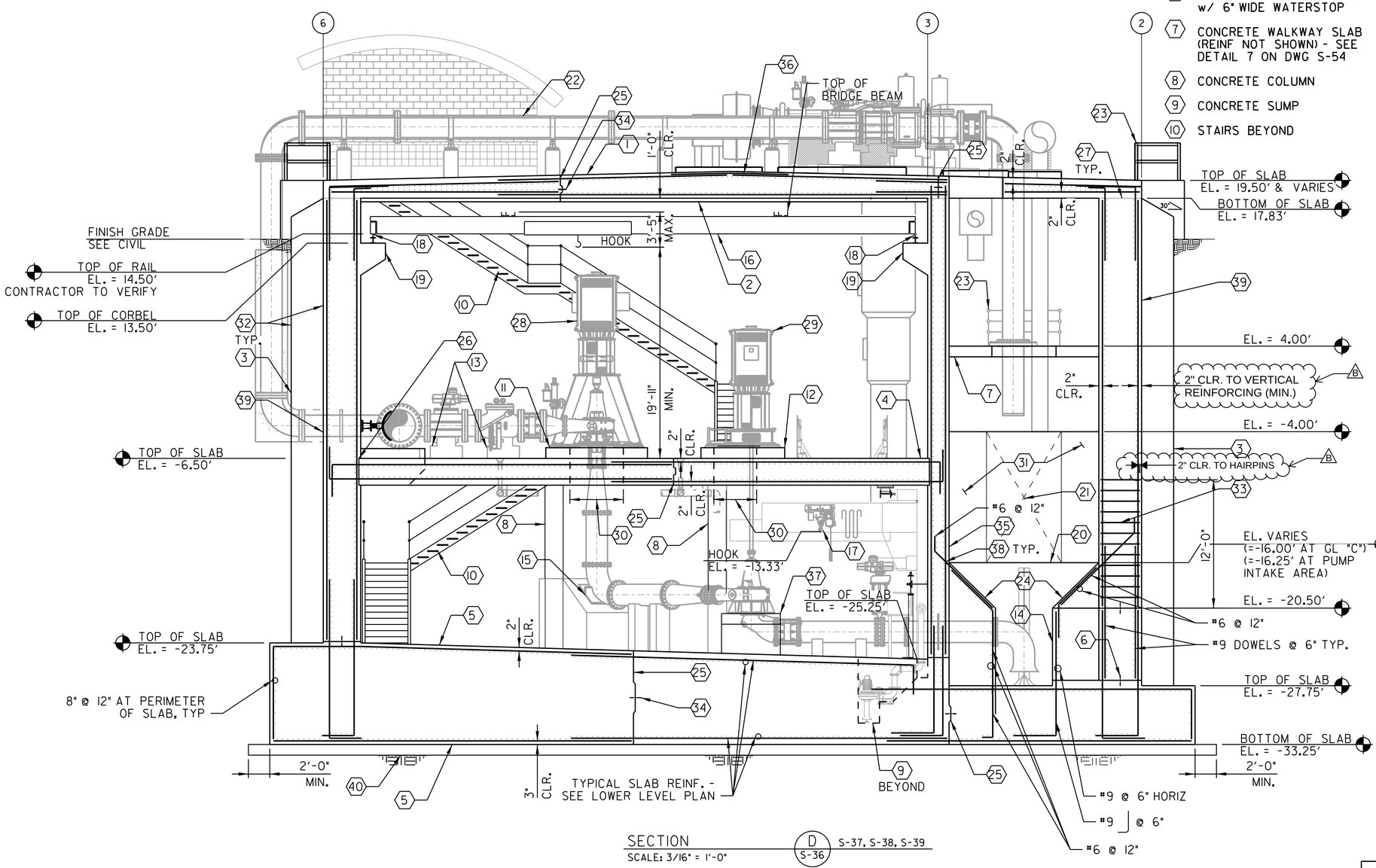
REGISTERED PROFESSIONAL ENGINEER DALE E. WAH No. 2582 STRUCTURAL STATE OF CALIFORNIA 3/19/19

Q:\DCS\Projects\WTR\60530732_SDPureWate\900-CAD-GIS\910-CAD\20-SHEETS\Pkg_A\S\60530732-SHT-STRUCT_S-27.dgn
December 4, 2020
4/22/2019 rothr1
Morena Pump Station

ADDENDUM B

B REVISED KEYED NOTE 15 AND PLAN

ADDENDUM B



SECTION
SCALE: 3/16" = 1'-0"

D S-36 — S-37, S-38, S-39

KEYED NOTES

1. CONCRETE ROOF SLAB
2. CONCRETE DROP BEAM
3. CONCRETE BUTTRESS
4. INTERMEDIATE CONCRETE SLAB
5. CONCRETE MAT SLAB
6. 1-1/2" HIGH STARTER WALL w/ 6" WIDE WATERSTOP
7. CONCRETE WALKWAY SLAB (REINF NOT SHOWN) - SEE DETAIL 7 ON DWG S-54
8. CONCRETE COLUMN
9. CONCRETE SUMP
10. STAIRS BEYOND
11. RAISED CONCRETE PAD FOR STAGE 2 PUMP, MOTOR AND FLYWHEEL - SEE DETAIL 10N DWG S-53
12. RAISED CONCRETE PAD FOR STAGE 1MOTOR AND FLYWHEEL - SEE DETAIL 1 ON DWG S-53
13. PIPE SUPPORT - SEE MECHANICAL DRAWINGS
14. THICKENED WALL IN WETWELL
15. PIPE ELBOW SUPPORT - SEE DETAIL 4 ON DWG S-53
16. BRIDGE CRANE BEAM - PROVIDE 8" MIN CLEAR BTWN BOT OF DROP BEAM AND TOP MOST PART OF BRIDGE BEAM
17. 6-TON WALL MOUNTED TRAVELING JIB CRANE - SEE DET 4 ON DWG S-61 FOR SUPPORTS. SEE MECH DWGS
18. CRANE RUNWAY BEAM AND CRANE RAIL - SEE DETAIL 3 ON DWG S-54 FOR CONNECTION
19. CONC CORBEL FOR RUNWAY BEAM - SEE DET 2 ON DWG S-54
20. SLAB BEYOND
21. WALL OPENING BEYOND
22. DRYWELL ACCESS STRUCTURE
23. GUARDRAIL
24. REINF CONC FILL. PROVIDE KEYS PER DET 9 ON DWG S-05
25. CONST JOINT AT SLAB - SEE DET 2 ON DWG S-05
26. 1" DEEP WALL RECESS FOR SLAB
27. ROUGHENED SURFACE AT JOINT (1/4" MIN APPLITUDE)
28. STAGE 2 PUMP, MOTOR AND FLYWHEEL
29. STAGE 1 PUMP MOTOR AND FLYWHEEL
30. OPENING IN CONCRETE FLOOR SLAB AND PUMP PAD
31. LATE POUR CONCRETE WALL BEYOND
32. USE CRYSTALLINE WATERPROOFING ADMIXTURE IN CONC AT BELOW-GRADE WALLS - SEE SPEC SECTION 03 30 00
33. #5 HAIRPINS @ 12" VERT & HORIZ SPACING - HOOK AROUND INTERSECTIONS OF VERT AND HORIZ WALL REINF
34. 6" WATERSTOP AT ROOF AND LOWER LEVEL SLAB JOINTS
35. COAT ALL INTERIOR SURFACE OF WET WELL THAT DO NOT HAVE T-LOCK
36. BENT BAR AT RIDGE OF SAME SIZE AND SPACING AS TYP ROOF SLAB REINF - LAP SPLICE w/ TYP REINF
37. RAISED PAD FOR STAGE 1PAD - SEE DET 11ON DWG S-56
38. REBAR COUPLERS
39. CONCRETE WALL w/ #9 @ 6" EW, EF
40. 12-INCH THK WELL GRADED CRUSHED ROCK WRAPPED IN FILTER FABRIC - COMPACT TO 95% RELATIVE COMPACTION PER ASTM D1557

PUMP STATION SECTION

S-43

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A
PUMP STATION
SECTION

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 140 OF 286 SHEETS

SEWER WBS B-15141

APPROVED FOR CITY ENGINEER N.L.) B.tt — 10/08/2020 DATE
NABIL BATTA PRINT NAME — C63631 RCE#

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ, PROJECT ENGINEER

REGISTERED PROFESSIONAL ENGINEER — DALE E. WAH — No. 2582 — STRUCTURAL — STATE OF CALIFORNIA — 8/14/20

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
B ADDENDUM B	CITY	N.L.) B.tt	12/2/20	

218-1707 CCS27 COORDINATE
6268407-1858444 CCS83 COORDINATE

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

40421-140-D

B ADDED CLARIFICATION ON DIMENSIONS

City of San Diego

CITY CONTACT: Stephen Samara, Principal Contract Specialist, Email: SSamara@sandiego.gov
Phone No. (619) 533-3619

ADDENDUM C

e - Bidding

FOR

MORENA PUMP STATION

BID NO.: K-21-1801-DBB-3-A
SAP NO. (WBS/IO/CC): B-15141
CLIENT DEPARTMENT: 2000
COUNCIL DISTRICT: 2, 7
PROJECT TYPE: KA, BP

BID DUE DATE:

2:00 PM
JANUARY 6, 2021

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

http://www.sandiego.gov/cip/bidopps/index.shtml

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:

Shapiro, Alan

Digitally signed by Shapiro, Alan
DN: cn=Shapiro, Alan, ou=USSDG1
Reason: I have reviewed this document
Date: 2020.12.11 13:22:12 -08'00'

1) Registered Engineer (Morena Pump Station) — 12/11/2020 Date — Seal:

2) For City Engineer (Morena Pump Station) — 12/11/20 Date — Seal:

A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

B. BIDDER's QUESTIONS

Q1. Geneva Pipe and Precast is a division of Northwest Pipe Company (NWP). NWP has discontinued the manufacturing and supply of PVC Liner, Ameritech T-Lock as specified in section 33 05 10 Materials sections 2.2.E. NWP through Geneva Pipe and Precast now offers HDPE Perfect Liner as manufactured by AGRU. Execution of the HDPE liner installation as specified in section 33 05 10 Execution Section 3.2 conforms to SSPWC Subsection 311-1.

We are asking to replace the "Ameritech T-Lock" product with "HDPE Perfect Liner".

A1. Installed HDPE liner shall conform to Specification 33 05 00, HDPE Liner, provided in this Addendum.

Q2. It is requested that EPDM tilting edge gaskets installed on an internal pipe coupler be permitted with the following changes, indicated with quotations, incorporated into the Specification: Rubber Gaskets: Rubber gaskets "used on the concrete spigot" shall be neoprene and shall comply with the requirements of ASTM C 361. "Any additional gaskets used internally, such as EPDM tilting edge gaskets on an internal pipe coupler, are permitted."

Please respond if EPDM tilting edge gaskets installed on an internal pipe coupler will be permitted.

A2. Installed HDPE liner shall conform to Specification 33 05 00, HDPE Liner, provided in this Addendum.

Q3. Perfect Pipe, as produced by Geneva Pipe and Precast, utilizes an internal joint coupler which compresses two EPDM tilting edge gaskets to an HDPE liner cast 360 degrees around the interior of the pipe to eliminate the need for field welding plastic in diameters 60" and smaller. The current specification calls for the liner to cover 330 degrees of the pipe interior surface, leaving an open arc of 30 degrees at the bottom of the pipe.

Please respond if a liner cast 360 degrees around pipe interior surface will be permitted.

A3. Liner cast 360 degrees within the pipe will not be permitted. HDPE lined RCP shall conform to Specification 33 05 01.10, HDPE Lined Reinforced Concrete Pipe for Jacking and Tunneling, provided in this addendum.

Q4. There are manholes on the upstream ends of the 60" interceptor up beside I-5 and the 78" interceptor in the YMCA parking lot. Can these structures be used for bypass pumping?

A4. Limited access to the YMCA parking lot will be allowed. Access to the sewer besides I-5 will require a Caltrans encroachment Permit.

Q5. Can Owner confirm whether or not all funding is in place for this project?

A5. Funding is secured.

Q6. Please confirm that a San Diego Business Tax certificate is not required until project award.

A6. Confirmed.

Q7. Regarding Section 09 90 00 Painting And Coating. Please confirm the attached is the current and correct version for the 12/17/20 bid opening.

A7. The "Final" issue is the correct version.

Q8. Regarding Part 3.7 Protective Coatings and 3.8 Architectural Paint Application Schedules. Absent a room finish schedule, please confirm that 3.7 and 3.8 of the attached Section 09 90 00 is an exhaustive list of the surface requiring field painting.

A8. Confirmed, Sections 3.7 and 3.8 are the schedules.

Q9. Key note 5 on drawing M-07 calls out for a Flanged coupling adapter that is depicted on detail 2 on page M-18. Keynote 5 on page M-11 calls out for a Romac ECF400 which is an equipment connection fitting different of what is depicted on detail 2 page M-18. Please specify which fitting is the correct one.

A9. Provide Equipment Connection Fittings, Romac ECF-400 or approved equal, at all locations shown as such on Drawing M-11.

Q10. On page M-07 Key note 12 calls out for a Surge protection relief pipe connection on detail 5 of pg M-20. There is no detail 5 on page M-20. Can you please provide this detail?

A10. Connection detail is shown on Detail 7 of Drawing S-63. The reference on drawing M-07 to Detail 5 on M-20 will be changed to Detail 7 on Drawing S-63. Plans revised as part of Addendum A.

Q11. Do any of the conveyance pipelines require CCTV?

A11. Gravity conveyance pipelines 48-inches in diameter and larger can be inspected visually with manned entry and do not require CCTV inspection.

Q12. Reference the window schedule on Sheet A-37. Mark A and Mark B are located in the same wall in the Screenings Building, however, they have different heights (A is 6’-0" H and B is 9’-4" H). Both Sheet A-13 and the schedule places the bottom sill at 17’-4" AFF (EL 33.33). Sheet S-36 shows that there is only 7’-4" of wall for the window to be placed (EL 40.67 – EL 33.33 = 7.34’). Please confirm that window B should be 6’-0" not 9’-4".

A12. Both Mark A and Mark B should be 6’-0”.

Q13. Section 07 72 00 Roof Accessories and 07 72 33 Roof Hatches (Bilco Type D) both cover the roof hatch. Why are there two different specifications for the same item? Can one be deleted so as not to confuse or contradict the other?

A13. Section 07 72 33 is deleted via this Addendum.

Q14. Reference Sheet S-31, which shows the overhang outside of B and C Line to be 2’-0". Sheet A-06 shows the same overhang to be 2’-10". Which dimension is correct?

A14. Use the 2' -0" overhang dimension as shown on S-31 for the Screening Facility.

Q15. On the Arema Table 1-5-6 on SHT 40-D of the plans, cathodic protection is marked as not required. On SHT 44-D, Detail 4, note 4, it states "The steel casing installation shall include a cathodic protection test station per SDW-121 and SDW-129 on each end of casing." Please provide clarification if cathodic protection will be required on the 36" Brine line.

A15. No cathodic protection is required for the casing. A 4-wire casing test station will be required at least on one end of the casing. Two wires attach to the pipe and two wires attach to the casing.

Q16. In specification Section 33 05 10, subpart 2.2.E states: "The liner shall cover 330 degrees of the pipe interior surface, leaving an open arc of 30 degrees at the bottom of the pipe for observation of cracks that may occur during D- Load tests." Although unlikely with the geotechnical conditions for this project, the trenchless method of installation has the potential to roll- turning the pipe in either direction, which would render the plastic lined interior out of the above-mentioned specification. Was this considered in the design? Is there an allowable deviation from this on the tunneled portions?

A16. Liner cast 360 degrees within the pipe will not be permitted. Installed HDPE lined RCP shall conform to Specification 33 05 01.10, HDPE Lined Reinforced Concrete Pipe for Jacking and Tunneling, provided in this Addendum.

Q17. In Section 31 71 19, subpart 1.5 the experience requirements for microtunneling are vaguely stated. They don't specify any particulars, such as amount of work performed previously, drive lengths, number of drives, etc. This allows for non-qualified contractors to bid this highly specialized work. This is different from other City-bid microtunneling projects in the past. We request that the City include specific microtunneling qualifications for the Contractor, Superintendent and MTBM Operator.

A17. Qualifications stated in solicitation shall remain.

Q18. White Book, SD, 54. Normal Working Hours - Unless specified otherwise, Normal Working Hours shall be 7:00 AM to 5:00 PM, Monday through Friday, inclusive. Saturdays, Sundays, and City Holidays are excluded.

SUPPLEMENTARY SPECIAL PROVISIONS; To the "WHITEBOOK", item 54, "Normal Working Hours", ADD the following: The Normal Working Hours are 8:00 AM to 4:00 PM. Construction activities outside of the normal working hours may occur with prior approval by the Resident Engineer, at no additional cost to the City.

A. This project specifies normal working hours 8 am to 4 pm, 8-hours a day and excludes work on weekends and holiday. To keep jacking load low tunnel work is typically performed during extended working hours or 24/7. We respectfully request the Owner identify what working hours will be allowed during the tunneling activities prebid at no additional cost to the City so this can be considered by the by the bidding Tunneling Contractors; I.E. See, below.

- Extended working hours, 12 hours a day
- Double shifts working hours, up 12-hours per shift
- Working hours, 24 x 7

A18. As stated in 1-2 Item 54 "Construction Activities outside of the normal working hours may occur with prior approval by the Resident Engineer, at no cost to the City." The Resident Engineer is likely to approve; extended working hours to 12-hours a day, double shifts, altering start times and end times, and continuous work for tunneling. The Contractor's request for altered working hours will need to address any changes in Traffic Control and anticipated work so the Resident Engineer can provide the appropriate staffing.

Q19. Will As-Built reports for the ground improvement projects for the North Metro Interceptor and the Mid-Coast Trolley be made available to bidding Contractors?

A19. The City is not in posession of the requested information.

Q20. Will foundation plans for the Pacific Highway bridge and the SANDAG MCTC bridge, including any post 1940s foundation improvements be made available to bidding Contractors?

A20. The City is not in posession of the requested information.

Q21. What is the allowable settlement of railroad racks for the MTS Trolley?

A21. No settlement of MTS tracks will be allowed.

Q22. Will a rip rap removal shaft be allowed at the 60" Influent Sewer alignment (should pilot tube proved encounter rip rap) as at the 36" Brine pipeline alignment (see Drawing C-16)

A22. Yes, a rip rap removal shaft would be appropriate at both locations, if the rip rap interferes with the proposed pipeline alignment.

Q23. SECTION 33 05 10, REINFORCED CONCRETE PIPE (RCP), RUBBER GASKET JOINT WITH PVC LINING, PART 2 PRODUCTS, 2.2 MATERIALS, E. PVC-Liner: PVC-liner shall conform to SSPWC Subsection 207.3 and shall be Amerplate T-Lock as manufactured by Northwest Pipe Company, Brea, California, or equal. The liner shall cover 330 degrees of the pipe interior surface, leaving an open arc of 30 degrees at the bottom of the pipe for observation of cracks that may occur during D- Load tests.

A. We understand the Amerplate T-Lock as manufactured by Northwest Pipe Company, Brea, California is no longer available, please identify whom provides an approved equal.

B. The liner only covering 330 degrees is potentially problematic, the rotation of the pipe within in a tunnel alignment cannot be controlled when using intermediate jacking stations that will be required on this work due to the tunnel lengths and pipe thrust capacities. We respectfully request the Owner change this requirement to 360 degrees or specify an alternative product to PLRCP with experience providing pipe for microtunneling installations.

A23. Liner cast 360 degrees within the pipe will not be permitted. HDPE lined RCP shall conform to Specification 33 05 01.10, HDPE Lined Reinforced Concrete Pipe for Jacking and Tunneling, provided in this Addendum.

Q24. Can the 48-inch Casing be increased to a 60-casing casing between Stations 3+33 to 1+00 at no cost to the Owner.

A24. Casing size may be increased at no cost to the Owner.

Q25. Can the 60-inch PLRCP be increased to a 66-PLRCP between Stations 19+53 to 22+30 at no cost to the Owner.

A25. Casing size may be increased at no cost to the Owner.

Q26. SECTION 31 71 19, MICROTUNNELING; C. Design Criteria: Sheet; 6. The MTBM shall meet the following minimum requirements: g. Provide access to the rear of the cutter wheel via an access door on MTBM that are over 60in outside diameter and on MTBM with an outside diameter over 72in with the provision of compressed air and an air lock if required.

A. The most challenging tunnel on the project will be the 48-inch PLRCP (59.50 OD) curved tunnel over 1,600 lf long that will not be over 60-inch outside diameter and installed without face access or the possibility of air interventions. Due to the limited footage on this project for the 60-inch and 66-inch PLRCP we would ask the Owner to consider removing the requirement in section (g) from the specification to significantly reduced the overall project costs.

A26. The pipe OD is nominal 59.5in the MTBM Body and overcut will be 60in or larger therefore face access is required.

Q27. SECTION 31 71 19, MICROTUNNELING; 2.2 EQUIPMENT: Control Systems 2. For long or curved drives Laser guided tachimetry or theodolite or gyroscope is also acceptable and in any case shall be used for guidance through the curved portions of the alignment. The guidance system shall be checked and calibrated at least every 50ft of pipe jacking or once every day whichever is the sooner.

A. The recommendation by the guidance system manufactures is to check and calibrate at least every 50-meters. We would ask the Owner to consider adopting the Guidance System MFG's recommendation.

A27. No change to the specification.

Q28. In the process of doing our outreach to meet the good faith effort requirements, several disadvantaged subcontractors have expressed concerns of not being able to bid this project because it is due a week

before the Christmas week and many of them take time off during that time. We respectfully request that the bid be postponed 2 to 3 weeks so that we get these subcontractors can submit their bid.

A28. See revised Bid Date in Addendum B.

Q29. We have concerns that we may not receive quotes for demolition of the existing facility from the demolition subcontractor because they did not attend the scheduled site visit. We would like to request a second site visit be set up so that these demolition subcontractors can attend.

A29. A second site visit is not available.

Q30. Specification section 01 50 25 describes the requirements for sewer bypass pumping on this project, but does not mention any restrictions related to the 78" NMVI bypass. The nearest upstream manhole on the 78" NMVI pipeline appears to be in the YMCA parking lot adjacent to the Mission Valley Preserve. Are there any restrictions with using a portion of the YMCA parking lot for this bypass? Are there any restrictions with installing bypass piping through the Mission Valley Preserve.

A30. At the Contractor's option, Diversion Structure 3 may be constructed without the use of a pumped bypass of the existing 78-inch NMVI. Construction methods such as the use of flow through tubes and construction sequencing shall be performed to maintain live sewage flow at all times through the work area. Addendum A, response to Q67 will be revised to state a detailed work plan for structure construction and sequencing will need to be submitted for City approval prior to construction. The work plan shall describe the construction sequence and means and methods employed to convey a maximum of approximately 80 MGD (City to confirm) through the work area without the possibility of a sewage spill or surcharging the upstream portion of the NMVI sewer. The City reserves the right to reject the Contractor's work plan if such means and methods do not provide sufficient protection from sewage spill or provide adequate flow through capacity.

Q31. The Owner Representative Field Office Per SSP 8-2.5F1 on page 179 states the office shall be available within 30 days of the notice to proceed through notice of completion. Please confirm the Owner Representative Field Office is to be removed after Intermediate Substantial Completion 750 working days from NTP.

A31. The Owner Representative field office is to be removed after Final Completion, 925 working days from NTP.

Q32. The project drawings call DIP piping to have Fusion Bonded Epoxy Lining and Coating (Key Notes 7/C03, 1/C08, 15/M-14, Details 1,2/M-16). Specification Section 09 90 00, Paragraph 3.7.B Coating and Lining for Steel and Ductile Iron Pipe, Fittings, Couplings, Adapters, and Valves provides specific requirements to such lining and coating. Although, per Spec Section 33 05 19, Paragraph 2.01.F.2, pipe and fittings shall be lined with 40-mil ceramic epoxy, as manufactured by Induron, or equal, and this section is silent on the matter of coating of ductile iron piping. Please clarify which provision applies to DIP lining and coating (buried, submerged, and exposed).

A32. All ductile iron pipe and fittings shall be fusion bonded epoxy lined and coated and conform to the requirements of Section 09 90 00 Part 3.07 B.

Q33. Specification Section 09 90 00, Paragraph 3.7.B is titled "Coating and Lining for Steel and Ductile Iron Pipe, Fittings, Couplings, Adapters, and Valves", although the first sentence of this paragraph only mentions Ductile Iron piping, fittings, etc., and requires it to be lined and coated with a fusion bonded epoxy system. There is no mentioning of the Steel piping within this paragraph and it is not clear whether Steel piping is also a subject for fusion epoxy lining and coating. Further, the Spec Section 33 05 24 Steel Pipe, Paragraph 3.7.A says: "Apply cement mortar lining to welded steel pipe, pipe fittings and specials except where the limits of epoxy or polyurethane lined pipe is shown on the Plans. Apply pipeline coatings to welded steel pipe, pipe fittings and specials according to the limits for the type of coating system as shown on the Plans, or as specified herein".

a. The drawings show 48" Pump Station Forcemain, CML & TCML welded steel pipe (Key Note 5/C-03). The profile for this pipe (Section A/C-07) calls for "1-inch min thick cement mortar liner & a coating of Rock Shield" (Note 1/C-07). Please provide a clarity on which lining and which coating applies to this section of steel pipe.

b. Key Note 7/M-08 calls for 24" CML&C steel pipe with … 1" cement liner. Please clarify cement mortar lining applies this pipe; also advise whether mortar coating will be practical for this exposed portion of pipe.

A33. a) Pump Station 48" Diameter Force Main shall be CML & TCMC welded steel pipe per Specification Section 33 05 24, with 1-inch min thick cement mortar liner per drawings.

b) Exposed 24" CML welded steel pipe shall receive 1-inch min thick cement mortar liner and coating per System 4 Specification Section 09 90 00.

Q34. The drawing C-29 shows what seems to be two existing lateral connections to newly installed 8" sewer line (between STA 11+50 and STA 11+90).

a. The size of these laterals is unknown. According to City of San Diego Sewer Design Guide, Table 2-6, the lateral connection shall be made either to Main itself or a Manhole, depending on the size/type combination of Lateral and Main. Since there is no new manholes shown where the Laterals connect to Main, it is fair to conclude that the intent is for these two connections to be made directly to Main line. If the results of potholing show that a Manhole is required to perform a connection, will the Contractor be entitled to payment for such additional work?

b. Please clarify what shall be assumed for bidding purposes: a) these existing laterals will be have to be re-built as they are shown on the drawing (going beyond the curb and sidewalk into the parking lot of the adjacent property); b) these existing laterals will be just disconnected from old Main, cut shorter and reconnected to new 8" Main, within limits of Sherman St.?

A34. Responses to a & b: Connect the lateral to the 8" main shown on Drawing C-29 in accordance with the sewer lateral connection standard COSD drawing SDS 105.

Q35. The Contractors Note on sheet C-29 says "The Contractor shall pothole all sewer laterals at property line between STA.10+00 and STA.11+90 prior to construction of new sewer main. This information will be

reviewed by the Resident Engineer for final sewer main slope and depth approval".

a. If the revised design requires additional work beyond what is shown in the bid documents, will the Contractor be entitled for additional compensation?

b. If more sewer laterals (over two shown on the drawing) are discovered on the course of the project, will the Contractor be entitled for additional compensation for work to construct such additional connections?

A35. Responses to a & b: Yes, additional compensation would be in accordance with the contract documents.

Q36. Bid Item #11 Sherman St. Sewer Relocation – Sewer Bypass eludes to bypassing required to perform the work on drawing C-29.

a. Please confirm flow rates of existing lines to be bypassed.

b. Please confirm where to intercept flow and discharge flow being bypassed.

c. Can the private owner laterals be stopped to tie in or can this be completed at night?

A36. Existing flow within the 10-inch VCP Sewer is unkown. Flow can be intercepted at the upstream manhole located. The sewer entering MH1 indicated on C-29 is a lateral from the adjacent property. The existing 10-inch diameter VCP sewer coming from the north along Grant Street has an upstream MH located approximately 230-feet north of MH2 and a downstream MH south of MH3 approximately 320 feet. The two laterals located east of MH3 are to be 4-inch laterals. CONTRACTOR shall coordinate with the ENGINEER for the timing of cross over. CONTACTOR to assume no more than 24hours of none sewer use for the properties. Connection points will need to occur in R/W.

Q37. Note 3 of the MTS Standard Construction Notes on Drawing G-07 states that a Railroad Protective Liability policy will most likely be required. Please clarify the limits that are likely required on this policy.

A37. Required insurance is stated in Item 6. of the MTS Rail License

Agreement. And summarized as follows: $2,000,000 for injury to or death to one or more persons as a result of any accident or incident and for damages to or destruction of any property of others; and $2,000,000 per occurrence and $6,000,000 general aggregate for a railroad protective liability insurance policy, with San Diego MTS listed as the named insured.

Q38. Please confirm this project is subject to the California Acts of God statute which relieves the contractor from the cost associated with damage caused by an earthquake exceeding 3.5 on the Richter Scale in excess of 5% of the contractor's bid.

A38. No, this project is not subject to Public Contract Code Chapter, Contract Clauses -7105. (a). However, the City isn't requiring the contractor to be responsible for acts of God.

Q39. Bidding Documents, Performance Bond, Labor and Materialmen's Bond Form. It would appear that a new sentence has been added to the existing bond form that automatically eliminates the ability of the Surety to consider using the Principal as its completion contractor. While we understand that the preceding sentence provides the City with the ability to reject any contractor proposed by the Surety, specifically eliminating the ability of the Surety to utilize the Principal may be prejudicial to the Surety and to the completion of the project itself. When a Surety makes the decision to utilize its Principal to complete the project, it does so after an independent investigation of, among other things, the most cost effective and expeditious means of completing the work. Effectively, the Surety becomes the intermediary between the Principal and the City and the City's future communication regarding project completion is directly with the Surety, as opposed to having to maintain a direct relationship with the Principal. As a result, it may be in the best interests of the City and the Surety to discuss the use of a particular completion contractor during the course of the Surety's investigation, as opposed to foreclosing the option at the outset. Accordingly, please consider the below revision:

~~"The Surety shall not utilize the Principal in completing the improvements and work specified in the Agreement in the event the City terminates the Principal for default.."~~

A39. The requested revision will not be incorporated.

Q40. The profile view on sheet C-16 shows the need for the contractor to remove a portion of the 66" Sewer Line that runs underneath the MTS Trolley Tracks because it blocks the path of the microtunneled brine line. The portion of pipe that is to be removed is within the "prohibited zone" as outlined in note 5.1. Excavating underneath the trolley tracks to install shoring is not feasible to remove this section of pipe. Will the contractor be allowed to lower the elevation of the microtunneled brine line in order to pass underneath the 66" Sewer line? Is there another way to avoid removing the section of the 66" Sewer line that runs underneath the trolley tracks and in the way of the microtunneled brine line?

A40. The profile of the brine centrate line cannot be lowered due to system hydraulics. It is anticipated that entry into the 66-inch NMVIS pipe will be required to remove the interfering portion of the pipe. Reference note 2 on C-16.

Q41. Please confirm gallon capacity requirement of the Hydromodification Tank to be designed by the Pre-Cast Concrete Supplier on drawing C-06.

A41. Precast tank has nominal volume of 83,776 Gallons.

Q42. Please provide Traffic Control Plans for work to be performed in Custer and Sherman Street adjacent to Pump Station. Specifically scope of work on Drawings D-02, C-03 & C-16.

A42. Contractor to submit TC plan for site work.

Q43. The Keynote 1/C-08 says "Provide 16" CL 300 Flanged DIP … for both HPO Sewer Intake and Oxygenated Lines…". Use of Flanged fittings will require using a pair of MJ or similar Adapters at each fitting to switch from Restrained Joint pipe to Flanged fitting, this way increasing the overall cost and creating additional potential leak points. Please advise whether fittings with Restrained or Mechanical joints (used as allowed by the specification) will be acceptable, or the intent is indeed to use specifically Flanged fittings for these pipe lines.

A43. Restrained joints in accordance with Specification 33 05 19 are acceptable.

Q44. Per SSP 6-2.2 Work Restrictions: The item below is in reference to the Morena Pump Station Drawings 40421-D: 1. Contractor shall provide flagged vehicular access to the MTS Trolley overflow lot located on Friar's Road during trolley operational hours. -- Please confirm the only flaggers required are identified on the Traffic Control Plan T-01 to T-08.

A44. Confirmed.

Q45. Per multiple Q&A in Addendum A concerning T-Lock PVC Liner that is no longer in production. Please consider providing approved product to be used in lieu of T-Lock PVC Liner before the bid date so the contractors are bidding the same product.

A45. HDPE lined RCP will be acceptable in leu of PVC lined pipe and shall conform to Specification 33 05 01.10, HDPE Lined Reinforced Concrete Pipe for Jacking and Tunneling, provided in this Addendum.

Q46. 7.4.17 Contractor Provided Insurance That Is Not Covered By The OCIP Insurance- This section outlines the insurance the Contractor shall procure and maintain for the excluded parties. Confirm the excluded parties can purchase or maintain such insurance to meet the requirement. I would recommend amending to "Contractor shall procure and maintain or cause to be procured and maintained. "

A46. Contractor shall procure and maintain or cause to be procured and maintained.

Q47. Per the OCIP Definitions, excluded parties include 6) Subcontractors work with a value of less than $10,000, unless their work extends to be greater than three days of work or more. Confirm these subcontractors are exempt from meeting the requirements specified in 7.4.17 as subcontractors of this size may not be able to meet the required limits and requiring them to purchase additional limits would add unneeded costs to the project

A47. Contractor shall specify insurance requirements for subcontractors less than $10,000.

Q48. A42 stated that Owner would provide the builders risk policy for review. Please provide access to it accordingly.

A48. Policy information related to OCIP has been added. See new link:

https://drive.google.com/drive/folders/1Pv7h5YLs3K-57mTVSrLGWOThlj1Inz21?usp=sharing

Q49. A49 stated that Owner will provide workers compensation, general liability, and excess liability insurance for review. Please provide access accordingly.

A49. Policy information related to OCIP has been added. See new link:

https://drive.google.com/drive/folders/1Pv7h5YLs3K-57mTVSrLGWOThlj1Inz21?usp=sharing

Q50. SECTION 31 71 19, MICROTUNNELING; 1.4 SUBMITTALS: A. Submit the following in accordance with the Contract Documents. 8. Provide details of site monitoring plan including provision of measuring ground movements at shafts and along the tunnel alignment and the monitoring of any existing structures within 100ft of the centerline of the excavation and tunnel alignment. Submit a plan for actions to be taken in the case of ground movements or movements of structures exceeding the allowable movement limits (Unless otherwise submitted 1/2in movement requires action to be taken as per the plan).

A50. Yes, 1/2 in movement requires action to be taken as per the plan.

Q51. Reference is made to Addendum A, response to Q67, which requires the Contractor to develop a plan and design to open the top of the 78" NMVI pipeline to provide the necessary bypass pumping (in the area between the NMI Junction Structure and the trolley tracks). The response to Q67 creates two significant problems with this approach.

a) The referenced site is not large enough to support all the bypass equipment and pumps, which is necessary to successfully bypass flows and maintain a sufficient work area to allow construction of the new Diversion Structure 3.

b) The response to Q67 also requires the Contractor to design the repair of the existing 78" NMVI pipe. The requirement for the Contractor to design the repair of existing 78" NMVI pipeline is unusual and typically the Engineer of Record would furnish this design requirement. Please provide the following:

1. Bypass plan for a mandated work area with design considerations for the construction of the new Diversion Structure 3.

2. Provide a design for removing the top portion and the repairing of the existing 78" NMVI Pipeline for this bypass operation.

A51. At the Contractor's option, Diversion Structure 3 may be constructed without the use of a pumped bypass of the existing 78-inch NMVI. Construction methods such as the use of flow through tubes and construction sequencing shall be performed to maintain live sewage flow at all times through the work area. Addendum A, response to Q67 will be revised to state a detailed work plan for structure construction and sequencing will need to be submitted for City approval prior to construction. The work plan shall describe the construction sequence and means and methods employed to convey a maximum of approximately 80 MGD (City to confirm) through the work area without the possibility of a sewage spill or surcharging the upstream portion of the NMVI sewer. The City reserves the right to reject the Contractor's work plan if such means and methods do not provide sufficient protection from sewage spill or provide adequate flow through capacity.

Q52. Regarding Spec Section 44 47 28.26, my odor control manufacturer Daniel Company respectfully requests for the City to revise the requirement of **having a service center 25 miles from the jobsite** (Section 44 47 28.26, paragraph 1.7.A.3) to **having a service center 200 miles from the jobsite**. PLEASE NOTE that when this project was previously issued for bids in Summer 2019 we had requested – and the City had granted – this same change. The City had changed it previously via addendum but forgot to include the change in the new set of specs. See attached Addendum C from the last go around. The City increased the distance to 200 miles on page 26 of 48.

A52. Service center will be increased to 200 miles of the jobsite D.

Q53. Attachment E Section 31 45 20 1.3G JET GROUTING calls for a monitoring plan. Please provide details on the monitoring requirement.

G. The contractor shall provide a monitoring plan for nearby existing improvements

1. MTS light rail.

2. Unitied States Army Corps of Engineers (USACE) levee north of and bording Friars Road.

A53. The contractor needs to submit a monitoring plan of the surrounding improvements to be approved by the Engineer and in some cases, by the USACE and the rail authority.

Q54. Will the Builder's Risk insurance policy provided by the OCIP exclude or limit coverage in regards to equipment testing, interior water damage, piling, dewatering, and/or defects?

A54. See OCIP Builders Risk Policy in the link provided below.

https://drive.google.com/drive/folders/1Pv7h5YLs3K-57mTVSrLGWOThlj1Inz21?usp=sharing

Q55. Per General Structural Note 4 in S-1, "no backfill or loading of concrete wall shall occur until roof slabs are constructed and concrete has reached its 28-day compressive strength." Is this requirement applicable to the Morena Pump Station since there are concrete buttresses on all sides of the structure (see S-36 Note 4)? Please confirm if it's acceptable to backfill walls around Pump Station after concrete walls reach full compressive strength (no roof slab will be in place before backfill).

A55. Pump Station roof slab is required to be in place before backfilling walls.

Q56. It appears there is Fire Alarm System required as shown on electrical building plan, but missing fire alarm spec. Please verify if fire alarm system will be included and issue fire alarm spec.

A56. A fire alarm system is to be provided as shown on the electrical building plans. Technical Section 28 31 00 is provided in pages 27 through 49 of this Addendum.

Q57. I'm contacting you today to add our IPS couplings to the steel piping section of the NC Morena Pump Station Testimonials/Specifications. Victaulic is already listed in the Ductile Iron and Stainless Steel sections. I have attached our steel pipe specification literature and corresponding submittals for your review and to add.

A57. Materials/Equipment addition request by the selected contractor will be reviewed upon submittal.

Q58. In Spec Attachment E (p.159), it states sewer discharge fees shall be paid by Contractor. However, in Spec Sect 01 29 00-1.14R it defines Dewatering and Discharge Fees –Allowance and says it's for fees paid by the Contractor to the City for disposal of dewatering discharges to the sanitary sewer system. In Addendum A Q&A 35 the City confirms the fees will be paid under Bid Item #27. However, in Addendum B Q&A 43 it states cost to discharge groundwater to the sewer system is part of Bid Item #15 which is not an allowance. The discharge fee is a function of the volume of discharge, which the City has directed the Contractor to assume at twice the high end of the Geotechnical report. However, it may vary considerably and the contaminants which are there are only the results from one monitoring well. So, these could vary considerably as well. It makes a lot more sense for this to be paid under an allowance item so that the City isn't paying for items that may or may not occur. Please confirm that the dewatering discharge fees will be paid under Bid Item #27.

A58. The discharge fee paid to Public Utilities shall be paid as part of Bid Item 27.

Q59. Reference is made to S-43/D and Note 33 at the Pump Station. Exterior concrete wall along Line '2' at the Pump Station requires #5 hairpins as shown in S-43/D. Rebar clearance between face of wall and main reinforcement is 2" as shown. With the addition of #5 hairpins, rebar clearance to hairpin is reduced to approximately 1 ¼". Please confirm the Engineer's intention to keep the 2" rebar clearance is to hairpins.

A59. See revised drawing S-43 on Addendum B.

Q60. Reference is made to Screening Facility in S-32 Note 34, Grout Fill. Plans do not provide limits of Grout Fill from Inlet Pipe in Screening Facility to floor at EL: -16.00. Please provide plan view of Grout Fill limits.

A60. See revised drawing S-43 on Addendum B.

Q61. Paint spec section 09 90 00, Part 3.7B states that all buried and exposed above ground ductile iron piping, fittings, valves etc. shall be lined and coated with a fusion bonded epoxy system. However, section 33 05 19 Part 2.1F for Ductile Iron pipe states that pipe and fittings for clean water shall be cement mortar lined and asphaltic seal-coated. It then states that pipe and fittings are to be lined with 40 mil of ceramic epoxy.

Please confirm whether the ductile iron pipe and fittings on the project are to be lined with fusion bonded epoxy system or with 40 mil of ceramic epoxy.

A61. All ductile iron pipe and fittings shall be fusion bonded epoxy lined and coated and conform to the requirements of Section 09 90 00 Part 3.07 B.

Q62. During the site visit we noticed there were some steel casings in the parking lot. Will those be removed prior to NTP by others or is the awarded Contractor to remove?

A62. Contractor shall be responsible for removing steel casings.

Q63. Drawing D-02 shows several overhead utilities to be relocated by others. Please provide information regarding timing and duration for this work.

A63. Timing for relocation will occur per Section 5-6.2. Section 5-6.2 shall be modified from the first 30 days of the Contract time to the first 83 days. Also Section 2-14.3 add h) AT&T Relocation for B15141 NC Morena Blvd. Pump Station and Pipeline (Sherman & Custer), Judith Villacruz-Brandt 858-886-1910.

Q64. Drawings C-10 and C-11 (Keynote 11) calls for replacement of pavement sections on Friars Road with AC over "AC Base". Please clarify the AC Base?

A64. Sheet C-10, Keynote 11 states 7-inches AC Pvmt over 7-inches AC base. Assume full depth AC of 14 inches per City Std drawing SDG 113.

Q65. In the soils report (Geotechnical Report Morena Pump Station by AECOM Jan 5, 2018) it calls for "ground improvements on the entire pump station site". Please confirm that the entire site should receive ground improvements and not only the pump station footprint.

A65. Yes, the entire site. Not just the pump station footprint.

Q66. Supplementary Special Provisions Section 1-2 shows "Normal Working Hours" to be from 8am to 4pm. Please consider revising this to 7am start as this would minimize additional cost to the bid.

A66. As stated in 1-2 Item 54 "Construction Activities outside of the normal working hours may occur with prior approval by the Resident Engineer, at no cost to the City." The Resident Engineer is likely to approve; extended working hours to 12-hours a day, double shifts, altering start times and end times, and continuous work for tunneling. The Contractor's request will for altered working hours will need to address any changes in Traffic Control and anticipated work so the Resident Engineer can provide the appropriate staffing.

Q67. Attachment B Phase Funding Provisions mentions "…fund availability for each phase" and issuing of NTP for each Phase. Please provide some clarity to each of the phases referenced in the section.

A67. The Contractor with Resident Engineer and City Project Manager will meet to discuss needed funds per fiscal year and will collectively determine the appropriate level phased funds for the project based on the Contractor's anticipated spend curve plus contingency.

Q68. Attachment E Section 7-8.1 calls for a street sweeper every working day. Please confirm that this is correct as it appears excessive given that most of the work will be confined to one location (i.e. pump station).

A68. Street Sweeping is intended for the pump station, Sherman Street and Friars Road and is appropriate for the project.

Q69. Attachment E Section 7-16 Community Outreach outlines a detailed description of the requirements for this work. Based on the amount of work that will be needed to meet this requirement, it appears that a dedicated consultant specializing in community outreach may be needed. Please confirm that a Contractor's staff member will suffice.

A69. A Contractor's staff member will suffice for the responsibilities indicated under Community Outreach. The City's Construction Manager has procured an outreach consultant (an assigned Community Liaison) will lead outreach activities, and the Contractor's designated team member will support.

Q70. Attachment E Section 6-7.1.2 calls for a shutdown moratorium from May until October for shutdown of 16" and larger pipes. Please specify the day in May and October (i.e. May 15…October 1??). We have prepared a preliminary construction schedule (including the 120 working days for

testing/commissioning PLUS 30 working days for Acceptance testing) and it shows that the moratorium will push the completion beyond the 750 day Milestone 1, if the moratorium end is towards the end of October.

A70. Actual dates for shutdown moratorium of 16-inch and larger water mains is determined annually based on fire risk danger.

Q71. Plan page C-08 calls out ductile to be epoxy lined and coated per the 099000 spec section. Spec section 099000 3.7 calls out for ductile iron to be epoxy lined and coated with 16 mils of 206N and to be holiday free. I have been informed by my supplier that they can only epoxy line and coat holiday free pipe up to 5'0" long. In spec Section 33 05 19 it calls out for ductile iron to be lined with 40 mils of P-401 lining. Please confirm what lining and coating needs to be used on ductile iron pipe and fittings.

A71. Lining: Ductile Iron Pipe and Fittings shall be lined with 40 mils ceramic epoxy as manufactured by Induron or equal as required in Specification Section 33 05 19. Coating: Buried Pipe shall be Asphaltic Coated as required in Specification Section 33 05 19. Exposed pipe shall receive Coating System 4 as specified in Specification Section 09 90 00 - Painting and Coating.

Q72. Addendum A, A41 states that owner is not responsible for any losses as a result of earthquake. Our insurance broker is stating that earthquake coverage cannot be purchased by contractor without an underlying policy for same maintained by owner. If Owner policy does not provide at least a minimum of coverage for earthquake contractor cannot purchase a wrap policy for any additional coverage for earthquake. If contractor is responsible for all losses as a result of earthquake please confirm that Owner will add at least a minimum of such cover to their policy

A72. The OCIP builders Risk policy does not include earthquake coverage.

Q73. Spec section 40 27 00 part 2.2B calls for the diameter of Cement-lined steel pipe to be determined by the lining inside diameter. Keynote callout 7 on Drawing M-8 calls for the overflow piping on top of the pump station roof to the wet well to be 24" CML&C. If this piping was actually required to be CML&C, it would need to have an OD of 27" to

meet the ID required by the spec. It would have to be specially fabricated (rolled) since standard mill-manufactured steel piping does not come in this size. Please confirm whether this was the intent. Note that keynote callout 3 on drawing M-11 shows the same overflow piping as 24" welded steel FE pipe. Is this piping run to be CML&C or just welded steel FE piping without cement lining and coating?

A73. Closest standard size pipe is acceptable. Pipe will CML and Paint coated with system 4 09 90 00.

Q74. Keynote callout 14 on drawing H-08 for FRP duct supports on top of the pump station calls for duct support details shown on drawing H-12. However, there are no duct support details for this support configuration on drawing H-12. Please provide a support detail for the FRP duct supports at this location.

A74. Use Detail 4 on M-12 as called out. Invert support and place on 6-inch concrete pad as shown on H-08.

Q75. Drawing M-13 does not provide a joint type for the 1" 316 stainless steel HPO piping. Please confirm the joint type.

A75. Provide Welded joints.

Q76. The specification does not provide clear directions on the cleaning requirements of the 1" HPO piping. Spec section 43 42 00 part 1.04B states that items precleaned prior to shipment does not require further cleaning after installation. However, this seems to only apply to the vaporizer specification. Please confirm whether the 1" HPO piping needs to be cleaned and dried in the field.

A76. 1” HPO piping shall be cleaned and dried in the field.

Q77. Spec sections 05 05 23, 1.2B, 2.1A, 3.2A and 3.3A all make mention of CWI inspections, but none of them are clear on whether a CWI is required to be present for pipe shop welds. The Pipe spec section doesn’t not clarify this either. Please confirm whether CWI Inspector and inspections are required for shop Pipe Fabrication.

A77. CWI requirement is for field welding, not shop welding.

Q78. Per Spec 055000 para 1.1 A (9), it mentioned a reference to NSF-61. However, we don't find further items in Spec Div 05 specifically calling for NSF-61 requirements. Does this requirement apply to any specific item / under water item?

A78. NSF-61 Compliance is required for items where called for in individual specifications or as required by the drawings.

Q79. Does the SS Manual Bar Rack per S-28, M-01, M-23 need NSF-61 Certification?

A79. NSF-61 Certification is not needed for the Manual Bar Rack.

C. ADDENDUM

1. To Addendum B, Section B, Bidder's Questions, page 15, Q38 and A38, **DELETE** in its entirety and **SUBSTITUTE** with the following:

   Q38. Will the General Liability and Excess Liability insurance coverage provided under the OCIP contain any exclusions for work within 50' of railroad property?

   No.

   Will MTS be allowed to be added as an Additional Insured on these policies if/when required by written contract/agreement?

   A38. Yes. The OCIP CGL policy is endorsed with Contractual Liability – Railroads CG 24 17 10 01 on a blanket basis.

D. SUPPLEMENTARY SPECIAL PROVISIONS

1. To Technicals, SECTION 07 72 33, Roof Hatches (BILCO Type D), pages 617 through 619, DELETE in its entirety.

2. To Technicals, **ADD** Division 28, Electronic Safety and Security Manufacturers, SECTION 28 31 00, FIRE DETECTION AND ALARM, in pages 27 through 49 of this Addendum

3. To Technicals, Division 33, Utilities, **ADD** SECTION 33 05 00, HDPE LINER, in pages 50 through 53 of this Addendum.

4. To Technicals, Division 33, Utilities, **ADD** SECTION 33 05 01.10 HDPE LINED REINFORCED CONCRETE PIPE FOR JACKING AND TUNNELING, in pages 54 through 57 of this Addendum.

James Nagelvoort, Director
Engineering & Capital Projects Department

Dated: *December 15, 2020*
San Diego, California

JN/AJ/lir

SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C62.41, Surge Voltages in Low-Voltage AC Power Circuits.
2. International Fire Code (IFC).
3. International Building Code (IBC).
4. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 72, National Fire Alarm Code.
   c. 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
   d. 101, Code for Safety to Life from Fire in Buildings and Structures.
   e. 820, Fire Protection in Wastewater Treatment and Collection Facilities.
   f. 1221 Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems.
5. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
6. National Institute for Certification in Engineering Technologies (NICET).
7. Telecommunications Industry Association (TIA):
   a. 232, Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange.
   b. 485, Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems.
8. Underwriters Laboratories, Inc. (UL):
   a. 217, Single and Multiple Station Smoke Alarms.
   b. 228, Door Closures-Holders, With or Without Integral Smoke Detectors.
   c. 268, Smoke Detectors for Fire Protective Signaling Systems.
   d. 286A, Smoke Detectors for Duct Application.
   e. 464, Audible Signal Appliances.
   f. 497B, Protectors for Data Communication and Fire Alarm Circuits.
   g. 864, Control Units for Fire-Protective Signaling Systems.

h. 1449, Standard for Transient Voltage Surge Suppressors.
i. 1480, Speakers for Fire-Protective Signaling Systems.
j. 1604, Electrical Equipment for Use in Class I and Class II, Division 2, and Class III Hazardous (Classified) Locations.
k. 1638, Visual Signaling Appliances – Private Mode Emergency and General Utility Signaling.
l. 1971, Signaling Devices for the Hearing Impaired.

9. Uniform Fire Code (UFC): 3-600-01, Design: Fire Protection Engineering for Facilities.
10. Unified Facilities Criteria (UFC): 4-021-01, Design and O&M: Mass Notification Systems.

1.02 DEFINITIONS

A. Addressable: A fire alarm system component with a unique identification that can have its status individually identified or that is used to individually control other functions.

B. AHJ: Authority Having Jurisdiction.

C. CAD: Computer Aided Design.

D. Coded: Audible or visible signal that conveys information about alarm event. Examples are, number of rings of a bell or flashes of a strobe. This could be used to convey location or type of alarm.

E. dB: Decibels.

F. DXF: Drawing Interchange Format.

G. ECP: Environmental Control Panel.

H. FACP: Fire Alarm Control Panel.

I. HVAC: Heating, Ventilating, and Air Conditioning.

J. I/O: Input/Output.

K. LCD: Liquid Crystal Display.

L. LED: Light-Emitting Diode.

M. MOV: Metal Oxide Varistor.

N. RAM: Random Access Memory.

O. SOM: Sequence of Operations Matrix.

P. Zone: A defined area within the protected premises. A zone can define an area from which an alarm signal can be received or an area to which a signal can be sent. The term zone is typically used when describing conventional, nonaddressable systems.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. Contract Drawings show location of fire alarm panel emergency alarm components required by IFC 2704. Other component locations and quantities shall be determined by fire alarm system installer and shall be included as part of their design. This includes, but is not limited to, smoke detectors, heat detectors, manual pull stations, and notification appliances. Design and installation shall meet requirements of the local AHJ.
2. Contract Drawings show location of fire alarm system components.
3. Design, coordinate, and provide system in accordance with building codes indicated in Section 01 61 00, Common Product Requirements.
4. Design conduit layout and wiring interconnection of devices specified herein.
5. Coordinate, and include in design, requirements for interfacing with HVAC system.
6. Equipment suitable for addressable fire alarm system.

B. Performance Requirements:

1. Actuation of alarm (smoke or heat detector, flow switch, or other normally open initiating device contact) or trouble (trouble or supervisory switch) shall cause the following operations:
   a. Audible and visual indications of alarmed devices on fire alarm control panel display.
2. Actuation of duct smoke detectors shall, send signal (contact closure) to air handling unit to shut off HVAC equipment and send a Supervisory Alarm to the fire control panel.
3. Sequence of Operations Matrix at the End of Section describes functions of fire alarm system.

1.04 SUBMITTALS

A. Action Submittals:

1. Descriptive product information for each individual system component.

2. Dimensional drawings of panels and associated equipment.
3. Itemized bill of material.
4. Operating and programming instructions.
5. Control panel configuration and module data.
6. Complete point to point wiring diagrams of system and device interconnection. Identify spare connection points.
7. Alarm initiating, indicating, and supervisory device electrical data.
8. Annunciator configuration and module data.
9. Plans showing device and panel locations as well as conduit and cable sizes. Prepare drawings and diagrams on drawing sheets of uniform size without extraneous information. Marked up electrical, HVAC, lighting or similar drawings or copies of catalog data sheets are not acceptable in lieu of required drawings or diagrams.
10. Sequence of Operation Matrix.
11. Battery sizing calculations.
12. Supervisory power requirements for equipment.
13. Alarm power requirements for equipment.
14. Power supply rating justification showing power requirements for system power supplies.
15. Voltage drop calculations for wiring runs, demonstrating worst case condition.
16. Conduit fill calculations.
17. Sample warranty.
18. Recommended types and quantities for spare parts.
19. For each system's control panel, provide written schedule of active and spare addresses provided on each addressable circuit.
20. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Experience and qualifications of firm(s) proposed to design and install system.
2. Certifications documenting service technician's training. Certification shall indicate name of individual, training, dates, systems qualified, and current status.
3. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
4. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection and Testing.
5. Copy of design documents, Shop Drawings, and calculations submitted to code-enforcement authorities.
6. Code-enforcement authority approval letter.
7. Factory test reports.

8. Detailed program and schedule for testing, inspection, and maintenance of fire alarm system that satisfies requirements of NFPA 72, manufacturer's recommendations, and local authority having jurisdiction.
9. Written documentation for logic modules as programmed, for system operation, with matrix showing interaction of input signals with output commands.
10. System program hard copy and CD-ROM showing system functions, controls, and labeling of equipment and devices.
11. Documentation of system voltage, current, and resistance readings taken during installation, testing, and ATP phases of system installation.
12. System record drawings and wiring details including one set of reproducible masters and drawings on CD-ROM in a DXF format suitable for use in a CAD drafting program.
13. NFPA 72, Record of Completion: Submit to Owner and code-enforcement authorities.
14. NFPA 72, Inspection and Testing Form: Submit to Owner and code enforcement authorities.
15. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Provide names of projects, locations, and telephone numbers of persons to contact for at least two installations where Contractor or Subcontractor has installed detection and alarm systems that are similar in size and scope as this.
2. System design, installation and testing shall be performed by licensed firm(s) with established reputation in fire alarm system industry having experience in design, installation, and testing of fire alarm systems.
3. Technician with minimum of NICET Level II Certification for fire alarm systems or professional engineer registered in State of California shall be available onsite.
4. Service technician shall be formally trained by manufacturer.

B. Regulatory Requirements: Submit Shop Drawings and system design calculations for approval to the following code enforcement authorities.

1. Fire Marshal

1.06 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of Work specified in this Specification section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.

1.07 MAINTENANCE

A. Maintenance Service: For 2 years after Correction Period, provide maximum of 2 service calls, at Owner's request, to make adjustments or repairs required to keep system in satisfactory, full operation.

1.08 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts:

Item	Quantity
Detectors and actuating devices	One complete set

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Siemens Building Technologies.
2. Simplex/Grinnell.
3. FCI.
4. Notifier Fire Systems.
5. Edwards Systems Technology.

2.02 GENERAL

A. Material and equipment shall be standard products of their respective manufacturers, and shall be of a model that has been in production for not less than 3 years. Equipment shall be supported by a service organization that is, in the opinion of Owner, reasonably convenient to Site.

B. Contractor shall become familiar with details of Project, verify dimensions in field, and revise conduit and equipment locations to avoid obstructions and allow installation of new equipment.

C. Contractor shall not begin system installation prior to receiving written approval of Shop Drawings from Engineer.

2.03 UL COMPLIANCE

A. Products manufactured within scope of Underwriters Laboratories, Inc. shall conform to UL Standards and have an applied UL listing mark.

B. Equipment shall be UL listed in accordance with requirements of NFPA.

2.04 SERVICE CONDITIONS

A. Altitude: Not greater than 3,300 feet above sea level.

B. Ambient Temperature:

1. Maximum 40 degrees C.
2. Minimum 0 degrees C.

C. Equipment shall be fully rated without derating for these conditions.

2.05 RADIO ALARM TRANSMITTER

A. Provide 8 zone (minimum) Monaco BT2-7 radio fire alarm transceiver, narrow band type. Notwithstanding any other provisions of this Contract, no other product will be accepted. Transceiver shall be factory assembled and tested, complete with manufacturer's locking cabinet, 60-hour rechargeable battery set, automatic battery charger, antenna surge arrestor, and coaxial cable.

B. Provide with manufacturer's standard wall mounted omnidirectional antenna and UHF antenna kit.

C. Provide manufacturer recommended lightning arrestor with NEMA 4 rated enclosure.

2.06 POSTED OPERATING INSTRUCTIONS (POI)

A. POIs shall be prepared on full size drawing sheets.

B. POIs shall be framed in extruded metal frames, mounted under glass and shall be water/weather resistant. Instructions shall be permanently mounted on reserved wall area in space shown on Drawings.

C. POIs shall include:

1. Facility floor plans showing location of fire equipment and devices with coordinated identification. Show items such as firewalls, fire dampers, and fire alarm devices.
2. Fire alarm wiring diagrams and schematics, with zone identification and device address list.

2.07 FIRE ALARM CONTROL PANELS

A. General:

1. Control panel circuit for 24V dc, power limited, initiating circuits per NFPA 70, Article 760.
2. Assembled panel UL 864 listed Product Category UOJ2, as an integrated control system.
3. Enclosure:
   a. NEMA 250 Type 1.
   b. Color: Red.
4. Internally Mounted Module with:
   a. Transformer with 120 V ac input and 21.5V ac output.
   b. Solid state rectifier for 21.5V ac input and fuse protected, filtered, and regulated 26V dc no-load output.
   c. Solid state transfer switch, minimum 8 amp-hours.
   d. Standby Ni-Cd batteries sized for system operating period of 24 hours of standby mode operation.
   e. Solid state battery charger.
   f. Over/under voltage monitor supervisory circuit.
   g. LEDs for status of normal power, battery trouble, and power supply module trouble.
   h. Alarm mode of 5 minutes after standby operation.
5. Local differentiating audible sound device for alarm, trouble, and supervisory conditions.
6. Full digital transmission protocol.
7. Addressable signal transmission protocol to be either digital pole/response protocol or proprietary communication protocol, with all antilog sensing device signals digitally transmitted to control panel.
8. MOV/gas discharge transient protection for power supply module.
9. For addressable systems provide additional 20 percent capacity for future indicating and initiating devices.
10. EMI/RF Protection:

a. Protect control equipment, devices, and wiring against unwanted radiated electro-magnetic interference (EMI) and from effects of audio and radio frequencies (RF) that can cause transmission of spurious alarms.
b. System shall be designed and installed so as to be unaffected (with control cabinet faceplates installed) by operation of handheld, portable radios of up to 5 watts, or portable cellular telephones up to 1 watt, within 12 inches of system components.

B. Three-Mode Control Panel:

1. Alarm, supervisory, and trouble modes of operation.
2. Modular construction with solid state microprocessor-based components and central processing unit, continuously scanning each module for status change.
3. Coded, fire alarm system with Class B, Style B initiating device circuits and Class B, Style Y notification appliance circuits.
4. Operator Interface Panel:
   a. Indicators, control switches, and tone device.
   b. LCD or digital display to indicate event type and zone location or LEDs with differentiating color lenses for:
      1) AC power on.
      2) Power trouble.
      3) System trouble.
      4) Supervisory alarm.
      5) Earth-ground trouble.
      6) Alarm for each zone.
      7) Trouble for each zone.
      8) Alarm signaling circuit trouble.
      9) Annunciator circuit trouble.
   c. Control Switches for:
      1) Alarm silence.
      2) System reset.
      3) Trouble signal silence and ring-back feature.
      4) Municipal connection circuit disconnect.
      5) Manual evacuation drill.
      6) Auxiliary one bypass.
      7) Auxiliary two bypass.
   d. Piezo-electric tone device with pulsed march time rate for alarm and continuous for trouble conditions.
5. Separate annunciator outputs rated 2-milliamperes supervisory and 120-milliamperes alarm.
6. Smoke Detector Output:
   a. Two- or four-wire as required, rated 2 amperes, 24V dc.

b. Interrupted when system is reset.

7. Supervised remote inputs for alarm silence and system reset.
8. Switch Selectable:
   a. System diagnostic tests.
   b. Alarm verification.
   c. Alarm silence inhibit.
   d. March time alarm code at cadence of 120 beats per minute.
   e. Temporal alarm code repeated at 1/2-second on and off intervals.
   f. Signal alarm circuit cutout.
   g. Manual evacuation.
   h. Selective signaling.
9. Two alarm and one trouble, Form C auxiliary/output relays rated 2 amperes, 30V dc, 0.5 ampere, 120V ac each.
10. Minimum of 12 input zones.

C. Addressable Control Panel:

1. Modular construction with solid state, microprocessor-based components, programmable central processor unit, back lighted display of primary control status and essential alarm operating conditions, and concealed, maintenance, purpose operator's keypad.
2. With Signaling Line Circuit Class B and Class B, Style Y Notification Appliance Circuits.
3. Main control module consisting of operator's keyboard/keypad, local and remote communications and supervision capabilities, system control memory, and programming interface.
   a. Two-line, back lighted, 80 alphanumerical LCD characters with:
      1) Visible cursor for entering data information.
      2) Displayable when cabinet door is open.
   b. Primary operators keypad with:
      1) Acknowledge keys and LEDs for system alarm, supervisory service, and system trouble conditions.
      2) Power on LED.
      3) Alarm silence reset keys.
      4) Displayable when cabinet door is closed.
   c. Pass code protected action display keypad for:
      1) Circuit/device enable or disable.
      2) Control on/off.
      3) Test/status.
      4) Auto or manual.
      5) Activate/reset.
      6) Display historical logs/real time.
      7) Function/menu.
      8) Program.

9) Delete.
10) Displayable when cabinet door is open.

d. Numerical entry and selection keypad, used in conjunction with action display keypad, to perform control function on system zones, initiating circuits, or auxiliary relays, and to gain access to system information. Displayable when cabinet door is closed.

e. Programmable control keypad with five pass code keys, associated LEDs, and identification labels for:
1) HVAC shutdown disable.
2) Displayable when door is open.

f. Four function keys for control of variable functions related to primary operations keypad, displayable when door is open.

4. TIA 485, NFPA 72, Style 4, Style 6, or Style 7 data circuit capability for remote annunciators.
5. Form C relay contacts rated 2 amperes, 24V dc.
6. Down loader port for connection to microprocessor-based transponder.
7. Power supply interface module generating digital voltage and current data to LCD with:
   a. dc power conversion and output terminals.
   b. Supervision and control of power supply.
8. Modules with coded input on first alarm, local trouble LED, and in/out capabilities for:
   a. 120 addressable initiating alarm sensors consisting of analog/addressable or traditional detector methods.
   b. Four hardwired I/O points, field selectable in any combination to be either NFPA 72, Style B or Style D, initiating device circuits or NFPA 72, Style Y or Style Z, indicating appliance circuits or auxiliary control circuits.
   c. Auxiliary control circuit contacts shall be single-pole, double-throw, rated 2 amperes at 24V dc and 0.5 amperes at 120V ac.
9. Auxiliary control circuit contacts shall be single-pole, double-throw rated, 2 amperes at 24V dc and 0.5 ampere at 120V ac.
10. Two isolated TIA 232 communication port modules.

2.08 ADDRESSABLE DETECTOR BASE

A. Solid state circuitry with integral LED visual alarm, dip switch or program selectable addressing, and common base receptacle for ionization, photoelectric, and heat detectors. Device address shall be located in base.

B. Constantly monitors detector status and status changes.

C. Suitable for mounting on standard outlet box.

D. Normally open, double-pole contacts rated 3 amperes, 125V ac for resistive loads.

2.09 INDIVIDUAL ADDRESSABLE MODULE

A. Solid state circuitry with selectable latch/nonlatch operating conditions and mounting plate.

B. Monitors single and multiple devices with dry contacts.

C. Suitable for installing inside 4-inch by 4-inch by 2-1/2-inch electrical box.

2.10 ZONE ADDRESSABLE MODULE

A. Monitor module with solid state circuitry for Class A four-wire detection circuits serving dry contact initiating devices.

B. Signal module with solid state circuitry for supervising and operating Class A circuits serving 24V dc signals, speakers, and telephone devices.

C. Control module with solid state circuitry for supervised control functions.

D. Module complete with mounting plate, suitable for installation in 4-inch by 4-inch by 2-1/2-inch electrical box having 1-1/2-inch deep extension ring.

2.11 INITIATING DEVICE

A. Pull Station, Fire:

1. Single-action station for general alarm.
2. Constructed of die-cast metal with baked red enamel finish, and raised white letters stating “FIRE.”
3. Surface-mounted with hinged front cover having keyed or allen-wrench reset lock.
4. Recessed pull handle for single action lift door and pull handle for double action operating station with plastic break rod.
5. Activated station pull handle, latched in protruding position until reset by key.
6. Stations keyed alike with fire alarm control panel.
7. Screw terminal for field connections.
8. Double-pole contacts rated 3 amperes, 125V ac for resistive loads.
9. Manual Pull Station: Microprocessor-based communication circuit address, and compatible with fire alarm control panel.

B. Smoke Detector:

1. Photoelectric type with plug-in, twist-lock addressable base per UL 217 and UL 268.
2. Solid state circuitry, unipolar, single source, dual sensing chamber, suitable for device releasing service.
3. Concealed, field adjustable, sensitivity test switch.
4. LED; pulsed indication for power availability and steady indication for activated detectors.
5. Self-Compensating Circuitry:
    a. Voltage Range: 15V dc to 30V dc, 24V dc nominal.
    b. Temperature Range: 0 degrees C to 38 degrees C.
    c. Operating Temperature Range: Minus 10 degrees C to 50 degrees C.
    d. Humidity Range: 0 to 95 percent relative humidity.
6. Double-pole contacts, rated 3 amperes, 125V ac for resistive loads.
7. Detectors equipped with insect screen.
8. Photoelectric sensors adjusted to within 3 percent of UL 217 window obturation sensitivity value.

C. Air Duct Smoke Detector:

1. Duct mounted housing with prealigned sampling and exhaust tubes, analog sensing, solid state circuitry, and plug-in, twist-lock addressable base for photoelectric detector in accordance with UL 286A, NFPA 72, NFPA 90A, and NFPA 101.
2. Sampling tubes to extend full width of branch air return duct.
3. Self-Compensating Circuitry:
    a. Voltage Range: 15V dc to 30V dc, 24V dc nominal.
    b. Temperature Range: 0 degrees C to 38 degrees C.
    c. Humidity Range: 10 percent to 90 percent relative humidity.
    d. Velocity Range: 400 feet to 4,000 feet per minute.
4. Front mounted LED with pulsed indication for alarm condition.
5. Normally open, single-pole, double-throw auxiliary relay with 2 amperes, 125V ac rated contacts for resistive loads.

2.12 ALARMS

A. Audible Alarm:

1. General:
    a. Polarized, 24V dc device with sound power measured dB in accordance with UL 464.
    b. Separate in/out wire leads for field connections.
    c. Baked red enamel finish.
    d. Audibility: In accordance with NFPA 72 and local requirements.

2. Modular Horn:
    a. Surface basic unit, complete with single projector, designed for mounting on 4-inch square standard electrical box.
    b. Manufacturer supplied box with flush grille plate and basic surface unit for recessed horns.

B. Visual Alarm, Fire:

1. Polarized, 24V dc, multi-candela indicating output per UL 1638.
2. Solid state circuitry for high-intensity control of xenon flashtube.
3. Tamper-proof, translucent molded, polycarbonate, pyramidal shaped lens with "FIRE" in red lettering visible from 180-degree viewing field; red enclosure.
4. Polarized in/out wiring.
5. Designed for mounting on wall, single-gauge electrical box, or as part of audible/visible base housing.

2.13 WIRING

A. AC power wiring shall meet requirements of Section 26 05 05, Conductors.

B. Low voltage wiring shall be solid copper or bunch tinned (bonded) stranded copper, minimum 14 AWG, and shall meet NEC Article 760 for nonpower limited service.

C. Network or addressable loop cables shall be as recommended by manufacturer for installation of their system and UL Listed for Fire Alarm Systems.

2.14 RACEWAYS

A. Conduit used for installation of Fire Alarm system shall follow requirements as identified in Section 26 05 33, Raceway and Boxes.

2.15 END-OF-LINE RESISTORS

A. Ohmic value and power rating as determined by manufacturer based upon number of circuit devices supplied and circuit configuration as installed.

B. Loose resistors at last device in circuit.

2.16 SURGE SUPPRESSORS

A. Transient Voltage Surge Suppressors (TVSS): In accordance with Section 26 43 00, Transient Voltage Suppression.

B. Transient Voltage Surge Suppressors (TVSS):

1. Provide to suppress voltage transients that might damage fire alarm panel/transmitter components. Unit shall wire in series to power supply of protected equipment with screw terminations.
2. Unit shall be UL 1449 listed with a 330-volt suppression level and have a maximum response time of 5 nanoseconds.
3. Unit shall meet IEEE C62.41 Category B tests for surge capacity.
4. Features:
    a. Multi-stage construction that includes inductors and silicon avalanche zener diodes.
    b. Long life indicator lamp (LED or neon lamp) which extinguishes upon failure of protection components. Fusing shall be externally accessible when this feature is available.
5. Manufacturer and Product: Edco of Florida, Ocala, FL; Model HSP-121BT2.

PART 3 EXECUTION

3.01 GENERAL

A. Coordinate with other trades for mounting and interfacing with fire alarm system related devices.

B. Install control panels, initiating and alarm devices, conduit, and wiring for interconnection of devices specified herein for complete and operable system.

3.02 INSTALLATION

A. Install and connect fire detection and alarm equipment in accordance with manufacturer's instructions and recommendations, and in accordance with applicable codes and standards.

B. Mount devices in accordance with manufacturer's instructions.

C. Provide outlet and junction boxes that are compatible with raceway system.

D. Mount detector LEDs so they are readily visible from floor.

E. Arrange duct detectors to monitor duct area and point of duct penetration sealed and reinsulated.

F. Install conductors in accordance with Section 26 05 05, Conductors, and NFPA 70, Article 760.

G. Install initiating alarm, signal, and communication conductors in separate and independent raceway system.

H. Circuit wiring color-code, as established by installer, to be maintained throughout installation.

I. Size conductors in accordance with device manufacturer's recommendations. Increase AWG size of alarm conductors, if necessary, to maintain terminal voltage drop within acceptable level required by NEC and NFPA.

J. Detectors shall not be installed until after construction clean up of trades is complete, per requirements of NFPA. Exception, where required by AHJ for protection during construction, detectors installed prior to final clean-up by trades shall be cleaned or replaced.

K. Duct Smoke Detector: Furnish, wire, and connect to fire alarm system in accordance with this Specification. Installed in accordance with Section 23 09 00, HVAC Controls, Field Components, and Instruments.

L. HVAC Equipment: Wire and connect fire alarm system to air handling system.

3.03 RADIO ALARM TRANSMITTER (RAT)

A. Installation shall be in strict accordance with manufacturer's recommended practices, product listings or approvals, NFPA 70, NFPA 72, and NFPA 1221. Ground transceiver and antenna to a driven ground rod and facility electrical ground system. Do not provide a separate ground rod. Mount transceiver adjacent to fire alarm panel. Supply power to transceiver through a line voltage surge suppressor as shown.

B. The Monaco BT2-7 transceiver frequency shall be determined by City. City personnel will be responsible for programming head end equipment.

3.04 CONDUIT

A. Requirements apply to fire alarm system conduits, electrical enclosures, terminal cabinets, junction boxes, pullboxes, and device backboxes.

B. Conduit systems shall be dedicated to fire alarm system and shall contain no unrelated conductors.

C. Fire alarm system conduits shall be of sizes and types specified under Section 26 05 33, Raceway and Boxes.

1. Conduit shall be as identified under Section 26 05 33, Raceway and Boxes. Flexible metallic conduit may be used for whips to devices only, maximum length 6 feet, 3/4-inch diameter minimum. Set screw type couplings or connectors are specifically prohibited.

2. Size conduits according to conductors contained therein. Cross sectional area percentage fill for fire alarm system conduits shall not exceed 40 percent.

D. Route and install conduit to minimize potential for physical damage, either mechanical or by fire, and so as not to interfere with existing building systems, facilities or equipment, and to facilitate service and minimize maintenance. Coordinate installation between different trades to avoid conflicts.

1. Conduit, except flexible conduit whips to devices, shall be solidly attached to building structural members or permanent walls. Conduit shall not be attached to existing conduit, ductwork, cable trays, other ceiling equipment, drop ceiling hangers/grids or partition walls, except where necessary to connect to initiating, evacuation signaling or auxiliary function devices.
2. Conduit shall be routed either parallel or perpendicular to building structural members.
3. Conduit shall be installed at a height so as not to obstruct any portion of a window, doorway cable tray, stairway or a passageway, and shall not interfere with operation of existing mechanical or electrical equipment.
4. Conduit, junction boxes, pull boxes, terminal cabinets, electrical enclosures and device backboxes shall be readily accessible for inspection, testing, service and maintenance.
5. Conduits shall be arranged to minimize the possibility of water in those conduits draining through control panels.
    a. Conduit, except nipples between control panels shall be arranged to enter control cabinets from below.
    b. Conduit shall be provided with three, 1/4-inch drain holes at horizontal low point beneath each control cabinet.
6. Bushings shall be provided at termination of conduit, prior to installation of wire.
7. Install junction boxes as necessary. Conductors shall be pulled through junction boxes, without splices.
8. Pullboxes shall be installed in each conduit at intervals not to exceed 100 feet. Pullboxes shall be 4-inch square, minimum.
9. Device backboxes and junction boxes shall be sized to accommodate number of conductors contained. Extension rings or extension boxes are prohibited.
10. Junction boxes, pull boxes, terminal cabinets, device backboxes, and raceways shall be gasketed and weather-tight per requirements of Section 26 05 33, Raceway and Boxes.

E. Conduit, junction boxes, panels, electrical enclosures, relays and device backboxes shall be exposed in unfinished areas. Conduit and device backboxes shall be concealed in walls, ceiling spaces, electrical shafts or closets, in finished areas, except as noted on Drawings. Exposed conduit penetrations of walls shall be provided with escutcheon plates on either side of the wall.

F. Conduit penetrations of walls, floors and ceilings shall be sealed around conduit(s) in accordance with Section 07 92 00, Joint Sealants, restoring walls, floors and ceilings to their original condition, fire resistance and integrity.

G. Pull boxes, junction boxes, conduit bodies, and terminal cabinets shall be painted “fire engine red” prior to installation. Provide touch-up painting, of normally visible pull boxes, junction boxes, and terminal cabinets prior to final acceptance testing.

H. Conduit shall be grounded by approved ground clamps, and per NEC requirements.

I. Mount end-of-line resistors on terminal blocks.

J. Detection and alarm wire shall be installed in separate conduits. Outgoing and return conductors for each supervised circuit shall be routed in separately as required by NFPA 72. The minimum separation of outgoing and return conduits shall be 1 foot vertically and 4 feet horizontally.

3.05 IDENTIFICATION

A. Junction, terminal, and pulling box covers shall be painted red and identified with engraved labels by zone and circuit that it contains.

B. Detection and terminal devices shall have engraved alphanumeric identification that shall be keyed to posted operations and maintenance instructions.

3.06 CONDUCTORS

A. Requirements apply to fire alarm system conductors, including all signaling line, initiating device, indicating appliance, releasing function, remote signaling, ac and dc power and grounding/shield drain circuits.

B. Conductors shall be:

1. New; wire that has scrapes, nicks, gouges or crushed insulation shall not be used.

2. Installed in conduit.
3. Continuous between devices and between devices and intermediary terminal cabinets.
4. Low voltage conductors shall be minimum size No. 14 AWG. Smaller conductors shall only be permitted where part of a manufacturer's specific communications cable, i.e. addressable system.
5. In accordance with requirements of NEC, Article 760 for nonpower limited service.

C. Splices in conductors are specifically prohibited.

D. Types:

1. Conductors, except ac power conductors and grounding conductors, shall be solid copper or bunch tinned (bonded) stranded copper.
2. Stranded copper conductors are acceptable for ac power conductors and grounding conductors only.

E. Terminations, including field connections to supervisory resistors, diodes, relays or other devices shall be to numbered terminals or terminal strips and readily accessible for inspection, service, testing and maintenance.

1. Terminations shall be within junction boxes, device backboxes, terminal cabinets, control panels or other suitable metal enclosures.
2. Terminals and terminal strips shall be suitable for the size and number of conductors connected to them.
3. Each conductor termination shall be uniquely numbered with durable plastic tags or uniquely identifiable by a combination of numbers and color codes. These conductor numbers shall be shown on Contractor's Record Drawings (floor plans and detailed wiring diagrams) in a manner allowing ready identification of conductor terminations.
4. Wire nuts are prohibited.
5. Where pigtail devices are factory provided with wires too short to be connected to terminal strips (i.e., solenoids), such connections shall be soldered and taped.

F. Control Panel Wiring:

1. Fully dressed and bundled with nylon tie wraps at 3-inch intervals.
2. Bundled wiring shall be routed parallel to terminal strips within control panels, with individual conductors turned out at 90 degree angles to their associated terminal connections.
3. AC power conductors shall be bundled and routed separately from low voltage conductors. A minimum 2-inch separation shall be maintained

between ac power conductors and low voltage conductors wherever possible.

4. Control cabinets shall be sized to accommodate the requirements of this Section.
5. Control panels shall not be used as raceways. Conductors that do not terminate within a control panel shall not be routed through that control panel.

G. Conductors shall be separated into the following categories:

1. Low voltage circuits that serve devices.
2. ac power circuits.

H. Each category of conductors shall be installed in physically separated, dedicated conduits, and shall not interface with one another, except at common associated control equipment. Conductors shall be further segregated as necessary to conform to fire alarm system manufacturer's recommendations and as necessary to prevent electrical crosstalk between conductors installed in common conduits.

I. Wiring shall be THHN or TFFN stranded. Use of multi-conductor twisted pair or similar wiring is not permitted.

J. Install as nonpower limited circuits in accordance with NFPA 72, and NEC, Article 760.

K. Conductors looped around terminals are prohibited.

L. Wire nut splices are prohibited.

M. T-tapping of circuits is prohibited.

N. Circuits shall be megger tested to voltage rating of their insulation before final terminations are made.

3.07 OVERVOLTAGE AND SURGE PROTECTION

A. Install TVSS for fire alarm control panel and radio alarm transmitter per manufacturer's requirements.

3.08 REPAIR/RESTORATION

A. Touch up scratches, mars, and dents, incurred during shipment or installation of equipment.

B. If required because of extensive damage, as determined by Engineer, refinish entire assembly.

C. Keep covers on smoke detectors until areas have been thoroughly cleaned.

3.09 TESTS AND INSPECTION

A. In accordance with Section 01 91 14, Equipment Testing and Facility Startup, and NFPA 72.

B. Demonstrate entire system meets performance requirements specified in Article System Description.

C. Perform tests in presence of code-enforcement authorities, Owner and Engineer.

D. Each smoke detector shall be individually field tested prior to installing device at its designated location to ensure reliability after shipment and storage conditions. A dated log indicating system address, type of device, sensitivity and initials of technician performing test, using test equipment specifically designed for that purpose, shall be prepared and kept for final acceptance documentation. After testing detection devices, base shall be labeled with system address, date, and initials of installing technician. Labeling shall not be visible after installation is complete.

E. Test wiring runs for continuity, short circuits, and grounds before system is energized. Resistance, current, and voltage readings shall be made as work progresses.

1. Systematic record shall be maintained of all readings using schedules or charts of tests and measurements. Areas shall be provided on logging form for readings, dates, and witnesses.
2. Notify Fire Marshal and Owner before start of any required tests. Correct items found at variance with Drawings or Specification during testing or inspection.
3. Deliver test reports to Fire Marshal and Owner as completed.

F. Prepare final as-built Sequence of Operations Matrix referencing each alarm input to every output function affected as a result of an alarm, trouble, or supervisory condition on that. In case of outputs programmed using more complex logic functions involving “any”, “or”, “not”, “count”, “time”, and “timer” statements; complete output equation shall be referenced in matrix.

G. Prepare complete listing of device labels for alphanumeric annunciator displays prior to acceptance test.

1. Test system wiring to demonstrate correct system response and correct subsequent system operation in event of:
    a. Open, shorted, and grounded intelligent analog signaling line circuit.
    b. Open, shorted, and grounded network signaling line circuit.
    c. Open, shorted, and grounded conventional initiating device circuits.
    d. Primary power or battery disconnected.
    e. Intelligent device removal.
    f. Incorrect device address.
2. Demonstrate system evacuation alarm indicating appliances as follows:
    a. Alarm notification appliances actuate as programmed.
    b. Audibility and visibility at required levels.
3. System indications shall be demonstrated as follows:
    a. Correct message display for each alarm input at control panel.
    b. Correct annunciator light for each alarm input.
4. Demonstrate system onsite and offsite reporting functions as follows:
    a. Correct alarm custom message display, address, device type, date and time transmitted, for each alarm input.
    b. Correct trouble custom message display, address, device type, date and time transmitted, for each alarm input.
    c. Trouble signals received for disconnect.
5. Secondary power capabilities shall be demonstrated as follows:
    a. Disconnect system primary power for a period of time as specified herein; at end of period, alarm condition shall be created and system shall perform as specified for period as specified.
    b. Restore system primary power for 48 hours and system-charging current shall be normal trickle charge for fully charged battery bank.
    c. Check system battery voltages and charging currents at fire alarm control panel using test codes and LCD displays

H. In the event system fails to perform as specified and programmed during acceptance test, test shall be terminated at discretion of acceptance inspector.

1. Retest system, correcting deficiencies and providing test documentation to acceptance inspector.
2. In event that software changes are required during acceptance test, system manufacturer to compare edited program with original and shall furnish utility program. Utility shall yield printed list of changes and system functions, inputs and outputs affected by changes. Items listed by program shall be minimum acceptable to be retested before calling for resumption of acceptance test. Submit printed list and printer log of retesting before scheduling of acceptance test.

3. Acceptance inspector may elect to require complete acceptance test to be performed again if, in their opinion, modifications to system hardware or software warrant complete retesting.

I. Upon completion of tests, complete and provide the following:

1. NFPA 72, Record of Completion, and Inspection and Testing Form.
2. Certification that final system meets UL.

3.10 MANUFACTURER'S SERVICES

A. Furnish manufacturer's representative in accordance with Section 01 43 33, Manufacturers' Field Services, for the following services at site or classroom as designated by Owner, for minimum person-days listed below, travel time excluded:

1. One person-day for installation assistance and inspection.
2. One person-day for functional and performance testing.
3. One person-days for prestartup classroom or site training.

END OF SECTION

HDPE LINER

Section 33 05 00

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: This specification incudes the requirements for production, installation, and testing of HDPE liner.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. D7240 - Standard Practice for Electrical Leak Location Using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive-Backed Geomembrane Spark Test)
   2. D7853 - Standard Test Method for Hydraulic Pullout Resistance of a Geomembrane with Locking Extensions Embedded in Concrete

B. International Organization for Standardization (ISO):
   1. 527 – Plastics – Determination of tensile properties.
   2. 1133 – Plastics – Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) f thermoplastics.
   3. 1183 – Plastics – Methods for determining the density of non-cellular plastics.

1.03 PERFORMANCE REQUIREMENTS

A. Plastic liner:
   1. Impermeable to sewage gases and liquids.
   2. Nonconductive to bacterial and fungus growth.
   3. Flexible.
   4. Attached to concrete by liner manufacturer selected extruded locking mechanism.
   5. Withstand 30 pounds per square inch back hydrostatic pressure applied to liners under surface without losing anchorage and without rupture and leakage.

1.04 SUBMITTALS

A. General: Submit as specified in bid document requirements

1.05 QUALITY ASSURANCE

A. Qualifications of welders:
   1. Welder and Weld Inspector shall be certified by the liner manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Field sheets:
   1. Material: High Density Poly Ethylene (HDPE).
   2. Thickness: Minimum of 1.65 mm.
   3. Manufactured from inert products combined with synthetic resins, pigments, and plasticizers.
   4. Color: PE yellow RAL 1018.

B. Performance characteristics:
   1. Chemical resistance: Resistant to oxidizing agents; sulfuric, phosphoric, nitric, chromic, oleic, and stearic acids; sodium and calcium hydroxides; ammonia, sodium, calcium, magnesium, and ferric chlorides; ferric sulfate, petroleum oils and greases; vegetable and animal oils, fats, greases, and soaps.
   2. Permeability to sewer gases and liquids: None.
   3. Conductivity to bacterial and fungus growth: None.
   4. Material Properties:

	Property	Standard	Unit	Product
	Specific density at 23 degrees C	ISO 1183	g/cm^3	0.94-0.96
	Melt Flow rate MFR 190/5	ISO 1133	g/10min	1.6-2.0
Mechanical Properties	Tensile stress at yield	ISO 527	MPa	≥ 12
	Elongation at yield	ISO 527	%	≥ 8
	Elongation at break	ISO 527	%	> 400
	Modulus of elasticity	ISO 527	%	≥ 620
System Properties	Pull out resistance at 23 degrees Celsius Tensile Test 5mm/min (short term)	DIN ISO 4624	N/Stud kN/m^2	≥ 500* 854
	Anchor stud arrangement	-	$Studs/m^2$	~1709 central section ~2324 edge section
	Backpressure Resistance at 23 degree Celsius	DIBt-Pruefmethode	1.5 bar/1000h	Fulfilled
	Max. Working Temperature	-	Degrees Celsius	60
	Linear coefficient of thermal expansion	DIN 53752	$K^{-1} \times 10^{-4}$	1.8**

	Flammability	UL 94 DIN 4102 EN 13501	-	94-HB B2 Class E
Other Properties	UV Stabilized	-	-	3 year Central Europe 15 month South-western Asia
	Color	-	-	yellow

* Pull-out test was carried out with self-compacting concrete.
** guide value.

5. Back pressure resistance per ASTM D7853: Minimum 30 pounds per square inch for 200 hours without losing anchorage of liner anchors or rupturing of liner without need of bonding adhesive or adhesive bond of self-consolidated concrete.

C. Joint welding strips: Polyester backed HDPE sheet, minimum thickness 3.0 mm.

D. Liner patches: Polyester backed HDPE sheet, minimum thickness 3.0 mm.

E. Liner adhesive: Construction grade, two part adhesive epoxy.

2.02 FABRICATION

A. Integrally mold with heat and pressure or extrude liner studs/anchors on back of liner, capable of providing stability under anticipated loads including loads imposed by steel bands and wires used to secure liner to forms.

2.03 SOURCE QUALITY CONTROL

A. Reject liners, including liner anchors, joint strips, corner strips, and welding strips, that have cracks, cleavages, and other defects that adversely affect the protective characteristics of liners.

B. Check liners electrically per ASTM D7240 to determine presence of porosity or pin holes.
1. Reject liners with porosity or pinholes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install per manufacturer's recommendations.

3.02 PLASTIC LINER REPAIRS

A. Patch liner defects in accordance with liner manufacturer's instructions.

B. Patch small defects, such as nails, form tie holes, and small repairs and abraded areas, by fusing welding strips over defects to liner.

C. Patch larger defects by adhering smooth liner patches over defects, plus minimum 1-inch around defects, to liner with adhesive, centering welding strips over edges of patches, and fusing welding strips to liner and patches.

3.03 FIELD QUALITY CONTROL AND TESTING

A. Provide equipment required to test liner in accordance with manufacturer's instructions and ASTM D7240

END OF SECTION

HDPE LINED REINFORCED CONCRETE PIPE FOR JACKING AND TUNNELING

Section 33 05 01.10

PART 1 GENERAL

1.01 SUMMARY

A. This specification incudes the requirements for production, installation, and testing HDPE Lined Concrete Pipe.

1.02 REFERENCES

ASTM International

- ASTM C76/C76M – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
- ASTM C361 – Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
- ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- ASTM C497 – Standard Test Methods for Concrete Pipe, Concrete Box Sections, Manhole Sections, or Tile
- ASTM C1619 – Standard Specification for Elastomeric Seals for Joining Concrete Structures.
- ASTM D7240 – Standard Practice for Electrical Leak Location Using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive-Backed Geomembrane Spark Test)

OTHER STANDARDS

- HDPE Liner Specification, Section 33 05 00
- NPCA (National Precast Concrete Association) Quality Control Manual

1.03 SUBMITTALS

A. All shop drawings will be submitted for approval prior to any production. Drawings will include details showing all pipe dimensions, reinforcing requirements, gasket details, and any lifting requirements needed.

B. Submittals shall include complete calculations needed for jacking and tunneling.

C. All material data sheets, and sourcing will be submitted for approval before production.

1.04 QUALITY ASSURANCE/QUALITY CONTROL (QAQC)

A. Producers must be certified by the NPCA (National Precast Concrete Association) Quality Control Program. Producer must be certified prior to, and during production of all pipe.

B. All quality control testing will be kept on file and easily accessible upon request. Test reports and inspections will be stored and maintained for a minimum 3 years.

PART 2 PRODUCT

2.01 MATERIALS

A. All materials used will be pre-approved and documented.

B. HDPE liner
   1. HDPE liner material shall have a manufactures certificate of compliance meeting applicable ASTM standards. All certifications will be kept on file per section 1.04.
   2. Liner material shall be HDPE (High-Density Polyethylene) concrete liner material with a minimum thickness of 1.65 mm.
   3. Liner material shall meet requirements of the HDPE Liner Specification

C. Concrete pipe materials
   1. All materials shall have manufactures certificate of compliance meeting applicable ASTM standards. All certifications will be kept on file per section 1.04.

D. All materials used to produce the HDPE Lined Concrete Pipe shall meet the requirements of ASTM C76/C76M
   1. Cementitious Materials – Section 6.2
   2. Aggregates – Section 6.3
   3. Admixtures – Section 6.4
   4. Steel Reinforcement – Section 6.5
   5. Water – Section 6.7

E. Concrete pipe joints
   1. All joint materials, including HDPE weld strips, rubber gaskets, and steel bell bands shall have product certifications. All certifications will be kept on file per section 1.04.
   2. HDPE weld strips shall meet the requirements of the HDPE Liner Specification.
   3. Rubber gaskets will be O-Ring Gaskets meeting ASTM C1619.
   4. Steel bell bands will meet the requirements of ASTM C361 section 6.6.

2.02 MANUFACTURE

A. All products will be manufactured with dedicated forming. Documentation of production dates and details will be kept on file.

B. The pipe shall be manufactured using the vertically cast method (wet-cast) between stationary inner and outer metal forms. The concrete shall be transported and placed by methods that shall prevent the separation of the concrete materials and the displacement of reinforcement steel in the forms.

C. Curing shall be performed as specified in ASTM C76/76M Section 10.2

D. Liner shall be cast at the top 330 degrees throughout the pipe interior, leaving the bottom 30 degrees of concrete pipe exposed at the invert.

E. Approved manufacturer – Geneva Pipe and Precast

2.03 DIMENSIONS

A. Permissible Variations - All pipe tolerances will meet the requirements of ASTM C76/76M.
   1. Internal Diameter – Section 12.1
   2. Wall Thickness – Section 12.2
   3. Length of Two Opposite Sides – Section 12.3
   4. Length of Pipe – Section 12.4
   5. Position or Area of Reinforcement – Section 12.5

B. Pipe Deficiencies - HDPE Lined Pipe that does not meet all specifications will be labeled as “Approval Needed”. Producer may repair imperfections with an approved submittal outlining the process and procedures to repair the product. If product does not meet requirements and cannot be repaired, it will be labeled as “Non-Compliant” and separated from the other approved products.

2.04 TESTING

A. All sampling, testing, and inspection will be documented and saved according to section 1.04.

B. All concrete sampling and testing will meet ASTM C76 sections 11.4-11.8

C. All product will have a pre-pour and post-pour inspection. These inspections will meet the requirements of ASTM C76 and NPCA Quality Control Manual. Documentation will be in accordance with section 1.04. At a minimum, the following items will be checked and documented:
   1. Pre-Pour
      a. Forming
         1) Cleanliness
         2) Smoothness
         3) Geometry
      b. Reinforcing Cage

1) Geometry
2) Area of Steel

c. Liner
1) Defects
2) Geometry

2. Post-Pour
a. Concrete Quality
b. Geometry
c. Liner

D. All HDPE Liner welded joints will be testing in accordance with ASTM D7240

E. Concrete Pipe
1. Joint testing will be completed using ASTM C497 to meet the requirements of ASTM C443. Joint testing will be completed using the same cushioning type material as used during the Jacking/Tunneling process. One joint per size and per class of pipe will be tested.
2. Concrete Three-Edge Bearing D-Load Testing will be completed using ASTM C497. Concrete Pipe to be tested will not have liner installed in the tested sections for more accurate crack evaluation. The frequency of the testing will be in accordance with the NPCA Quality Control Manual. Daily concrete sampling and testing will also be required per section 4.02.

PART 3 EXECUTION

3.01 GENERAL

A. All lined HDPE Concrete Pipe will be handled, stored, and installed per manufactures recommendations. Extra care will be taken to insure product is not damaged.

3.02 JACKING/TUNNELING PROCESS

A. Concrete Pipe jacking/tunneling processes will be approved by the manufacturer. Items of concern are total jacking forces, alignment of jacking/tunneling, and any other special conditions that would put loading on the pipe.

3.03 FIELD TESTS

A. All lined HDPE Concrete Jacked/Tunneled Pipe will be required to have field welded joints. Welds will be completed by an approved certified welder from the liner manufacturer. All welds will be spark tested per ASTM D7240.

B. Infiltration/Exfiltration Test: Maximum allowable leakage shall be per local specification requirements.

C. Individual Joint Testing: For pipes large enough to enter, individual joints may be pressure tested with a portable tester to 5 psi maximum with air or water in lieu of line infiltration/exfiltration or air testing.

City of San Diego

CITY CONTACT: Stephen Samara, Principal Contract Specialist, Email: SSamara@sandiego.gov
Phone No. (619) 533-3619

ADDENDUM D

e - Bidding

FOR

MORENA PUMP STATION

BID NO.: K-21-1801-DBB-3-A
SAP NO. (WBS/IO/CC): B-15141
CLIENT DEPARTMENT: 2000
COUNCIL DISTRICT: 2, 7
PROJECT TYPE: KA, BP

BID DUE DATE:

2:00 PM
JANUARY 13, 2021

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

http://www.sandiego.gov/cip/bidopps/index.shtml

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:

Shapiro, Alan

Digitally signed by Shapiro, Alan
DN: cn=Shapiro, Alan, ou=USSDG1
Reason: I have reviewed this document
Date: 2020.12.23 13:46:11 -08'00'

12/23/2020 Seal:

1) Registered Engineer (Morena Pump Station) Date

Nabil Batta

12/23/2020 Seal:

2) For City Engineer (Morena Pump Station) Date

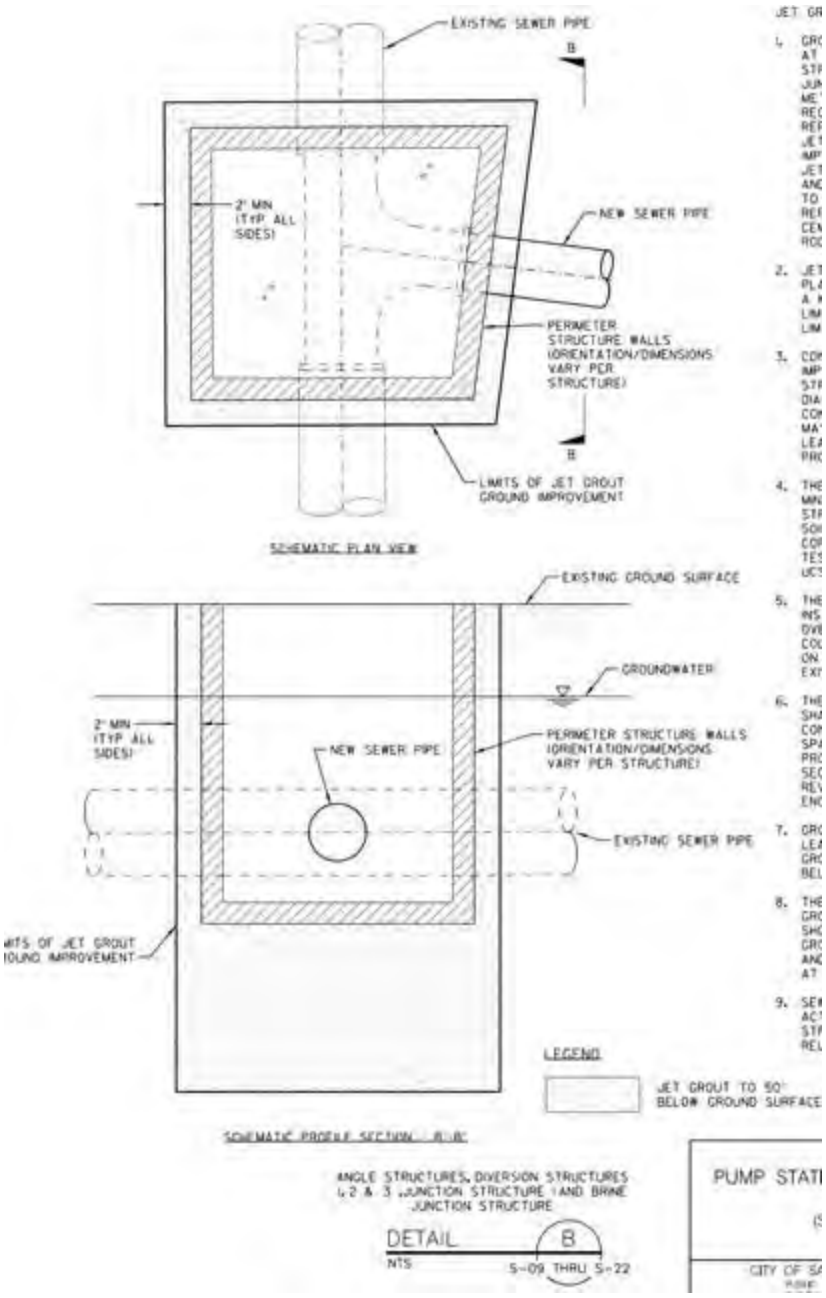
A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

B. THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN EXTENDED AS STATED ON THE COVER PAGE.

C. BIDDER's QUESTIONS

Q1. Reference Detail B on Drawing Sheet C-22: There is a 2' section of jet grout at the perimeter of the structure. Is the intent to use the 2' section as a form to which the structure will be poured? If so, this 2' section is not feasible as shown. Since the purpose of the jet grout is to stabilize the ground beneath the new structure, we suggest that the jet grout only be required from the structure subgrade to 50' below ground surface. Additionally, if the concern is to stabilize the subgrade beneath the structure and at the perimeter, a realistic option would be to backfill with concrete slurry. Please review and advise.



A1. The 2’ perimeter grout was intended to extend the ground improvement 2’ around the structure from the bottom of the structure footing to 50’ below the ground surface. The portion of the grout above the bottom of the structure footing was intended for potential shoring for the excavation to build the structure. The grout above the bottom of the structure footing is not required, but the contractor would be required to provide shoring for the excavation support.

Q2. Specification 01 91 14 – 3.13.G states an estimated quantity of 5760 hours has been allocated for maintenance personnel during Integration Period. Please confirm whether contractors should include this qty and cost in the bid, or if it is going to be paid out from an allowance?

A2. Contractor's operators shall be included in the Contract Price with an estimated 5760 hours. Note the Contractor will operate during startup and testing, until Substantial Completion.

Q3. Specification 01 91 14 – 3.13.A states "The project milestone for the commencement of the 120 Day Integration Period is 120 days after Intermediate Substantial Completion" and "A 120-Day time period commencing 120 days after the Intermediate Substantial Completion…" This would make the total duration after the Intermediate Substantial Completion to the end of the Integration Period, be 240 Days. Please clarify if the second "120 days" in each of those sentences is meant to be deleted as the duration as it is currently won't fit in the project schedule.

A3. Modify Statement in 01 91 14 - 3.313.A "The project milestone for the commencement of the 120 Day Integration Period is 60 days after Intermediete Substantial Completion." Please note that the days described in Section 01 91 14 are Calendar Days.

Q4. Specification 01 32 00 – 3.1.A provides time allowance for inclement weather. Should its successor be Intermediate Substantial Completion with 39 working days or Substantial Completion with 52 working days?

A4. The successor should be substantial completion with 52 working days.

Q5. 2.03.B.4 lists 10 inch flanges and 2.03.C.1 part number indicates 12 inch flanges. Drawing M-14 shows 12 inch flanges. 12 inch flanges are the correct design parameter.

A5. Flange size shall be 12-inch as shown on Drawing M-14.

Q6. Drawing M-13 shows a 16 inch magmeter on 16 inch pipe which seems to be adequate. Drawing I-16 indicates a 24 inch magmeter. Please verify the requirement for the 16 inch magmeter.

A6. Magnetic flow meter shall be 16-inch as shown on Drawing M-13.

Q7. Is the PLC control system provided by ECO2 under 44 47 00 subject to the requirements of section 40 99 90 Packaged Control Systems?

a. 44 47 00 Part 2.06.B.2.a specifies an Allen Bradley Micrologix PLC where 40 99 00 Part 2.06.A.1.a requires an Allen Bradley ControlLogix. ECO2 standard is Micrologix.

b. 44 47 00 Part 2.06.B.4.a calls out 304 stainless steel panels where 40 99 00 Part 2.05.D calls out 316 stainless steel panels.

A7. The High Purity Oxygen PLC Control System is subject to 40 99 90 Packaged Control Systems.

a. Allen Bradley Micrologix PLC is acceptable for the High Purity Oxygen System PLC.

b. The PLC control system is subject to the requirements of Section 40 99 90.

Q8. Can you confirm where the technical details are located in the specs for the 1/2 HP pump shown in plan C-06? It references drawing M-20 which refers to the specifications but we can't find any details in the specs.

A8. Pump shall be covered under Specification Section 43 42 56.04 Submersible Pumps except as follows:

- Pump design operating point is 85 gpm @ 23 feet of head, minimum efficiency of 40%.
- 3600 RPM 1-1/2 hp Motor.
- Pump shall be EBARA Submersible stainless steel pump model 50DWF(A)U61.1 or approved equal.

Q9. I'm trying to see if there's a way I can have our technology be considered for this project. I've attached our brochure for you to look over. Our small footprint units only need water and electrical hook ups to work. We use Hydroxyl Radicals as our oxidant to break the bonds of H2S and other odor compounds. We are also a great source for breaking up FOG and stopping Corrosion.

A9. Product will be reviewed as part of the Submittal process.

Q10. Bidding Documents, Certifications and Forms – List of Subcontractors and Named Equipment/ Material Supplier List (pages 2207 & 2208): Each of these lists state that if the Subcontractor or Supplier is a DBE, that the Bidder shall include a valid proof of certification. When is this proof certification to be submitted?

A10. Proof of certification is to be submitted with the Good Faith Effort (GFE) Documentation. Please refer to section 12.7.3 of the Notice of Inviting Bids for GFE submittal instructions.

Q11. For the 48" x 48" gates in Diversion Structures 1 & 2 (Dwngs C-11 and C-11A), the gate operators are shown below the chamber ceiling. The thickness of the chamber ceiling and height of electric operator are not called out. Will you please let us know the thickness of the chamber ceiling and desired height of electric operator?

A11. Electric operator maximum height is 22-inches above the frame, or 120 inches above the pipe invert. Diversion Structures 1&2 top slab arrangement including thickness and access panel thickness are shown on Drawings S-13, S-15 and S-17.

Q12. Keynote #3 on Drawing C-11A refers to 2 slide gates… one 48" x 48" slide gate in Diversion Structure #1 and one 48" x 48" slide gate in Diversion Structure #2. Are those two 48" x 48" gates are also intended to be non-rising stem gates, just as the 60" x 60" gate in Diversion Structure #1 and the 72" x 72" gate in Diversion Structure #2 are called out to be in Keynotes 6 and 7 on Sheet C-11A?

A12. Yes, Diversion Structure 1 and 2 - 48" x 48" slide gates are both non-rising stem.

Q13. Addendum B, question 12 response stated that horizontal construction joints beyond those shown are NOT allowable in pump station walls. This response incidentally eliminates any internally braced shoring systems from being used for the pump station excavation, which significantly increases shoring costs. The pump station excavation will have to be a tieback system without the allowance of an additional horizontal construction joint. Please note, there will be vertical construction joints in the pump station walls, so the addition of a

horizontal construction joint will not have an impact on the structure's performance. Please confirm additional horizontal construction joints will be allowable to accommodate an internally braced shoring systems as selected by the Contractor.

A13. The Answer to Question 12 of Addendum B shall be revised as follows: The addition of horizontal construction joints will be allowed. Contractor shall consider in the construction cost for these joints (including all waterstops and rebar couplers, etc.) that will be needed and the engineering cost by the design consultant to modify the drawings to include these joints and obtain City approval. Contractor shall provide the engineering for any portion of the new structure required to retain backfill loads prior to the construction of the permanent supports for said portions.

D. ADDENDUM

1. To Addendum A, Section D, Attachments, Item 1, FUNDING AGENCY PROVISIONS, (CASRF), (EPA), (CWSRF), (DWSRF), (WIFIA) PROP 68 and (BOR), item 10, DAVIS-BACON WAGE RATES AND PROVISIONS, Wage Rates, pages 28 through 57, **DELETE** in its entirety and **SUBSTITUTE** with pages 13 through 41 of this Addendum.

2. To Addendum B, Section B, Bidder's Questions, page 6, Q12 and A12, **DELETE** in their entirety and **SUBSTITUTE** with the following:

   Q12. The Pump Station Section Drawings show walls pouring full height from top of SOG to bottom of upper deck with exception to Wet Well walls that have a CJ shown at EL -20.50. In an effort to reduce wall pour heights is it possible to install a horizontal Construction Joint in the Pump Station Walls.

   A12. The addition of horizontal construction joints will be allowed. Contractor shall consider the construction cost for these joints (including all waterstops and rebar couplers, etc.) that will be needed and the engineering cost by the design consultant to modify the drawings to include these joints and obtain City approval. Contractor shall provide the engineering for any portion of the new structure required to retain backfill loads prior to the construction of the permanent supports for said portions.

3. To Addendum C, Section B, Bidder's Questions, page 11, Q32 and A32, **DELETE** in their entirety and **SUBSTITUTE** with the following:

   Q32. The project drawings call DIP piping to have Fusion Bonded Epoxy Lining and Coating (Key Notes 7/C03, 1/C08, 15/M-14, Details 1,2/M-16). Specification Section 09 90 00, Paragraph 3.7.B Coating and Lining for Steel and Ductile Iron Pipe, Fittings, Couplings, Adapters, and Valves provides specific requirements to such lining and coating. Although, per Spec Section 33 05 19, Paragraph 2.01.F.2, pipe and fittings shall be lined with 40-mil ceramic epoxy, as manufactured by Induron, or equal, and this section is silent on the matter of coating of ductile iron piping. Please clarify which provision applies to DIP lining and coating (buried, submerged, and exposed).

   A32. All ductile iron pipe and fittings shall be fusion bonded epoxy lined and coated and conform to the requirements of Section 09 90 00 Part 3.7 B

4. To Addendum C, Section B, Bidder's Questions, pages 20 and 21, Q61 and A61, **DELETE** in their entirety and **SUBSTITUTE** with the following:

   Q61. Paint spec section 09 90 00, Part 3.7B states that all buried and exposed above ground ductile iron piping, fittings, valves etc. shall be lined and coated with a fusion bonded epoxy system. However, section 33 05 19 Part 2.1F for Ductile Iron pipe states that pipe and fittings for clean water shall be cement mortar lined and asphaltic seal-coated. It then states that pipe and fittings are to be lined with 40 mil of ceramic epoxy. Please confirm whether the ductile iron pipe and fittings on the project are to be lined with fusion bonded epoxy system or with 40 mil of ceramic epoxy.

   A61. All ductile iron pipe and fittings shall be fusion bonded epoxy lined and coated and conform to the requirements of Section 09 90 00 Part 3.7 B.

5. To Addendum C, Section B, Bidder's Questions, page 21, Q63 and A63, **DELETE** in their entirety and **SUBSTITUTE** with the following:

   Q63 Drawing D-02 shows several overhead utilities to be relocated by others. Please provide information regarding timing and duration for this work.

   A63 Timing for relocation will occur per Section 5-6, Item 2 of the Supplementary Special Provisions. Item 2 is modified from the first 30 days of the Contract time to the first 83 days. To Section 2-14.3 **ADD**:

   h) AT&T Relocation for B15141 NC Morena Blvd. Pump Station and Pipeline (Sherman & Custer), Judith Villacruz-Brandt 858-886-1910.

6. To Addendum C, Section B, Bidder's Questions, pages 23 and 24, Q73 and A73, **DELETE** in their entirety and **SUBSTITUTE** with the following:

   Q73. Spec section 40 27 00 part 2.2B calls for the diameter of Cement-lined steel pipe to be determined by the lining inside diameter. Keynote callout 7 on Drawing M-8 calls for the overflow piping on top of the pump station roof to the wet well to be 24" CML&C. If this piping was actually required to be CML&C, it would need to have an OD of 27" to meet the ID required by the spec. It would have to be specially fabricated (rolled) since standard mill-manufactured steel piping does not come in this size. Please confirm whether this was the intent. Note that keynote callout 3 on drawing M-11 shows the same overflow piping as 24" welded steel FE pipe. Is this piping run to be CML&C or just welded steel FE piping without cement lining and coating?

   A73. Closest standard size pipe is acceptable. Pipe shall be CML and Paint coated with System 4 per Technical Section 09 90 00.

E. SUPPLEMENTARY SPECIAL PROVISIONS

1. To Section 2-14.3, COORDINATION, page 115, **ADD** the following:

   h) AT&T Relocation for B15141 NC Morena Blvd. Pump Station and Pipeline (Sherman & Custer), Judith Villacruz-Brandt (858) 886-1910.

2. To Section 5.6, COOPERATION, Item 2, page 128, **DELETE** in its entirety and **SUBSTITUTE** with the following:

   2. SDG&E will be relocating power poles on Sherman and Custer Streets during the first 83 days of the Contract time.

3. To Techicals, Section 01 91 14, Testing, Integration and Setup, Part 3, Execution, sub-section 3.13, Integration Testing Period, Item A, page 354, **DELETE** in its entirety and **SUBSTITUTE** with the following:

   A. 120-Day time period commencing 60 days after Intermediate Substantial Completion during which the overall Pure Water Program system will be tested and operated, including the Morena Conveyance, the NCWRP Expansion, NCPWF Influent Pump Station and Conveyance, NCPWF the Metropolitan Biosolids Center Improvements, the NCPW Pump Station and the NCPWPL, and Dechlorination Facilities. The project milestone for the commencement of the120 Day Integration Period is 60 days after Intermediate Substantial Completion. The overall logic of the 120-Day Integration Period is shown on Attachment 1 – Phase 1 Commissioning Model.

4. To Technicals, Section 44 47 28.26, ACTIVATED CARBON ODOR CONTROL SYSTEMS, Sub-section 1.7, QUALITY ASSURANCE, ITEM A, Qualifications, Sub-item 3, page 1974, **DELETE** in its entirey and **SUBSTITUTE** with the following:

   3. The odor control system supplier shall have complete, ongoing service capability with factory trained personnel. The supplier shall have a service center/manufacturing facility located in southern California within 200 miles of the jobsite for quick response. The service center/manufacturing facility shall be staffed with at least five (5) full- time employees of the odor

control system supplier. A manufacturer's sales representative office and sales representative personnel staffing shall not be acceptable. No exception to this requirement will be allowed.

James Nagelvoort, Director
Engineering & Capital Projects Department

Dated: *December 23, 2020*
San Diego, California

JN/JA/lir

WAGE RATES This contract shall be subject to the following Davis-Bacon Wage Decisions:

"General Decision Number: CA20200001 12/11/2020
Superseded General Decision Number: CA20190001
State: California

Construction Types: Building, Heavy (Heavy and Dredging), Highway and Residential

County: San Diego County in California.

BUILDING CONSTRUCTION PROJECTS; DREDGING PROJECTS (does not include hopper dredge work); HEAVY CONSTRUCTION PROJECTS (does not include water well drilling); HIGHWAY CONSTRUCTION PROJECTS; RESIDENTIAL CONSTRUCTION PROJECTS (consisting of single family homes and apartments up to and including 4 stories)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.80 for calendar year 2020 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.80 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2020. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate,if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2020
1	01/10/2020
2	01/31/2020
3	03/06/2020
4	04/17/2020
5	05/29/2020
6	06/05/2020
7	07/03/2020
8	07/17/2020
9	07/24/2020

Modification Number	Publication Date
10	07/31/2020
11	08/07/2020
12	08/14/2020
13	08/21/2020
14	08/28/2020
15	09/04/2020
16	09/25/2020
17	10/02/2020
18	10/09/2020
19	10/16/2020
20	10/23/2020
21	10/30/2020
22	12/04/2020
23	12/11/2020

ASBE0005-002 07/06/2020

	Rates	Fringes
Asbestos Workers/Insulator (Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems)	$ 45.39	23.74
Fire Stop Technician (Application of Firestopping Materials for wall openings and penetrations in walls, floors, ceilings and curtain walls)	$ 28.92	18.73

ASBE0005-004 07/01/2019

	Rates	Fringes
Asbestos Removal worker/hazardous material handler (Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing of all insulation materials from mechanical systems, whether they contain asbestos or not)	$ 20.63	12.17

BOIL0092-003 03/01/2018

	Rates	Fringes
BOILERMAKER	$ 44.07	33.52

* BRCA0004-008 11/01/2019

	Rates	Fringes
BRICKLAYER; MARBLE SETTER	$ 39.60	18.05

BRCA0018-004 06/01/2019

	Rates	Fringes
MARBLE FINISHER	$ 33.43	14.11
TILE FINISHER	$ 28.23	12.65
TILE LAYER	$ 40.07	18.36

BRCA0018-010 09/01/2020

	Rates	Fringes
TERRAZZO FINISHER	$ 33.66	14.20
TERRAZZO WORKER/SETTER	$ 41.60	14.73

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 CARP0409-002 07/01/2016

                                  Rates            Fringes
Diver
     (1) Wet.....................$ 712.48           17.03
     (2) Standby.................$ 356.24           17.03
     (3) Tender..................$ 348.24           17.03
     (4) Assistant Tender........$ 324.24           17.03

Amounts in ""Rates' column are per day
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 CARP0409-008 08/01/2010

                                  Rates            Fringes
Modular Furniture Installer......$ 17.00            7.41
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 CARP0547-001 07/01/2018

                                  Rates            Fringes
CARPENTER
     (1)  Bridge.................$ 42.34           19.17
     (2)  Commercial Building....$ 37.11           19.17
     (3)  Heavy & Highway........$ 42.21           19.17
     (4)  Residential Carpenter..$ 29.69           19.17
     (5)  Residential
     Insulation Installer........$ 18.00            8.16
MILLWRIGHT.......................$ 42.71           19.17
PILEDRIVERMAN....................$ 42.34           19.17
---------------------------------------------------------------
 CARP0547-002 07/01/2017

                                  Rates            Fringes
Drywall
     (1) Work on wood framed
     construction of single
     family residences,
     apartments or condominiums
     under four stories
      Drywall Installer/Lather...$ 22.95           18.85
      Drywall Stocker/Scrapper...$ 12.50           12.27
     (2) All other work
      Drywall Installer/Lather...$ 32.00           17.63
      Drywall Stocker/Scrapper...$ 12.50           12.27
---------------------------------------------------------------
 ELEC0569-001 06/01/2020

                                  Rates          Fringes
Electricians (Tunnel Work)
     Cable Splicer...............$ 51.38         3%+14.88
     Electrician.................$ 50.63         3%+14.88
Electricians: (All Other
Work, Including 4 Stories
Residential)
     Cable Splicer...............$ 45.75         3%+14.88
     Electrician.................$ 45.00         3%+14.88
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ELEC0569-004 06/01/2020

	Rates	Fringes
ELECTRICIAN (Sound & Communications Sound Technician)	$ 33.95	13.55

SCOPE OF WORK Assembly, installation, operation, service and maintenance of components or systems as used in closed circuit television, amplified master television distribution, CATV on private property, intercommunication, burglar alarm, fire alarm, life support and all security alarms, private and public telephone and related telephone interconnect, public address, paging, audio, language, electronic, background music system less than line voltage or any system acceptable for class two wiring for private, commercial, or industrial use furnished by leased wire, freuency modulation or other recording devices, electrical apparatus by means of which electricity is applied to the amplification, transmission, transference, recording or reproduction of voice, music, sound, impulses and video. Excluded from this Scope of Work - transmission, service and maintenance of background music. All of the above shall include the installation and transmission over fiber optics.

ELEC0569-005 06/01/2020

	Rates	Fringes
Sound & Communications Sound Technician	$ 33.95	13.55

SCOPE OF WORK Assembly, installation, operation, service and maintenance of components or systems as used in closed circuit television, amplified master television distribution, CATV on private property, intercommunication, burglar alarm, fire alarm, life support and all security alarms, private and public telephone and related telephone interconnect, public address, paging, audio, language, electronic, background music system less than line voltage or any system acceptable for class two wiring for private, commercial, or industrial use furnished by leased wire, freuency modulation or other recording devices, electrical apparatus by means of which electricity is applied to the amplification, transmission, transference, recording or reproduction of voice, music, sound, impulses and video. Excluded from this Scope of Work - transmission, service and maintenance of background music. All of the above shall include the installation and transmission over fiber optics.

SOUND TECHNICIAN: Terminating, operating and performing final check-out

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* ELEC0569-006 10/01/2020

Work on street lighting; traffic signals; and underground systems and/or established easements outside of buildings

	Rates	Fringes
Traffic signal, street light and underground work		
Utility Technician #1	$ 33.42	3%+7.70
Utility Technician #2	$ 27.85	3%+7.70

STREET LIGHT & TRAFFIC SIGNAL WORK:

UTILITY TECHNICIAN #1: Installation of street lights and traffic signals, including electrical circuitry, programmable controller, pedestal-mounted electrical meter enclosures and laying of pre-assembled cable in ducts. The layout of electrical systems and communication installation including proper position of trench depths, and radius at duct banks, location for manholes, street lights and traffic signals.

UTILITY TECHNICIAN #2: Distribution of material at jobsite, installation of underground ducts for electrical, telephone, cable TV land communication systems. The setting, leveling, grounding and racking of precast manholes, handholes and transformer pads.

ELEC0569-008 08/31/2020

	Rates	Fringes
ELECTRICIAN (Residential, 1-3 Stories)	$ 35.74	7.68

ELEC1245-001 06/01/2020

	Rates	Fringes
LINE CONSTRUCTION		
(1) Lineman; Cable splicer	$ 59.14	20.78
(2) Equipment specialist (operates crawler tractors, commercial motor vehicles, backhoes, trenchers, cranes (50 tons and below), overhead & underground distribution line equipment)	$ 47.24	19.59
(3) Groundman	$ 36.12	19.19
(4) Powderman	$ 51.87	18.79

HOLIDAYS: New Year's Day, M.L. King Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day and day after Thanksgiving, Christmas Day

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ELEV0018-001 01/01/2020

	Rates	Fringes
ELEVATOR MECHANIC	$ 57.40	34.765+a+b

FOOTNOTE:
  a. PAID VACATION: Employer contributes 8% of regular hourly rate as vacation pay credit for employees with more than 5 years of service, and 6% for 6 months to 5 years of service.
  b. PAID HOLIDAYS: New Years Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Friday after Thanksgiving, and Christmas Day.

ENGI0012-003 07/01/2020

	Rates	Fringes
OPERATOR: Power Equipment (All Other Work)		
GROUP 1	$ 48.25	27.20
GROUP 2	$ 49.03	27.20
GROUP 3	$ 49.32	27.20
GROUP 4	$ 50.81	27.20
GROUP 5	$ 48.96	25.25
GROUP 6	$ 51.03	27.20
GROUP 8	$ 51.14	27.20
GROUP 9	$ 49.29	25.25
GROUP 10	$ 51.26	27.20
GROUP 11	$ 49.41	25.25
GROUP 12	$ 51.43	27.20
GROUP 13	$ 51.53	27.20
GROUP 14	$ 51.56	27.20
GROUP 15	$ 51.64	27.20
GROUP 16	$ 51.76	27.20
GROUP 17	$ 51.93	27.20
GROUP 18	$ 52.03	27.20
GROUP 19	$ 52.14	27.20
GROUP 20	$ 52.26	27.20
GROUP 21	$ 52.43	27.20
GROUP 22	$ 52.53	27.20
GROUP 23	$ 52.64	27.20
GROUP 24	$ 52.76	27.20
GROUP 25	$ 52.93	27.20
OPERATOR: Power Equipment (Cranes, Piledriving & Hoisting)		
GROUP 1	$ 49.60	27.20
GROUP 2	$ 50.38	27.20
GROUP 3	$ 50.67	27.20
GROUP 4	$ 50.81	27.20
GROUP 5	$ 51.03	27.20
GROUP 6	$ 51.14	27.20
GROUP 7	$ 51.26	27.20
GROUP 8	$ 51.43	27.20
GROUP 9	$ 51.60	27.20
GROUP 10	$ 52.60	27.20
GROUP 11	$ 53.60	27.20
GROUP 12	$ 54.60	27.20
GROUP 13	$ 55.60	27.20

	Rates	Fringes
OPERATOR: Power Equipment (Tunnel Work)		
GROUP 1	$ 50.10	27.20
GROUP 2	$ 50.88	27.20
GROUP 3	$ 51.17	27.20
GROUP 4	$ 51.31	27.20
GROUP 5	$ 51.53	27.20
GROUP 6	$ 51.64	27.20
GROUP 7	$ 51.76	27.20

PREMIUM PAY:

$3.75 per hour shall be paid on all Power Equipment Operator work on the followng Military Bases: China Lake Naval Reserve, Vandenberg AFB, Point Arguello, Seely Naval Base, Fort Irwin, Nebo Annex Marine Base, Marine Corp Logistics Base Yermo, Edwards AFB, 29 Palms Marine Base and Camp Pendleton

Workers required to suit up and work in a hazardous material environment: $2.00 per hour additional. Combination mixer and compressor operator on gunite work shall be classified as a concrete mobile mixer operator.

SEE ZONE DEFINITIONS AFTER CLASSIFICATIONS

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Bargeman; Brakeman; Compressor operator; Ditch Witch, with seat or similar type equipment; Elevator operator-inside; Engineer Oiler; Forklift operator (includes loed, lull or similar types under 5 tons; Generator operator; Generator, pump or compressor plant operator; Pump operator; Signalman; Switchman

GROUP 2: Asphalt-rubber plant operator (nurse tank operator); Concrete mixer operator-skip type; Conveyor operator; Fireman; Forklift operator (includes loed, lull or similar types over 5 tons; Hydrostatic pump operator; oiler crusher (asphalt or concrete plant); Petromat laydown machine; PJU side dum jack; Screening and conveyor machine operator (or similar types); Skiploader (wheel type up to 3/4 yd. without attachment); Tar pot fireman; Temporary heating plant operator; Trenching machine oiler

GROUP 3: Asphalt-rubber blend operator; Bobcat or similar type (Skid steer); Equipment greaser (rack); Ford Ferguson (with dragtype attachments); Helicopter radioman (ground); Stationary pipe wrapping and cleaning machine operator

GROUP 4: Asphalt plant fireman; Backhoe operator (mini-max or similar type); Boring machine operator; Boxman or mixerman (asphalt or concrete); Chip spreading machine operator; Concrete cleaning decontamination machine operator; Concrete Pump Operator (small portable); Drilling machine operator, small auger types (Texoma super economatic or similar types - Hughes 100 or 200 or similar types -

drilling depth of 30' maximum); Equipment greaser (grease truck); Guard rail post driver operator; Highline cableway signalman; Hydra-hammer-aero stomper; Micro Tunneling (above ground tunnel); Power concrete curing machine operator; Power concrete saw operator; Power-driven jumbo form setter operator; Power sweeper operator; Rock Wheel Saw/Trencher; Roller operator (compacting); Screed operator (asphalt or concrete); Trenching machine operator (up to 6 ft.); Vacuum or much truck

GROUP 5: Equipment Greaser (Grease Truck/Multi Shift).

GROUP 6: Articulating material hauler; Asphalt plant engineer; Batch plant operator; Bit sharpener; Concrete joint machine operator (canal and similar type); Concrete planer operator; Dandy digger; Deck engine operator; Derrickman (oilfield type); Drilling machine operator, bucket or auger types (Calweld 100 bucket or similar types - Watson 1000 auger or similar types - Texoma 330, 500 or 600 auger or similar types - drilling depth of 45' maximum); Drilling machine operator; Hydrographic seeder machine operator (straw, pulp or seed), Jackson track maintainer, or similar type; Kalamazoo Switch tamper, or similar type; Machine tool operator; Maginnis internal full slab vibrator, Mechanical berm, curb or gutter(concrete or asphalt); Mechanical finisher operator (concrete, Clary-Johnson-Bidwell or similar); Micro tunnel system (below ground); Pavement breaker operator (truck mounted); Road oil mixing machine operator; Roller operator (asphalt or finish), rubber-tired earth moving equipment (single engine, up to and including 25 yds. struck); Self-propelled tar pipelining machine operator; Skiploader operator (crawler and wheel type, over 3/4 yd. and up to and including 1-1/2 yds.); Slip form pump operator (power driven hydraulic lifting device for concrete forms); Tractor operator-bulldozer, tamper-scraper (single engine, up to 100 h.p. flywheel and similar types, up to and including D-5 and similar types); Tugger hoist operator (1 drum); Ultra high pressure waterjet cutting tool system operator; Vacuum blasting machine operator

GROUP 8: Asphalt or concrete spreading operator (tamping or finishing); Asphalt paving machine operator (Barber Greene or similar type); Asphalt-rubber distribution operator; Backhoe operator (up to and including 3/4 yd.), small ford, Case or similar; Cast-in-place pipe laying machine operator; Combination mixer and compressor operator (gunite work); Compactor operator (self-propelled); Concrete mixer operator (paving); Crushing plant operator; Drill Doctor; Drilling machine operator, Bucket or auger types (Calweld 150 bucket or similar types - Watson 1500, 2000 2500 auger or similar types - Texoma 700, 800 auger or similar types - drilling depth of 60' maximum); Elevating grader operator; Grade checker; Gradall operator; Grouting machine operator; Heavy-duty repairman; Heavy equipment robotics operator; Kalamazoo balliste regulator or similar type; Kolman belt loader and similar type; Le Tourneau blob compactor or

similar type; Loader operator (Athey, Euclid, Sierra and similar types); Mobark Chipper or similar; Ozzie padder or similar types; P.C. slot saw; Pneumatic concrete placing machine operator (Hackley-Presswell or similar type); Pumpcrete gun operator; Rock Drill or similar types; Rotary drill operator (excluding caisson type); Rubber-tired earth-moving equipment operator (single engine, caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. up to and including 50 cu. yds. struck); Rubber-tired earth-moving equipment operator (multiple engine up to and including 25 yds. struck); Rubber-tired scraper operator (self-loading paddle wheel type-John Deere, 1040 and similar single unit); Self-propelled curb and gutter machine operator; Shuttle buggy; Skiploader operator (crawler and wheel type over 1-1/2 yds. up to and including 6-1/2 yds.); Soil remediation plant operator; Surface heaters and planer operator; Tractor compressor drill combination operator; Tractor operator (any type larger than D-5 - 100 flywheel h.p. and over, or similar-bulldozer, tamper, scraper and push tractor single engine); Tractor operator (boom attachments), Traveling pipe wrapping, cleaning and bendng machine operator; Trenching machine operator (over 6 ft. depth capacity, manufacturer's rating); trenching Machine with Road Miner attachment (over 6 ft depth capacity): Ultra high pressure waterjet cutting tool system mechanic; Water pull (compaction) operator

GROUP 9: Heavy Duty Repairman

GROUP 10: Drilling machine operator, Bucket or auger types (Calweld 200 B bucket or similar types-Watson 3000 or 5000 auger or similar types-Texoma 900 auger or similar types-drilling depth of 105' maximum); Dual drum mixer, dynamic compactor LDC350 (or similar types); Monorail locomotive operator (diesel, gas or electric); Motor patrol-blade operator (single engine); Multiple engine tractor operator (Euclid and similar type-except Quad 9 cat.); Rubber-tired earth-moving equipment operator (single engine, over 50 yds. struck); Pneumatic pipe ramming tool and similar types; Prestressed wrapping machine operator; Rubber-tired earth-moving equipment operator (single engine, over 50 yds. struck); Rubber tired earth moving equipment operator (multiple engine, Euclid, caterpillar and similar over 25 yds. and up to 50 yds. struck), Tower crane repairman; Tractor loader operator (crawler and wheel type over 6-1/2 yds.); Woods mixer operator (and similar Pugmill equipment)

GROUP 11: Heavy Duty Repairman - Welder Combination, Welder - Certified.

GROUP 12: Auto grader operator; Automatic slip form operator; Drilling machine operator, bucket or auger types (Calweld, auger 200 CA or similar types - Watson, auger 6000 or similar types - Hughes Super Duty, auger 200 or similar types - drilling depth of 175' maximum); Hoe ram or similar

with compressor; Mass excavator operator less tha 750 cu. yards; Mechanical finishing machine operator; Mobile form traveler operator; Motor patrol operator (multi-engine); Pipe mobile machine operator; Rubber-tired earth- moving equipment operator (multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck); Rubber-tired self- loading scraper operator (paddle-wheel-auger type self-loading - two (2) or more units)

GROUP 13: Rubber-tired earth-moving equipment operator operating equipment with push-pull system (single engine, up to and including 25 yds. struck)

GROUP 14: Canal liner operator; Canal trimmer operator; Remote- control earth-moving equipment operator (operating a second piece of equipment: $1.00 per hour additional); Wheel excavator operator (over 750 cu. yds.)

GROUP 15: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. and up to and including 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine-up to and including 25 yds. struck)

GROUP 16: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 17: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine, Euclid, Caterpillar and similar, over 50 cu. yds. struck); Tandem tractor operator (operating crawler type tractors in tandem - Quad 9 and similar type)

GROUP 18: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, up to and including 25 yds. struck)

GROUP 19: Rotex concrete belt operator (or similar types); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds.and up to and including 50 cu. yds. struck); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - multiple engine, up to and including 25 yds. struck)

GROUP 20: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar

types in any combination, excluding compaction units - single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps, and similar types in any combination, excluding compaction units - multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 21: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck)

GROUP 22: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, up to and including 25 yds. struck)

GROUP 23: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. and up to and including 50 yds. struck); Rubber-tired earth-moving equipment operator, operating with the tandem push-pull system (multiple engine, up to and including 25 yds. struck)

GROUP 24: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 25: Concrete pump operator-truck mounted; Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck)

CRANES, PILEDRIVING AND HOISTING EQUIPMENT CLASSIFICATIONS

GROUP 1: Engineer oiler; Fork lift operator (includes loed, lull or similar types)

GROUP 2: Truck crane oiler

GROUP 3: A-frame or winch truck operator; Ross carrier operator (jobsite)

GROUP 4: Bridge-type unloader and turntable operator; Helicopter hoist operator

GROUP 5: Hydraulic boom truck; Stinger crane (Austin-Western or similar type); Tugger hoist operator (1 drum)

GROUP 6: Bridge crane operator; Cretor crane operator; Hoist operator (Chicago boom and similar type); Lift mobile operator; Lift slab machine operator (Vagtborg and similar types); Material hoist and/or manlift operator; Polar gantry crane operator; Self Climbing scaffold (or similar type); Shovel, backhoe, dragline, clamshell operator (over 3/4 yd. and up to 5 cu. yds. mrc); Tugger hoist operator

GROUP 7: Pedestal crane operator; Shovel, backhoe, dragline, clamshell operator (over 5 cu. yds. mrc); Tower crane repair; Tugger hoist operator (3 drum)

GROUP 8: Crane operator (up to and including 25 ton capacity); Crawler transporter operator; Derrick barge operator (up to and including 25 ton capacity); Hoist operator, stiff legs, Guy derrick or similar type (up to and including 25 ton capacity); Shovel, backhoe, dragline, clamshell operator (over 7 cu. yds., M.R.C.)

GROUP 9: Crane operator (over 25 tons and up to and including 50 tons mrc); Derrick barge operator (over 25 tons up to and including 50 tons mrc); Highline cableway operator; Hoist operator, stiff legs, Guy derrick or similar type (over 25 tons up to and including 50 tons mrc); K-crane operator; Polar crane operator; Self erecting tower crane operator maximum lifting capacity ten tons

GROUP 10: Crane operator (over 50 tons and up to and including 100 tons mrc); Derrick barge operator (over 50 tons up to and including 100 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 50 tons up to and including 100 tons mrc), Mobile tower crane operator (over 50 tons, up to and including 100 tons M.R.C.); Tower crane operator and tower gantry

GROUP 11: Crane operator (over 100 tons and up to and including 200 tons mrc); Derrick barge operator (over 100 tons up to and including 200 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 100 tons up to and including 200 tons mrc); Mobile tower crane operator (over 100 tons up to and including 200 tons mrc)

GROUP 12: Crane operator (over 200 tons up to and including 300 tons mrc); Derrick barge operator (over 200 tons up to and including 300 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 200 tons, up to and including 300 tons mrc); Mobile tower crane operator (over 200 tons, up to and including 300 tons mrc)

GROUP 13: Crane operator (over 300 tons); Derrick barge operator (over 300 tons); Helicopter pilot; Hoist operator, stiff legs, Guy derrick or similar type (over 300 tons); Mobile tower crane operator (over 300 tons)

TUNNEL CLASSIFICATIONS

GROUP 1: Skiploader (wheel type up to 3/4 yd. without attachment)

GROUP 2: Power-driven jumbo form setter operator

GROUP 3: Dinkey locomotive or motorperson (up to and including 10 tons)

GROUP 4: Bit sharpener; Equipment greaser (grease truck); Slip form pump operator (power-driven hydraulic lifting device for concrete forms); Tugger hoist operator (1 drum); Tunnel locomotive operator (over 10 and up to and including 30 tons)

GROUP 5: Backhoe operator (up to and including 3/4 yd.); Small Ford, Case or similar; Drill doctor; Grouting machine operator; Heading shield operator; Heavy-duty repairperson; Loader operator (Athey, Euclid, Sierra and similar types); Mucking machine operator (1/4 yd., rubber-tired, rail or track type); Pneumatic concrete placing machine operator (Hackley-Presswell or similar type); Pneumatic heading shield (tunnel); Pumpcrete gun operator; Tractor compressor drill combination operator; Tugger hoist operator (2 drum); Tunnel locomotive operator (over 30 tons)

GROUP 6: Heavy Duty Repairman

GROUP 7: Tunnel mole boring machine operator

ENGINEERS ZONES

$1.00 additional per hour for all of IMPERIAL County and the portions of KERN, RIVERSIDE & SAN BERNARDINO Counties as defined below:

That area within the following Boundary: Begin in San Bernardino County, approximately 3 miles NE of the intersection of I-15 and the California State line at that point which is the NW corner of Section 1, T17N,m R14E, San Bernardino Meridian. Continue W in a straight line to that point which is the SW corner of the northwest quarter of Section 6, T27S, R42E, Mt. Diablo Meridian. Continue North to the intersection with the Inyo County Boundary at that point which is the NE corner of the western half of the northern quarter of Section 6, T25S, R42E, MDM. Continue W along the Inyo and San Bernardino County boundary until the intersection with Kern County, as that point which is the SE corner of Section 34, T24S, R40E, MDM. Continue W along the Inyo and Kern County boundary until the intersection with Tulare County, at that point which is the SW corner of the SE quarter of Section 32, T24S, R37E, MDM. Continue W along the Kern and Tulare County boundary, until that point which is the NW corner of T25S, R32E, MDM. Continue S following R32E lines to the NW corner of T31S, R32E, MDM. Continue W to the NW corner of T31S, R31E, MDM. Continue S to the SW corner of T32S, R31E, MDM. Continue W to SW corner of SE quarter of Section 34, T32S, R30E, MDM. Continue S to SW corner of T11N, R17W, SBM. Continue E along south boundary of T11N, SBM to SW corner of T11N, R7W, SBM. Continue S to SW corner of T9N, R7W, SBM. Continue E along

south boundary of T9N, SBM to SW corner of T9N, R1E, SBM. Continue S along west boundary of R1E, SMB to Riverside County line at the SW corner of T1S, R1E, SBM. Continue E along south boundary of T1s, SBM (Riverside County Line) to SW corner of T1S, R10E, SBM. Continue S along west boundary of R10E, SBM to Imperial County line at the SW corner of T8S, R10E, SBM. Continue W along Imperial and Riverside county line to NW corner of T9S, R9E, SBM. Continue S along the boundary between Imperial and San Diego Counties, along the west edge of R9E, SBM to the south boundary of Imperial County/California state line. Follow the California state line west to Arizona state line, then north to Nevada state line, then continuing NW back to start at the point which is the NW corner of Section 1, T17N, R14E, SBM

$1.00 additional per hour for portions of SAN LUIS OBISPO, KERN, SANTA BARBARA & VENTURA as defined below:

That area within the following Boundary: Begin approximately 5 miles north of the community of Cholame, on the Monterey County and San Luis Obispo County boundary at the NW corner of T25S, R16E, Mt. Diablo Meridian. Continue south along the west side of R16E to the SW corner of T30S, R16E, MDM. Continue E to SW corner of T30S, R17E, MDM. Continue S to SW corner of T31S, R17E, MDM. Continue E to SW corner of T31S, R18E, MDM. Continue S along West side of R18E, MDM as it crosses into San Bernardino Meridian numbering area and becomes R30W. Follow the west side of R30W, SBM to the SW corner of T9N, R30W, SBM. Continue E along the south edge of T9N, SBM to the Santa Barbara County and Ventura County boundary at that point whch is the SW corner of Section 34.T9N, R24W, SBM, continue S along the Ventura County line to that point which is the SW corner of the SE quarter of Section 32, T7N, R24W, SBM. Continue E along the south edge of T7N, SBM to the SE corner to T7N, R21W, SBM. Continue N along East side of R21W, SBM to Ventura County and Kern County boundary at the NE corner of T8N, R21W. Continue W along the Ventura County and Kern County boundary to the SE corner of T9N, R21W. Continue North along the East edge of R21W, SBM to the NE corner of T12N, R21W, SBM. Continue West along the north edge of T12N, SBM to the SE corner of T32S, R21E, MDM. [T12N SBM is a think strip between T11N SBM and T32S MDM]. Continue North along the East side of R21E, MDM to the Kings County and Kern County border at the NE corner of T25S, R21E, MDM, continue West along the Kings County and Kern County Boundary until the intersection of San Luis Obispo County. Continue west along the Kings County and San Luis Obispo County boundary until the intersection with Monterey County. Continue West along the Monterey County and San Luis Obispo County boundary to the beginning point at the NW corner of T25S, R16E, MDM.

$2.00 additional per hour for INYO and MONO Counties and the Northern portion of SAN BERNARDINO County as defined below:

That area within the following Boundary: Begin at the intersection of the northern boundary of Mono County and the California state line at the point which is the center of

Section 17, T10N, R22E, Mt. Diablo Meridian. Continue S then SE along the entire western boundary of Mono County, until it reaches Inyo County at the point which is the NE corner of the Western half of the NW quarter of Section 2, T8S, R29E, MDM. Continue SSE along the entire western boundary of Inyo County, until the intersection with Kern County at the point which is the SW corner of the SE 1/4 of Section 32, T24S, R37E, MDM. Continue E along the Inyo and Kern County boundary until the intersection with San Bernardino County at that point which is the SE corner of section 34, T24S, R40E, MDM. Continue E along the Inyo and San Bernardino County boundary until the point which is the NE corner of the Western half of the NW quarter of Section 6, T25S, R42E, MDM. Continue S to that point which is the SW corner of the NW quarter of Section 6, T27S, R42E, MDM. Continue E in a straight line to the California and Nevada state border at the point which is the NW corner of Section 1, T17N, R14E, San Bernardino Meridian. Then continue NW along the state line to the starting point, which is the center of Section 18, T10N, R22E, MDM.

REMAINING AREA NOT DEFINED ABOVE RECIEVES BASE RATE

ENGI0012-004 08/01/2020

	Rates	Fringes
OPERATOR: Power Equipment (DREDGING)		
(1) Leverman	$ 56.40	30.00
(2) Dredge dozer	$ 50.43	30.00
(3) Deckmate	$ 50.32	30.00
(4) Winch operator (stern winch on dredge)	$ 49.77	30.00
(5) Fireman-Oiler, Deckhand, Bargeman, Leveehand	$ 49.23	30.00
(6) Barge Mate	$ 49.84	30.00

IRON0433-006 07/01/2020

	Rates	Fringes
IRONWORKER		
Fence Erector	$ 34.58	24.81
Ornamental, Reinforcing and Structural	$ 41.00	33.45

PREMIUM PAY:

$6.00 additional per hour at the following locations:

China Lake Naval Test Station, Chocolate Mountains Naval Reserve-Niland,
Edwards AFB, Fort Irwin Military Station, Fort Irwin Training Center-Goldstone, San Clemente Island, San Nicholas Island, Susanville Federal Prison, 29 Palms - Marine Corps, U.S. Marine Base - Barstow, U.S. Naval Air Facility - Sealey, Vandenberg AFB

$4.00 additional per hour at the following locations:

Army Defense Language Institute - Monterey, Fallon Air Base, Naval Post Graduate School - Monterey, Yermo Marine Corps Logistics Center

$2.00 additional per hour at the following locations:

Port Hueneme, Port Mugu, U.S. Coast Guard Station - Two Rock

LABO0089-001 07/01/2020

	Rates	Fringes
LABORER (BUILDING and all other Residential Construction)		
Group 1	$ 34.18	20.48
Group 2	$ 34.86	20.48
Group 3	$ 35.57	20.48
Group 4	$ 36.37	20.48
Group 5	$ 38.30	20.48
LABORER (RESIDENTIAL CONSTRUCTION - See definition below)		
(1) Laborer	$ 30.82	18.80
(2) Cleanup, Landscape, Fencing (Chain Link & Wood)	$ 29.53	18.80

RESIDENTIAL DEFINITION: Wood or metal frame construction of single family residences, apartments and condominums - excluding (a) projects that exceed three stories over a garage level, (b) any utility work such as telephone, gas, water, sewer and other utilities and (c) any fine grading work, utility work or paving work in the future street and public right-of-way; but including all rough grading work at the job site behind the existing right of way

LABORER CLASSIFICATIONS

GROUP 1: Cleaning and handling of panel forms; Concrete Screeding for Rought Strike-off; Concrete, water curing; Demolition laborer; Flagman; Gas, oil and/or water pipeline laborer; General Laborer; General clean-up laborer; Landscape laborer; Jetting laborer; Temporary water and air lines laborer; Material hoseman (walls, slabs, floors and decks); Plugging, filling of Shee-bolt holes; Dry packing of concrete; Railroad maintenance, Repair Trackman and road beds, Streetcar and railroad construction trac laborers; Slip form raisers; Slurry seal crews (mixer operator, applicator operator, squeegee man, Shuttle man, top man), filling of cracks by any method on any surface; Tarman and mortar man; Tool crib or tool house laborer; Window cleaner; Wire Mesh puling-all concrete pouring operations

GROUP 2: Asphalt Shoveler; Cement Dumper (on 1 yard or larger mixer and handling bulk cement); Cesspool digger and installer; Chucktender; Chute man, pouring concrete, the handling of the cute from ready mix trucks, such as walls, slabs, decks, floors, foundations, footings, curbs, gutters and sidewalks; Concrete curer-impervious membrane and form oiler; Cutting torch operator (demoliton); Guinea chaser; Headboard man-asphlt; Laborer,
packing rod steel and pans; membrane vapor barrier installer; Power broom sweepers (small); Riiprap, stonepaver, placing stone or wet sacked concrete; Roto scraper and tiller; Tank sealer and cleaner; Tree climber, faller, chain saw operator, Pittsburgh Chipper and similar type brush shredders; Underground laborers, including caisson bellower

GROUP 3: Buggymobile; Concrete cutting torch; Concrete cutting torch; Concrete pile cutter; Driller, jackhammer, 2 1/2 feet drill steel or longer; Dri Pak-it machine; High sealer (including drilling of same); Hydro seeder and similar type; Impact wrench, mult-plate; Kettlemen, potmen and mean applying asphalt, lay-kold, creosote, line caustic and similar type materials (applying means applying, dipping, brushing or handling of such materials for pipe wrapping and waterproofing); Operators of pneumatic, gas, electric tools, vibratring machines, pavement breakers, air blasting, come-along, and similar mechanical tools not separately classified herein; Pipelayers back up man coating, grouting, making of joints, sealing, caulking, diapering and inclduing rubber gasket joints, pointing and any and all other services; Rotary Scarifier or multiple head concrete chipping scaarifier; Steel header board man and guideline setter; Tampers, Barko, Wacker and similar type; Trenching machine, handpropelled

GROUP 4: Asphalt raker, luterman, ironer, apshalt dumpman and asphalt spreader boxes (all types); Concrete core cutter (walls, floors or ceilings), Grinder or sander; Concrete saw man; cutting walls or flat work, scoring old or new concrete; Cribber, shorer, lagging, sheeting and trench bracing, hand-guided lagging hammer; Laser beam in connection with laborer's work; Oversize concrete vibrator operator 70 pounds and over; Pipelayer performing all services in the laying, installation and all forms of connection of pipe from the point of receiving pipe in the ditch until completion of oepration, including any and all forms of tubular material, whether pipe, metallic or non-metallic, conduit, and any other stationary type of tubular device used for the conveying of any substance or element, whether water, sewage, solid, gas, air or other product whatsoever and without regard to the nature of material from which the tubular material is fabricated; No joint pipe and stripping of same; Prefabricated manhole installer; Sandblaster (nozzleman), Porta shot-blast, water blasting

GROUP 5: Blasters Powderman-All work of loading holes, placing and blasting of all pwder and explosives of

whatever type, regardless of method used for such loading and placing; Driller-all power drills, excluding jackhammer, whether core, diamond, wagon, track, multiple unit, and any and all other types of mechanical drills without regard to the form of motive power.

LABO0089-002 11/01/2020

	Rates	Fringes
LABORER (MASON TENDER)	$ 33.00	19.23

LABO0089-004 07/01/2020

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
Laborers:		
Group 1	$ 35.30	20.48
Group 2	$ 35.76	20.48
Group 3	$ 36.17	20.48
Group 4	$ 37.01	20.48
Group 5	$ 40.28	20.48

LABORER CLASSIFICATIONS

GROUP 1: Laborer: General or Construction Laborer, Landscape Laborer. Asphalt Rubber Material Loader. Boring Machine Tender (outside), Carpenter Laborer (cleaning, handling, oiling & blowing of panel forms and lumber), Concrete Laborer, Concrete Screeding for rough strike-off, Concrete water curing. Concrete Curb & Gutter laborer, Certified Confined Space Laborer, Demolition laborer & Cleaning of Brick and lumber,Expansion Joint Caulking; Environmental Remediation, Monitoring Well, Toxic waste and Geotechnical Drill tender, Fine Grader, Fire Watcher, Limbers, Brush Loader, Pilers and Debris Handlers. flagman. Gas Oil and Water Pipeline Laborer. Material Hoseman (slabs, walls, floors, decks); Plugging, filling of shee bolt holes; Dry packing of concrete and patching; Post Holer Digger (manual); Railroad maintenance, repair trackman, road beds; Rigging & signaling; Scaler, Slip-Form Raisers, Filling cracks on any surface, tool Crib or Tool House Laborer, Traffic control (signs, barriers, barricades, delineator, cones etc.), Window Cleaner

GROUP 2: Asphalt abatement; Buggymobile; Cement dumper (on 1 yd. or larger mixers and handling bulk cement); Concrete curer, impervious membrane and form oiler; Chute man, pouring concrete; Concrete cutting torch; Concrete pile cutter; driller/Jackhammer, with drill steel 2 1/'2 feet or longer; Dry pak-it machine; Fence erector; Pipeline wrapper, gas, oil, water, pot tender & form man; Grout man; Installation of all asphalt overlay fabric and materials used for reinforcing asphalt; Irrigation laborer; Kettleman-Potman hot mop, includes applying asphalt, lay-klold, creosote, lime caustic and similar tyhpes of

materials (dipping, brushing, handling) and waterproofing; Membrane vapor barrier installer; Pipelayer backup man (coating, grouting, making of joints, sealing caulkiing, diapering including rubber basket joints, pointing); Rotary scarifier, multiple head concrete chipper; Rock slinger; Roto scraper & tiller; Sandblaster pot tender; Septic tank digger/installer; Tamper/wacker operator; Tank scaler & cleaner; Tar man & mortar man; Tree climber/faller, chainb saw operator, Pittsburgh chipper & similar type brush shredders.

GROUP 3: Asphalt, installation of all frabrics; Buggy Mobile Man, Bushing hammer; Compactor (all types), Concrete Curer - Impervious membrane, Form Oiler, Concrete Cutting Torch, Concrete Pile Cutter,Driller/Jackhammer with drill steel 2 1/2 ft or longer, Dry Pak-it machine, Fence erector including manual post hole digging, Gas oil or water Pipeline Wrapper - 6 ft pipe and over, Guradrail erector, Hydro seeder, Impact Wrench man (multi plate), kettleman-Potman Hot Mop includes applying Asphalt, Lay-Kold, Creosote, lime caustic and similar types of materials (dipping, brushing or handling) and waterproofing. Laser Beam in connection with Laborer work. High Scaler, Operators of Pneumatic Gas or Electric Tools, Vibrating Machines, Pavement Breakers, Air Blasting, Come-Alongs and similar mechanical tools, Remote-Controlled Robotic Tools in connection with Laborers work. Pipelayer Backup Man (Coating, grouting,m makeing of joints, sealing, caulking, diapering including rubber gasket joints, pointing and other services). Power Post Hole Digger, Rotary Scarifier (multiple head concrete chipper scarifier), Rock Slinger, Shot Blast equipment (8 to 48 inches), Steel Headerboard Man and Guideline Setter, Tamper/Wacker operator and similar types, Trenching Machine hand propelled.

GROUP 4: Any worker exposed to raw sewage. Asphalt Raker, Luteman, Asphalt Dumpman, Asphalt Spreader Boxes, Concrete Core Cutter, Concrete Saw Man, Cribber, Shorer, Head Rock Slinger. Installation of subsurface instrumentation, monitoring wells or points, remediation system installer; Laborer, asphalt-rubber distributor bootman; Oversize concrete vibrator operators, 70 pounds or over. Pipelayer, Prfefabricated Manhole Installer, Sandblast Nozzleman (Water Balsting-Porta Shot Blast), Traffic Lane Closure.

GROUP 5: Blasters Powderman-All work of loading holes, placing and blasting of all powder and explosives of whatever type, regardless of method used for such loading and placing; Horizontal directional driller, Boring system, Electronic traking, Driller: all power drills excluding jackhammer, whether core, diamond, wagon, track, multiple unit, and all other types of mechanical drills without regard to form of motive power. Environmental remediation, Monitoring well, Toxic waste and Geotechnical driller, Toxic waste removal. Welding in connection with Laborer's work.

LABO0300-005 03/01/2020

	Rates	Fringes
Asbestos Removal Laborer.....	$ 36.13	20.33

SCOPE OF WORK: Includes site mobilization, initial site cleanup, site preparation, removal of asbestos-containing material and toxic waste, encapsulation, enclosure and disposal of asbestos- containing materials and toxic waste by hand or with equipment or machinery; scaffolding, fabrication of temporary wooden barriers and assembly of decontamination stations.

LABO0345-001 07/01/2020

	Rates	Fringes
LABORER (GUNITE)		
GROUP 1.....	$ 45.05	19.62
GROUP 2.....	$ 44.10	19.62
GROUP 3.....	$ 40.56	19.62

FOOTNOTE: GUNITE PREMIUM PAY: Workers working from a Bosn'n's Chair or suspended from a rope or cable shall receive 40 cents per hour above the foregoing applicable classification rates. Workers doing gunite and/or shotcrete work in a tunnel shall receive 35 cents per hour above the foregoing applicable classification rates, paid on a portal-to-portal basis. Any work performed on, in or above any smoke stack, silo, storage elevator or similar type of structure, when such structure is in excess of 75'-0"" above base level and which work must be performed in whole or in part more than 75'-0"" above base level, that work performed above the 75'-0"" level shall be compensated for at 35 cents per hour above the applicable classification wage rate.

GUNITE LABORER CLASSIFICATIONS

GROUP 1: Rodmen, Nozzlemen

GROUP 2: Gunmen

GROUP 3: Reboundmen

LABO1184-001 07/01/2020

	Rates	Fringes
Laborers: (HORIZONTAL DIRECTIONAL DRILLING)		
(1) Drilling Crew Laborer...	$ 37.85	15.99
(2) Vehicle Operator/Hauler.	$ 38.02	15.99
(3) Horizontal Directional Drill Operator.....	$ 39.87	15.99

	Rates	Fringes
(4) Electronic Tracking Locator	$ 41.87	15.99
Laborers: (STRIPING/SLURRY SEAL)		
GROUP 1	$ 39.06	19.01
GROUP 2	$ 40.36	19.01
GROUP 3	$ 42.37	19.01
GROUP 4	$ 44.11	19.01

LABORERS - STRIPING CLASSIFICATIONS

GROUP 1: Protective coating, pavement sealing, including repair and filling of cracks by any method on any surface in parking lots, game courts and playgrounds; carstops; operation of all related machinery and equipment; equipment repair technician

GROUP 2: Traffic surface abrasive blaster; pot tender - removal of all traffic lines and markings by any method (sandblasting, waterblasting, grinding, etc.) and preparation of surface for coatings. Traffic control person: controlling and directing traffic through both conventional and moving lane closures; operation of all related machinery and equipment

GROUP 3: Traffic delineating device applicator: Layout and application of pavement markers, delineating signs, rumble and traffic bars, adhesives, guide markers, other traffic delineating devices including traffic control. This category includes all traffic related surface preparation (sandblasting, waterblasting, grinding) as part of the application process. Traffic protective delineating system installer: removes, relocates, installs, permanently affixed roadside and parking delineation barricades, fencing, cable anchor, guard rail, reference signs, monument markers; operation of all related machinery and equipment; power broom sweeper

GROUP 4: Striper: layout and application of traffic stripes and markings; hot thermo plastic; tape traffic stripes and markings, including traffic control; operation of all related machinery and equipment

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LABO1414-003 08/05/2020

	Rates	Fringes
LABORER		
PLASTER CLEAN-UP LABORER	$ 36.03	21.01
PLASTER TENDER	$ 38.58	21.01

Work on a swing stage scaffold: $1.00 per hour additional.

Work at Military Bases - $3.00 additional per hour:
Coronado Naval Amphibious Base, Fort Irwin, Marine Corps Air Station-29 Palms, Imperial Beach Naval Air Station, Marine

Corps Logistics Supply Base, Marine Corps Pickle Meadows, Mountain Warfare Training Center, Naval Air Facility-Seeley, North Island Naval Air Station, Vandenberg AFB.

PAIN0036-001 07/01/2020

	Rates	Fringes
Painters: (Including Lead Abatement)		
(1) Repaint (excludes San Diego County)	$ 29.59	17.12
(2) All Other Work	$ 33.12	17.24

REPAINT of any previously painted structure. Exceptions: work involving the aerospace industry, breweries, commercial recreational facilities, hotels which operate commercial establishments as part of hotel service, and sports facilities.

PAIN0036-010 10/01/2020

	Rates	Fringes
DRYWALL FINISHER/TAPER		
(1) Building & Heavy Construction	$ 36.69	18.90
(2) Residential Construction (Wood frame apartments, single family homes and multi-duplexes up to and including four stories)	$ 27.11	17.51

PAIN0036-012 10/01/2020

	Rates	Fringes
GLAZIER	$ 45.55	18.06

PAIN0036-019 06/01/2020

	Rates	Fringes
SOFT FLOOR LAYER	$ 32.27	17.24

PLAS0200-005 08/07/2019

	Rates	Fringes
PLASTERER	$ 43.73	16.03

NORTH ISLAND NAVAL AIR STATION, COLORADO NAVAL AMPHIBIOUS BASE, IMPERIAL BEACH NAVAL AIR STATION: $3.00 additional per hour.

PLAS0500-001 07/01/2018

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER		
GROUP 1	$ 26.34	21.12
GROUP 2	$ 27.99	21.12
GROUP 3	$ 30.07	21.12

CEMENT MASONS - work inside the building line, meeting the following criteria:

GROUP 1: Residential wood frame project of any size; work classified as Type III, IV or Type V construction; interior tenant improvement work regardless the size of the project; any wood frame project of four stories or less.

GROUP 2: Work classified as type I and II construction

GROUP 3: All other work

PLUM0016-006 09/01/2020

	Rates	Fringes
PLUMBER, PIPEFITTER, STEAMFITTER		
Camp Pendleton; Vandenberg Air Force Base	$ 55.88	23.66
Work ONLY on new additions and remodeling of commercial buildings, bars, restaurants, and stores not to exceed 5,000 sq. ft. of floor space	$ 50.70	23.73
Work ONLY on strip malls, light commercial, tenant improvement and remodel work	$ 38.73	22.06
All other work except work on new additions and remodeling of bars, restaurant, stores and commercial buildings not to exceed 5,000 sq. ft. of floor space and work on strip malls, light commercial, tenant improvement and remodel work	$ 52.28	24.71

PLUM0016-011 09/01/2020

	Rates	Fringes
PLUMBER/PIPEFITTER		
Residential	$ 41.62	20.63

PLUM0345-001 09/01/2020

	Rates	Fringes
PLUMBER		
Landscape/Irrigation Fitter	$ 35.30	24.10
Sewer & Storm Drain Work	$ 39.39	21.48

ROOF0045-001 07/01/2020

	Rates	Fringes
ROOFER	$ 36.25	9.24

SFCA0669-001 04/01/2020

	Rates	Fringes
SPRINKLER FITTER	$ 41.57	24.10

SHEE0206-001 07/01/2020

	Rates	Fringes
SHEET METAL WORKER		
Camp Pendleton	$ 42.62	29.55
Except Camp Pendleton	$ 40.62	29.55
Sheet Metal Technician	$ 30.51	9.49

SHEET METAL TECHNICIAN - SCOPE:
a. Existing residential buildings, both single and multi-family, where each unit is heated and/or cooled by a separate system b. New single family residential buildings including tracts. c. New multi-family residential buildings, not exceeding five stories of living space in height, provided each unit is heated or cooled by a separate system. Hotels and motels are excluded. d. LIGHT COMMERCIAL WORK: Any sheet metal, heating and air conditioning work performed on a project where the total construction cost, excluding land, is under $1,000,000 e. TENANT IMPROVEMENT WORK: Any work necessary to finish interior spaces to conform to the occupants of commercial buildings, after completion of the building shell

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TEAM0166-001 09/01/2019

	Rates	Fringes
Truck drivers:		
GROUP 1	$ 18.90	34.69
GROUP 2	$ 26.49	34.69
GROUP 3	$ 26.69	34.69
GROUP 4	$ 26.89	34.69
GROUP 5	$ 27.09	34.69
GROUP 6	$ 27.59	34.69
GROUP 7	$ 29.09	34.69

FOOTNOTE: HAZMAT PAY: Work on a hazmat job, where hazmat certification is required, shall be paid, in addition to the classification working in, as follows: Levels A, B and C - +$1.00 per hour. Workers shall be paid hazmat pay in increments of four (4) and eight (8) hours.

TRUCK DRIVER CLASSIFICATIONS

GROUP 1: Fuel Man, Swamper

GROUP 2: 2-axle Dump Truck, 2-axle Flat Bed,Concrete Pumping Truck, Industrial Lift Truck, Motorized Traffic Control, Pickup Truck on Jobsite

GROUP 3: 2-axle Water Truck, 3-axle Dump Truck, 3-axle Flat Bed, Erosion Control Nozzleman, Dump Crete Truck under 6.5 yd, Forklift 15,000 lbs and over, Prell Truck, Pipeline Work Truck Driver, Road Oil Spreader, Cement Distributor or Slurry Driver, Bootman, Ross Carrier

GROUP 4: Off-road Dump Truck under 35 tons 4-axles but less than 7-axles, Low-Bed Truck & Trailer, Transit Mix Trucks under 8 yd, 3-axle Water Truck, Erosion Control Driver, Grout Mixer Truck, Dump Crete 6.5yd and over, Dumpster Trucks, DW 10, DW 20 and over, Fuel Truck and Dynamite, Truck Greaser, Truck Mounted Mobile Sweeper 2-axle Winch Truck

GROUP 5: Off-road Dump Truck 35 tons and over, 7-axles or more, Transit Mix Trucks 8 yd and over, A-Frame Truck, Swedish Cranes

GROUP 6: Off-Road Special Equipment (including but not limited to Water Pull Tankers, Athey Wagons, DJB, B70 Wuclids or like Equipment)

GROUP 7: Repairman

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

City of San Diego

CITY CONTACT: Stephen Samara, Principal Contract Specialist, Email: SSamara@sandiego.gov
Phone No. (619) 533-3619

ADDENDUM E

e - Bidding

FOR

MORENA PUMP STATION

BID NO.: K-21-1801-DBB-3-A
SAP NO. (WBS/IO/CC): B-15141
CLIENT DEPARTMENT: 2000
COUNCIL DISTRICT: 2, 7
PROJECT TYPE: KA, BP

BID DUE DATE:

2:00 PM
JANUARY 13, 2021

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

http://www.sandiego.gov/cip/bidopps/index.shtml

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:

Shapiro, Alan — Digitally signed by Shapiro, Alan DN: cn=Shapiro, Alan, ou=USSDG1 Reason: I have reviewed this document Date: 2020.12.29 11:22:19 -08'00'

1) Registered Engineer (Morena Pump Station)

12/29/2020 Date

Seal:

Nabil Batta

2) For City Engineer (Morena Pump Station)

12/29/20 Date

Seal:

A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

B. BIDDER's QUESTIONS

Q1. Drawing C-09 indicates the 60" PLRCP from Station 19+53.01 at Junction Structure No. 1 to 22+30.23 at the Influent Screening Structure wall to be installed using "trenchless construction". Several Mechanical drawings, including M-01 show a series of 3, 4 foot long bell and spigot joints of pipe leading into the screening structure. There does not appear to be a specification in the bid documents addressing this situation, the pipe material requirements, or the parameters for allowable or expected deflection of these pipe joints. Please clarify the designer's intent to install the three short joints of pipe using trenchless methods.

A1. The trenchless construction limits have been revised as shown on drawing C-09, provided in this Addendum.

Q2. Addenda B, Q&A 15 addresses wall ring details and describes an acceptable method for a closure sequence between microtunneled pipe and the cast in place structure wall. Is this same method acceptable for closure between the microtunneled 60" PLCRP and the Screening Structure cast in place wall?

A2. The trenchless construction limits have been revised as shown on drawing C-09, provided in this Addendum.

Q3. Specification Section 03 33 00 requires the Contractor to develop a thermal control plan for mass concrete with a thickness of 2'-6" or greater. ACI 207.1R defines mass concrete as, "any volume of concrete with dimensions large enough to require that measures be taken to cope with the generation of heat from hydration of the cement and attendant volume change to minimize cracking." The amount of construction joints and the size of the pours on the Morena Pump Station greatly limit the possibility of cracking. Please confirm that the requirement for a thermal control plan be concrete that is greater than 4' thick.

A3. Confirmed.

Q4. Addendum A, drawing E-50, provides information regarding the precast concrete pull box in Detail 1; this detail calls for a 4-inch Fiber Optic Conduit. Details 2 and A in the same Drawings calls for 2-inch FO conduit. Confirm that 2-inch conduit is the correct size Fiber Optic.

A4. Confirmed, 2" conduit is the correct size.

Q5. Drawing M-13 calls for all gas piping to be insulated per specification 40 27 00. Specification 40 27 00 states: Insulation - as shown on the drawings. Please provide details for gas pipe insulation (material, thickness, finish, etc.)

Please advise on the DDC control strategy for the Vertical Air Handling Unit (AHU/CU-1). Control detail or points list would be most beneficial.

A5. Insulation shall be minimum ¾-inch thick flexible polyethylene or EPDM rated for -160 to 200 degrees F or better, and covered with Stainless Steel Insulation Shields as specified in Specification 22 10 01 Paragraph 2.04.G.1. Contractor shall provide details per Specification Section 23 09 00 Part 1.4, Item B, Shop Drawings.

Q6. Please advise on the DDC control strategy for the Split System Heat Pump (FC/HP-1). Control detail or points list would be most beneficial.

A6. Contractor shall provide per Specification Section 23 09 00 Part 1.4, Item B, Shop Drawings.

Q7. Please advise on the DDC control strategy for all Supply and Exhaust Fans that are scheduled, some of which has Variable Frequency Drives (VFD). Control detail or points list would be most beneficial.

A7. Contractor shall provide per Specification Section 23 09 00 Part1.4, Item B, Shop Drawings

Q8. How much DDC system operator training is needed after project completion?

A8. Missing Specification 40 98 06 Training is provided in this Addendum.

Q9. Drawings M-12, M-11, M-26, M-13 all call for 3", 4", 6" and 16" plug valves respectively. However, Spec Section 40 27 02 part 2.04B only provides information for plug valves 24" – 48". Please provide the required specifications for the 3", 4", 6" and 16" plug valves.

A9. Revised Specification 40 27 02 Process Valves and Operators is provided in this Addendum.

Q10. The scope of required settlement monitoring for tunneling is vague. Can the city define what will be required more precisely by indicating required survey points and instrumentation on the plans? This will eliminate misinterpretation by all parties for what is required. For example, we have the following questions:

a. Reference Plan C-25 and Note 2, which states that the minimum instrumentation for tunnel monitoring shall include the monitoring instrumentation at the locations shown on Plan Sheets C-09, C-12, C-13, and C-16. The only monitoring instrumentation that is shown on these sheets is a single Inclinometer on Sheet C-09. Please verify that this is the only required monitoring instrumentation.

b. Note 1 on C-09, 12, 13, 14, 15 & 16 requires bridge monitoring using optical surveying methods. "Several locations shall be marked on the bridge to survey for both vertical and horizontal movement." Please specify how many locations be marked and surveyed at each bridge crossing.

c. Reference Plan C-25 and Note 2, which states that the minimum survey points shall be located at the following five designated locations along the MTS railroad track: 1) At the track centerline, directly above the tunnel installation location. 2) Four Additional Points: at 10 Feet and 25 Feet either side of the tunnel alignment centerline survey point.

i. Are we correct interpreting that Note 2 requires that we have 5 locations for each crossing for a total of 15 survey points?

ii. Do these survey points need to be constructed per detail 2 on C-25 or is a pk nail in the pavement an acceptable survey point?

iii. Are these survey points in addition to the optical surveying methods stipulated at several locations marked on the bridge (As per Note 1 on C-09, 12, 13, 14, 15 & 16)?

d. Reference Plan C-09 and the Sandag MCTC which crosses over the 48" PLRCP via a bridge. Is the 5-point survey array required for this track crossing also or is just a bridge survey required here?

e. Plan C-25 provides detail 3 for Utility Monitoring Points but there is no indication on the plans as to which utilities requires monitoring. Are we to assume all utilities that cross the tunnel alignment require monitoring per this detail?

f. Plan C-25 provides a detail for Surface Deformation Points but there is no indication on the plans regarding the location or frequency of points. If points are located over existing hardscape features (i.e. asphalt or concrete pavement) will a PK nail or anchor bolt be sufficient?

A10. Per Specification 31 71 19, Section 1.04 (8) and 31 50 00, Section 1.04 (E) and Dwg C-09, Note 1, the Contractor shall submit a monitoring plan for review and approval.

Q11. Please confirm that the cost of DCSP is not to be included in the bid since this scope is provided by the City's DSC provided Emerson Process Management as stated in Specification section 40 90 00 section 1.1 C. "A Distributed Control System (DCS), when applicable, as specified in Section 40 90 03, General Requirements, will be provided by the City's DCS provider, Emerson Process Management (EPM). The Contractor shall be responsible for terminating and integrating all I&C equipment with the EPM DCS systems."

A11. The Contractor shall be responsible for the design, procurement, installation, testing, training, and documentation for I&C systems provided under this Contract in accordance with Sections 40 90 00 and 40 90 07, Scope of Work.

Q12. Addendum C contains three answers regarding lining and coating of ductile iron pipe. Per A32 and A61 “All ductile iron pipe and fittings shall be fusion bonded epoxy lined and coated and conform to the requirements of Section 09 90 00 Part 3.07 B.”. This differs from the answer A71 “Lining: Ductile Iron Pipe and Fittings shall be lined with 40 mils ceramic epoxy as manufactured by Induron or equal as required in Specification Section 33 05 19. Coating: Buried Pipe shall be Asphaltic Coated as required in Specification Section 33 05 19. Exposed pipe shall receive Coating System 4 as specified in Specification Section 09 90 00 - Painting and Coating”. If either of these options is acceptable, can we suggest abandoning fusion bonded epoxy requirement and using the lining/coating scheme provided by Q71 as more readily available and less expensive?

A12. Lining: Ductile Iron Pipe and Fittings shall be lined with 40 mils ceramic epoxy as manufactured by Induron or equal as required in Specification Section 33 05 19. Coating: Buried Pipe shall be Asphaltic Coated as required in Specification Section 33 05 19. Exposed pipe shall recieve coating system 4 as specified in Specification Section 09 90 00.

Q13. Question 19- Addendum C. Will As-Built reports for the ground improvement projects for the North Metro Interceptor and the Mid-Coast Trolley be made available to bidding Contractors? A19. The City is not in posession of the requested information. Question 20 – Addendum C. Will foundation plans for the Pacific Highway bridge and the SANDAG MCTC bridge, including any post 1940s foundation improvements be made available to bidding Contractors? The City is not in posession of the requested information.

A13. As was stated previously, the City does not possess the requested information.

Q14. Q21-Addendum C, what is the allowable settlement of railroad tracks for the MTS Trolley? Owner Response A21. No settlement of MTS tracks will be allowed.

All Engineered microtunneling installation consider some amount systematic settlement in the design, it is not possible for a microtunneling installation in these ground conditions to be installed with no settlement allowances. We respectfully request the Owner provide the following related to systematic settlement allowances;

Action Trigger Levels, Contractor Response Levels as a percentage of Maximum Allowable Movement and Maximum Allowable Movement.

Bid item for allowance for ground improvement along the tunneling alignment to protect surface and subsurface structures along with a design to implement.

A14. Bidders are advised that the information in the specification Section 31 71 19 is to be used. Provide details of site monitoring plan including provision of measuring ground movements at shafts and along the tunnel alignment and the monitoring of any existing structures within 100 ft of the centerline of the excavation and tunnel alignment. Submit a plan for actions to be taken in the case of ground movements or movements of structures exceeding the allowable movement limits (Unless otherwise submitted ½ inch movement requires action to be taken as per the plan). Q21-Addendum C, what is the allowable settlement of railroad tracks for the MTS Trolley? Owner Response A21 "No settlement of MTS tracks will be allowed" is modified to ½ inch allowable settlement beneath the rails before action is required to be taken. The MTS LRT tracks are defined as an existing structure.

Q15. Question 50, addendum C; SECTION 31 71 19, MICROTUNNELING; 1.4 SUBMITTALS: A. Submit the following in accordance with the Contract Documents. 8. Provide details of site monitoring plan including provision of measuring ground movements at shafts and along the tunnel alignment and the monitoring of any existing structures within 100ft of the centerline of the excavation and tunnel alignment. Submit a plan for actions to be taken in the case of ground movements or movements of structures exceeding the allowable movement limits (Unless otherwise submitted 1/2in movement requires action to be taken as per the plan)

A. Has the Owner conducted systematic settlement calculation for this project?
B. If so, can they be shared with the bidding contractors
C. If not, how do you know if something less than 0.50-inch of movement is achievable?

Owner Response: A50. Yes, 1/2 in movement requires action to be taken as per the plan.

Please note the Owner has not yet responded to the above items A, B and C above in questions no. 3. The shallowest area along the 66-inch PLRCP tunnel alignment is 11-feet deep to top of pipe or 8-feet from bottom of the surface monitoring point to top of pipe. The calculated systematic settlement is 1.21 inches using an 80.50" OD Pipe, 1.50" overcut, 50% fill of the annular backfill gap, 1% face loss and the settlement trough is 10.22 feet wide. In addition, the 66-inch PLRCP and the adjacent 48-inch PLRCP tunnel alignments have 12-feet of separation, so the settlement troughs will overlap each other which will on increase the systematic settlement. It appears by this conservative calculation the 0.50 inches of movement which requires some type of an action to be taken is greatly exceeded. We respectfully request the Owner provide the following related to systematic settlement allowances;

- Action Trigger Levels, Contractor Response Levels as a percentage of Maximum Allowable Movement and Maximum Allowable Movement.

- Bid item for allowance for ground improvement along the tunneling alignment to protect surface and subsurface structures along with a design to implement.

A15. Responses: A. No, B. N/A, C. Contractor is to include in his bid the risk and cost of possible ground treatment and track levelling required to achieve the settlement tolerance on structures

Q16. Can the 48-inch PLRCP be increased to a 60-PLRCP between Stations 10+52 to 19+28 and 1+15 to 17+75 at no cost to the Owner.

A16. Yes.

Q17. HDPE LINED REINFORCED CONCRETE PIPE FOR JACKING AND TUNNELING; Section 33 05 01.10, 2.02 MANUFACTURE; D. Liner shall be cast at the top 330 degrees throughout the pipe interior, leaving the bottom 30 degrees of concrete pipe exposed at the invert. E. Approved manufacturer – Geneva Pipe and Precast

Several questions were asked requesting a change to a 360-degree lining and the 330-degree requirement remains. Again, we must ask was this considered in during design by the Trenchless Engineers?

Has Geneva Pipe previously produced Perfect Pipe with a liner cast at the top 330-degrees throughout the pipe interior, leaving the bottom 30 degrees of concrete pipe exposed at the invert.

A17. The owner will accept the use of 360 degree, fully HDPE lined and complete 360 degree welded joints at no additional cost to the owner.

Q18. DWG. S-27, Keynote 14 calls for SS ¼" Bent Plate. There is no detail call out for the bend or anchorage detail. Please provide detail for SS bent plate and anchorage.

A18. Callouts added to Detail 1 on Sheet S-63; Detail reference added to KN 14 on Sheet S-27. See revised Sheets S-27 and S-63 provided in this Addendum.

Q19. DWG. S-39, Keynote 15 calls for Aluminum guardrail at the hatches and perimeter or the roof. However, on DWG. S-40 keynote 13 calls for FRP guardrail. Please clarify type of material for guardrails at the hatches and perimeter of the pump station roof.

A19. All railing on the Pump Station roof is to be aluminum. KN 27 added to drawing S-40 and KN reference pointing to roof guardrail have been revised from KN 13, to new KN 27. See revised Sheet S-40 provided in this Addendum.

Q20. What is the schedule for the MCTC contractor? Are they going to be complete by NTP to allow the contractor to begin work in Friars road?

A20. The MCTC Contractor will be completed and demobilized prior to NTP of this Contract.

Q21. Upon speaking with various ready mix concrete suppliers it has come to our attention that there is a Fly Ash shortage due to economic and operational effects at Coal Power Plants that produce Fly ash. The current Ready mix Concrete spec calls out for Fly ash with no detailed substitution. Ready Mix Facilities are currently using Slag as a substitution for Fly Ash. Can these specs be revised to include a substitution for Fly ash? If so, can we be notified of what this substitution be to obtain an accurate bid for ready mix concrete?

A21. Material substitutions will be considered during the construction phase.

Q22. Spec 43 20 05, paragraph 2.2.A.2 calls out to furnish one complete set of Rotalign Ultra system to owner. Contractor is potentially going to sub out machine alignment to professional services. This equipment could cost $35000. Please confirm if district wants contractor to furnish a new set of this system.

A22. Contractor is to provide the system per Spec 43 20 05.

Q23. The 16" piping to the speece cone in the high purity oxygen system is call out to be class 300 ductile iron pipe. Please confirm that the piping material for this 16" pipe in the HPO system does not require to be stainless steel.

A23. Provide piping system as shown on the contract drawings.

Q24. On Drawing C-21 it shows locations of where to use 50’ and 80’ stone columns. However, it does not show the existing 66” RCP that runs thru the southwest corner of the site. The stone columns will be installed at the onset of the project and the existing 66” RCP is to be used later in the project for bypassing and as such, needs to be protected in place during the stone column installation. At a minimum the stone column spacing will need to be adjusted in this area. However, since there are no proposed improvements in this area, would the City consider deleting the stone columns in this area so as not to potentially damage the existing 66” RCP?

A24. If there are no improvements in that area, including utility connections, it is reasonable to consider eliminating the stone columns in the area. This will be reviewed for approval during the construction phase.

Q25. Sheet C-09 refers to sheet E-50 for additional information regarding the CP-DS panels. Can you please provide sheet E-50?

A25. E-50 was provided in Addendum A.

Q26. Are there any sample drawings, elevation drawings, or wiring diagrams available for CP-DS1/2 and CP-DS3? If so, can you please provide them?

A26. CP-DS1/2 and CP-DS3 will be new control panels to be furnished by contractor under this project. Contractor to furnish panel drawings. Refer to Section 409513 for field cabinet requirements.

Q27. City of San Diego typically allows a maximum of 144,000 gallons per day to be discharged into the sewer. Will an exception be granted to allow for 860,000 gallons per day to be discharged into the sewer for this project?

A27. 860,000 gallons per day will be allowed to be discharged as indicated on Diversion Scenarios in Specification 01 50 25.

Q28. The sewer permit states that during and after a rain event the Permit Holder (Contractor) will have to shutoff the discharge (dewatering). By enforcing the dewatering shutoff during a rain event will flood the site's excavation. Please confirm the requirement to shutoff dewatering operations to the sewer during and after rain events will not be required.

A28. Shutoff of Dewatering activities will not be required.

Q29. Please confirm if the sewer discharge fees will be waived. If not, please increase the discharge fee allowance bid item to a value that would include the fees for discharging up to 860,000 gallons per day for two years.

A29. Sewer Discharge fees shall be paid per Bid Item 27 Dewatering Permit and Discharge Fees (EOC Type I). If additional funds are needed for the allowance bid item they will be added as needed.

Q30. Spec 43 42 00, paragraph 3.3.B says that initial tank fill will be supplied by the OWNER for the LOX tanks. Addendum 2, question 36 calls out that contractor is supposed to cover the cost for initial fill and testing of chemicals. Please clarify if district will provide the first fill for liquid oxygen.

A30. Response as stated in Addendum B, A36 is confirmed.

Q31. Will there be an OIT requirement for CP-DS1/2 or CP-DS3?

A31. All monitoring and control functions shall be through local actuator control station.

Q32. In addendum C – Q38/A38 states that Contractor will not be responsible for Acts of God as defined under CA7105. In addendum A – Q41/A41 states that owner is not responsible for all losses as they relate to earthquake. In the event of an earthquake please confirm WHO will be responsible for such losses.

A32. All Pure Water projects are exempt from mandatory requirements of California Public Contract Code 7105 (a). Response to Q38 in Addendum C will be revised via this Addendum.

Q33. Sheet H-02 lists Fans EF-01 through EF-07 and SF-01 through SF-05. Fans EF-01, EF-02, EF-03, and EF-04 are listed in spec section 44 47 28.26. However, is it unclear what spec sections the remaining fans pertain to as there is no indication of this in spec sections 23 34 00 HVAC Fans and 23 34 00 Axil HVAC Fans. Please specify the spec section related to each of the remaining fans.

A33. EF-07 thru EF-11 pertain to section 23 34 00, "Axial Fans" part 2.02.

Q34. Addendum D clarifies that there is a 60 calendar day period prior to the start of the 120 day integration period and also clarifies that the inclement weather activity should be 52 working days with successor being substantial completion. The activities in between Milestone 1 and 2 are the 60 Calendar Day duration, the 120 Calendar Day Integration Period, the 30 Calendar Day Facility Acceptance Period, followed by the 52 Working Day Inclement Weather. This equals more than 202 Working Days. The duration between milestones 1 and 2 is 145 Working Days per contract. Please clarify if the durations should be changed to

maintain the 145 working day duration or if the milestone 2 will be pushed back to accommodate the durations called out.

A34. The 52 working days for inclement weather shall have a predecessor of NTP and days are used up as needed before the substantial completion.

Q35. Reference drawing S-30. Note 8 calls for FRP guardrail per detail 9 on S-06. This detail is for aluminum guardrail. Please clarify.

A35. KN 8 to be revised to Aluminum.

Q36. Reference drawing A-10 notes 27 and 28 calling for liquid waterproofing and waterproofing membrane system, respectively. There do not appear to be specifications, identification of limits, termination details, etc. for this waterproofing system provided in the bid documents. This question also applies to drawings A-11, A-18, A-19 and A-20. Further, similar structural drawings indicate crystalline waterproofing admixture is to be included in the concrete mix (e.g., note 30 drawing S-32) and no mention of liquid or sheet applied waterproofing. Please clarify intent and provide any needed specifications and details.

A36. Crystalline waterproofing concrete admixture is to be used in lieu of externally applied waterproofing at the screening facility and pump station. For structures that require externally applied below-grade waterproofing, refer to specification 07 13 26. Notes 27 and 28 on Sheet A-10 revised to refer to the structural drawings.

Q37. Reference drawing A-11 and note 8 calling for coating of influent channel surfaces. The note refers to the structure drawings. Drawing S-33 shows the same section view as A-11 and includes note 15 calling for a coating on influent channel surfaces per another note on drawing S-27. There does not appear to be a note on drawing S-27 regarding this coating. What coating is required on the influent channel surfaces? What are the limits of this coating? Do these limits include the floor slab? Extend the full height of the walls? Is there a special detail for this coating at its termination or across construction joints?

A37. The coating note is located in the lower left corner of Sheet S-27 and includes material and coverage requirements.

C. ADDENDUM

1. To Addendum A, Section B, Bidder's Questions, page 21, Q67 and A67, **DELETE** in their entirety and **SUBSTITUTE** with the following:

Q67. Can you please provide the following information related to the bypass of the 78" NMVI pipeline:

a. What is the diameter of the manhole located in the YMCA parking lot (MH-1)?

b. Can the 78" NMVI pipeline be surcharged above the top of the 78" pipe?

c. Can you please provide as-builts of the existing NMI Junction structure, including the diameters of the manholes.

d. Are there any other sewer lines that dump into the 78" NMVI pipeline between MH-1 (in the YMCA parking lot) and the existing NMI Junction Structure?

A67. It is understood that bypass pumping operation will not fit in a manhole. Due to the constraints of limited property at the upstream manhole and the adjacency to the Mission Valley Preserve it is anticipated that the NMVI will be exposed between NMI Junction Structure and the trolley tracks where bypass pumping can occur. The CONTRACTOR shall develop a plan for approval by the ENGINEER to open top of the NMVI and provide bypass pumping and repair upon completion.

Structure 3 may be constructed without the use of a pumped bypass of the existing 78-inch NMVI. Construction methods such as the use of flow through tubes and construction sequencing shall be performed to maintain live sewage flow at all times through the work area.

The Contractor shall develop a detailed work plan for structure construction and sequencing for approval by Engineer prior to construction. The work plan shall describe the construction sequence and means and methods employed to convey the identified maximum wet weather flow described in

Section 01 50 25 through the work area without the possibility of a sewage spill or surcharging the upstream portion of the NMVI Sewer. The City reserves the right to reject the Contractor's work plan if such means and methods do not provide sufficient protection from sewage spill or provide adequate flow through capacity.

Routing pipes through the preserve will not be allowed.

Record drawings 27256-D and 27152-D links have been provided via Addendum A.

2. To Addendum C, Section B, Bidder's Questions, page 8, Q21 and A21, **DELETE** in their entirety and **SUBSTITUTE** with the following:

   Q21. What is the allowable settlement of railroad racks for the MTS Trolley?

   A21. ½ inch allowable settlement beneath the rails before action is required to be taken. The MTS LRT tracks are defined as an existing structure.

3. To Addendum C, Section B, Bidder's Questions, page 14, Q38 and A38, **DELETE** in their entirety and **SUBSTITUTE** with the following:

   Q38. Please confirm this project is subject to the California Acts of God statute which relieves the contractor from the cost associated with damage caused by an earthquake exceeding 3.5 on the Richter Scale in excess of 5% of the contractor's bid.

   A38. All Pure Water projects are exempt from mandatory requirements of California Public Contract Code 7105 (a).

D. SUPPLEMENTARY SPECIAL PROVISIONS

1. To Technicals, Section 40 27 02, PROCESS VALVES AND OPERATORS, pages 1505 through 1519, **DELETE** in its entirety and **SUBSTITUTE** with pages 18 through 33 of this Addendum.

2. To Technicals, **ADD** Section 40 98 06, TRAINING, to pages 34 through 36 of this Addendum.

E. PLANS

1. To Drawing Sheet Numbers 40421-01-D, 40421-31-D, 40421-68-D, 40421-124-D, 40421-127-D, 40421-137-D, 40421-160-D, **DELETE** in their entirety and **REPLACE** with pages 37 through 43 of this Addendum.

James Nagelvoort, Director
Engineering & Capital Projects Department

Dated: *December 30, 2020*
San Diego, California

JN/JA/lir

SECTION 40 27 02
PROCESS VALVES AND OPERATORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Gas Association (AGA): 3, Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids.
2. American National Standards Institute (ANSI): Z21.15, Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
3. American Society of Mechanical Engineers (ASME):
   a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   b. B16.44, Manually Operated Metallic Gas Valves for Use in Above Ground Piping Systems up to 5 psi.
4. American Society of Sanitary Engineers (ASSE): 1011, Performance Requirements for Hose Connection Vacuum Breakers.
5. American Water Works Association (AWWA):
   a. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   b. C500, Metal-Seated Gate Valves for Water Supply Service.
   c. C504, Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).
   d. C508, Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.
   e. C509, Resilient-Seated Gate Valves for Water Supply Service.
   f. C510, Double Check Valve Backflow Prevention Assembly.
   g. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
   h. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
   i. C515, Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
   j. C541, Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
   k. C542, Electric Motor Actuators for Valves and Slide Gates.
   l. C550, Protective Interior Coatings for Valves and Hydrants.
   m. C606, Grooved and Shouldered Joints.
   n. C800, Underground Service Line Valves and Fittings.
6. ASTM International (ASTM):

a. A276, Standard Specification for Stainless Steel Bars and Shapes.
b. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
c. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
d. A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
e. B61, Standard Specification for Steam or Valve Bronze Castings.
f. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
g. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
h. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
i. B139/B139, Standard Specification for Phosphor Bronze Rod, Bar and Shapes.
j. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
k. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
l. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
m. D429, Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
n. D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

7. Canadian Standards Association, Inc. (CSA): 9.1, Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
8. Chlorine Institute (CI): Pamphlet 6, Piping Systems for Dry Chlorine.
9. FM Global (FM).
10. Food and Drug Administration (FDA).
11. International Association of Plumbing and Mechanical Officials (IAPMO).
12. Manufacturers Standardization Society (MSS):
    a. SP-80, Bronze Gate, Globe, Angle, and Check Valves.
    b. SP-81, Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
    c. SP-85, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
    d. SP-88, Diaphragm Valves.
    e. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
13. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

14. NSF International (NSF):
    a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
    b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
15. Underwriters Laboratories (UL).
16. USC Foundation for Cross-Connection Control and Hydraulic Research.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.
    b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
    c. Certification for compliance to NSF/ANSI 61 for valves used for drinking water service.
    d. Power and control wiring diagrams, including terminals and numbers.
    e. For each power actuator provided, manufacturer's standard data sheet, with application specific features and options clearly identified.
    f. Sizing calculations for open-close/throttle and modulating valves.
    g. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for:
    a. Electric actuators; full compliance with AWWA C542.
    b. Butterfly valves; full compliance with AWWA C504.
3. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection and Testing.
4. Tests and inspection data.
5. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
6. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS

2.01 GENERAL

A. Valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, operating nut, chain, wrench, and accessories to allow a complete operation from the intended operating level.

B. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

C. Valve same size as adjoining pipe, unless otherwise called out on Drawings or in Supplements.

D. Valve ends to suit adjacent piping.

E. Resilient seated valves shall have no leakage (drip-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this section or in stated valve standard.

F. Size operators and actuators to operate valve for full range of pressures and velocities.

G. Valve to open by turning counterclockwise, unless otherwise specified.

H. Factory mount operator, actuator, and accessories.

I. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 MATERIALS

A. Bronze and brass valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.

1. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100), B139/B139M (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
2. Stainless steel Alloy 18-8 may be substituted for bronze.

B. Valve materials in contact with or intended for drinking water service to meet the following requirements:

1. Materials to comply with requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements.
2. Coatings materials to be formulated from materials deemed acceptable to NSF/ANSI 61.
3. Supply certification product is certified as suitable for contact with drinking water by an accredited certification organization in accordance with NSF/ANSI 61. Provide certification for each valve type used for drinking water service.

2.03 FACTORY FINISHING

A. General:

1. Interior coatings for valves and hydrants shall be in accordance with AWWA C550, unless otherwise specified.
2. Exterior coating for valves and hydrants shall be in accordance with Section 09 90 00, Painting and Coating.
3. Material in contact with potable water shall conform to NSF/ANSI 61.
4. Exposed safety isolation valves and lockout valves with handles, handwheels, or chain wheels shall be “safety yellow.”

B. Where epoxy lining and coating are specified, factory finishing shall be as follows:

1. In accordance with AWWA C550.
2. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as “fusion” or “fusion bonded” epoxy.
3. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

2.04 VALVES

A. Ball Valves:

1. Type V300 Ball Valve 3 Inches and Smaller for General Water and Air Service:

a. Two-piece, standard port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.
b. Manufacturers and Products:
1) Threaded:
a) Conbraco Apollo; 70-100.
b) Nibco; T-580-70.
c) Or equal.
2) Soldered:
a) Conbraco Apollo; 70-200.
b) Nibco; S-580-70.
c) Or equal.

2. Type V301 Ball Valve 2 Inches and Smaller for General Water and Air Service:
a. Two-piece, full port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.
Manufacturers and Products:
1) Threaded:
a) Conbraco Apollo; 77-100.
b) Nibco; T-585-70.
c) Or equal.
2) Soldered:
a) Conbraco Apollo; 77-200.
b) Nibco; S-585-70.
c) Or equal.

3. Type V306 Stainless Steel Ball Valve 2 Inches and Smaller:
a. Two-piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece, NPT threaded ends, ASTM A276 Type 316 stainless steel ball, reinforced PTFE seats, seals, and packing, adjustable packing gland, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 1,000 psig CWP, complies with MSS SP-110.
b. Manufacturers and Products:
1) Conbraco Apollo; 76F-100 Series.
2) Nibco; T-585-S6-R-66-LL.
3) Or equal.

B. Plug Valves:

1. Type V407 Eccentric Plug Valve 24 Inches to 48 Inches:
   a. 100% Port, nonlubricated type rated 250 psig CWP, drip-tight shutoff with pressure from either direction, ductile-iron body, exposed service flanged ends with drilling per ANSI/ASME B16.1 Class 125 and flange rating of 250 psi flanged joints ends unless otherwise shown, eccentric plug, ductile iron plug material plug coated with NBR, seats welded nickel, stem bearings lubricated stainless steel or bronze, stem seal multiple V-rings or U-cups with O-rings of nitrile rubber, grit seals on both upper and lower bearings.
   b. Provide quarter-turn electric motor actuator with backup handwheel per requirements of this spec section.
   c. Manufacturers and Products:
      1) APCO DeZurik; Style PEF.
      2) Pratt.
      3) Milliken.
      4) Or equal.

2. Type V405 Eccentric Plug Valve 3 Inches to 12 Inches:
   a. Nonlubricated type rated 175 psig CWP, drip-tight shutoff with pressure from either direction, cast-iron body, exposed service flanged ends per ASME B16.1 or grooved ends in accordance with AWWA C606 for rigid joints, buried service mechanical joint ends, unless otherwise shown.
   b. Plug cast iron with round or rectangular port of no less than 80 percent of connecting pipe area and coated with Buna N, seats welded nickel, stem bearings lubricated stainless steel or bronze, stem seal multiple V rings, or U cups with O rings of nitrile rubber, grit seals on both upper and lower bearings.
   c. For buried service, provide external epoxy coating.
   d. Operators:
      1) 3 Inch to 4 Inch Valves: Wrench lever manual.
      2) 6 Inch to 12 Inch Valves: Totally enclosed, geared, manual operator with handwheel, 2 inch nut or chain wheel. Size operator for 1.5 times maximum operating shutoff pressure differential for direct and reverse pressure, whichever is higher. For buried service, provide completely sealed operator filled with heavy lubricant and 2 inch nut.
   e. Manufacturers and Products:
      1) Pratt; Ballcentric.
      2) DeZurik; Style PEC
      3) Type V406 Eccentric Plug Milliken; Millcentric Series 600.

3. Type V406 Eccentric Plug Valve 14 Inches to 20 Inches:

a. Nonlubricated type rated 150 psig CWP, drip-tight shutoff with pressure from either direction, cast-iron body, exposed service flanged ends per ASME B16.1 or grooved ends in accordance with AWWA C606 for rigid joints, buried service mechanical joint ends, unless otherwise shown. Plug cast iron with round or rectangular port of no less than 80 percent of connecting pipe area and coated with Buna N, seats welded nickel, stem bearings lubricated stainless steel or bronze, stem seal multiple V rings, or U cups with O rings of nitrile rubber, grit seals on both upper and lower bearings.
b. Totally enclosed, geared, manual operator with handwheel, 2-inch nut or chain wheel. Size operator for 1.5 times maximum operating shutoff pressure differential for direct and reverse pressure, whichever is higher. For buried service, provide completely sealed operator filled with heavy lubricant and 2-inch nut.
c. For buried service, provide external epoxy coating.
d. Manufacturers and Products:
    1) Pratt; Ballcentric.
    2) DeZurik; Style PEC
    3) Milliken; Millcentric Series 600.

C. Check and Flap Valves:

1. Type V608 Swing Check Valve 2 Inches to 24 Inches:
    a. AWWA C508, flange drilling confirming to ANSI/ASME B16.1, Class 125, with flange rating of 125 psi, ductile-iron body and ductile iron cover, NBR rubber disc sent, 316 stainless steel sent.
    b. Ductile-iron disc and disc arm.
    c. PTFE Packing.
    d. Type 316 stainless steel pivot shaft.
    e. Type 316 stainless steel bushings.
    f. Ductile-iron counterweight assembly.
    g. Provide air cushion cylinder with speed control assembly
    h. Valve shall have a working pressure rating of 250 psi.
    i. Manufacturers and Products:
        1) Dezurik, APCO CVS-250.
        2) Or equal.

D. Stainless Steel Check Valve (Scum Pumps)

1. Swing Check Valve 2 Inches to 24 Inches:
    a. Flange drilling confirming to ANSI/ASME B16.1, Class 125, with flange rating of 125 psi, stainless steel body and cover, NBR rubber disc sent, 316 stainless steel sent.
    b. Stainless Steel disc and disc arm.
    c. PTFE Packing.
    d. Type 316 stainless steel pivot shaft.
    e. Type 316 stainless steel bushings.

f. Stainless steel hing assembly.
g. Valve shall have a working pressure rating of 150 psi.
h. Manufacturers and Products:
   1) FNW 471A Steel Flanged Check Valve.
   2) Or equal.

E. Sewage Pressure Relief Valve

1. 4 Inches to 48 Inches:
   a. Valve body shall be constructed of gray iron casting that confirms to ASTM Specifications A 126 Class B. Internal stainless steel Components shall confirm to ASTM Specification A-743 Grade CF-8 or CF-8M. The threaded assembly shall confirm to ANSI standards.
   b. Type 316 stainless steel seat ring.
   c. Type 316 stainless steel bushings and fasteners
   d. Type 316 stainless steel seat support assembly
   e. The control assembly shall be rigid red brass no less than 0.5" in diameter.
   f. Valve shall have a working pressure rating of 250 psi.
   g. The valve shall be coated with NSF Certified Epoxy (Tenemec Series FC20 or approved equal). Coating shall be in accordance with ANSI/NSF Std. 61 and confirming to AWWA D102 Inside System No. 1
   h. Manufacturers and Products:
      1) Ross Series 70SWR-E
      2) Or equal.

F. Knife Gate Valves at Pump Station:

1. Body material: 316 stainless steel.
2. PTFE braided packing.
3. 304 stainless steel yoke.
4. 316 stainless steel gate.
5. Painted cast iron handwheel.
6. 420 stainless steel roll pin.
7. 316 stainless steel gland.
8. NBR seat ring
9. 304 stainless steel stem.
10. Pressure rating 150 psi.
11. Wafer-style flanges.
12. Provide multi-turn electric actuators.
13. Manufacturer: Dezurik/APCO or equal.

2.05 OPERATORS AND ACTUATORS

A. Manual Operators:

1. General:
   a. For AWWA valves, operator force not to exceed requirements of applicable valve standard. Provide gear reduction operator when force exceeds requirements.
   b. For non-AWWA valves, operator force not to exceed applicable industry standard or 80 pounds, whichever is less, under operating condition, including initial breakaway. Provide gear reduction operator when force exceeds requirements.
   c. Operator self-locking type or equipped with self-locking device.
   d. Position indicator on quarter-turn valves.
   e. Worm and gear operators one-piece design, worm-gears of gear bronze material. Worm of hardened alloy steel with thread ground and polished. Traveling nut type operator's threaded steel reach rod with internally threaded bronze or ductile iron nut.
2. Exposed Operator:
   a. Galvanized and painted handwheel.
   b. Cranks on gear type operator.
   c. Chain wheel operator with tieback, extension stem, floor stand, and other accessories to permit operation from normal operation level.
   d. Valve handles to take a padlock and wheels a chain and padlock.
3. Buried Operator:
   a. Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
   b. Buried service operators to be grease packed and gasketed to withstand submersion in water to 20 feet minimum.
   c. Buried valves shall have extension stems, bonnets, and valve boxes.

B. Electric Motor Actuators, 480 Volts:

1. General:
   a. Comply with latest version of AWWA C542.
   b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of valve.

c. Controls integral with actuator and fully equipped as specified in AWWA C542.
d. Stem protection for rising stem valves.

2. Actuator Operation—General:
   a. Suitable for full 90-degree rotation of quarter-turn valves or for use on multiturn valves, as applicable.
   b. Manual override handwheel.
   c. Valve position indication.
   d. Operate from FULL CLOSED to FULL OPEN positions or the reverse in the number of seconds given in Electric Actuated Valve Schedule.
   e. Nonintrusive Electronic Control: Local controls, diagnostics, and calibration, including limit and torque settings, shall be accomplished non-intrusively. Electronic valve position display with capability to show continuous torque output.
3. Open-Close(O/C)/Throttling(T) Service:
   a. Size motors for one complete OPEN-CLOSE-OPEN cycle no less than once every 10 minutes.
   b. Actuator suitable for throttling operation of valve at intermediate positions.
   c. LOCAL-OFF-REMOTE Selector Switch, padlockable in each position:
      1) Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.
      2) Remote OPEN-STOP-CLOSE momentary control dry contact inputs in REMOTE position. Integral seal-in circuits for remote OPEN and CLOSE commands; valve travel stops when remote STOP contact opens.
      3) Auxiliary contact that closes in REMOTE position.
   d. OPEN and CLOSED indicating lights.
   e. Integral reversing motor starter with built-in overload protection.
4. Limit Switch:
   a. Single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 5 amps at 120 volts ac.
   b. Each valve actuator to have a minimum of two auxiliary transfer contacts at end position, one for valve FULL OPEN and one for valve FULL CLOSED.
   c. Housed in actuator control enclosure.
5. Control Features: Electric motor actuators with features as noted above, and as modified/supplemented in Electric Actuated Valve Schedule.
6. Manufacturers and Products:
   a. Rotork Controls.
   b. Flowserve Limitorque.
   c. EIM.
   d. AUMA.

e. Or equal.

2.06 ACCESSORIES

A. Tagging: 1-1/2-inch diameter stainless steel tag attached with No. 16 solid brass or stainless steel jack chain for each valve operator, and valves 6-inch and larger.

B. Limit Switch:

1. Factory installed NEMA 4X limit switch by actuator manufacturer.

C. T-Handled Operating Wrench where shown on Drawings:

1. Each galvanized operating wrenches, 4 feet long.
2. Manufacturers and Products:
   a. Mueller; No. A-24610.
   b. Clow No.; F-2520.

D. Extension Bonnet for Valve Operator where shown on Drawings: Complete with enclosed stem, extension, support brackets, and accessories for valve and operator.

1. Manufacturers and Products:
   a. Pratt.
   b. DeZurik.

E. Floor Stand where shown on Drawings:

1. Nonrising, heavy pattern, indicating type.
2. Complete with solid extension stem, coupling, handwheel, stem guide brackets, and yoke attachment. Stem length as required to connect valve operating nut and floor stand.
3. Stem Guide: Space such that stem L/R ratio does not exceed 200.
4. Anchor Bolts: Type 304 stainless steel.
5. Manufacturers and Products:
   a. Clow; Figure F-5515.
   b. Mueller, Figure A-26426.

F. Floor Box where shown on Drawings:

1. Plain type, for support of nonrising type stem.
2. Complete with solid extension stem, operating nut, and stem guide brackets. Stem length as required to extend valve operating nut to within 3 inches of finish floor.
3. Stem Guide: Space such that stem L/R ratio does not exceed 200.

4. Anchor Bolts: Type 304 stainless steel.
5. Manufacturers and Products:
   a. Neenah Foundry; R 7506.
   b. Clow; No. F5690.

G. Chain Wheel and Guide where shown on Drawings:

1. Handwheel direct-mount type.
2. Complete with chain.
3. Galvanized or cadmium-plated.
4. Manufacturers and Products:
   a. Clow Corp.; Figure F-5680.
   b. Walworth Co.; Figure 804.
   c. DeZurik Corp.; Series W or LWG.

H. Cast-Iron Valve Box where shown on Drawings: Designed for traffic loads, sliding type, with minimum of 5-1/4-inch ID shaft.

1. Box: Cast iron with minimum depth of 9 inches.
2. Lid: Cast iron, minimum depth 3 inches locking type, marked WATER, or SEWER.
3. Extensions: Cast iron.
4. Two-piece box and lid for valves 4 inches through 12 inches, three-piece box and lid for valves larger than 12 inches with base sized for valve.
5. Valve extension stem for valves with operating nuts 3 feet or greater below finish grade.
6. Manufacturers and Products:
   a. East Jordan Iron Works; Cast-Iron Valve Boxes.
   b. Bingham & Taylor; Cast-Iron Valve Boxes.

I. Concrete Valve Box: Designed for traffic loads, sliding type, with minimum of 10-inch ID shaft.

1. Box: High-density, reinforced concrete, minimum depth 12 inches, cast-iron ring seat.
2. Lid: Cast iron, minimum depth 3 inches, marked WATER or SEWER.
3. Extensions: Concrete.
4. Manufacturers and Products:
   a. Christy Concrete Products; G Series.
   b. BES Concrete Products; G Series.

J. Indicator Post Assembly:

1. Cast or ductile iron post head, bell, and wrench with cast or ductile iron or steel barrel.

2. Plexiglas or equal protected window to indicate OPEN and CLOSED position.
3. Padlockable eye bolt for wrench.
4. Adjustable bury depth. Bury depth as required for valve installation.
5. UL Listed and FM Approved.
6. Manufacturers and Products:
   a. Clow; Style 2945.
   b. Mueller; A-20806.

PART 3 EXECUTION

3.01 INSTALLATION

A. Flange Ends:

1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:

1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

C. PVC Valves: Install using solvents approved for valve service conditions.

D. Valve Installation and Orientation:

1. General:
   a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
   b. Install valves in location for easy access for routine operation and maintenance.
   c. Install valves per manufacturer's recommendations.
2. Gate, Globe, and Ball Valves:
   a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
   b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.
3. Eccentric Plug Valves:
   a. Unless otherwise restricted or shown on Drawings, install valve as follows:
      1) Liquids with suspended solids service with horizontal flow: Install valve with stem in horizontal position with plug up

when valve is open. Install valve with seat end upstream (flow to produce unseating pressure).

2) Liquids with suspended solids service with vertical flow: Install valve with seat in highest portion of valve (seat up).

3) Clean Liquids and Gas Service: Install valve with seat end downstream of higher pressure when valve is closed (higher pressure forces plug into seat).

4. Butterfly Valves:
   a. Unless otherwise restricted or shown on Drawings, install valve a minimum of 8 diameters downstream of a horizontal elbow or branch tee with shaft in horizontal position.
   b. For vertical elbow or branch tee immediately upstream of valve, install valve with shaft in vertical position.
   c. For horizontal elbow or branch tee immediately upstream of valve, install valve with shaft in horizontal position.
   d. When installed immediately downstream of swing check, install valve with shaft perpendicular to swing check shaft.
   e. For free inlet or discharge into basins and tanks, install valve with shaft in vertical position.
5. Check Valves:
   a. Install valve in accordance with manufacturer's instructions and provide required distance from immediate upstream fitting.
   b. Install valve in vertical flow (up) piping only for gas services.
   c. Install swing check valve with shaft in horizontal position.
   d. Install double disc swing check valve to be perpendicular to flow pattern when discs are open.
6. Solenoid Valves: Install in accordance with manufacturer's instructions.

E. Install line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

F. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

G. Extension Stem for Operator: Where depth of valve operating nut is 3 feet or greater below finish grade, furnish operating extension stem with 2-inch operating nut to bring operating nut to a point within 6 inches of finish grade.

H. Torque Tube: Where operator for quarter-turn valve is located on floor stand, furnish extension stem torque tube of a type properly sized for maximum torque capacity of valve.

I. Floor Box and Stem: Steel extension stem length shall locate operating nut in floor box.

3.02 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.

C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.

D. Count and record number of turns to open and close valve; account for discrepancies with manufacturer's data.

E. Set, verify, and record set pressures for relief and regulating valves.

F. Automatic valves to be tested in conjunction with control system testing. Set opening and closing speeds, limit switches, as required or recommended by Engineer.

G. Test hydrostatic relief valve seating; record leakage. Adjust and retest to maximum leakage of 0.1 gpm per foot of seat periphery.

3.03 MANUFACTURER'S SERVICES

A. All valves in this project require manufacturer's field services:

B. Manufacturer's Representative: Present at Site for minimum person-days listed below, travel time excluded:

1. Five person-days for installation assistance and inspection.
2. Three person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

END OF SECTION

SECTION 40 98 06
TRAINING

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The DDC (Direct Digital Control) vendor shall develop and implement a training program that will allow personnel to develop the skills and knowledge necessary to safely and efficiently operate and maintain the all systems of the DCS (Distributed Control System) and related ancillary items.

B. The DDC vendor shall furnish all tools, equipment, materials and supplies, and shall perform all functions and service required to complete the work as specified herein.

C. All training shall be a prerequisite to the Statement of Partial Completion of the Segment, CIP or project. Applicable training specific to any given process area shall be completed prior to cut-over and Beneficial Use of the equipment in that process area.

D. Training shall be provided in the operation and maintenance of equipment manufactured by the DDC vendor, by the manufacturer, and by the manufacturer of specific associated equipment items, other than DCS components. Each of the courses shall be taught by authorized representatives of each respective equipment manufacturer, at the DDC vendor approved staging site, City Operations facility, or other local facility as determined by the City's representative. Each manufacturer's representative shall be fully knowledgeable in the operations and maintenance of their equipment and shall be a full-time instructor under the employ of the respective manufacturer.

E. The DDC vendor shall prepare a complete Training Plan. The Training Plan shall be submitted in accordance with Section 01300, Submittals. The DCS Training Plan will provide the structure and syllabus for training sessions as follows:
   1. In accordance with Division 1, the DDC vendor shall submit a training plan which contains, as a minimum, course outlines and schedules for training to be provided. The training plan shall include:
      a. Course descriptions and syllabuses
      b. Schedule of training courses including dates, duration's, and locations of each class
      c. Resumes of the instructors who will actually implement the plan

2. Courses shall be scheduled in series so as to allow the same personnel to attend more than one training course.
3. The training shall be scheduled in accordance with Division 1.
4. Proposed training materials, including a detailed training agenda itemizing relative emphasis on various topics of each course and support materials shall be submitted to the City's representative in accordance with of Division 1 and Specification 01 33 00, Submittal Procedures.
5. City's representative shall review this outline and provide comments that shall be incorporated into the course.
6. Dedicated hardware and software shall be assigned for training purposes. The live system shall NOT be used for training purposes.
7. Training shall be developed so that home study is not required.
8. Training shall combine classroom and field hands-on training that is structured and scheduled to facilitate trainee comprehension on subject material.
9. The training shall be provided by qualified instructors of the equipment manufacturers or their representative, as approved by the City's representative based on technical and instructional qualifications.
10. Training shall be structured to develop comprehension of the process theory for each system, its component subsystems, and the interrelationship of the operating variables, the responses required for various types of abnormalities, safety precautions, procedures for safe start-up and shutdown, equipment maintenance overview and troubleshooting.
11. Following completion of the training, the DDC vendor shall provide the City's representative six (6) complete hardcopy sets, and one (1) soft copy, of training materials, such as lesson plan, student manual, and support materials for each course.
12. Training shall be provided using the equipment of the same model and family being supplied as part of this project.
13. Training shall be conducted so as not to impact normal plant operations, or the construction schedule.
14. No course shall be provided at the same time as another unless otherwise permitted by the City's representative.
15. All training shall be monitored and approved by the City's representative. Any session or portion thereof deemed unsatisfactory, based on evaluation of the training shall be repeated by the DDC vendor at no additional cost to the CITY.
16. Each course shall be for up to 8 people
17. Training shall utilize actual graphics for each individual plant Segment control services. The use of 'canned' or 'typical' training systems shall be limited to a minimum.

1.2 REFERENCES

1. Divisions 0 – General Conditions
2. Division 1 – General Requirements
3. Specification 01 33 00 – Submittal Procedures
4. Division 26 – Electrical
5. Division 40 – Process Integration

PART 2 – PRODUCTS

2.1 COURSE DESCRIPTIONS

A. Training courses shall be tailored to Operations and Maintenance staff who are already generally familiar with the COMNET DCS. The DDC vendor is responsible for developing several training courses. For each course, the DDC vendor is responsible for developing a curriculum and course materials. The DDC vendor may use its standard training material where applicable.

B. The DDC vendor shall submit a project specific training plan for City review, comment and approval prior to implementing the training.

PART 3 – EXECUTION

3.1 REQUIRED TRAINING:

A. Training is required to educate all system users and selected City representative members. The trainings will occur locally at the DDC vendor approved staging site, Wastewater Operations building or other City facility as directed by the City's representative. Any training aids and/or materials are the responsibility of the DDC vendor.

END OF SECTION

NC MORENA BLVD PUMP STATION AND PIPELINES

PACKAGE A

CONTRACTOR'S RESPONSIBILITIES

1. PURSUANT TO SECTION 4216 OF THE GOVERNMENT CODE, AT LEAST 2 WORKING DAYS PRIOR TO EXCAVATION, YOU MUST CONTACT THE REGIONAL NOTIFICATION CENTER (E.G. UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA) AND OBTAIN AN INQUIRY IDENTIFICATION NUMBER.
2. NOTIFY SDG&E AT LEAST 10 WORKING DAYS PRIOR TO EXCAVATING WITHIN 10' OF SDG&E UNDERGROUND HIGH VOLTAGE TRANSMISSION POWER LINES. (I.E., 69 KV & HIGHER)
3. LOCATE AND RECONNECT ALL SEWER LATERALS. LOCATIONS AS SHOWN ON THE PLANS ARE APPROXIMATE ONLY. LATERAL RECORDS ARE AVAILABLE TO THE CONTRACTOR AT THE WATER DEPARTMENT, 2797 CAMINITO CHOLLAS. LOCATE THE IMPROVEMENTS THAT WILL BE AFFECTED BY LATERAL REPLACEMENTS.
4. EXCAVATE AROUND WATER METER BOX (CITY PROPERTY SIDE) TO DETERMINE IN ADVANCE, THE SIZE OF EACH SERVICE BEFORE TAPPING MAIN.
5. CITY FORCES, WHEN SPECIFIED OR SHOWN ON THE PLANS, WILL MAKE PERMANENT CUTS & PLUGS AND CONNECTIONS.
6. KEEP EXISTING MAINS IN SERVICE IN LIEU OF HIGH-LINING, UNLESS OTHERWISE SPECIFIED SHOWN ON PLANS.
7. THE LOCATIONS OF EXISTING BUILDINGS AS SHOWN ON THE PLAN ARE APPROXIMATE.
8. STORM DRAIN INLETS SHALL REMAIN FUNCTIONAL AT ALL TIMES DURING CONSTRUCTION.
9. UNLESS OTHERWISE NOTED AS PREVIOUSLY POTHOLED (PH), ELEVATIONS SHOWN ON THE PROFILE FOR EXISTING UTILITIES ARE BASED ON A SEARCH OF THE AVAILABLE RECORD INFORMATION ONLY AND ARE SOLELY FOR THE CONTRACTOR'S CONVENIENCE. THE CITY DOES NOT GUARANTEE THAT IT HAS REVIEWED ALL AVAILABLE DATA. THE CONTRACTOR SHALL POTHOLE ALL EXISTING UTILITIES EITHER SHOWN ON THE PLANS OR MARKED IN THE FIELD IN ACCORDANCE WITH THE SPECIFICATIONS SECTION 33-UTILITIES.
10. EXISTING UTILITY CROSSING AS SHOWN ON THE PLANS ARE APPROXIMATE AND ARE NOT REPRESENTATIVE OF ACTUAL LENGTH AND LOCATION OF CONFLICT AREAS. SEE PLAN VIEW.
11. CONTRACTOR SHALL ATTEND PRECONSTRUCTION MEETING AS REQUIRED BY THE MITIGATION MONITORING AND REPORTING PROGRAM PER THE ENVIRONMENTAL IMPACT REPORT.

CONSTRUCTION STORM WATER PROTECTION NOTES

1. TOTAL SITE DISTURBANCE AREA (ACRES) 1.50
   HYDROLOGIC UNIT/ WATERSHED SAN DIEGO/SAN DIEGO RIVER (A)
   HYDROLOGIC SUBAREA NAME & NO. MISSION SAN DIEGO/907.11
2. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF THE
   - ☐ WPCP
     THE PROJECT IS SUBJECT TO MUNICIPAL STORM WATER PERMIT NO. R9-2013-0001 AS AMENDED BY R9-2015-0001 AND R9-2015-0100
   - ☒ SWPPP
     THE PROJECT IS SUBJECT TO MUNICIPAL STORM WATER PERMIT NO. R9-2013-0001 AS AMENDED BY R9-2015-0001 AND R9-2015-0100 AND CONSTRUCTION GENERAL PERMIT ORDER 2009-0009-DWQ AS AMENDED BY ORDER 2010-0014-DWQ AND 2012-0006-DWQ
     TRADITIONAL: RISK LEVEL 1☐ 2☒ 3☐
     LUP: RISK TYPE 1☐ 2☐ 3☐
3. CONSTRUCTION SITE PRIORITY
   ☐ ASBS ☒ HIGH ☐ MEDIUM ☐ LOW

ABBREVIATIONS

ABAND	ABANDON
ABAND'D	ABANDONED
AC	ASBESTOS CEMENT PIPE, ASPHALTIC CONCRETE
AHD	AHEAD
ASSY	ASSEMBLY
BFV	BUTTERFLY VALVE
BK	BACK
BTWN	BETWEEN
CATV	CABLE TV
CI	CAST IRON PIPE
CJP	COMPLETE JOINT PENETRATION
CML&C	CEMENT MORTAR LINED & COATED
CML&TCMC	CEMENT MORTAR LINED & TAPE, CEMENT MORTAR COATED
℄	CENTER LINE
COND	CONDUIT
CONT	CONTINUED, CONTINUATION
CONTR	CONTRACTOR
DB	DIRECT BURIED
DI	DUCTILE IRON
DWG	DRAWING
DS	DIVERSION STRUCTURE
E/O	EAST OF
EB	ENCASED BURIED
EL, ELEV	ELEVATION
ELEC	ELECTRIC
ETC	ETCETERA
ETWU	ESTIMATED TOTAL WATER USE
EX, EXIST	EXISTING
F, FLG	FLANGE
FE	FLANGED END
FF	FINISHED FLOOR
FH	FIRE HYDRANT
FO	FIBER OPTIC
FRP	FIBER REINFORCED PLASTIC
FS	FIRE SERVICE
GV	GATE VALVE
HDPE	HIGH-DENSITY POLYETHYLENE
HGL	HYDRAULIC GRADE LINE
HP	HIGH PRESSURE
HPI	HORIZONTAL POINT OF INTERSECTION
IE, INV EL	INVERT ELEVATION
JT	JOINT
LT	LEFT
MAWA	MAXIMUM APPLIED WATER ALLOWANCE
MAX	MAXIMUM
MCTC	MID-COAST TRANSIT CORRIDOR
MH	MANHOLE
MIN	MINIMUM
MJ	MECHANICAL JOINT
MPS	MORENA PUMP STATION
MTS	SAN DIEGO METROPOLITAN TRANSIT SYSTEM
MTD	MULTIPLE TELEPHONE DUCT
N/O	NORTH OF
NE	NORTH EAST
NO	NUMBER
NW	NORTH WEST
OC	ON CENTER
OHE	OVER HEAD ELECTRIC
OVHD	OVER HEAD
PCC	PORTLAND CEMENT CONCRETE
PCO	PRESSURE CLEANOUT
PLRCP	PLASTIC LINED REINFORCED CONCRETE PIPE
PROP	PROPOSED
PS	PUMP STATION
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
R, RAD	RADIUS
R/W	RIGHT OF WAY
RED	REDUCER
RP	REDUCED BACKFLOW PREVENTER
RT	RIGHT
℄	SURVEY LINE
SANDAG	SAN DIEGO ASSOCIATION OF GOVERNMENTS
SCH	SCHEDULE
SD	STORM DRAIN
SD&IV	SAN DIEGO & IMPERIAL VALLEY RAILROAD
SDA&E	SAN DIEGO ARIZONA & EASTERN RAILROAD
SDG&E	SAN DIEGO GAS & ELECTRIC
SDRSD	SAN DIEGO REGIONAL STANDARD DRAWING
SDSD	SAN DIEGO STANDARD DRAWING
SDTI	SAN DIEGO TROLLEY INC.
SE	SOUTH EAST
SO	STUB OUT
S/O	SOUTH OF
SQ	SQUARE
SS, SST	STAINLESS STEEL
SSPWC	STANDARD SPECIFICATION FOR PUBLIC WORKS CONSTRUCTION
SW	SOUTH WEST
SWQMP	STORMWATER QUALITY MANAGEMENT PLAN
SWR	SEWER
TEL	TELEPHONE
TOC	TOP OF CONCRETE
TW,TOW	TOP OF WALL
TYP	TYPICAL
UNK	UNKNOWN
VC	VITRIFIED CLAY PIPE
WM	WATER METER
WSP	WELDED STEEL PIPE
WTR	WATER
W/	WITH
W/O	WEST OF

EXISTING STRUCTURES

EX WATER MAIN & VALVES		EX TRAFFIC SIGNAL	TS
EX WATER METER		EX STREET LIGHT	SL.
EX FIRE HYDRANT		EX UTILITY POLE	
EX SEWER MAIN & MANHOLES		GAS MAIN	
EX DRAINS		ELEC. COND., OVERHEAD ELEC., TEL. COND., CATV	E OHE T C
EX PAVEMENT (PROFILE)		RAILROAD, TROLLEY TRACKS	
EX GROUND LINE (PROFILE)			

WORK TO BE DONE

THE PROJECT CONSISTS OF THE DEMOLITION OF EXISTING FACILITIES AT THE PROPOSED MORENA PUMP STATION SITE, THE CONSTRUCTION OF A NEW 37.7 MGD MORENA WASTEWATER PUMP STATION FACILITY, INCLUDING ODOR CONTROL SYSTEMS, ELECTRICAL BUILDING, SCREENING FACILITY, HIGH PURITY OXYGEN SYSTEM, MAINTENANCE BUILDING, ASSOCIATED CIVIL SITE WORK INCLUDING STORM DRAINAGE, YARD PIPING, PERIMETER WALLS, ACCESS GATES, PAVEMENT, AND LANDSCAPING.

THE PROJECT ALSO INCLUDES THE CONSTRUCTION OF 48-INCH, 60-INCH & 66-INCH DIVERSION AND OVERFLOW SEWERS, THREE DIVERSION STRUCTURES WITH SLIDE GATES AND JUNCTION STRUCTURE NO. 1.

SITE ADDRESS

887 SHERMAN STREET
SAN DIEGO, CA 92110

LEGAL DESCRIPTION

SEE DWG G-01A

ASSESSOR'S NUMBER

436-451-06-00, 436-451-05-00 & 436-660-47-00

SECURITY PLANS

SECURITY PLANS WILL BE FURNISHED TO THE CONTRACTOR UPON AWARD OF CONSTRUCTION CONTRACT. A BID ALLOWANCE ITEM HAS BEEN IDENTIFIED IN THE BID SCHEDULE.

VICINITY MAP
NOT TO SCALE

PROJECT TEAM

AECOM ENGINEERING - (619) 610.7700
KEH & ASSOCIATES - (760) 891.4180
AIR-X UTILITY SURVEYORS - (760) 480.2347
GMK CONSULTING INC. - (760) 975.3680
MATALON ARCHITECTURE - (858) 483.6587
MICHAEL BAKER INTERNATIONAL - (858) 614.5000

FIELD DATA

BENCHMARK:
THE BASIS OF ELEVATIONS FOR THIS PLAN IN THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29) PER CITY OF SAN DIEGO VERTICAL CONTROL NETWORK BENCHMARK: NBP (NORTH BRASS PLUG) LOCATED AT GAINES AND NAPA STREET.
ELEVATION: 21.742 (FEET)

BASIS OF BEARINGS / COORDINATES:
THE BASIS OF BEARINGS FOR THIS PLAN IS THE CALIFORNIA STATE PLANE COORDINATE SYSTEM OF 1983 (NAD83), EPOCH 1991.35, BASED ON THE LINE BETWEEN CITY OF SAN DIEGO HORIZONTAL CONTROL POINTS 1037 & 1040 PER ROS 14492. I.E. S 75°17'56" E

DATUM: MEAN SEA LEVEL

REFERENCES:
MAP NO. 569 & DRAWING NO. 40421

TOPOGRAPHY SOURCE:
CITY OF SAN DIEGO, GROUND SURVEY AND UTILITIES BY MBI. AERIAL MAPPING BY AEROTEK MAPPING, FLIGHT DATE 1/30/17

OWNER

SAN DIEGO PUBLIC UTILITIES DEPARTMENT
9192 TOPAZ WAY
SAN DIEGO CA. 92123
PHONE NUMBER (858) 292-6300
PROJECT MANAGER NABIL BATTA

ZONING

ZONE:	IL-3-1
CONSTRUCTION TYPE:	V-B
BUILDING CODE YEAR:	2016
EXISTING USE OF BUILDING:	LIGHT INDUSTRIAL
PROPOSED USE OF BUILDING:	MUNICIPAL

LEGEND

IMPROVEMENTS	STANDARD DRAWINGS	SYMBOL
SEWER MAIN	SDS-101, SDS-110 (TYPE C), SDW-161	
SEWER VAULT		
WATER MAIN & APPURTENANCES	SDM-105, SDW-110 SDW-151, SDW-161, SDW-162	
TEMPORARY WATER PIPE	SDM-105, SDW-110 SDW-151, SDW-161	
PROPOSED WATER BEND	SDM-105, SDW-110 SDW-151, SDW-161	
VALVES WITH CAPS AND WELLS	SDW-109, SDW-152, SDW-153, WV-05	
FIRE SERVICE CONNECTION ASSEMBLY & BACKFLOW PREVENTER (WHERE APPLICABLE)	SDW-109, SDW-118, SDW-152, SDW-153, SDW-105	PROPOSED RP IF NEEDED, P.L., RP, FS
6" FIRE HYDRANT ASSEMBLY & MARKER 2-PORT UNLESS SPECIFIED AS 3-PORT	SDW-104, SDW-109, SDW-152, SDW-153	PROPOSED WATER
1" WATER SERVICE UNLESS OTHERWISE SPECIFIED	SDW-107, SDW-134, SDW-136, SDW-137, SDW-138, SDW-150, WS-03	PROPOSED WATER, WM, P.L., W
BLOW-OFF ASSEMBLY	SDW-106, SDW-143, SDW-144, SDW-145, SDW-146, WB-05,	B.O., PROPOSED WATER
AIR & VACUUM VALVE	SDW-117, SDW-158, SDW-159, SDW-160	A.V.
ABANDONED WATER MAIN	WP-03	
CUTTING AND PLUGGING ABANDONED WATER MAIN	WP-03	
TRANSITION / REPAIR COUPLING	SEE APPROVED MATERIALS LIST	E
FLOOD ZONE BOUNDARY		PROPOSED WTR, EX WTR
PROPOSED WATER W/HOSE BIBB		
PROPOSED BACKFLOW PREVENTER ASSEMBLY	SDW-155	
PROPOSED WATER METER	SDW-113, SDW-149	
MANHOLE PIPE CONNECTORS	SDG-108	
SURVEY MONUMENT	M-10, M-10A, M-10B	△
TRENCH RESURFACING	SDG-107	

FOR LANDSCAPING LEGEND SEE SHEET L-01.

FOR IRRIGATION LEGEND SEE SHEET L-02.

FOR ADDITIONAL SYMBOLS SEE CURB RAMP AND TRAFFIC CONTROL SHEETS.

DECLARATION OF RESPONSIBLE CHARGE

* I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THE PROJECT AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE AND THAT THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS. I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE CITY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.

ALAN SHAPIRO — 10/07/20 DATE

MONUMENTATION/SURVEY NOTES

THE CONTRACTOR SHALL BE RESPONSIBLE FOR SURVEY MONUMENTS AND/OR VERTICAL CONTROL BENCHMARKS WHICH ARE DISTURBED OR DESTROYED BY CONSTRUCTION. A LICENSED LAND SURVEYOR OR LICENSED CIVIL ENGINEER AUTHORIZED TO PRACTICE LAND SURVEYING IN THE STATE OF CALIFORNIA SHALL FIELD LOCATE, REFERENCE, AND/OR PRESERVE ALL HISTORICAL OR CONTROLLING MONUMENTS PRIOR TO ANY EARTHWORK, DEMOLITION OR SURFACE IMPROVEMENTS. IF DESTROYED, A LICENSED LAND SURVEYOR SHALL REPLACE SUCH MONUMENT(S) WITH APPROPRIATE MONUMENTS. WHEN SETTING SURVEY MONUMENTS USED FOR RE-ESTABLISHMENT OF THE DISTURBED CONTROLLING SURVEY MONUMENTS AS REQUIRED BY SECTIONS 6730.2 AND 8771 OF THE BUSINESS AND PROFESSIONS CODE OF THE STATE OF CALIFORNIA, A CORNER RECORD OR RECORD OF SURVEY, AS APPROPRIATE, SHALL BE FILED WITH THE COUNTY SURVEYOR. IF ANY VERTICAL CONTROL IS TO BE DISTURBED OR DESTROYED, THE CITY OF SAN DIEGO FIELD SURVEY SECTION SHALL BE NOTIFIED IN WRITING AT LEAST 7 DAYS PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COST OF REPLACING AND VERTICAL CONTROL BENCHMARKS DESTROYED BY THE CONSTRUCTION.

CONSTRUCTION CHANGE / ADDENDUM

CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.
A	11/12/20	1, 22, 92, 103, 155, 156, 170 & (261 New Sheet)	
B	12/2/20	104, 124 & 140	
E	12/30/20	31, 68, 124, 127, 137 & 160	

WARNING
0 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

The City of SAN DIEGO Public Utilities

AS-BUILT INFORMATION

MATERIALS	MANUFACTURER
PIPE CL 235 (WATER)	-
PIPE SDR 35 (SEWER)	-
GATE VALVES	-
FIRE HYDRANTS	-
SEWER MANHOLES	-
REHABILITATE SEWER MANHOLES	-
REHABILITATE SEWER MAIN	-

REGISTERED PROFESSIONAL ENGINEER ALAN B. SHAPIRO Exp. CIVIL STATE OF CALIFORNIA
10/07/20

SPEC. NO.

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 01 OF 274 SHEETS

SEWER WBS B-15141

APPROVED: Nabil Batta FOR CITY ENGINEER — 10/08/2020 DATE
NABIL BATTA PRINT DCE NAME — C63631 RCE#

SUBMITTED BY: NABIL BATTA PROJECT MANAGER
CHECKED BY: J. BERMUDO PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
△A ADDENDUM A	CITY	Nabil Batta	11/23/20	

SEE SHEETS CCS27 COORDINATE
SEE SHEETS CCS83 COORDINATE

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

40421-01-D

△A REVISE WATERSHED NAME.

G-01

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A

COVER SHEET

CONVEYANCE SYSTEM & MORENA PUMP STATION

ADDENDUM E

WEST INFLUENT SEWER PLAN & PROFILE

TRENCHLESS CONSTRUCTION

FRIARS ROAD

STA 9+96.97 START OF ALIGNMENT
STA 10+06.05 60" IE = -4.9+/- IN DIVERSION STRUCTURE NO 1 W/T-LOCK, SEE DWG C-11
STA 10+14.85 48" IE = -5.0 OUT
STA 10+34.15 48" IE = -5.1 IN
STA 10+43.10 72" IE = -5.2 IN DIVERSION STRUCTURE NO 2 W/T-LOCK, SEE DWG C-11
STA 10+52.28 48" IE = -6.0 OUT

PACIFIC HWY EX BRIDGE CLEARANCE = 14.0' (FIELD VERIFY)

R/W SANDAG MCTC R/W
BRIDGE CLEARANCE = 14.0' (FIELD VERIFY)

EX GRADE

RECEIVING SHAFT

EX 8" CI PIPE (ABANDONED) IE = UNKNOWN
EX 30" CI PIPE (ABANDONED) IE = UNKNOWN
EX GAS IE = UNKNOWN
EX 12" CI PIPE IE = -1.0+/-
EX NAVY FUEL LINE IE = -1.0+/-
EX CONC ENCASED CONDUITS IE = UNKNOWN

Q=6.0 MGD
V=5.90 fps
d/D=0.17
Fr=1.50

PIPE OD (TYP)

48" PLRCP @ -0.86%

EX 60" RCP SD (ABANDONED) REMOVE INTERFERING PORTIONS AS NEEDED IE = -2.0+/-

48" PLRCP @ -0.52%
Q=9.60 MGD
V=5.77 fps
d/D=0.25
Fr=1.51

L=876.30'

STA 19+28.58 JUNCTION STRUCTURE NO 1 48" IE = -13.5 IN
STA 19+53.01 JUNCTION STRUCTURE NO 1 60" IE = -13.6 OUT

LAUNCHING SHAFT

66" OVERFLOW SEE DWG C-14 IE = -7.0

48" DIVERSION SEWER SEE DWG C-12 IE = -13.5

60" PLRCP @ -0.14%

L=277.22'

TRENCHLESS CONSTRUCTION

R/W R/W
EX LEVEE
EX GROUND
R/W

EX 18" SD IE = UNKNOWN
ELEC CONDUIT IE = UNKNOWN
FO IE = UNKNOWN

EX 14" HP SLUDGE IE = 1.4+/- FIELD VERIFY

EX 66" SEWER TO BE ABANDONDED IE = 0.0 REMOVE SECTIONS AS NECESSARY

STA 21+73.43 PERIMETER WALL
STA 21+98.00 8' DIA T-LOCK LINED SEWER MANHOLE W/ 2-36" MANWAY AT GRADE
STA 22+08.38 PERIMETER WALL
STA 22+30.23 60" IE = -14.0 IN SEE DWG M-04

Q=37.7 MGD
V=5.24 fps
d/D=0.55
Fr=0.61

SCALE
1"=40' HORIZ.
1"=4' VERT.

NOTE:
1. MICROTUNNELING NOTES: FOR DETAILS SEE DWG C-20. CLSM BACKFILL IN PATH OF MICROTUNNELING SHALL BE COMPATABLE WITH PROPOSED MTBM. SUBMITTAL REQUIRED. BRIDGE MONITORING SHALL BE PERFORMED USING OPTICAL SURVEYING METHODS. SEVERAL LOCATIONS SHALL BE MARKED ON THE BRIDGE TO SURVEY FOR BOTH VERTICAL AND HORIZONTAL MOVEMENT. SURVEYS SHALL BE PERFORMED ONE WEEK PRIOR TO COMMENCEMENT OF CONSTRUCTION, AND ONE WEEK AFTER CONSTRUCTION IS COMPLETE.

10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00

EX 66" SEWER TO BE ABANDONDED, SEE DWG C-26

ELEC INSTRUMENTATION PANEL, SEE DWG E-50
N 1858485.30
E 6268366.98

EX ELEC
EX 8" CI WTR
EX 20" GAS
EX OVERHEAD ELEC

ANNA AVE
SHERMAN ST
MORGAN ST (CLOSED)

INFLUENT SCREENING STRUCTURE
PERIMETER WALL
RECEIVING SHAFT (15'X15')
8' DIA SEWER MANHOLE W/ 2" CHEMICAL INJECTION LINE STA 21+98.00 SEE DWG C-03
PROPOSED PERIMETER WALL
INCLINOMETER, PER DETAIL 1, DWG C-25
EX COLUMN

EX 60" RCP SD (ABANDONED)
EX 72" PLRCP SEWER
PROPOSED 2" PVC FO & 2" ELEC CONDUIT, SEE DWG E-47
DIVERSION STRUCTURE NO 1 STA 10+06.05 SEE DWG C-11
DIVERSION STRUCTURE NO 2 STA 10+43.10 SEE DWG C-11
EX ELEC
EX FO
EX TEL
EX 8" WTR
PACIFIC HWY
FUEL LINE
SEE NOTE 1
SEE NOTE 1
EX UNDERGROUND ENCASED CONDUITS
SANDAG MCTC
R/W
EX RAILROAD BRIDGE SUPPORT
JUNCTION STRUCTURE NO 1 STA 19+28.58, SEE DWG C-10
EX ELEC
CAUTION 900 PSI WORKING PRESSURE
60" PLRCP
R/W LAUNCHING SHAFT
EX 14" HP SLUDGE
LAYDOWN AREA
48" DIVERSION SEWER SEE DWG C-12
EX 12" CI PIPE
EX GAS
MCTC BRIDGE COLUMN SUPPORTS
PROPOSED 2" PVC FIBER OPTIC & 2" PVC ELEC CONDUITS, SEE DWG E-50
FRIARS ROAD
48" PLRCP
EX FO
EX 54" SD
SOIL BORING DS-3 SEE GEOTECHNICAL REPORT
LAYDOWN AREA
SOIL BORING DS-6 SEE GEOTECHNICAL REPORT
EX BRIDGE SUPPORT
HV-100t
0.0g
48" PLRCP
EX FO
EX 54" RCP SD NOT FOUND ON EX DWG 13352-13-D '71 AS REFERENCED AND SHOWN IN CITY GIS
PROPOSED FO & ELEC FOR CONTINUATION SEE DWG C-12
EX COLUMN
EX 90" SD
RECEIVING SHAFT
EX FO
EX 6" PERFORATED PIPE
EX PUMP STATION MH
EX BRIDGE SUPPORT
66" OVERFLOW SEE DWG C-14
TOP OF LEVEE
48" PLRCP
EX 90" RCP SD NOT FOUND ON EX DWG 13352-13-D '71 AS REFERENCED AND SHOWN IN CITY GIS

NOTE:
SEE DWG C-10 FOR ALIGNMENT TABLE.

REFERENCE:

WATER:	NO INFO
SEWER:	11761-2-D, 27591-20-D, 9864-2-AD, 9843-3-AD
STORM DRAIN:	13352-13-D
GAS:	NO INFO
ELECTRIC:	15780 - 18925
CATV TV:	NO INFO
TELEPHONE:	NO INFO
IMPROVEMENTS:	NO INFO
100' SCALE/FIELD BOOK:	D17, E17
THOMAS BROS.:	1268
HGL: 390	

N W E S

0 40 80 120
SCALE 1"=40'

C-09

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A
WEST DIVERSION & PUMP STATION INFLUENT SEWER PLAN & PROFILE

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 31 OF 286 SHEETS

SEWER WBS B-15141

REGISTERED PROFESSIONAL ENGINEER — No. 49036 Exp. — CIVIL — STATE OF CALIFORNIA — 1/17/19

APPROVED FOR CITY ENGINEER — 10/08/2020 DATE
NABIL BATTA PRINT NAME — C63631 RCE#

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ, PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XX/XX			
E ADDENDUM E	CITY		12/30/20	

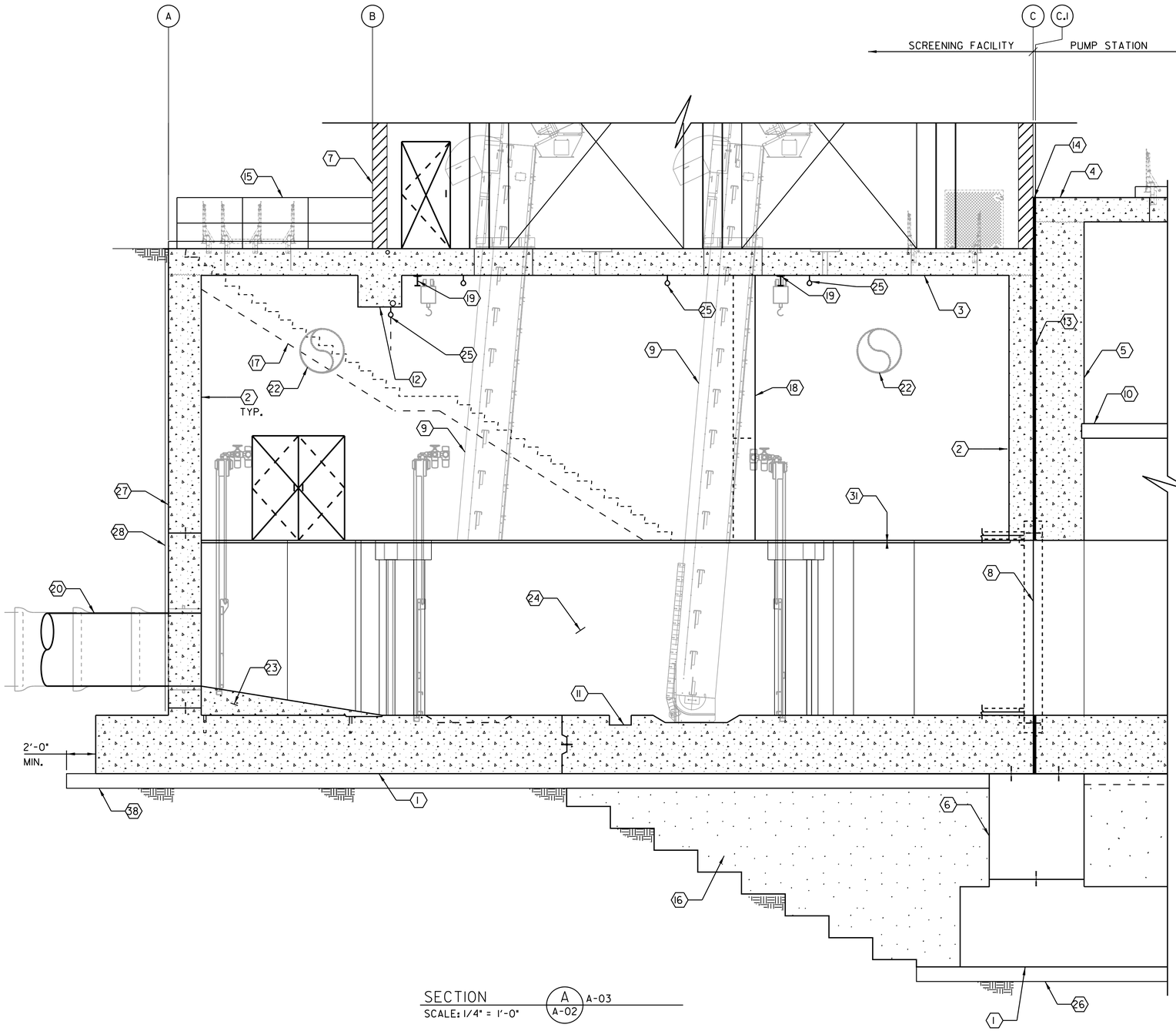
218-1707 CCS27 COORDINATE
6268407-1858444 CCS83 COORDINATE
40421-31-D

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

S:\Projects\San Diego-City of\Morena Pump Sta (AECOM-02-16)\900 CAD\Sheets\Civil\Microstation\Package A\C-09.dgn
December 30, 2020 Morena Pump Station
4/22/2019 jditch

E REVISED LIMITS OF TRENCHLESS

ADDENDUM E



SECTION A A-03 / A-02
SCALE: 1/4" = 1'-0"

KEY NOTES

1. CONCRETE MAT SLAB
2. CONCRETE WALL
3. CONCRETE SLAB
4. PUMP STATION ROOF SLAB
5. PUMP STATION WALL
6. PUMP STATION LOWER WALL
7. CONCRETE BLOCK WALL
8. BACKER ROD AND SEALANT - SEE STRUCTURAL DRAWINGS
9. BAR SCREEN
10. PUMP STATION INTERMEDIATE SLAB
11. SUMP
12. CONCRETE DROP BEAM
13. 1" THICK NEOPRENE JOINT FILLER
14. JOINT SEALANT
15. GUARDRAIL BEYOND
16. SLURRY BACKFILL
17. CONCRETE STAIRS BEYOND
18. END OF INTERIOR STAIRWELL WALL BEYOND
19. MONORAIL BEAM
20. INLET PIPE - SEE MECHANICAL
21. REMOVABLE FRP COVER
22. ODOR CONTROL DUCT WORK - SEE HVAC DRAWINGS FOR SUPPORTS
23. GROUT FILL - SEE STRUCTURAL DRAWINGS
24. COAT SURFACE OF INFLUENT CHANNEL - SEE STRUCTURAL DRAWINGS
25. LIFTING EYE CENTERED OVER FRP STOP PLATE BELOW - SEE STRUCTURAL DRAWINGS
26. 12-INCH THICK WELL GRADED CRUSHED ROCK - COMPACT TO 95% RELATIVE COMPACTION PER ASTM D1557
27. REFER TO STRUCTURAL FOR WATERPROOFING SYSTEM
28. REFER TO STRUCTURAL FOR WATERPROOFING SYSTEM

E

SCREENING FACILITY SECTION

A–10

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A

SCREENING FACILITY
SECTION

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 68 OF 286 SHEETS

SEWER WBS B-15141

APPROVED: FOR CITY ENGINEER — 10/08/2020 DATE
NABIL BATTA PRINT NAME — C63631 RCE#

SUBMITTED BY: NABIL BATTA PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
E ADDENDUM E	CITY		12/30/20	

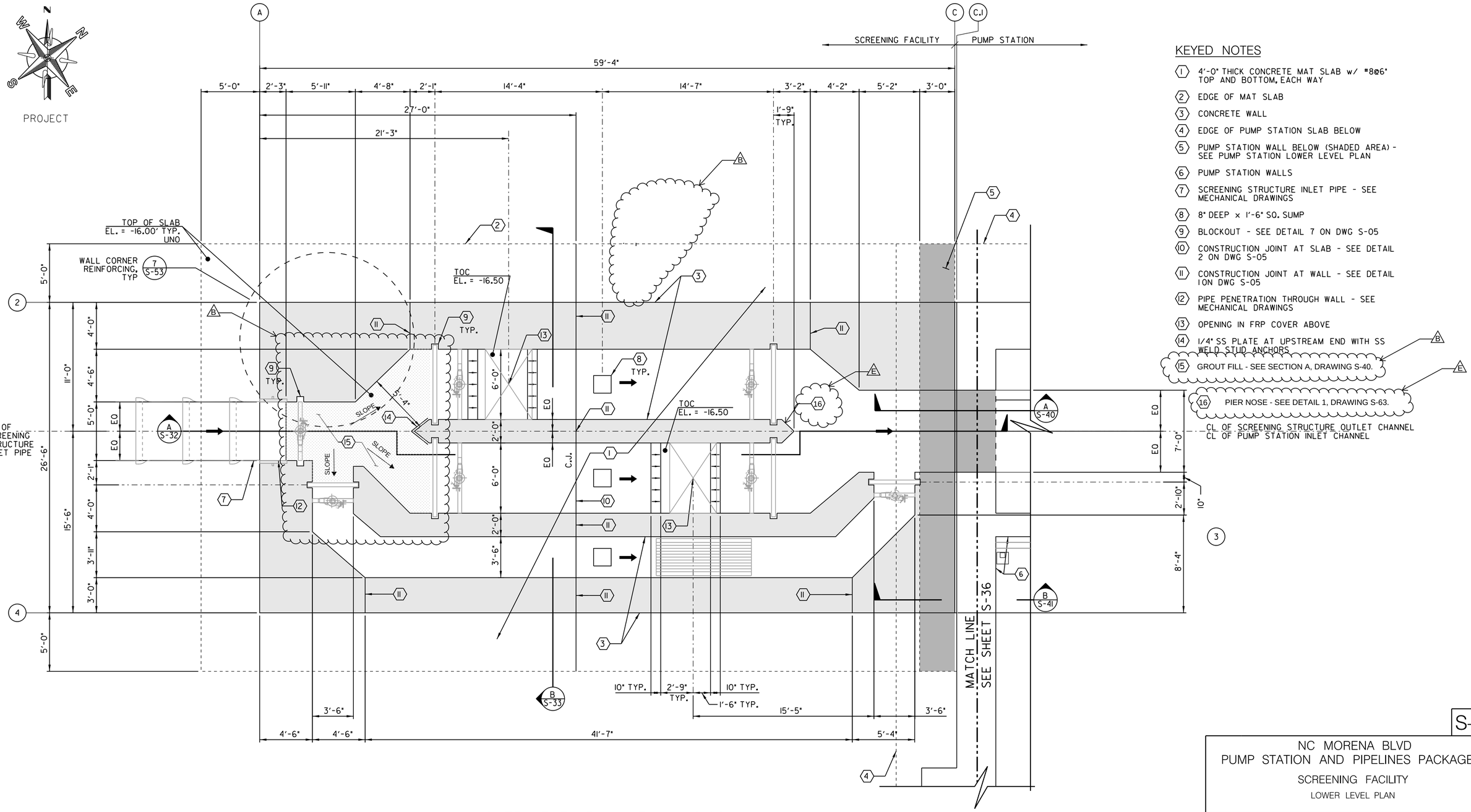
218-1707 CCS27 COORDINATE
6268407-1858444 CCS83 COORDINATE
40421– 68 –D

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

matalon
architecture & planning

E REVISED NOTES 27 & 28

ADDENDUM E



KEYED NOTES

1. 4'-0" THICK CONCRETE MAT SLAB w/ #8@6" TOP AND BOTTOM, EACH WAY
2. EDGE OF MAT SLAB
3. CONCRETE WALL
4. EDGE OF PUMP STATION SLAB BELOW
5. PUMP STATION WALL BELOW (SHADED AREA) - SEE PUMP STATION LOWER LEVEL PLAN
6. PUMP STATION WALLS
7. SCREENING STRUCTURE INLET PIPE - SEE MECHANICAL DRAWINGS
8. 8" DEEP x 1'-6" SQ. SUMP
9. BLOCKOUT - SEE DETAIL 7 ON DWG S-05
10. CONSTRUCTION JOINT AT SLAB - SEE DETAIL 2 ON DWG S-05
11. CONSTRUCTION JOINT AT WALL - SEE DETAIL 1 ON DWG S-05
12. PIPE PENETRATION THROUGH WALL - SEE MECHANICAL DRAWINGS
13. OPENING IN FRP COVER ABOVE
14. 1/4" SS PLATE AT UPSTREAM END WITH SS WELD STUD ANCHORS
15. GROUT FILL - SEE SECTION A, DRAWING S-40.
16. PIER NOSE - SEE DETAIL 1, DRAWING S-63.

LOWER LEVEL PLAN (EL. = -16.00')

SCALE : 1/4" = 1'-0"

NOTE: ALL CHANNELS SHALL BE COATED WITH AN EPOXY COATING, RAVEN LINING SYSTEM 405 OR APPROVED EQUAL. THE EPOXY COATING SHALL COVER THE FLOOR AND EXTEND TO THE TOP OF THE CHANNEL WALLS. THE EPOXY COATING SHALL BE APPLIED AND QUALITY TESTED PER MANUFACTURER RECOMMENDATIONS.

SCREENING FACILITY LOWER LEVEL PLAN

S-27

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A
SCREENING FACILITY
LOWER LEVEL PLAN

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 124 OF 286 SHEETS

SEWER WBS B-15141

APPROVED: FOR CITY ENGINEER — 10/08/2020 DATE
NABIL BATTA PRINT NAME — C63631 RCE#

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ, PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
B ADDENDUM B	CITY	N.C.L. B.H.	12/2/20	
E ADDENDUM E	CITY	N.C.L. B.H.	12/30/20	

218-1707 CCS27 COORDINATE
6268407-1858444 CCS83 COORDINATE
40421-124-D

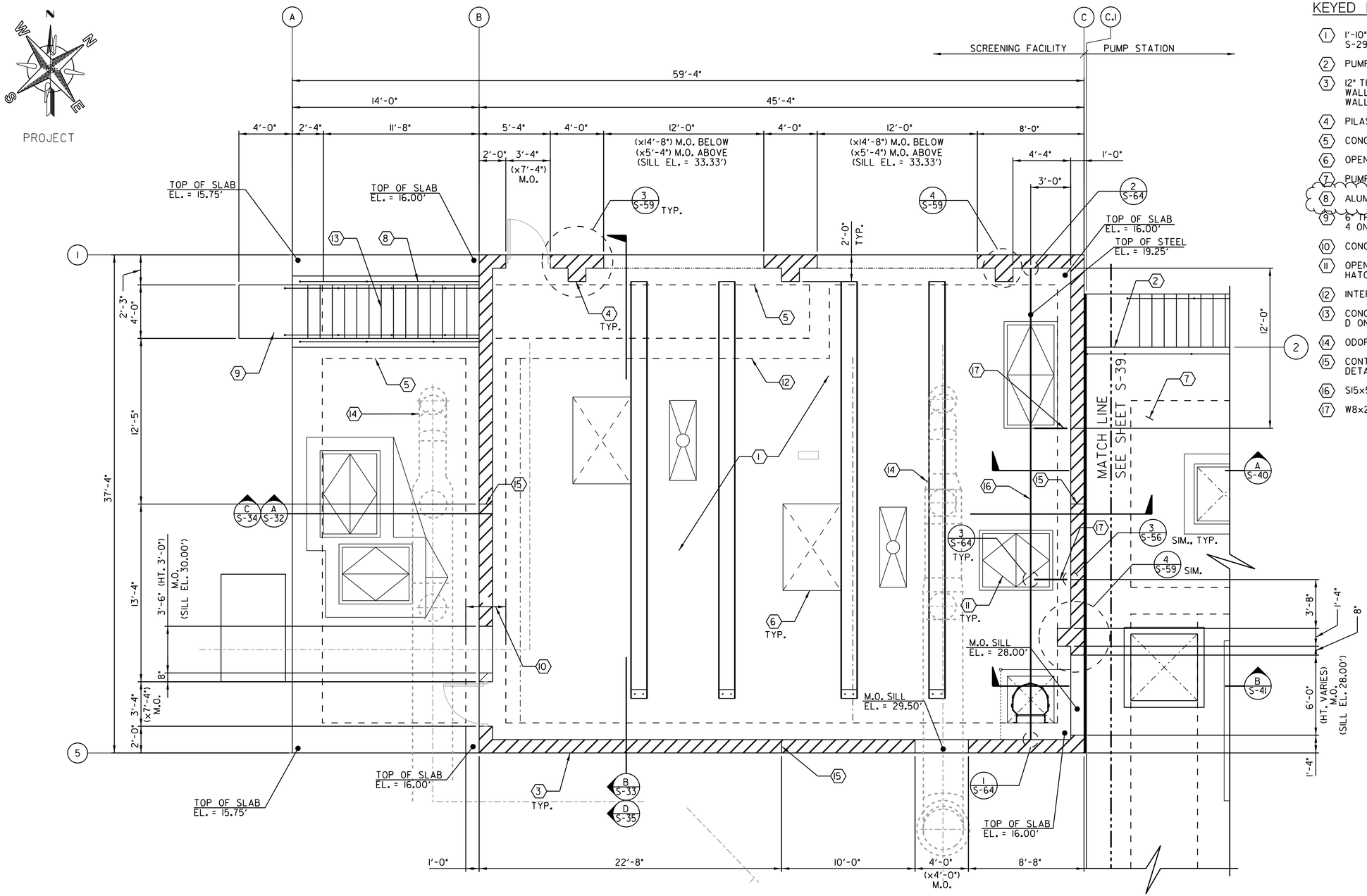
CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

REGISTERED PROFESSIONAL ENGINEER DALE E. WAH No. 2582 STRUCTURAL STATE OF CALIFORNIA 3/19/19

B REVISED KEYED NOTE 15 AND PLAN
E ADDED KEYED NOTE 16

ADDENDUM E

Q:\DCS\Projects\WTR\60530732_SDPureWate\900-CAD-GIS\910-CAD\20-SHEETS\Pkg_A\S\60530732-SHT-STRUCT_S-27.dgn
December 30, 2020 Morena Pump Station
4/22/2019 rothr1



KEYED NOTES

1. 1'-10" THICK CONCRETE SLAB - SEE DWG S-29 FOR REINFORCEMENT
2. PUMP STATION WALL
3. 12" THICK (NOMINAL) CONCRETE BLOCK WALL (FULLY GROUTED) COORDINATE BLOCK WALL CONSTRUCTION WITH ARCH DRAWINGS
4. PILASTER
5. CONCRETE WALL BELOW
6. OPENING IN CONCRETE SLAB
7. PUMP STATION ROOF SLAB
8. ALUMINIUM GUARDRAIL - SEE DETAIL 9 ON DWG S-06
9. 6" THICK CONCRETE LANDING - SEE DETAIL 4 ON DWG S-55
10. CONCRETE DROP BEAM BELOW
11. OPENING IN CONCRETE SLAB FOR ACCESS HATCH - SEE MECHANICAL DWGS FOR SIZE
12. INTERIOR STAIRWELL WALL BELOW
13. CONCRETE STAIRS - SEE STAIR LAYOUT PLAN D ON DWG S-66
14. ODOR CONTROL DUCTWORK BELOW
15. CONTINUOUS VERTICAL JOINT IN WALL - SEE DETAIL 10 ON DWG S-07
16. SI5x50 MONORAIL BEAM
17. W8x24 BRACE BEAM

WALL REINFORCING SCHEDULE			
	REINFORCING	LOCATION	REMARKS
VERTICAL	#5 @ 16" EA. FACE	TYPICAL UNO	
HORIZ.	#5 @ 16" EA. FACE	TYPICAL UNO	LOCATE HORIZ. BARS INSIDE OF VERT. BARS
HORIZ. CHORD BARS	#5 @ 8"	GRIDLINE 1	SEE BOND BEAM DETAILS ON S-57 AS REFERENCED FROM S-31
HORIZ. PIER TIES	#5 @ 8"	GRIDLINE 1	SEE DETAILS 3 & 4 ON SHEET S-59

UPPER LEVEL PLAN 2 (EL. = 16.00')

SCALE : 1/4" = 1'-0"
(CMU WALL INFORMATION)

SCREENING FACILITY - UPPER LEVEL PLAN 2

S-30

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A
SCREENING FACILITY
UPPER LEVEL PLAN 2

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 127 OF 286 SHEETS

REGISTERED PROFESSIONAL ENGINEER DALE E. WAH No. 2582 STRUCTURAL STATE OF CALIFORNIA 5/19/19

APPROVED: FOR CITY ENGINEER — 10/08/2020 DATE
NABIL BATTA PRINT NAME — C63631 RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
E ADDENDUM E	CITY		12/30/20	

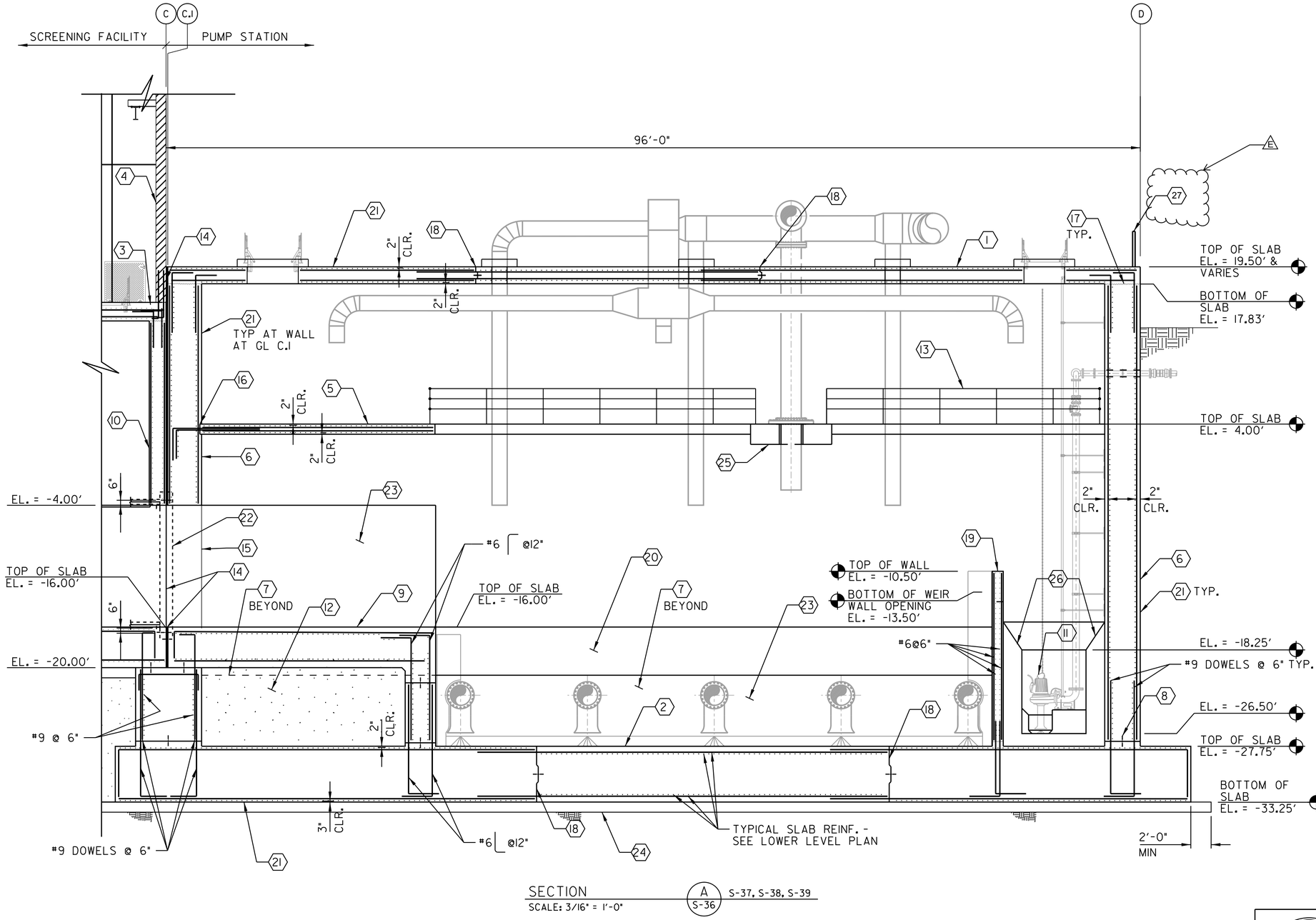
CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

SEWER WBS B-15141
SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
DESIGNED BY: DARIN SANCHEZ, PROJECT ENGINEER
218-1707 CCS27 COORDINATE
6268407-1858444 CCS83 COORDINATE
40421-127-D

Q:\DCS\Projects\WTR\60530732_SDPureWate\900-CAD-GIS\910-CAD\20-SHEETS\Pkg_A\S\60530732-SHT-STRUCT_S-30.dgn
December 30, 2020 Morena Pump Station
4222019 rothr1

E REVISED NOTE 8

ADDENDUM E



SECTION (A / S-36)

SCALE: 3/16" = 1'-0"

S-37, S-38, S-39

KEYED NOTES

1. CONCRETE ROOF SLAB
2. CONCRETE MAT SLAB
3. SCREENING FACILITY UPPER LEVEL FLOOR SLAB
4. SCREENING FACILITY CONCRETE BLOCK WALL
5. CONCRETE WALKWAY - SEE DETAIL 8 ON DWG S-54 FOR REINF
6. CONCRETE WALL w/ #9 @ 6" EW, EF
7. THICKENED LOWER CONCRETE WALL
8. 1-1/2" HIGH STARTER WALL w/ 6" WIDE WATERSTOP
9. RAISED CONCRETE SLAB IN WETWELL - SEE DWG S-37 FOR REINF
10. SCREENING FACILITY CONCRETE WALL
11. SCUM REMOVAL SUMP
12. SLURRY FILL
13. FRP GUARDRAIL - SEE DWG S-38
14. MOVEMENT JOINT AT SLAB AND WALLS - SEE DETAIL 5 ON DWG S-63
15. CONSTRUCTION JOINT
16. 1" DEEP RECESS INTO WALL FOR SLAB - AT CONTRACTOR'S OPTION, THREADED "FORM SAVER" REBAR COUPLERS MAY BE USED AT SLAB/WALL CJ IN LIEU OF DOWELING THRU WALL FORMS
17. ROUGHENED SURFACE AT JOINT (1/4" MIN APPLITUDE)
18. CONSTRUCTION JOINT IN SLAB w/ 6" WATERSTOP - SEE DETAIL 2 ON DWG S-05
19. CONCRETE WEIR WALL
20. SLOPED REINFORCED CONCRETE
21. USE CRYSTALLINE WATERPROOFING ADMIXTURE IN CONCRETE AT BELOW-GRADE WALLS AND SLABS EXPOSED TO OUTSIDE SUBGRADE AND WEATHER - SEE SPECIFICATION SECTION 03 30 00
22. PVC WATERSTOP AROUND INFLUENT OPENING - SEE SCREENING FACILITY
23. COAT ALL INTERIOR SURFACE OF WET WELL THAT DO NOT HAVE T-LOCK
24. 12-INCH THICK WELL GRADED CRUSHED ROCK WRAPPED IN FILTER FABRIC - COMPACT TO 95% RELATIVE COMPACTION PER ASTM D1557
25. CONCRETE BEAM - SEE DETAIL 7 ON DWG S-63
26. CIP CONCRETE SUMP LINER - SEE DETAIL G ON DWG S-44 FOR REINFORCING AND DIMENSIONS/ELEVATIONS
27. ALUMINUM GUARDRAIL (E)

PUMP STATION SECTION

S-40

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A

PUMP STATION

SECTION

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 137 OF 286 SHEETS

SEWER WBS B-15141

APPROVED: FOR CITY ENGINEER — DATE 10/08/2020
NABIL BATTA, PRINT NAME — C63631, RCE#

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ, PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
(E) ADDENDUM E	CITY		12/30/20	

218-1707 CCS27 COORDINATE

6268407-1858444 CCS83 COORDINATE

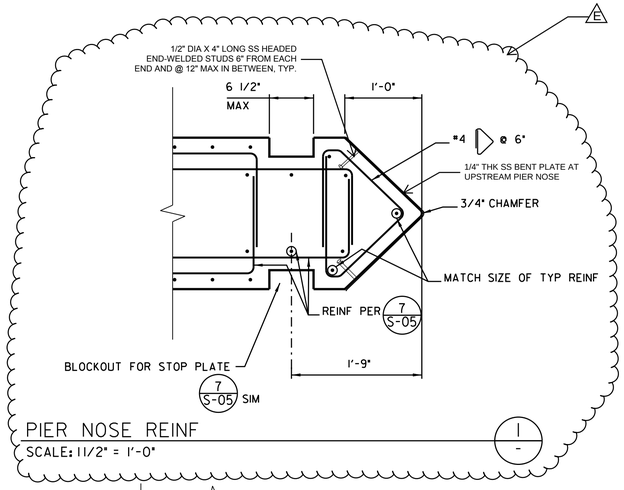
CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

40421-137-D

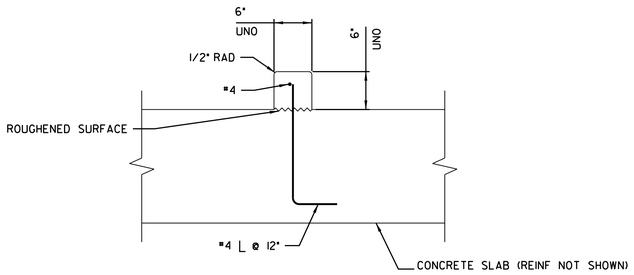
REGISTERED PROFESSIONAL ENGINEER — DALE E. WAH — No. 2582 — CIVIL STRUCTURAL — STATE OF CALIFORNIA — 3/14/20

(E) ADDED KEYED NOTE 27

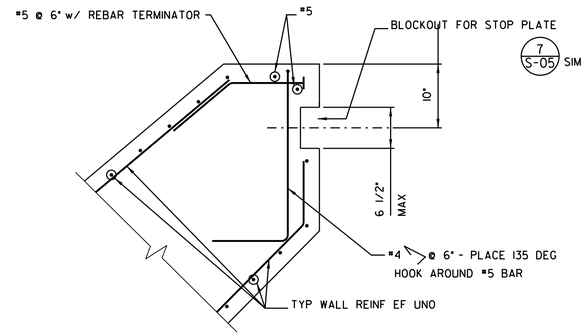
ADDENDUM E



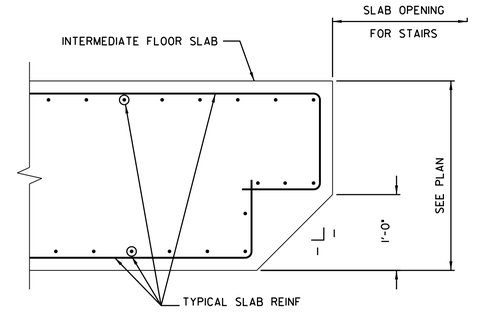
PIER NOSE REINF (1)
SCALE: 11/2" = 1'-0"



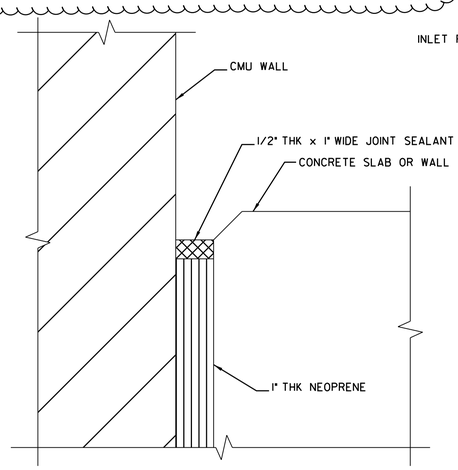
CONCRETE CURB (2)
SCALE: NTS



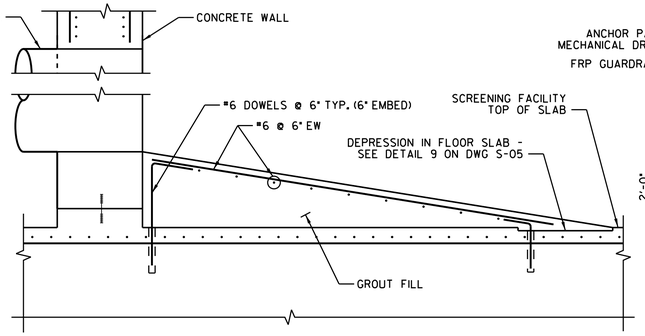
PIER END REINFORCEMENT (3)
SCALE: NTS



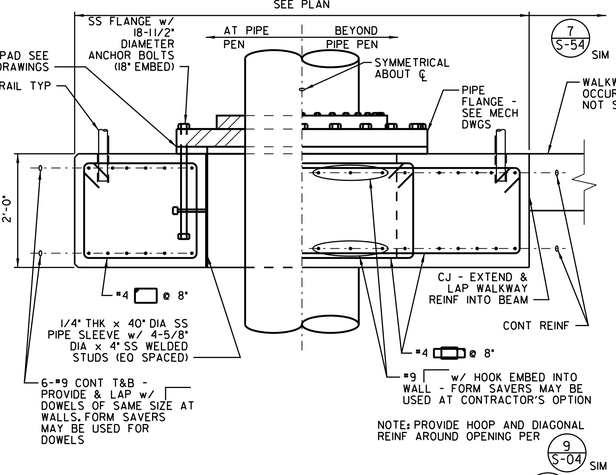
EDGE OF SLAB AT OPENING (4)
SCALE: NTS



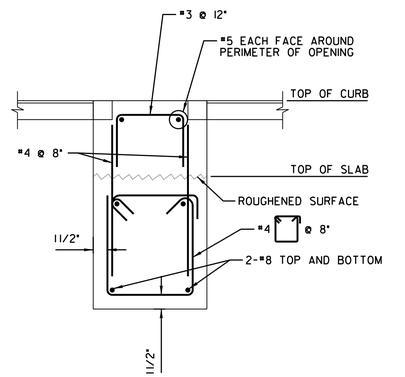
EXPANSION JOINT (5)
SCALE: 3/4" = 1'-0"



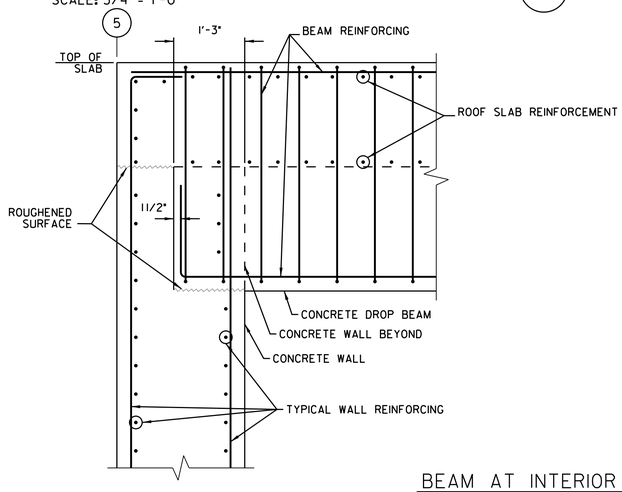
GROUT FILL TIP (6)
SCALE: NTS

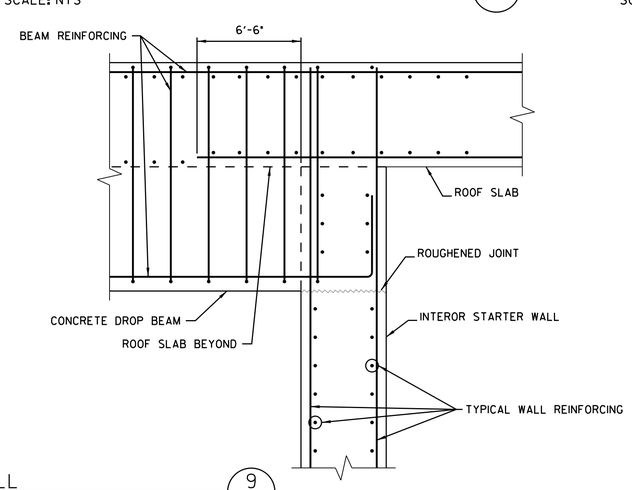


WET WELL BEAM (7)
SCALE: 3/4" = 1'-0"



BEAM BETWEEN HATCH OPENINGS (8)
SCALE: 11/2" = 1'-0"





BEAM AT INTERIOR WALL (9)
SCALE: 3/4" = 1'-0"

STRUCTURAL DETAILS 11

S-63

NC MORENA BLVD
PUMP STATION AND PIPELINES PACKAGE A
STRUCTURAL DETAILS 11

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET 160OF 286 SHEETS

SEWER WBS B-15141

APPROVED: FOR CITY ENGINEER — DATE 10/08/2020
NABIL BATTA, PRINT NAME — RCE# C63631

SUBMITTED BY: NABIL BATTA, PROJECT MANAGER
CHECKED BY: DARIN SANCHEZ, PROJECT ENGINEER

REGISTERED PROFESSIONAL ENGINEER — DALE E. WAH — No. 2582 — STRUCTURAL — STATE OF CALIFORNIA — 3/19/19

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				
E ADDENDUM E	CITY		12/30/20	

SEE SHEETS — CCS27 COORDINATE
SEE SHEETS — CCS83 COORDINATE
CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED
40421-160-D

E ADJUSTED DETAIL 1

ADDENDUM E

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December 30, 2020 Morena Pump Station
4/22/2019 rothr1

FLATIRON

ATTACHMENT A – LETTER OF ASSENT

To be signed by all Contractors awarded work covered by the Project LaborAgreement prior to commencing work.

March 4, 2021

City of San Diego
525 B Street, Suite 750
San Diego, CA 92101

Attention: Lea Fields-Bernard

Re: City of San Diego Project Labor Agreement for Pure Water Program Phase I Project

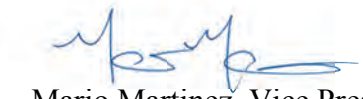
Dear Lea:

This is to confirm Flatiron West, Inc. agrees to be party to and bound by the City of San Diego Project Labor Agreement for Construction of Pure Water Program Phase I Projects, effective May 1, 2020, as such Agreement may from time to time be amended by the negotiating Parties or interpreted pursuant to its terms. Such obligation to be a Party and bound by this Agreement shall extend to all work covered by the Agreement undertaken by this Company on the Project pursuant to City Contract No.K-21-1801-DBB-3-A, Morena Pump Station, and this Company shall require all of its subcontractors of whatever tier to be similarly bound for all work within the scope of the Agreement by signing and furnishing to you an identical Letter of Assent prior to their commencement of work.

Sincerely,

Flatiron West, Inc.

By:



Mario Martinez, Vice President

[Copies of this Letter must be submitted to the Project Labor Coordinator and to the Councilconsistent with Article 3, Section 3.3(b)]

16470 West Bernardo Drive
Suite 120
San Diego, CA 92127

P +1.760.916.9100
F +1.760.916.9101

FLATIRONCORP.COM
A HOCHTIEF Company

Bid Results

Bidder Details

Vendor Name	Flatiron West, Inc.
Address	16470 West Bernardo Drive Suite 120 San Diego, California 92127 United States
Respondee	Mario Martinez
Respondee Title	Vice President
Phone	760-916-9100
Email	mmartinez@flatironcorp.com
Vendor Type	PQUAL, CADIR
License #	772589
CADIR	1000003999

Bid Detail

Bid Format	Electronic
Submitted	01/13/2021 1:57 PM (PST)
Delivery Method	
Bid Responsive	
Bid Status	Submitted
Confirmation #	239317
Ranking	0

Respondee Comment

(cc:jcarter@flatironcorp.com)

Buyer Comment

Bond

eBond Contract ID	

Attachments

File Title	File Name	File Type
Disclosure of Lobbying Activities.pdf	Disclosure of Lobbying Activities.pdf	General Attachments
4500-4 DBE Participation Form_Final.pdf	4500-4 DBE Participation Form_Final.pdf	General Attachments
Commitment to Comply with Skilled and Trained Workforce.pdf	Commitment to Comply with Skilled and Trained Workforce.pdf	General Attachments
Bid Bond.pdf	Bid Bond.pdf	Bid Bond
Debarment and Suspension Certification_Prime.pdf	Debarment and Suspension Certification_Prime.pdf	General Attachments
Debarment Forms_Compressed.pdf	Debarment Forms_Compressed.pdf	General Attachments
4500-3 Revised.pdf	4500-3 Revised.pdf	General Attachments
Mandatory Disclosure of Business Interest.pdf	Mandatory Disclosure of Business Interest.pdf	General Attachments
Contractor's Certification of Pending Actions.pdf	Contractor's Certification of Pending Actions.pdf	General Attachments

Subcontractors

Showing 10 of undefined Subcontractors

Name & Address	Desc	License Num	CADIR	Amount	Type
Condon Johnson 9685 Via Excelencia Suite 106 San Diego, California 921	Stone Columns, Excavation Support systems(Parti	300068	1000004443	$2,100,000.0(	
Forkert Engineering 22311 Brookhurst St Huntington Beach, Califor	Construction Survey	N/A	1000017379	$48,712.00	
G&F Concrete Cutting 13653 ALONDRA BLVD SANTA FE SPRINGS, Ca	Concrete Cutting	590310	1000001776	$111,251.00	DBE, MBE, CADIR, SDB, WOSB
GGG Demolition 1130 West Trenton Ave Orange, California 92867	Demolition and Abatement	988669	1000000629	$242,915.00	
Integrity Rebar Placers 1345 Nandina Avenue Perris, California 92571	Reinforcing Steel	533729	1000005302	$2,482,792.0(	MBE, CADIR, MALE, LAT
Keller North America, Inc. 10303 Channel Road Lakeside, California 9204	Jet Grouting	482246	1000006388	$3,540,000.0(	
National Coating & Lining 26713 Madison Ave Murrieta, California 92532	Paint and Coating	886430	1000013795	$511,239.00	
Select Masonry Contracto 7864 Rhein Court Rancho Cucamonga, Cal	Masonry	777293	1000042912	$704,817.00	
Southern Contracting Co. 559 N. Twin Oaks Valley I San Marcos, California 92	Electrical and I and C	222252	1000002172	$6,500,000.0(	CADIR
Ward & Burke Tunnelling 20 S 3rd Street, Suite 210 Columbus, Ohio 43215	Microtunnelin	1050689	1000553016	$14,534,308.(	

Line Items

Item #	Item Description	UOM	QTY	Unit Price	Line Total	Comment
Main Bid					$110,386,350.	
1	Mobilization	LS	1	$2,000,000.00	$2,000,000.00	
2	Bonds (Payment and Performance)	LS	1	$72,000.00	$72,000.00	
3	Field Office	LS	1	$300,000.00	$300,000.00	
4	Surface Improvements	LS	1	$100,000.00	$100,000.00	
5	Traffic Control	LS	1	$450,000.00	$450,000.00	
6	Stone Columns	LS	1	$3,000,000.00	$3,000,000.00	
7	Demolition of Site and Structures	LS	1	$1,000,000.00	$1,000,000.00	
8	Influent, Diversion and Overflow Sewers	LS	1	$25,000,000.00	$25,000,000.0	
9	Sherman St., Sewer Relocation 8" SDR 26 PVC	LF	200	$600.00	$120,000.00	
10	Sherman St., Sewer Relocation - 4'x3' Manhole	EA	3	$10,000.00	$30,000.00	
11	Sherman St., Sewer Relocation - Sewer Bypass	LS	1	$11,000.00	$11,000.00	

12	Sherman St., Sewer Relocation - Sewer Lateral with Private Replumbing	EA	2	$7,000.00	$14,000.00
13	Sherman St., Sewer Relocation - Connection to Exist Sewer Main	EA	2	$12,000.00	$24,000.00
14	Trench Shoring	LS	1	$15,000.00	$15,000.00
15	Shoring, Bracing and Dewatering of Non Hazardous and Hazardous Contaminated Groundwater	LS	1	$10,000,000.00	$10,000,000.0
16	Abandon Existing 66-Inch Sewer	LF	2439	$150.00	$365,850.00
17	Handling and Disposal of Non-friable Asbestos Material	LF	1	$10,000.00	$10,000.00
18	Morena Pump Station	LS	1	$59,500,000.00	$59,500,000.0
19	Permits and Fees (EOC Type I)	AL	1	$660,000.00	$660,000.00

20	Preparation of Hazardous Waste Management Plan and Reporting	LS	1	$25,000.00	$25,000.00
21	Monitoring of Contaminated Soil	HR	1000	$45.00	$45,000.00
22	Testing, Sampling, Site Storage, and Handling of Petroleum Contaminated Soil	TON	16000	$3.00	$48,000.00
23	Loading, Transportation, and Disposal of Petroleum Contaminated Soil	TON	16000	$3.50	$56,000.00
24	Testing, Sampling, Site Storage, and Handling of Transportation, and Disposal of Containerized RCRA Hazardous Waste	55 GAL Drum	1	$2,500.00	$2,500.00

25	Testing, Sampling, Site Storage, and Handling of Transportation, and Disposal of Containerized RCRA Non-Hazardous Waste	55 GAL Drum	1	$2,500.00	$2,500.00
26	Testing, Sampling, Site Storage, and Handling of Transportation, and Recycling/Disposal Of Universal Waste (Lightbulbs)	LS	1	$5,000.00	$5,000.00
27	Dewatering Permit and Discharge Fees (EOC Type I)	AL	1	$100,000.00	$100,000.00
28	SWPPP Development	LS	1	$25,000.00	$25,000.00
29	SWPPP Implementation	LS	1	$250,000.00	$250,000.00
30	SWPPP Permit Fee (EOC Type I)	AL	1	$5,000.00	$5,000.00
31	Suspension of Work - Resources	DAY	5	$7,000.00	$35,000.00

32	Sewer Bypass and Pumping Plan (Diversion Plan)	LS	1	$750,000.00	$750,000.00
33	Field Orders (EOC Type II)	AL	1	$5,016,000.00	$5,016,000.00
34	Security Systems (EOC Type I)	AL	1	$657,500.00	$657,500.00
35	Portable Changeable Message Signs (EOC Type I)	MO	180	$400.00	$72,000.00
36	Dispute Resolution Board (EOC Type I)	AL	1	$50,000.00	$50,000.00
37	Integration Period Support	LS	1	$550,000.00	$550,000.00
38	Potholing for Shoring	LS	1	$20,000.00	$20,000.00
Grand Total	$110,386,350.00				

PHASED FUNDING SCHEDULE AGREEMENT

The particulars left blank below, such as the total number of phases and the amounts assigned to each phase, will be completed with funding specific information from the Pre-Award Schedule and Construction Cost Loaded Schedule submitted to and approved by the City.

BID NUMBER: K-21-1801-DBB-3-A

CONTRACT OR TASK TITLE: Morena Pump Station

CONTRACTOR: Flatiron West, Inc.

Funding Phase	Phase Description	Phase Start	Phase Finish	Not-to-Exceed Amount
1	Mobilization, procurement, demolition, shoring, ground improvements, dewatering, swppp, excavation, PS concrete, Elec bldg. concrete and architectural, HPO system concrete, microtunneling and associated structures, traffic control	NTP	8/31/2022	$53,531,000
2	Complete PS Concrete, backfill PS, PS Mechanical & Piping, PS Electrical and Instruments, Hydromodification tank, PS Architectural, PS HVAC and Odor Control, HPO Mechanical & Electrical, Electrical Equipment, Yard Piping, Complete microtunneling and Friars road restoration	9/1/2022	8/31/2023	$44,446,000
3	Complete PS Electrical, Maintenance Building, CMU Screen Wall, Site flatwork and paving, Site Landscaping, O&M manuals, Start-Up/Functional and Performance Testing, 120 Day Integration Testing	9/1/2023	8/31/2024	$11,297,000

4	Continue 120 day Integration Testing, 30 Day Acceptance testing, Punchlist, Demobilization	9/1/2024	Final Completion & Project Acceptance	$1,112,350
			Contract Total	$110,386,350.00

Notes:

1) WHITEBOOK section 6-1.4, "Phased Funding Compensation" applies.
2) The total of all funding phases shall be equal to the TOTAL BID PRICE as shown on BID SCHEDULE 1 - PRICES.
3) This PHASED FUNDING SCHEDULE AGREEMENT will be incorporated into the CONTRACT and shall only be revised by written modifications to the CONTRACT.

CITY OF SAN DIEGO

PRINT NAME: Steve Lindsay
Construction Senior Engineer

Signature: _____

Date: 3/16/21

PRINT NAME: Reyhaneh Martin
Design Senior Engineer

Signature: Reyhaneh Martin

Date: 3/15/2021

CONTRACTOR

PRINT NAME: Mario Martinez

Title: Vice President

Signature: _____

Date: March 12, 2021