

City of San Diego

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D.Manela/J.Borja/egz

BIDDING DOCUMENTS



FOR ORIGINAL



PUMP STATION 2 POWER RELIABILITY AND SURGE PROTECTION

BID NO.: K-17-1456-DBB-3
SAP NO. (WBS/IO/CC): S-00312
CLIENT DEPARTMENT: 2012
COUNCIL DISTRICT: 2
PROJECT TYPE: BP

THIS CONTRACT WILL BE SUBJECT TO THE FOLLOWING:

- PHASED-FUNDING
- FEDERAL EQUAL OPPORTUNITY CONTRACTING REQUIREMENTS.
- PREVAILING WAGE RATES: STATE FEDERAL
- APPRENTICESHIP
- THIS IS A CLEAN WATER STATE REVOLVING FUND FUNDED CONTRACT THROUGH THE CALIFORNIA STATE WATER RESOURCES CONTROL BOARD OF THE STATE OF CALIFORNIA.

BID DUE DATE:

2:00 PM

OCTOBER 27, 2016

CITY OF SAN DIEGO

PUBLIC WORKS CONTRACTS

1010 SECOND AVENUE, 14th FLOOR, MS 614C

SAN DIEGO, CA 92101

R-311217

ENGINEER OF WORK

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

Eric Lovering

09/09/2016

Seal:

1) Registered Engineer/Architect

Date



9/17/16

Seal:

2) For City Engineer

Date



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NOTICE INVITING BIDS

1. **SUMMARY OF WORK:** This is the City of San Diego's (City) solicitation process to acquire Construction services for Pump Station 2 Power Reliability and Surge Protection. For additional information refer to Attachment A.
2. **FULL AND OPEN COMPETITION:** This contract is open to full competition and may be bid on by Contractors who are on the City's current 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 construction cost for this project is **\$41,500,000.**
4. **BID DUE DATE AND TIME ARE: OCTOBER 27, 2016, at 2:00 PM.**
5. **PREVAILING WAGE RATES APPLY TO THIS CONTRACT:** Refer to Attachment D.
6. **LICENSE REQUIREMENT:** The City has determined that the following licensing classification(s) are required for this contract: A
7. **SUBCONTRACTING PARTICIPATION PERCENTAGES:** Subcontracting participation percentages apply to this contract.

7.1. 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 must 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.

- 7.2.** Bid shall be **declared non-responsive** if the Bidder fails any of the following conditions:
1. Submission of GFE documentation, as specified in the **Special Provisions**.
 2. Attending the Pre-Submittal Meeting.

3. Bidder's submission of Good Faith Effort documentation, saved in searchable Portable Document Format (PDF) and stored on 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 within **4 Working Days** of the Bid opening.

8. PRE-BID MEETING:

- 8.1. Prospective Bidders are required to attend the Pre-Bid Meeting. The purpose of the meeting is to discuss the scope of the Project, submittal requirements, the pre-qualification process and any Equal Opportunity Contracting Program requirements and reporting procedures. To request a sign language or oral interpreter for this visit, call the Public Works Contracts Division at (619) 533-3450 at least 5 Working Days prior to the meeting to ensure availability. Failure to attend the Mandatory Pre-Bid Meeting and Pre-Bid Site Visit shall result in the Design-Builder's Bid being deemed non-responsive. The Pre-Bid meeting is scheduled as follows:

Date: **SEPTEMBER 29, 2016**
Time: **10:00 AM**
Location: **1010 Second Avenue Suite 1400 (Large Conference Room)
San Diego, CA 92101**

Attendance at the Pre-Bid Meeting will be evidenced by the Bidder's representative's signature on the attendance roster. It is the responsibility of the Bidder's representative to complete and sign the attendance roster.

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

9. PRE-BID SITE VISIT:

- 9.1. All those wishing to submit a bid **MUST** visit the Work Site with the Engineer. The purpose of the Pre-Bid Site Visit is to acquaint Bidders with the Site conditions. To request a sign language or oral interpreter for this visit, call the Public Works Contracts at (619) 533-3450 at least 5 Working Days prior to the meeting to ensure availability. The Pre-Bid Site Visit is scheduled as follows:

Time: **12:00 PM**
Date: **SEPTEMBER 29, 2016**
Location: **4077 North Harbor Drive, San Diego, CA 92101**

10. AWARD PROCESS:

- 10.1. 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.
- 10.2. Upon acceptance of a Bid, the City will prepare contract documents for execution within approximately 21 days of the date of the Bid opening. The City will then award the Contract within approximately 14 days of receipt of properly signed Contract, bonds, and insurance documents.

- 10.3. 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.
- 10.4. The low Bid will be determined by Base Bid alone.
- 10.5. Once the low bid has been determined, the City may, at its sole discretion, award the contract for the Base Bid alone.

11. SUBMISSION OF QUESTIONS:

- 11.1. The Public Works Department is responsible for opening, examining, and evaluating the competitive Proposals submitted to the City for the acquisition, construction, and completion of any public improvement except when otherwise set forth in these documents. All questions related to this solicitation shall be submitted to:

Public Works Contracts
1010 Second Avenue, 14th Floor
San Diego, California, 92101
Attention: Michelle Muñoz

OR:

MichelleM@sandiego.gov

- 11.2. Questions received less than 14 days prior to the date for opening of Bids may not be considered.
- 11.3. 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.
- 11.4. 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.

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

INSTRUCTIONS TO BIDDERS

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

<http://www.sandiego.gov/cip/bidopps/prequalification.shtml>

- 1.2. The completed application must be submitted online no later than 2 weeks prior to the bid opening. For additional information or the answer to questions about the prequalification program, contact David Stucky at 619-533-3474 or dstucky@sandiego.gov.
- 1.3. Due to the City's fiduciary requirement to safeguard vendor data, 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 an 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 which 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 in 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.shtml>.
- 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 10 Working Days after receiving the Contract forms. See 2-1.1.2, "Joint Venture Contractors" in The WHITEBOOK for details.
7. **PREVAILING WAGE RATES WILL APPLY:** Refer to Attachment D.
8. **SUBCONTRACTING PARTICIPATION PERCENTAGES:** Subcontracting participation percentages apply to this contract. Refer to Attachment E.
9. **INSURANCE REQUIREMENTS:**
- 9.1. 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.
- 9.2. Refer to sections 7-3, "LIABILITY INSURANCE", and 7-4, "WORKERS' COMPENSATION INSURANCE" of the Supplementary Special Provisions (SSP) for the insurance requirements which must be met.
10. **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")	2015	PWPI070116-01
City of San Diego Standard Specifications for Public Works Construction ("The WHITEBOOK")*	2015	PWPI070116-02

Title	Edition	Document Number
City of San Diego Standard Drawings*	2016	PWPI070116-03
Caltrans Standard Specifications	2010	PITS070112-04
Caltrans Standard Plans	2010	PITS070112-05
California MUTCD	2012	PITS070112-06
City Standard Drawings - Updates Approved For Use (when specified)*	Varies	Varies
Standard Federal Equal Employment Opportunity Construction Contract Specifications and the Equal Opportunity Clause Dated 09-11-84	1984	769023
NOTE: *Available online under Engineering Documents and References at: http://www.sandiego.gov/publicworks/edocref/index.shtml		

11. **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 addendum are made effective as though originally issued with the Bid. The Bidders shall acknowledge the receipt of Addenda at the time of bid submission.
12. **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.
13. **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.
14. **SUBCONTRACTOR INFORMATION:**
 - 14.1. **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 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 - General; Paragraph 2-3 Subcontracts, 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.

- 14.2. **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)** 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.
- 14.3. **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.
15. **SUBMITTAL OF "OR EQUAL" ITEMS:** See Section 4-1.6, "Trade Names or Equals" in The WHITEBOOK and as amended in the SSP.
16. **AWARD PROCESS:**
 - 16.1. The Award of this contract is contingent upon the Contractor's compliance with all conditions precedent to Award.
 - 16.2. 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.
 - 16.3. 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.
17. **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.
18. **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 Public Works Contracts.
19. **ONLY ONE BID PER CONTRACTOR SHALL BE ACCEPTED:** 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.

20. **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.

21. **BIDDER'S GUARANTEE OF GOOD FAITH (BID SECURITY):**

21.1. 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.

21.2. 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.

21.3. 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.

21.4. 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. Within twenty-four (24) hours after the bid due date and time, the first five (5) apparent low bidders must provide the City with the original bid security.

21.5. Failure to submit the electronic version of the bid security at the time of bid submission AND failure to provide the original within twenty-four (24) hours may cause the bid to be rejected and deemed **non-responsive**.

22. **AWARD OF CONTRACT OR REJECTION OF BIDS:**

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

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

22.3. 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.

- 22.4. 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.
- 22.5. 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.
- 22.6. 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.
- 22.7. 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.
- 22.8. 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.

23. BID RESULTS:

- 23.1. 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.
- 23.2. 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.

24. THE CONTRACT:

- 24.1. 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.
- 24.2. 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.
- 24.3. 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.

- 24.4. 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.
- 24.5. 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 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.
25. **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, 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.
26. **CITY STANDARD PROVISIONS:** This contract is subject to the following standard provisions. See The WHITEBOOK for details.
- 26.1. The City of San Diego Resolution No. R-277952 adopted on May 20, 1991 for a Drug-Free Workplace.
- 26.2. The City of San Diego Resolution No. R-282153 adopted on June 14, 1993 related to the Americans with Disabilities Act.
- 26.3. The City of San Diego Municipal Code §22.3004 for Pledge of Compliance.
- 26.4. The City of San Diego's Labor Compliance Program and the State of California Labor Code §§1771.5(b) and 1776.
- 26.5. 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.
- 26.6. The City's Equal Benefits Ordinance (EBO), Chapter 2, Article 2, Division 43 of The San Diego Municipal Code (SDMC).
- 26.7. The City's Information Security Policy (ISP) as defined in the City's Administrative Regulation 90.63.

27. PRE-AWARD ACTIVITIES:

- 27.1. 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**.
- 27.2. 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:

Steve P. Rados, Inc., a corporation, as principal, and Travelers Casualty and Surety Company of America, 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 Fifty Six Million Two Hundred Twenty Eight Thousand Dollars and Zero Cents (\$56,228,000.00) for the faithful performance of the annexed contract, and in the sum of Fifty Six Million Two Hundred Twenty Eight Thousand Dollars and Zero Cents (\$56,228,000.00) for the benefit of laborers and materialmen designate 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.

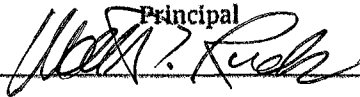
PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND (continued)

The Surety shall pay reasonable attorney's fees should suit be brought to enforce the provisions of this bond.

Dated January 6, 2017

Approved as to Form


Steve P. Rados, Inc.

By 
Principal

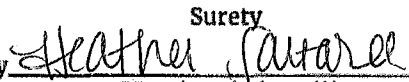
Walter S. Rados

Printed Name of Person Signing for Principal


Mara W. Elliott, City Attorney

By 
Deputy City Attorney

Travelers Casualty and Surety Company of America

By 
Surety
Heather Saltarelli
Attorney-in-fact

Approved

By 
Mayor or Designee

21688 Gateway Center Drive

Local Address of Surety

Diamond Bar, CA 91765

Local Address (City, State) of Surety

(909) 612-3675

Local Telephone No. of Surety

Premium \$ 351,947.00

Bond No. 106512442

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

CIVIL CODE § 1189

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.

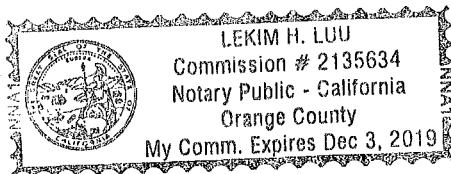
State of California)
County of Orange)

On JAN 06 2017 before me, Lekim H. Luu, Notary Public
Date Here Insert Name and Title of the Officer
personally appeared Heather Saltarelli
Name(s) of Signer(s)

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.



Signature [Handwritten Signature]
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document

Title or Type of Document: _____ Document Date: _____
Number of Pages: _____ Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____
 Corporate Officer -- Title(s): _____
 Partner -- Limited General
 Individual Attorney in Fact
 Trustee Guardian or Conservator
 Other: _____
Signer Is Representing: _____

Signer's Name: _____
 Corporate Officer -- Title(s): _____
 Partner -- Limited General
 Individual Attorney in Fact
 Trustee Guardian or Conservator
 Other: _____
Signer Is Representing: _____



POWER OF ATTORNEY

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company

St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company

Attorney-In Fact No. 230992

Certificate No. 006959357

KNOW ALL MEN BY THESE PRESENTS: That Farmington Casualty Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company are corporations duly organized under the laws of the State of Connecticut, that Fidelity and Guaranty Insurance Company is a corporation duly organized under the laws of the State of Iowa, and that Fidelity and Guaranty Insurance Underwriters, Inc., is a corporation duly organized under the laws of the State of Wisconsin (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint

Jeri Apodaca, Rhonda C. Abel, Kim Luu, Mike Parizino, Rachelle Rheault, James A. Schaller, Heather Saltarelli, Maria Guise, and T. Craig Williams

of the City of Newport Beach, State of California, their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, 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 29th day of August, 2016.

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company

St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company



State of Connecticut
City of Hartford ss.

By: [Signature]
Robert L. Raney, Senior Vice President

On this the 29th day of August, 2016, before me personally appeared Robert L. Raney, who acknowledged himself to be the Senior Vice President of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty 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 the corporations 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.



[Signature]
Marie C. Tetreault, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty 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 Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty 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, I have hereunto set my hand and affixed the seals of said Companies this _____ day of JAN 06 2017, 20 ____.


Kevin E. Hughes, Assistant Secretary



To verify the authenticity of this Power of Attorney, call 1-800-421-3880 or contact us at www.travelersbond.com. Please refer to the Attorney-In-Fact number, the above-named individuals and the details of the bond to which the power is attached.

ATTACHMENTS

ATTACHMENT A
SCOPE OF WORK

SCOPE OF WORK

1. **SCOPE OF WORK:** Demolish two office trailers and two natural gas engines and drive systems. Construct building to house two new 3MW Natural Gas Engine Generators, two new 4MW Emergency Diesel Engine Generators, and new switchgear. Upgrade heat exchanger system, two 2250 HP motor and drive systems, accessibility of facility and office space. Provide new fuel storage tank, refueling system, piping, instrumentation, electrical, control and instrumentation for functional operation.
 - 1.1. The Work shall be performed in accordance with:
 - 1.1.1. The Notice Inviting Bids and Plans numbered **38027-1-D** through **38027-285-D** (<ftp://ftp.sannet.gov/OUT/ECP/AEP/P2/>), inclusive.
2. **LOCATION OF WORK:** The location of the Work is as follows:

4077 North Harbor Drive, San Diego, CA 92101
3. **ESTIMATED CONSTRUCTION COST:** The City's estimated construction cost for this project is **\$41,500,000**.
4. **CONTRACT TIME:** The Contract Time for completion of the Work, including the Plant Establishment Period, shall be **1,460 Calendar Days**.
 - 4.1. **CONTRACTOR'S LICENSE CLASSIFICATION:** In accordance with the provisions of California Law, the Contractor shall possess valid, appropriate license(s) at the time that the Bid is submitted. Failure to possess the specified license(s) may render the Bid as **non-responsive** and ineligible for award.
 - 4.2. The City has determined that the following licensing classification(s) are required for this contract:
 - CLASS A

ATTACHMENT B
PHASED FUNDING PROVISIONS

PHASED FUNDING PROVISIONS

1. PHASED FUNDING:

- 1.1.** For phased funded contracts, the City typically secures enough funds for the first 90 days of the contract prior to award. Within 10 Working Days after Bid opening date the Apparent Low Bidder must contact the Project Manager to discuss fund availability and the duration of the first phase and submit the Pre-Award Schedule to the City for approval and preparation of the first Phased Funding Schedule Agreement.
- 1.2.** The Apparent Low Bidder will be required to provide a Pre-award Schedule in accordance with 6-1, "CONSTRUCTION SCHEDULE AND COMMENCEMENT OF THE WORK" and 9-3, "PAYMENT" prior to award of Contract.
- 1.3.** If the Bid submitted by the Apparent Low Bidder is rejected by the City for any reason, the next Apparent Low Bidder is to provide the Pre-Award Schedule within 5 Working Days after receiving notice. This process will continue until the City has selects an Awardee or rejects all Bids.
- 1.4.** The first Phased Funding Schedule Agreement must show the fund availability for the first phase. Upon selection of the Awardee and acceptance by the City of the Pre-Award Schedule, the City will present the first Phased Funding Schedule Agreement to you.
- 1.5.** At the City's request, meet with the City's project manager before execution of the first Phased Funding Schedule Agreement to discuss their comments and requests for revision to the Pre-Award Schedule.
- 1.6.** Your failure to perform the any of the following may result in the Bid being rejected as non-responsive:
 1. Meet with the City's project manager, if requested to do so, to discuss and respond to the City's comments regarding the Pre-Award Schedule,
 2. Revise the Pre-Award Schedule as requested by the City within the specified 22 Working Days timeframe, or
 3. Execute the first Phased Funding Schedule Agreement within a day after receipt.

PHASED FUNDING SCHEDULE AGREEMENT

Check one:

- First Phased Funding Schedule Agreement
- Final Phased Funding Schedule Agreement

BID NUMBER: K-17-1456-DBB-3 Phase Funding

CONTRACT TITLE: Pump Station 2 – Power Reliability and Surge protection

CONTRACTOR: Steve P. Rados, Inc.

Funding Phase	Phase Description	Phase Start	Phase Finish	Not-to-Exceed Amount
1	Bonds/Insurance, Mobilization, Submittals	NTP	8/31/17	\$10,000,000
2	Existing Building upgrades, New building footprint	9/1/17	8/31/18	\$7,000,000
3	New building construction, Fuel station, Release/test/delivery of Generators	9/1/18	8/31/19	\$16,000,000
4	Existing Pump station upgrades, APCD permitting, Facility Testing/Commissioning	9/1/19	8/31/20	\$12,000,000
5	Upgrade pump engines, Site/yard construction, closeout	9/1/20	NOC	\$11,228,000
Total				\$56,228,000

Notes:

- (1) City Supplement 9-3.6, "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 a written modification to the CONTRACT.

CITY OF SAN DIEGO
By: B. David Manela

CONTRACTOR
By: Walter S. Rados

Name: B. David Manela
Project Manager

Name: Walter S. Rados

Department Name: Public Works-Engineering

Title: Co-President

Date: 6-12-17

Date: 6-12-17

END OF PHASED FUNDING SCHEDULE AGREEMENT

ATTACHMENT C
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ATTACHMENT D
CLEAN WATER STATE REVOLVING FUND (CWSRF)
FUNDING AGENCY PROVISIONS

FUNDING AGENCY PROVISIONS

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

1. NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246).

1.1. 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:

	<u>Goal</u>
1. Minority Participation:	16.9%
2. Female Participation:	6.9%

1.2. 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 Work.

1.3. 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.

1.4. 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.

1.5. 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.

2. EQUAL OPPORTUNITY CLAUSES:

2.1. 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.

3. STANDARD FEDERAL EQUAL EMPLOYMENT SPECIFICATIONS:

3.1. The Contractor is required to comply with the 16 "Standard Federal Equal Employment Specifications" located at 41 CFR 60-4.3 for federal and federally-assisted construction contracts in excess of \$10,000, set forth below.

3.2. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of 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 actions steps at least as extensive as the following:

1. 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 2 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.

2. 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.
3. Maintain a current file of the names, addresses and telephone numbers of each minority and female walk-in 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.
4. 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.
5. Develop on-the-job training opportunities, participate in training programs for the area, or both 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 item 2 of section 3.2.
6. 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 agreements; 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.
7. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignments, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as superintendents, foreman, etc., prior to the initiation of 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 dispositions of the subject matter.
8. 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.

9. 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.
10. 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.
11. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.
12. 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.
13. 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.
14. Ensure that all facilities and company activities are non-segregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
15. 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.
16. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

4. VIOLATION OR BREACH OF REQUIREMENTS:

- 4.1. 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.

5. MONTHLY EMPLOYMENT UTILIZATION REPORTS:

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

1. State of California Department of Transportation Payroll Report. Due to the City weekly.
2. 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.

6. RECORDS OF PAYMENTS TO DBEs:

6.1. 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.

7. FEDERAL WAGE REQUIREMENTS FOR FEDERALLY FUNDED PROJECTS:

7.1. 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).

7.2. 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.

7.3. 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.

7.4. The minimum wage rate to be paid by the Contractor and the Subcontractors shall be in accordance with the Federal Labor Standards Provisions (see pages 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.

7.5. 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.

- 7.6. To be eligible for award, each Bidder shall comply with the affirmative action requirements which are contained in the specifications.
- 7.7. 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.
8. **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.
- 8.1. **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.
- 8.1.1. 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.
- 8.1.2. 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.

- 8.2. 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.
- 8.3. 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.
- 8.3.1.** For contracts entered into on or after April 1, 2015, Contractor and their subcontractors shall furnish records specified in Labor Code section 1776 directly to the Labor Commissioner in the manner required by Labor Code section 1771.4.
- 8.4. 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.
- 8.5. 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 design professionals 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 sections 1810 through 1815.
- 8.6. 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.
- 8.7. 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."
- 8.8. 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 Equal Opportunity Contracting Department at 619-236-6000.

8.9. Contractor and Subcontractor Registration Requirements. This project is subject to compliance monitoring and enforcement by the DIR. As of March 1, 2015, no contractor or subcontractor may be listed on a bid or proposal for a public works project unless registered with the DIR pursuant to Labor Code section 1725.5. As of April 1, 2015, a contractor or subcontractor shall not be qualified to bid on, be listed in a bid proposal, or enter into any contract for public work, unless currently registered and qualified to perform public work pursuant to Labor Code section 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 DIR in compliance with Labor Code sections 1771.1 and 1725.5, and Contractor shall provide proof of registration to the City upon request.

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

General Decision Number: CA160001 09/16/2016 CA1

Superseded General Decision Number: CA20150001

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 \$10.15 for calendar year 2016 applies to all contracts subject to the Davis-Bacon Act for which the 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 \$10.15 (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 2016. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/08/2016
1	02/12/2016
2	02/19/2016
3	02/26/2016
4	03/04/2016
5	03/18/2016
6	07/01/2016
7	07/08/2016
8	07/22/2016
9	08/12/2016
10	08/26/2016
11	09/16/2016

ASBE0005-002 07/01/2015

	Rates	Fringes
Asbestos Workers/Insulator (Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems).....	\$ 36.74	19.49
Fire Stop Technician (Application of Firestopping Materials for wall openings and penetrations in walls, floors, ceilings and curtain walls).....	\$ 25.38	16.81

ASBE0005-004 06/29/2015

	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)....	\$ 18.06	10.57

BOIL0092-003 10/01/2012

	Rates	Fringes
BOILERMAKER.....	\$ 41.17	28.27

BRCA0004-008 11/01/2015

	Rates	Fringes
BRICKLAYER; MARBLE SETTER.....	\$ 34.44	17.21

BRCA0018-004 06/01/2014

	Rates	Fringes
MARBLE FINISHER.....	\$ 28.45	11.38
TILE FINISHER.....	\$ 23.78	9.84
TILE LAYER.....	\$ 35.14	14.33

BRCA0018-010 09/01/2013

	Rates	Fringes
TERRAZZO FINISHER.....	\$ 26.59	10.34
TERRAZZO WORKER/SETTER.....	\$ 33.63	11.13

CARP0409-002 07/01/2008

	Rates	Fringes
Diver		
(1) Wet.....	\$ 663.68	9.82
(2) Standby.....	\$ 331.84	9.82
(3) Tender.....	\$ 323.84	9.82
(4) Assistant Tender.....	\$ 299.84	9.82

Amounts in "Rates" column are per day

CARP0409-008 08/01/2010

	Rates	Fringes
Modular Furniture Installer.....	\$ 17.00	7.41

CARP0547-001 07/01/2009

	Rates	Fringes
CARPENTER		
(1) Bridge.....	\$ 37.28	10.58
(2) Commercial Building....	\$ 32.30	10.58
(3) Heavy & Highway.....	\$ 37.15	10.58
(4) Residential Carpenter..	\$ 25.84	10.58
(5) Residential Insulation Installer.....	\$ 18.00	8.16
MILLWRIGHT.....	\$ 37.65	10.58
PILEDRIVERMAN.....	\$ 37.28	10.58

CARP0547-002 07/01/2009

	Rates	Fringes
Drywall		
(1) Work on wood framed construction of single family residences, apartments or condominiums under four stories		
Drywall Installer/Lather...	\$ 21.00	8.58
Drywall Stocker/Scrapper...	\$ 11.00	6.67
(2) All other work		
Drywall Installer/Lather...	\$ 27.35	9.58
Drywall Stocker/Scrapper...	\$ 11.00	6.67

ELEC0569-001 08/31/2015

	Rates	Fringes
Electricians (Tunnel Work)		
Cable Splicer.....	\$ 46.88	13.54
Electrician.....	\$ 46.13	13.51
Electricians: (All Other		

Work, Including 4 Stories
Residential)

Cable Splicer.....	\$ 41.75	13.38
Electrician.....	\$ 41.00	13.36

ELEC0569-005 06/06/2016

	Rates	Fringes
Sound & Communications		
Sound Technician.....	\$ 30.22	12.21

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

ELEC0569-006 10/05/2015

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.....	\$ 29.50	8.31
Utility Technician #2.....	\$ 24.65	8.16

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 06/06/2016

	Rates	Fringes
ELECTRICIAN (Residential, 1-3 Stories).....	\$ 31.69	3%+6.61

ELEC1245-001 06/01/2015

	Rates	Fringes
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LINE CONSTRUCTION

(1) Lineman; Cable splicer..\$ 52.85	15.53
(2) Equipment specialist (operates crawler tractors, commercial motor vehicles, backhoes, trenchers, cranes (50 tons and below), overhead & underground distribution line equipment).....\$ 42.21	14.32
(3) Groundman.....\$ 32.28	14.03
(4) Powderman.....\$ 47.19	14.60

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

ELEV0018-001 01/01/2015

	Rates	Fringes
ELEVATOR MECHANIC.....\$ 49.90		28.38

FOOTNOTE:

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.
PAID HOLIDAYS: New Years Day, Memorial Day, Independence Day,
Labor Day, Veterans Day, Thanksgiving Day, Friday after
Thanksgiving, and Christmas Day.

* ENGI0012-003 07/01/2016

	Rates	Fringes
OPERATOR: Power Equipment (All Other Work)		
GROUP 1.....\$ 39.95		23.35
GROUP 2.....\$ 40.73		23.35
GROUP 3.....\$ 41.02		23.35
GROUP 4.....\$ 42.51		23.35
GROUP 5.....\$ 41.86		23.35
GROUP 6.....\$ 41.83		23.35
GROUP 8.....\$ 42.84		23.35
GROUP 9.....\$ 42.19		23.35
GROUP 10.....\$ 42.96		23.35
GROUP 11.....\$ 42.31		23.35
GROUP 12.....\$ 43.13		23.35
GROUP 13.....\$ 43.23		23.35
GROUP 14.....\$ 43.26		23.35
GROUP 15.....\$ 43.34		23.35
GROUP 16.....\$ 43.46		23.35
GROUP 17.....\$ 43.63		23.35
GROUP 18.....\$ 43.73		23.35
GROUP 19.....\$ 43.84		23.35

GROUP 20.....	\$ 43.96	23.35
GROUP 21.....	\$ 44.13	23.35
GROUP 22.....	\$ 44.23	23.35
GROUP 23.....	\$ 44.34	23.35
GROUP 24.....	\$ 44.46	23.35
GROUP 25.....	\$ 44.63	23.35
OPERATOR: Power Equipment (Cranes, Piledriving & Hoisting)		
GROUP 1.....	\$ 43.20	22.15
GROUP 2.....	\$ 43.98	22.15
GROUP 3.....	\$ 44.27	22.15
GROUP 4.....	\$ 44.41	22.15
GROUP 5.....	\$ 44.63	22.15
GROUP 6.....	\$ 44.74	22.15
GROUP 7.....	\$ 44.86	22.15
GROUP 8.....	\$ 45.03	22.15
GROUP 9.....	\$ 45.20	22.15
GROUP 10.....	\$ 46.20	22.15
GROUP 11.....	\$ 47.20	22.15
GROUP 12.....	\$ 48.20	22.15
GROUP 13.....	\$ 49.20	22.15
OPERATOR: Power Equipment (Tunnel Work)		
GROUP 1.....	\$ 41.80	23.35
GROUP 2.....	\$ 42.58	23.35
GROUP 3.....	\$ 42.87	23.35
GROUP 4.....	\$ 43.01	23.35
GROUP 5.....	\$ 43.23	23.35
GROUP 6.....	\$ 43.34	23.35
GROUP 7.....	\$ 43.46	23.35

PREMIUM PAY:

\$3.75 per hour shall be paid on all Power Equipment Operator work on the following 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, 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, SBM 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 which 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 08/01/2015

	Rates	Fringes
OPERATOR: Power Equipment		
(DREDGING)		
(1) Leverman.....	\$ 49.50	23.60
(2) Dredge dozer.....	\$ 43.53	23.60
(3) Deckmate.....	\$ 43.42	23.60
(4) Winch operator (stern winch on dredge).....	\$ 42.87	23.60
(5) Fireman-Oiler, Deckhand, Bargeman,		

Leveehand.....	\$ 42.33	23.60
(6) Barge Mate.....	\$ 42.94	23.60

IRON0377-002 07/01/2016

	Rates	Fringes
Ironworkers:		
Fence Erector.....	\$ 28.33	20.64
Ornamental, Reinforcing and Structural.....	\$ 34.75	29.20

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 07/18/2016

	Rates	Fringes
LABORER (BUILDING and all other Residential Construction)		
Group 1.....	\$ 29.42	19.78
Group 2.....	\$ 30.10	19.78
Group 3.....	\$ 30.81	19.78
Group 4.....	\$ 31.61	19.78
Group 5.....	\$ 33.54	19.78
LABORER (RESIDENTIAL CONSTRUCTION - See definition below)		
(1) Laborer.....	\$ 27.32	18.11
(2) Cleanup, Landscape, Fencing (Chain Link & Wood).	\$ 26.03	18.11

RESIDENTIAL DEFINITION: Wood or metal frame construction of single family residences, apartments and condominiums - 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, luteran, 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 11/01/2015

	Rates	Fringes
LABORER (MASON TENDER).....	\$ 29.12	15.39

* LABO0089-004 07/03/2016

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
Laborers:		
Group 1.....	\$ 30.54	19.73
Group 2.....	\$ 31.00	19.73
Group 3.....	\$ 31.41	19.73
Group 4.....	\$ 32.25	19.73
Group 5.....	\$ 36.37	19.73

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, Prefabricated Manhole Installer, Sandblast Nozzleman (Water Blasting-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 tracking, 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 01/01/2016

	Rates	Fringes
Asbestos Removal Laborer.....	\$ 30.43	16.07

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.

LABO1184-001 07/04/2016

	Rates	Fringes
Laborers: (HORIZONTAL DIRECTIONAL DRILLING)		
(1) Drilling Crew Laborer...	\$ 33.65	13.95
(2) Vehicle Operator/Hauler.	\$ 33.82	13.95
(3) Horizontal Directional Drill Operator.....	\$ 35.67	13.95
(4) Electronic Tracking Locator.....	\$ 37.67	13.95
Laborers: (STRIPING/SLURRY SEAL)		
GROUP 1.....	\$ 34.86	17.03

GROUP 2.....	\$ 36.16	17.03
GROUP 3.....	\$ 38.17	17.03
GROUP 4.....	\$ 39.91	17.03

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

 * LAB01414-003 08/03/2016

	Rates	Fringes
LABORER		
PLASTER CLEAN-UP LABORER....	\$ 31.60	19.28
PLASTER TENDER.....	\$ 34.15	19.28

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 07/01/2015

	Rates	Fringes
Painters: (Including Lead Abatement)		
(1) Repaint (excludes San Diego County).....	\$ 27.29	12.83
(2) All Other Work.....	\$ 30.72	12.83

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 10/01/2015

	Rates	Fringes
DRYWALL FINISHER/TAPER		
(1) Building & Heavy Construction.....	\$ 27.84	15.20
(2) Residential Construction (Wood frame apartments, single family homes and multi-duplexes up to and including four stories).....	\$ 21.00	13.91

PAIN0036-012 10/01/2015

	Rates	Fringes
GLAZIER.....	\$ 40.80	17.66

PAIN0036-019 01/01/2016

	Rates	Fringes
SOFT FLOOR LAYER.....	\$ 26.77	13.53

PLAS0200-005 08/06/2015

	Rates	Fringes
PLASTERER.....	\$ 38.44	13.77

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

PLAS0500-001 07/01/2016

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER		
GROUP 1.....	\$ 23.84	22.85
GROUP 2.....	\$ 25.49	22.85
GROUP 3.....	\$ 27.57	22.85

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 07/01/2016

	Rates	Fringes
PLUMBER, PIPEFITTER, STEAMFITTER		
Camp Pendleton.....	\$ 51.69	21.41
Plumber and Pipefitter 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.....	\$ 47.19	21.41
Work ONLY on new additions and remodeling of commercial buildings, bars, restaurants, and stores not to exceed 5,000 sq. ft. of floor space.....	\$ 45.73	20.43
Work ONLY on strip malls, light commercial, tenant improvement and remodel work.....	\$ 35.69	18.76

 PLUM0016-011 07/01/2016

	Rates	Fringes
PLUMBER/PIPEFITTER		
Residential.....	\$ 38.17	17.33

PLUM0345-001 07/01/2014

	Rates	Fringes
PLUMBER		
Landscape/Irrigation Fitter..\$ 29.27		19.75
Sewer & Storm Drain Work....\$ 33.24		17.13

ROOF0045-001 07/01/2012

	Rates	Fringes
ROOFER.....\$ 25.08		7.28

SFCA0669-001 04/01/2016

	Rates	Fringes
SPRINKLER FITTER.....\$ 37.67		19.56

SHEE0206-001 07/01/2015

	Rates	Fringes
SHEET METAL WORKER		
Camp Pendleton.....\$ 37.55		23.23
Except Camp Pendleton.....\$ 35.33		23.23
Sheet Metal Technician.....\$ 25.22		6.69

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

TEAM0036-001 07/06/2015

	Rates	Fringes
Truck drivers:		
GROUP 1.....\$ 15.40		28.69
GROUP 2.....\$ 24.99		28.69
GROUP 3.....\$ 25.19		28.69
GROUP 4.....\$ 25.39		28.69
GROUP 5.....\$ 25.59		28.69
GROUP 6.....\$ 26.09		28.69
GROUP 7.....\$ 27.59		28.69

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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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

10. FEDERAL LABOR STANDARDS PROVISIONS (Office of the Secretary of Labor 29 CFR 5):

Applicability

The Project or Program to which the construction work covered by this contract pertains is being assisted by the United States of America and the following Federal Labor Standards Provisions are included in this Contract pursuant to the provisions applicable to such Federal assistance.

A. 1. Minimum Wages. (i) All laborers and mechanics employed or working upon the site of the work, (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project) 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 29 CFR 5.5(a)(1)(iv); 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 29 CFR 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 29 CFR 5.5(a)(1)(ii) 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.

(ii) (A) 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 Federal Agency or its designee shall approve 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 contracting officer or its designee agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer 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 contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise 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 subparagraphs (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 Federal Agency or its designee shall upon its own action or upon written request of 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 (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the contract, the Federal Agency or its designee 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 preserved for a period of 3 years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project. 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.

(ii) (A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Federal Agency or its designee if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant sponsor, or owner, as the case may be, for transmission to the Federal Agency or its designee. The payrolls submitted 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 weekly transmittals. 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

<http://www.dol.gov/esa/whd/forms/wh347instr.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 Federal Agency or its designee if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant sponsor, or owner, as the case may be, for transmission to the Federal Agency, 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 subparagraph 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 sponsoring government agency (or the applicant, sponsor, or, owner).

(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 29 CFR 5.5 (a)(3)(ii), the appropriate information is being maintained under 29 CFR 5.5(a)(3)(i), 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 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 subparagraph 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.

(iii) The contractor or subcontractor shall make the records required under subparagraph A.3.(i) of this section available for inspection, copying, or transcription by authorized representatives of the Federal Agency or its designee 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, Federal agency or its designee 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 subcontractor'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 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 29 CFR Part 5 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 will insert in any subcontracts the clauses contained in 29 CFR 5.59(a)(1) through (10 and such other clauses as the Federal Agency may by appropriate instructions require, and a copy of the applicable prevailing wage decision, 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 the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. (i) Certification of Eligibility. 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.

b. Contract Work Hours and Safety Standards Act. The provisions of this paragraph b are applicable where the amount of the prime contract exceeds \$100,000. As used in this paragraph, the terms "laborers" and "mechanics" include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which the individual is employed on such work to work in excess of 40 hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of 40 hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in subparagraph (b)(1) of this section, the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a

territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in subparagraph (b)(1) of this paragraph, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by the clause set forth in subparagraph (b)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The Federal Agency or its designee shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contract, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act which is held by the same prime contractor such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in subparagraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in subparagraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in subparagraphs (b)(1) through (4) of this section.

C. In addition to the clauses contained in paragraph (b), in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in Sec. 5.1, the Agency Head shall cause or require the contracting officer to insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Agency Head shall cause or require the contracting officer to insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

11. AGENCY SPECIFIC PROVISIONS:

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

11.1. All EPA Funded Contracts:

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 the Notice Inviting Bids.
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:
1. 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.
 2. 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, whenever possible, posting solicitations for bids or proposals for a minimum of 30 days before the bid or proposal closing date.
 3. 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."
 4. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.
 5. 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.
 6. If the Contractor awards Subcontracts, the Contractor shall take the steps in paragraphs (1) through (5) above.

11.1.1. Semiannual DBE Utilization Reporting:

The Contractor shall report to the City on a semiannual basis, their utilization of Minority Business Enterprise and Women's Business Enterprise Subcontractors and Suppliers using EPA Form 5700-52A.

11.1.2. Clean Water State Revolving Fund (CWSRF) Projects Only:

11.1.3. For contracts subject to CWSRF, refer to Subsection 11.1, "All EPA Funded Contracts" above and the following:

11.1.4. 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.

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

1. Utilization of the US Small Business Administration (SBA) 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 15 Working Days prior to Bid opening and solicitation to DBE Subcontractors at least 10 Working 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 (CWSRF Form 1) 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 3 (or all, if less than 3) 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 5. If a low bid was not accepted, an explanation shall be provided.
8. See "DBE Potential Resources Centers" Section in a later part these specifications.

11.1.6 Semiannual DBE Utilization Reporting:

The Contractor shall report to the City on a semiannual 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 SBA and 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 15 Working Days prior to Bid opening and solicitation to DBE subcontractors at least 10 Working 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 1. 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 3 (or all, if less than 3) 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 5. 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: http://dsbs.sba.gov/dsbs/search/dsp_dsbs.cfm ¹
San Francisco, CA 94105	Bid Notification: https://eweb1.sba.gov/subnet/common/dsp_login.cfm ²
RE: Minority Enterprise Development Offices	
U.S. Department of Commerce	(415) 704-7415
Minority Business Development Agency	Bid Notification: http://www.mbda.gov/workspace ³
555 Montgomery Street	
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	<u>DBE Database:</u> www.dot.ca.gov/hq/bep/find_certified.htm
CA Public Utilities Commission (CPUC) ⁵	
505 Van Ness Avenue	<u>Directory:</u>
San Francisco, CA 94102-3298	https://sch.thesupplierclearinghouse.com/FrontEnd/SearchCertifiedDirectory.asp

Notes:

1. The Contractor shall use the SBA’s Dynamic Business search database for potential subcontractors, suppliers, and/or manufacturers. Provide copy of search records with GFE documentation.

2. The Contractor shall use SUB-Net to post subcontracting opportunities. The 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. Provide copy of the Display Solicitation Record with the GFE documentation.
3. The Contractors shall use MBDA web portal to post subcontracting opportunities. The 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. 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. Provide copy of search records with GFE documentation.
5. CPUC maintains a database of DBE-owned business enterprises and serves to inform the public. Provide copy of search records with GFE documentation.

13. GOOD FAITH EFFORT DOCUMENTATION SUBMITTALS:

13.1. The affirmative GFE steps documentation shall be submitted **within 4 Working Days of 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
PUBLIC WORKS CONTRACTS
1010 SECOND AVENUE, 14TH FLOOR, MS 614C
SAN DIEGO, CA 92101

SUBJECT: AFFIRMATIVE GOOD FAITH EFFORT DOCUMENTATION

BID NO. K-17-1456-DBB-3

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. E-BIDDING FORMS - The following CWSRF shall be completed and submitted within **4 Working Days of 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. | CWSRF Form 1: | Good Faith Effort List of Subcontractors Solicited |
| 3. | CWSRF Form 2: | Good Faith Effort Bids Received List |
| 4. | CWSRF Form 3: | DBE/Contractor Certification |
| 5. | CWSRF Form 4: | DBE Prime Contractor/Recipient Selected |
| 6. | CWSRF Form 5: | Summary of Bids Received from Subcontractors, Suppliers and Brokers |

FUNDING AGENCY PROVISIONS

FORMS

**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. Recipients 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	

Return to:
Barbara August
Division of Financial Assistance
SWRCB
PO Box 944212
Sacramento, CA 94244-2120

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.

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.

ITEM 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

Clean Water State Revolving Fund Loan Program DBE Instructions

FORM 1

DISADVANTAGE BUSINESS ENTERPRISE (DBE)

"GOOD FAITH" EFFORT LIST OF SUBCONTRACTORS SOLICITED

Contractor Name	Contractor Address	How Located	Date of Contact	Contact Method	Task Description	Response (Yes/No)

Form with information required to be submitted with the AOA package.

**Clean Water State Revolving Fund Loan Program DBE Instructions
FORM 2**

**DISADVANTAGE BUSINESS ENTERPRISE (DBE)
“GOOD FAITH” EFFORT BIDS RECEIVED LIST**

Contractor Name	Category (DBE)	Task Description	Bid Amount	Selected (Check)	Explanation for Not Selecting

Form with information required to be submitted with the AOA package.

January 2009

Clean Water State Revolving Fund Loan Program DBE Instructions

FORM 3

DISADVANTAGE BUSINESS ENTERPRISE (DBE)

CONTRACTOR CERTIFICATION

Firm Name:		Phone:	
Address:			
Principal Service or Product:	Bid Amount \$		
PLEASE INDICATE PERCENTAGE OF OWNERSHIP			
<input type="checkbox"/> DBE _____ % Ownership			
<input type="checkbox"/> Prime Contractor		<input type="checkbox"/> Supplier of Material/Service	
<input type="checkbox"/> Subcontractor		<input type="checkbox"/> Broker	
<input type="checkbox"/> Sole Ownership		<input type="checkbox"/> Corporation	
<input type="checkbox"/> Partnership		<input type="checkbox"/> Joint Venture	
Certified by:		Title:	
DBE Sub (ORIGINAL SIGNATURE AND DATE REQUIRED)			
Name:		Date:	

IMPORTANT: CONTRACTORS CAN NO LONGER SELF-CERTIFY. THEY MUST BE CERTIFIED BY EPA, SMALL BUSINESS ADMINISTRATION (SBA), DEPARTMENT OF TRANSPORTATION (DOT) OR BY STATE, LOCAL, TRIBAL OR PRIVATE ENTITIES WHOSE CERTIFICATION CRITERIA MATCH EPA'S. PROOF OF CERTIFICATION MUST BE PROVIDED. A COPY OF THE CONTRACTOR CERTIFICATION MUST BE SUBMITTED WITH THIS FORM.

THIS FORM MUST BE SUBMITTED WITHIN 4 WORKING DAYS AFTER THE BID OPENING DATE.

January 2009

Clean Water State Revolving Fund Loan Program DBE Instructions

FORM 4 (Attachment B)

PRIME CONTRACTOR/RECIPIENT

SELECTED DISADVANTAGE BUSINESS ENTERPRISE (DBE)

CONTRACT RECIPIENTS NAME:		CONTRACT NO. OR SPECIFICATION NO.:	
PROJECT DESCRIPTION:		PROJECT LOCATION:	
PRIME CONTRACTOR INFORMATION			
NAME AND ADDRESS (Include Zip Code, Federal Employer Tax ID #):		AMOUNT OF CONTRACT \$	
DBE INFORMATION			
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> NONE*			
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> DBE		NAME AND ADDRESS (INCLUDE ZIP CODE)	
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> SUBCONTRACTOR	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> SUPPLIER/SERVICE		
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> JOINT VENTURE	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> BROKER		
AMOUNT OF CONTRACT \$			
WORK TO BE PERFORMED			
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> DBE		NAME AND ADDRESS (INCLUDE ZIP CODE)	
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> SUBCONTRACTOR	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> SUPPLIER/SERVICE		
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> JOINT VENTURE	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> BROKER		
AMOUNT OF CONTRACT \$			
WORK TO BE PERFORMED			
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> DBE		NAME AND ADDRESS (INCLUDE ZIP CODE)	
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> SUBCONTRACTOR	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> SUPPLIER/SERVICE		
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> JOINT VENTURE	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> BROKER		
AMOUNT OF CONTRACT \$			
WORK TO BE PERFORMED			
TOTAL DBE AMOUNT: \$ _____			
SIGNATURE OF PERSON COMPLETING FORM: _____			
TITLE: _____ PHONE: _____ DATE: _____			

*Negative reports are required. ORIGINAL SIGNATURE AND DATE REQUIRED. Failure to complete and submit this form within 4 Working Days of bid opening will cause bid to be rejected as non-responsive.

January 2009

Clean Water State Revolving Fund Loan Program DBE Instructions

FORM 5

SUMMARY OF BIDS RECEIVED FROM SUBCONTRACTOR, SUPPLIERS, AND BROKERS (DBE & NON-DBE)						
THIS SUMMARY IS PREPARED BY THE PRIME CONTRACTOR						
Type of Job	Company Name	Selected	Bid Amount	DBE	NON-DBE	Explanation for Not Selecting
List type of jobs alphabetically, from low to high in each category and selected low bidder.						

January 2009

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") currently in effect.
2. The **2015 Edition** of the City of San Diego Standard Specifications for Public Works Construction (The "WHITEBOOK").
 - a) General Provisions (A) for all Contracts.

SECTION 1 – TERMS, DEFINITIONS, ABBREVIATIONS, UNITS OF MEASURE, AND SYMBOLS

- 1-2 TERMS AND DEFINITIONS.** To the City Supplement, item 54, "Normal Working Hours", ADD the following:

The **Normal Working Hours** are 8:30 AM to 3:30 PM. or as designated on Traffic Control Permit

SECTION 2 - SCOPE AND CONTROL OF WORK

- 2-3.2 Self Performance.** DELETE in its entirety and SUBSTITUTE with the following:

1. You shall perform, with your own organization, Contract Work amounting to at least 30% of the base Bid.

- 2-5.3.4 Supporting Information. To the City Supplement,** ADD the following:

2. For landscaping and irrigation materials, submit samples and test results to the Engineer within 15 Days of the NTP.

- 2-7 SUBSURFACE DATA.** To the City Supplement, 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) Updated Final Report of Geotechnical Investigation Pump Station No. 2 Power Reliability and Surge Protection, dated August 12, 2016 by Allied Geotechnical Engineers, Inc.
5. The reports listed above are available for review by contacting the Contract Specialist or visiting:

<ftp://ftp.sannet.gov/OUT/ECP/2-7%20SUBSURFACE%20DATA/>

2-9.2

Survey Service. DELETE in its entirety and SUBSTITUTE with the following:

1. Prior to the start of construction, you shall submit a letter to the Engineer identifying the Licensed Land Surveyor or the Registered Civil Engineer authorized to practice land surveying within the State of California that will be performing the survey services for the Project.
2. You are responsible for performing and meeting the accuracy of surveying standards adequate for construction through a Licensed Land Surveyor or a Registered Civil Engineer authorized to practice land surveying within the State of California.
3. Survey stakes shall be set and stationed by you for curbs, headers, water mains, sewers, storm drains, structures, rough grade, and any other structures and appurtenances that are needed for the Project. A corresponding cut or fill to finished grade (or flow line) shall be indicated on a grade sheet.
4. Surveys performed shall list the basis of bearings as tied to Record of Survey 14492 or equivalent, based on the California Coordinate System of 1983, Zone 6, U.S. Survey foot, epoch 1991.35, along with a completed calibration sheet (blank form will be supplied by City Surveys). The vertical datum used shall be NGVD 29 in accordance with the City of San Diego Vertical Bench Book.
5. You shall preserve construction survey stakes, control points, and other survey related marks for the duration of the Project. If any construction survey stakes are lost or disturbed and need to be replaced, such replacement shall be performed by the Engineer at your expense.

2-9.2.1

Survey Files.

1. All Computer Aided Drafting (CAD) Work shall be done in accordance with the City of San Diego's Citywide Computer Aided Design and Drafting (CADD) Standards and shall be in City seed files (.job, .txt, .dgn, .alg, .raw, .fwd, .dtm, .pdf, .docx, .xlsx, .tif, and .jpg).
2. All survey files shall be completed in accordance with the City of San Diego's Citywide CADD Standards and shall adhere to the City's Microstation level and attribute structure.
3. The survey file deliverable will be either one Master .dgn file containing all xref's in geospatially referenced (and attached) models or one Master dgn with all xref's geospatially referenced (and attached) as dgn files. Resource files may be sent to you if requested.
4. Survey files shall include, but shall not be limited to, the following items:
 - a. Street center line and (record width) right-of-way lines.
 - b. Project geometry (.alg) files (this will be generated for use in InRoads).
 - c. 3D surface model (.dtm, break line and spot elevation) file.
 - d. Spot elevations of the new utility main at each intersection, midblocks, and for any change in grade.
 - e. Monuments.

- f. Curb lines (top curb and gutter).
 - g. All other appurtenances including but not limited to water valves, meters, vaults, manholes, fire hydrants, utility boxes, cleanouts, and poles.
5. You shall use the survey information to produce red-lines drawings as described in Section 2-5.4 "Red-lines and Record Documents."

2-9.2.2 Submittal.

- 1. Survey files shall be submitted in accordance with 2-5.3, "Submittals" and 2-5.4, "Red-Lines and Record Documents". You shall provide the Survey Files, proposed Drawings, and/or Red-line Drawings on a CD/DVD to the Engineer and shall post the Survey Files, proposed Drawings, and/or Red-line Drawings to the following website:

ftp://ftp.sannet.gov/IN/SURVEYS/
- 2. After the documents have been posted to the website, you shall send a confirmation email, which includes the hyperlink to the website, to the Engineer and to SurveyReview@sandiego.gov.
- 3. All survey Work and submittals which reveal non-compliance with the requirements of the Construction Documents shall be corrected as deemed necessary by the Engineer and the cost of the corrections to your survey submittals shall be at your expense.

2-9.2.3 Payment.

- 1. The payment for survey services Work shall be included in the lump sum Bid item for "Survey Services".

2-16 CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM. To the City Supplement, item 1, DELETE in its entirety.

SECTION 3 – CHANGES IN WORK

ADD:

3-5.2.5 Dispute Resolution Board.

- 1. If mediation is unsuccessful in settling the dispute and if both parties agree, a no mandatory dispute resolution board process may be used.
- 2. The parties may impanel a Dispute Resolution Board (DRB) and the DRB process shall be conducted in accordance with the City's alternative dispute resolution process, utilizing board members who are individuals who have expertise in construction. The selection process shall be administered by the American Arbitration Association or any other such neutral organization selected by the City hereinafter called the "Administrator". Claims made for \$60,000 or less shall be heard by 1 DRB member and claims for more than \$60,000 shall be heard by 3 DRB members.

3. To initiate the DRB procedures, the parties shall jointly execute and file a "Submission to Dispute Resolution Board Procedures" request with the Administrator. Upon receipt by the Administrator of the submission form, the Administrator will furnish to the parties a list of individuals skilled in dispute resolution and that have expertise in construction from which to select for the Dispute Resolution Board.
4. Within 10 Working Days from the date the list is sent to the parties, the parties shall return the list to the Administrator and shall strike out any individuals to which the parties have any factual objections to and shall number the remaining individuals in preference order. The Administrator will appoint the highest mutually preferred individuals to the DRB that are available to serve in the time frame designated above.

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) and 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 letters, refer to Appendix J", 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.

4-1.3.4 Inspection Paid For by the Contractor. To the City Supplement, ADD the following:

2. The special inspections required are listed on Sheet S-2.

4-1.3.5 Special Inspection. To the City Supplement, ADD the following:

5. The payment for special inspection Work specified under this section shall be paid in accordance with 4-1.3.4.1, "Payment".

4-1.3.6 Preapproved Materials. To the City Supplement, 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 City Supplement, 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:

<http://www.sandiego.gov/publicworks/edocref/index.shtml>

SECTION 5 – UTILITIES

5-2 **PROTECTION.** To the City Supplement, item 2, **ADD** the following:

- g) Refer to Appendix "F" for more information on the protection of AMI devices.

5-6 **COOPERATION.** 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).

SECTION 6 - PROSECUTION, PROGRESS AND ACCEPTANCE OF WORK

6-1.1 **Construction Schedule.** To item 20, ADD the following:

The 120 Calendar Day for the Plant Establishment Period is included in the stipulated Contract Time.

ADD:

6-3.2.1.1 **Environmental Document.**

- 1. The City of San Diego Environmental Analysis Section (EAS) of the Development Services Department has prepared a **Notice of Exemption (NOE)** and **Coastal Development Permit (CDP)** for **Pump Station No. 2 Power Reliability & Surge Protection**, as referenced in the Contract Appendix. You shall comply with all requirements of the **NOE** and **CDP** as set forth in **Appendix A**.
- 2. Compliance with the City's environmental document shall be included in the Contract Price, unless separate bid items have been provided.

6-8.3 **Warranty.** To the City Supplement, item 1, **DELETE** in its entirety and **SUBSTITUTE** with the following:

- 1. Warranty and repair all defective materials and workmanship for a period of **1 year**. This call back warranty period shall start on the date that the Work was accepted by the City. Additionally, you shall warranty the Work against all latent and patent defects for a period of **10 years**.

6-8.3.1 **Defective Work.** To the City Supplement, item 6, **DELETE** in its entirety and **SUBSTITUTE** with the following:

- 6. For Building Projects which require a certificate of occupancy, not including sewer and water facilities, if you fail to correct the defective Work listed on the City's Punchlist within 45 Days after the Contract Time, you shall reimburse the City for all

costs to provide inspection services required to monitor Work beyond the 45 Days. The City shall bill you for the additional inspection at the City's established rates.

SECTION 7 - RESPONSIBILITIES OF THE CONTRACTOR

7-3 INSURANCE. DELETE in its entirety and SUBSTITUTE with the following:

7-3 INSURANCE.

2. The insurance provisions herein shall not be construed to limit your indemnity obligations contained in the Contract.

7-3.1 Policies and Procedures.

1. You shall procure the insurance described below, at its sole cost and expense, to provide coverage against claims for loss including injuries to persons or damage to property, which may arise out of or in connection with the performance of the Work by you, your agents, representatives, officers, employees or Subcontractors.
2. Insurance coverage for property damage resulting from your operations is on a replacement cost valuation. The market value will not be accepted.
3. You shall maintain this insurance for the duration of this Contract and at all times thereafter when you are correcting, removing, or replacing Work in accordance with this Contract. Your liabilities under the Contract, e.g., your indemnity obligations, is not deemed limited to the insurance coverage required by this Contract.
4. The payment for insurance shall be included in the Contract Price as bid by you. Except as specifically agreed to by the City in writing, you are not entitled to any additional payment. Do not begin any Work under this Contract until you have provided and the City has approved all required insurance.
5. Policies of insurance shall provide that the City is entitled to 30 Days (10 Days for cancellation due to non-payment of premium) prior written notice of cancellation or non-renewal of the policy. Maintenance of specified insurance coverage is a material element of the Contract. Your failure to maintain or renew coverage or to provide evidence of renewal during the term of the Contract may be treated by the City as a material breach of the Contract.

7-3.2 Types of Insurance.

7-3.2.1 Commercial General Liability Insurance.

1. Commercial General Liability Insurance shall be written on the current version of the ISO Occurrence form CG 00 01 07 98 or an equivalent form providing coverage at least as broad.

2. The policy shall cover liability arising from premises and operations, XCU (explosions, underground, and collapse), independent contractors, products/completed operations, personal injury and advertising injury, bodily injury, property damage, and liability assumed under an insured's contract (including the tort liability of another assumed in a business contract).
3. There shall be no endorsement or modification limiting the scope of coverage for either "insured vs. insured" claims or contractual liability. You shall maintain the same or equivalent insurance for at least 10 years following completion of the Work.
4. All costs of defense shall be outside the policy limits. Policy coverage shall be in liability limits of not less than the following:

<u>General Annual Aggregate Limit</u>	<u>Limits of Liability</u>
Other than Products/Completed Operations	\$2,000,000
Products/Completed Operations Aggregate Limit	\$2,000,000
Personal Injury Limit	\$1,000,000
Each Occurrence	\$1,000,000

7-3.2.2 Commercial Automobile Liability Insurance.

1. You shall provide a policy or policies of Commercial Automobile Liability Insurance written on the current version of the ISO form CA 00 01 12 90 or later version or equivalent form providing coverage at least as broad in the amount of \$1,000,000 combined single limit per accident, covering bodily injury and property damage for owned, non-owned, and hired automobiles ("Any Auto").
2. All costs of defense shall be outside the limits of the policy.

7-3.2.3 Contractors Pollution Liability Insurance.

1. You shall procure and maintain at your expense or require your Subcontractor, as described below, to procure and maintain the Contractors Pollution Liability Insurance including contractual liability coverage to cover liability arising out of cleanup, removal, storage, or handling of hazardous or toxic chemicals, materials, substances, or any other pollutants by you or any Subcontractor in an amount not less than \$2,000,000 limit for bodily injury and property damage.
2. All costs of defense shall be outside the limits of the policy. Any such insurance provided by your Subcontractor instead of you shall be approved separately in writing by the City.
3. For approval of a substitution of your Subcontractor's insurance, you shall certify that all activities for which the Contractors Pollution Liability Insurance will provide coverage will be performed exclusively by the Subcontractor providing the insurance. The deductible shall not exceed \$25,000 per claim.

4. Contractual liability shall include coverage of tort liability of another party to pay for bodily injury or property damage to a third person or organization. There shall be no endorsement or modification of the coverage limiting the scope of coverage for either "insured vs. insured" claims or contractual liability.
5. Occurrence based policies shall be procured before the Work commences and shall be maintained for the Contract Time. Claims Made policies shall be procured before the Work commences, shall be maintained for the Contract Time, and shall include a 12 month extended Claims Discovery Period applicable to this contract or the existing policy or policies that shall continue to be maintained for 12 months after the completion of the Work without advancing the retroactive date.
6. Except as provided for under California law, the policy or policies shall provide that the City is entitled to 30 Days prior written notice (10 Days for cancellation due to non-payment of premium) of cancellation or non-renewal of the policy or policies.

7-3.2.4

Contractors Hazardous Transporters Pollution Liability Insurance.

1. You shall provide at your expense or require your Subcontractor to provide, as described below, Contractors Hazardous Transporters Pollution Liability Insurance including contractual liability coverage to cover liability arising out of transportation of hazardous or toxic, materials, substances, or any other pollutants by you or any Subcontractor in an amount not less than \$2,000,000 limit per occurrence/aggregate for bodily injury and property damage.
2. All costs of defense shall be outside the limits of the policy. The deductible shall not exceed \$25,000 per claim. Any such insurance provided by a subcontractor instead of you shall be approved separately in writing by the City.
3. For approval of the substitution of Subcontractor's insurance the Contractor shall certify that all activities for which Contractors Hazardous Transporters Pollution Liability Insurance will provide coverage will be performed exclusively by the Subcontractor providing the insurance.
4. Contractual liability shall include coverage of tort liability of another party to pay for bodily injury or property damage to a third person or organization. There shall be no endorsement or modification of the coverage limiting the scope of coverage for either "insured vs. insured" claims or contractual liability. Occurrence based policies shall be procured before the Work commences and shall be maintained for the duration of this Contract. Claims Made policies shall be procured before the Work commences, shall be maintained for the duration of this contract, and shall include a 12 month extended Claims Discovery Period applicable to this contract or the existing policy or policies that shall continue to be maintained for 12 months after the completion of the Work under this Contract without advancing the retroactive date.

5. Except as provided for under California law, the policy or policies shall provide that the City is entitled to 30 Days prior written notice (10 Days for cancellation due to non-payment of premium) of cancellation or non-renewal of the policy or policies.

7-3.2.5

Contractors Builders Risk Property Insurance.

1. You shall provide at your expense, and maintain until Final Acceptance of the Work, a Special Form Builders Risk Policy or Policies. This insurance shall be in an amount equal to the replacement cost of the completed Work (without deduction for depreciation) including the cost of excavations, grading, and filling. The policy or policies limits shall be 100% of this Contract value of the Work plus 15% to cover administrative costs, design costs, and the costs of inspections and construction management.
2. Insured property shall include material or portions of the Work located away from the Site but intended for use at the Site and shall cover material or portions of the Work in transit. The policy or policies shall include as insured property scaffolding, falsework, and temporary buildings located at the Site. The policy or policies shall cover the cost of removing debris, including demolition.
3. The policy or policies shall provide that all proceeds thereunder shall be payable to the City as Trustee for the insured, and shall name the City, the Contractor, Subcontractors, and Suppliers of all tiers as named insured. The City, as Trustee, will collect, adjust, and receive all monies which may become due and payable under the policy or policies, may compromise any and all claims thereunder, and will apply the proceeds of such insurance to the repair, reconstruction, or replacement of the Work.
4. Any deductible applicable to the insurance shall be identified in the policy or policies documents and responsibility for paying the part of any loss not covered because of the application of such deductibles shall be apportioned among the parties except for the City as follows: if there is more than one claimant for a single occurrence, then each claimant shall pay a pro-rata share of the per occurrence deductible based upon the percentage of their paid claim to the total paid for insured. The City shall be entitled to 100% of its loss. You shall pay the City any portion of that loss not covered because of a deductible at the same time the proceeds of the insurance are paid to the City as trustee.
5. Any insured, other than the City, making claim to which a deductible applies shall be responsible for 100% of the loss not insured because of the deductible. Except as provided for under California law, the policy or policies shall provide that the City is entitled to 30 Days prior written notice (10 Days for cancellation due to non-payment of premium) of cancellation or non-renewal of the policy or policies.

7-3.3

Rating Requirements. Except for the State Compensation Insurance Fund, all insurance required by this Contract as described herein shall be carried only by responsible insurance companies with a rating of, or equivalent to, at least "A-, VI" by

A.M. Best Company, that are authorized by the California Insurance Commissioner to do business in the State, and that have been approved by the City.

7-3.3.1 Non-Admitted Carriers. The City will accept insurance provided by non-admitted, "surplus lines" carriers only if the carrier is authorized to do business in the State and is included on the List of Approved Surplus Lines Insurers (LASLI list).

All policies of insurance carried by non-admitted carriers shall be subject to all of the requirements for policies of insurance provided by admitted carriers described herein.

7-3.4 Evidence of Insurance. Furnish to the City documents e.g., certificates of insurance and endorsements evidencing the insurance required herein, and furnish renewal documentation prior to expiration of this insurance. Each required document shall be signed by the insurer or a person authorized by the insurer to bind coverage on its behalf. We reserve the right to require complete, certified copies of all insurance policies required herein.

7-3.5 Policy Endorsements.

7-3.5.1 Commercial General Liability Insurance.

7-3.5.1.1 Additional Insured.

1. You shall provide at your expense policy endorsement written on the current version of the ISO Occurrence form CG 20 10 11 85 or an equivalent form providing coverage at least as broad.
2. To the fullest extent allowed by law e.g., California Insurance Code §11580.04, the policy shall be endorsed to include the City and its respective elected officials, officers, employees, agents, and representatives as additional insured.
3. The additional insured coverage for projects for which the Engineer's Estimate is \$1,000,000 or more shall include liability arising out of:
 - a) Ongoing operations performed by you or on your behalf,
 - b) your products,
 - c) your Work, e.g., your completed operations performed by you or on your behalf, or
 - d) premises owned, leased, controlled, or used by you.
4. The additional insured coverage for projects for which the Engineer's Estimate is less than \$1,000,000 shall include liability arising out of:
 - a) Ongoing operations performed by you or on your behalf,
 - b) your products, or
 - c) premises owned, leased, controlled, or used by you.

7-3.5.1.2 Primary and Non-Contributory Coverage. The policy shall be endorsed to provide that the coverage with respect to operations, including the completed operations, if appropriate, of the Named Insured is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives. Further, it shall provide that any insurance maintained by the City and its elected officials, officers, employees, agents and representatives shall be in excess of your insurance and shall not contribute to it.

7-3.5.1.3 Project General Aggregate Limit. The policy or policies shall be endorsed to provide a Designated Construction Project General Aggregate Limit that will apply only to the Work. Only claims payments which arise from the Work shall reduce the Designated Construction Project General Aggregate Limit. The Designated Construction Project General Aggregate Limit shall be in addition to the aggregate limit provided for the products-completed operations hazard.

7-3.5.2 Commercial Automobile Liability Insurance.

7-3.5.2.1 Additional Insured. Unless the policy or policies of Commercial Auto Liability Insurance are written on an ISO form CA 00 01 12 90 or a later version of this form or equivalent form providing coverage at least as broad, the policy shall be endorsed to include the City and its respective elected officials, officers, employees, agents, and representatives as additional insured, with respect to liability arising out of automobiles owned, leased, hired or borrowed by you or on your behalf. This endorsement is limited to the obligations permitted by California Insurance Code §11580.04.

7-3.5.3 Contractors Pollution Liability Insurance Endorsements.

7-3.5.3.1 Additional Insured.

1. The policy or policies shall be endorsed to include as an Insured the City and its respective elected officials, officers, employees, agents, and representatives, with respect to liability arising out of:
 - a) Ongoing operations performed by you or on your behalf,
 - b) your products,
 - c) your work, e.g., your completed operations performed by you or on your behalf, or
 - d) premises owned, leased, controlled, or used by you.

Except that in connection with, collateral to, or affecting any construction contract to which the provisions of subdivision (b) of § 2782 of the California Civil Code apply, this endorsement shall not provide any duty of indemnity coverage for the active negligence of the City and its respective elected officials, officers, employees, agents, and representatives in any case where an

agreement to indemnify the City and its respective elected officials, officers, employees, agents, and representatives would be invalid under subdivision (b) of §2782 of the California Civil Code.

2. In any case where a claim or loss encompasses the negligence of the Insured and the active negligence of the City and its respective elected officials, officers, employees, agents, and representatives that are not covered because of California Insurance Code §11580.04, the insurer's obligation to the City and its respective elected officials, officers, employees, agents, and representatives shall be limited to obligations permitted by California Insurance Code §11580.04.

7-3.5.3.2 Primary and Non-Contributory Coverage. The policy or policies shall be endorsed to provide that the insurance afforded by the Contractors Pollution Liability Insurance policy or policies is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives with respect to operations including the completed operations of the Named Insured. Any insurance maintained by the City and its elected officials, officers, employees, agents and representatives shall be in excess of your insurance and shall not contribute to it.

7-3.5.3.3 Severability of Interest. For Contractors Pollution Liability Insurance, the policy or policies shall provide that your insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability and shall provide cross-liability coverage.

7-3.5.4 Contractors Hazardous Transporters Pollution Liability Insurance Endorsements.

7-3.5.4.1 Additional Insured.

1. The policy or policies shall be endorsed to include as an Insured the City and its respective elected officials, officers, employees, agents, and representatives, with respect to liability arising out of:
 - a) Ongoing operations performed by you or on your behalf,
 - b) your products,
 - c) your work, e.g., your completed operations performed by you or on your behalf, or
 - d) premises owned, leased, controlled, or used by you.

Except that in connection with, collateral to, or affecting any construction contract to which the provisions of subdivision (b) of §2782 of the California Civil Code apply, this endorsement shall not provide any duty of indemnity coverage for the active negligence of the City and its respective elected officials, officers, employees, agents, and representatives in any case where an

agreement to indemnify the City and its respective elected officials, officers, employees, agents, and representatives would be invalid under subdivision (b) of §2782 of the California Civil Code.

2. In any case where a claim or loss encompasses the negligence of the Insured and the active negligence of the City and its respective elected officials, officers, employees, agents, and representatives that are not covered because of California Insurance Code §11580.04, the insurer's obligation to the City and its respective elected officials, officers, employees, agents, and representatives shall be limited to obligations permitted by California Insurance Code §11580.04.

7-3.5.4.2 Primary and Non-Contributory Coverage. The policy or policies shall be endorsed to provide that the insurance afforded by the Contractors Pollution Liability Insurance policy or policies is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives with respect to operations including the completed operations of the Named Insured. Any insurance maintained by the City and its elected officials, officers, employees, agents and representatives shall be in excess of your insurance and shall not contribute to it.

7-3.5.4.3 Severability of Interest. For Contractors Hazardous Transporters Pollution Liability Insurance, the policy or policies shall provide that your insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability and shall provide cross-liability coverage.

7-3.5.5 Builders Risk Endorsements.

7-3.5.5.1 Waiver of Subrogation. The policy or policies shall be endorsed to provide that the insurer will waive all rights of subrogation against the City, and its respective elected officials, officers, employees, agents, and representatives for losses paid under the terms of the policy or policies and which arise from Work performed by the Named Insured for the City.

7-3.5.5.2 Builders Risk – Partial Utilization. If the City desires to occupy or use a portion or portions of the Work prior to Acceptance in accordance with this Contract, the City will notify you and you shall immediately notify your Builder's Risk insurer and obtain an endorsement that the policy or policies shall not be cancelled or lapse on account of any such partial use or occupancy. You shall obtain the endorsement prior to the City's occupation and use.

7-3.6 Deductibles and Self-Insured Retentions. You shall pay for all deductibles and self-insured retentions. You shall disclose deductibles and self-insured retentions to the City at the time the evidence of insurance is provided.

7-3.7 Reservation of Rights. The City reserves the right, from time to time, to review your insurance coverage, limits, deductibles and self-insured retentions to determine if they are acceptable to the City. The City will reimburse you, without overhead, profit,

or any other markup, for the cost of additional premium for any coverage requested by the Engineer but not required by this Contract.

7-3.8 Notice of Changes to Insurance. You shall notify the City 30 Days prior to any material change to the policies of insurance provided under this Contract.

7-3.9 Excess Insurance. Policies providing excess coverage shall follow the form of the primary policy or policies e.g., all endorsements.

7-3.10 Architects and Engineers Professional Insurance (Errors and Omissions Insurance).

1. For Contracts with required engineering services (e.g., Design-Build, preparation of engineered Traffic Control Plans (TCP), and etc) by you, you shall keep or require all of your employees or Subcontractors, who provide professional engineering services under this contract, Professional Liability coverage with a limit of **\$1,000,000** per claim and **\$3,000,000** annual aggregate in full force and effect.
2. You shall ensure the following:
 - a) The policy retroactive date is on or before the date of commencement of the Project.
 - b) The policy will be maintained in force for a period of 3 years after completion of the Project or termination of this Contract, whichever occurs last. You agree that for the time period specified above, there will be no changes or endorsements to the policy that affect the specified coverage.
3. If professional engineering services are to be provided solely by the Subcontractor, you shall:
 - a) Certify this to the City in writing and
 - b) Agree in writing to require the Subcontractor to procure Professional Liability coverage in accordance with the requirements set forth above.

7-4 Not Used. DELETE in its entirety and SUBSTITUTE with the following:

7-4 Workers' Compensation Insurance and Employers Liability Insurance.

1. In accordance with the provisions of §3700 of the California Labor Code, you shall provide at your expense Workers' Compensation Insurance and Employers Liability Insurance to protect you against all claims under applicable state workers compensation laws. The City, its elected officials, and employees will not be responsible for any claims in law or equity occasioned by your failure to comply with the requirements of this section.

2. Limits for this insurance shall be not less than the following:

<u>Workers' Compensation</u>	<u>Statutory Employers Liability</u>
Bodily Injury by Accident	\$1,000,000 each accident
Bodily Injury by Disease	\$1,000,000 each employee
Bodily Injury by Disease	\$1,000,000 policy limit

3. By signing and returning the Contract you certify that you are aware of the provisions of §3700 of the Labor Code which requires every employer to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that code and you shall comply with such provisions before commencing the Work as required by §1861 of the California Labor Code.

7-4.1. Waiver of Subrogation. The policy or policies shall be endorsed to provide that the insurer will waive all rights of subrogation against the City and its respective elected officials, officers, employees, agents, and representatives for losses paid under the terms of the policy or policies and which arise from Work performed by the Named Insured for the City.

7-5 PERMITS, FEES, AND NOTICES. To the City Supplement, ADD the following:

2. The City will obtain, at no cost to you, the following permits:
 - a) Building Permit – DSD Project # 407224
 - b) Coastal Permit – Permit # 6-14-1548

7-8.1 General. To the City Supplement, ADD the following:

2. Use a PM-10 certified self-loading motorized street sweeper equipped with a functional water spray system for this project.

7-8.6 Water Pollution Control. To the City Supplement, ADD the following:

6. Based on a preliminary assessment by the City, this Contract is subject to SWPPP.

7-20 ELECTRONIC COMMUNICATION. To the City Supplement, ADD the following:

2. Virtual Project Manager shall be used on this Contract.

7-21.1 General. To the City Supplement, item 3, DELETE in its entirety and SUBSTITUTE with the following:

3. 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.

SECTION 9 - MEASUREMENT AND PAYMENT

9-3.2 Partial and Final Payment. To 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, no less than 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.

ADD:

9-3.7 Compensation Adjustments for Price Index Fluctuations. To the City Supplement ADD the following:

5. This Contract is not subject to the provisions of The "WHITEBOOK" for Compensation Adjustments for Price Index Fluctuations for paving asphalt.

SECTION 203 - BITUMINOUS MATERIALS

203-3.4.4 RUBBER POLYMER MODIFIED SLURRY (RPMS). To the City Supplement, ADD the following:

1. RPMS shall be used on this Contract.

SECTION 209 - PRESSURE PIPE

209 PRESSURE PIPE. To the City Supplement, 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.

SECTION 304 - METAL FABRICATION AND CONSTRUCTION

304-5 PAYMENT. To the City Supplement, REVISE section "304-5" to "304-6".

SECTION 306 – OPEN TRENCH CONDUIT CONSTRUCTION

306-7.8.2.1 General. To the City Supplement, item 2, ADD the following:

- a) Specified test pressure for Class 235 pipe shall be 150 psi.
- b) Specified test pressure for Class 305 pipe shall be 200 psi.

EQUAL OPPORTUNITY CONTRACTING PROGRAM (EOCP)

SECTION A – GENERAL REQUIREMENTS

4.1 Nondiscrimination in Contracting Ordinance. To the City Supplement, 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.

END OF SUPPLEMENTARY SPECIAL PROVISIONS (SSP)

TECHNICALS

City of San Diego

CONTRACT DOCUMENTS for



Pump Station No. 2 – Power Reliability and Surge Protection

VOLUME 01

MASTER TECHNICAL SPECIFICATIONS – DIVISIONS 01 THROUGH 12

SPECIFICATION NO. 38027

WBS NO. S-00312

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FTP References, <ftp://ftp.sannet.gov/OUT/ECP/AEP/P2/>

1. Metro Pump Station No.2 – Additional Pumps Installation of 8th Pump and Engine Drives, 26275-D, 1991
2. Pump Station 1 & Pump Station 2 Electrical Upgrade and New Building at Pump Station 2, 35265-D, 2010
3. Pump Station No. 2, 11053-D, 1960
4. Hawthorne Power Systems Drawing 11090-2E, 1992
5. General Fiber Optic Between PS 1 and PS 2, 30708-D, 2001
6. North Metro Interceptor Fiber Optic Conduit, 30192-D, 2000
7. Pump Station No.2 Instrumentation Upgrade – Comnet Implementation, 31822-D, 2008
8. October 2014 Topographic Survey of a Portion of Pump Station 2.
9. Preliminary Survey from City
10. Pump Station 2 Loop Drawings

FTP References, <ftp://ftp.sannet.gov/OUT/ECP/AEP/P2/>

1. Pump Station 1 & 2 San Diego, CA BEC WO#11575 Medium Voltage Switchgear, Submittal No. 16300.001.4
2. Field Revisions to Switchgear No. 1 & 2.
3. Deck/Ramps for Planning Trailers at Pump Station No.2
4. Updated Final Report of Geotechnical Investigation Pump Station No.2 Power Reliability and Surge Protection Dated November 17, 2014.
5. Pump Stations 1 & 2 WO#11575 Unit Substation (Pump Station 2), Submittal #16310.001.4
6. Lead Related Construction Specification

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SECTION 01014 - WORK SEQUENCE

PART 1 -- GENERAL

1.1. THE REQUIREMENT

- A. The CONTRACTOR shall coordinate the scheduling of construction activities so that the operation of the existing pump station and the flow of sewage shall not be disrupted.

1.2. RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 Earthwork
- B. Section 13300 Instrumentation and Control –
(Appendix A2 – Process and Control Strategies and Design Philosophy)
- C. Section 13350 Commissioning

1.3. CONTRACTOR SUBMITTALS

In addition to the Construction Schedule required by the General Requirements, the CONTRACTOR shall submit a detailed sequence of operation plan and schedule. The plan shall address the detailed implementation steps necessary to accomplish the scope of work, Work specified herein, and work per the Contract Documents. The detailed implementation steps shall address and include, but not be limited to, the following conditions and restrictions:

- A. Specific restrictions and conditions specified in Part 3 – EXECUTION of this section of the Specifications.
- B. A detailed outage plan and time schedule for operations.
- C. The detailed plan shall describe the CONTRACTOR's method of operation and the length of time required to complete said operation.
- D. Systems or individual equipment items that will be isolated, dewatered, decommissioned, de-energized, or depressurized in accordance with the detailed outage plan and schedule. Notify the ENGINEER in writing at least one week in advance of the planned operation.
- E. The CONTRACTOR shall provide detailed plans and details showing temporary shoring and protection of existing pipelines and utilities. Detailed plan shall be designed and signed by Registered Engineer in the State of California and approved by the ENGINEER per Section 02200, Earthwork.

1.4. CONTINUITY OF SYSTEM OPERATIONS

- A. The Existing Pump Station No. 2 is currently and continuously receiving and conveying sewage, and those functions shall not be interrupted except as specified herein. The CONTRACTOR shall coordinate the WORK to avoid any interference with normal operation of the system.

1.5. SEWAGE SPILLS

- A. Spills of untreated or partially treated sewage to surface waters or drainage courses is prohibited. In the event of a spill caused by the CONTRACTOR's operations, the CITY shall immediately be entitled to employ others to stop the spill without giving written notice to the CONTRACTOR.
- B. Cost of penalties imposed on the CITY as a result of a spill caused by the actions of the CONTRACTOR, its employees, or subcontractors, shall be borne in full by the CONTRACTOR, including legal fees and other expenses to the CITY resulting directly or indirectly from the spill.

1.6. PS2 MAIN SEWAGE PUMPING RESTRICTIONS FOR PLANNED OUTAGES TO FACILITATE CONSTRUCTION

- A. See Section 13300, Instrumentation and Control – Appendix A2 - Process and Control Strategies and Design Philosophy, for historical number of main sewage pumps that are required to pump.
- B. Wet weather season sewage flows occur from October 1st thru May 31st; dry weather season sewage flows comprise of the balance. See Contract Documents for restrictions during wet weather season.
- C. Nighttime sewage flows are defined from 10:00pm to 5:00am; daytime sewage flows comprise of the balance. See Contract Documents for restrictions during wet weather season.
- D. PS2 has a total of 8 operational main sewage pumps. The table below shows the minimum number of main sewage pumps that must remain operationally ready during construction.

	Dry Weather Season Sewage Flows	Wet Weather Season Sewage Flows
Nighttime Sewage Flows	1*	3*
Daytime Sewage Flows	4*	6*

Note: * If a storm is forecasted, then all eight pumps must remain operationally ready during the storm event.

- E. Demolition of the direct drive engine pumps No.4 and No.5 must occur during the dry weather season, and if this coincides with a storm event, then only 7 pumps are required to remain operationally ready during the storm event.
- F. During any allowed outage of the main sewage pump(s) the CONTRACTOR shall provide daily updates each morning to the CITY's Construction Manager as to the status of the forecasted weather.
- G. The main sewage pumps require many ancillary systems operational in order to run PS2 and the main sewage pumps. These ancillary systems must remain operational. See Contract Documents and Reference Documents throughout for these ancillary systems.

- H. The CONTRACTOR shall submit detailed plans for CITY approval that require any disruptions to normal PS2 operations. Since the risk of a sewage spill is lower at night due to reduced nighttime flows, some of the WORK is anticipated to occur after “normal workdays and times” specified in the front-end boilerplate Specifications. The CONTRACTOR must justify why the work is required to be done off hours (if said work can be done safely during normal hours, then said work will not likely be approved for afterhours work), and the CITY shall approve said work at their discretion.
- I. The CONTRACTOR may request a complete outage of all the main sewage pumps as long as the following conditions are met:
 - i. Only allowed during dry weather season.
 - ii. Only allowed from 1:00am to 5:00am. CONTRACTOR must provide guarantees that the system will be operational again by 5:00am.
 - iii. Cannot occur for more than one consecutive day.
 - iv. Cannot occur on a Monday morning or a holiday.
 - v. Cannot occur more than two times in any given week.
 - vi. CITY at their discretion, may not allow a shutdown to occur.
 - vii. Confirm with the weather report that no storm is forecasted during the outage and the proceeding 3 days.
 - viii. The DCS remains operational.

PART 2 -- PRODUCTS

- 2.1 CONTRACTOR shall provide all required equipment and personnel necessary to perform Work specified herein. Any approved deviations from Work herein shall be borne in full by the CONTRACTOR at no additional cost to the CITY.
- 2.2 Redlines: CONTRACTOR shall keep the Contract Documents continuously redlined based on modifications as a result of RFI responses, submittal comments and approvals, and approved deviations. Redlines include markups to the Contract Drawings as well as the Contract Specifications. The CONTRACTOR shall maintain onsite at least one redline set.

Every six months, the CONTRACTOR shall digitally scan and email an electronic copy to the CITY. The CITY’s Engineer will then have the markups incorporated, and will re-issue them electronically within approximately 4 weeks. If the redlines are minor, the CITY at their discretion may skip re-issuing a revised set. Once the new incorporated set is revised, the CONTRACTOR shall then review the revised set to assure the markups were appropriately picked up to the CONTRACTOR’s intent. Once all parties agree that the revised set is satisfactory, the CONTRACTOR and CITY shall replace all their sets, including that of their subs, with the updated revised set. Note, the CONTRACTOR, shall still keep the original perforated and stamped DSD set onsite at all times. Other older sets should be destroyed and removed from the site. This scheme shall repeat every six months for the duration of the Contract. The goal is to limit confusion in the field because of

outdated Contract Documents.

PART 3 -- EXECUTION

3.1 SEQUENCE OF WORK:

Listed below is an outline of the workflow in sequential order. Not all items are listed, and the detailed schedules shall be provided by the CONTRACTOR per the Contract Requirements. In addition, many of the durations for the items in the work sequence below are specified per Section 13350 Commissioning.

- A. Within 30 days from the NTP, the CONTRACTOR shall submit the Commissioning Coordinators qualifications per Section 13350 Commissioning.
- B. Provide all the upgrades to the second floor office space, restroom modifications, elevator improvements, and ADA access improvements.
- C. Obtain occupancy permit from DSD for the second floor office space.
- D. Relocation of the two office trailers shall not begin until the occupancy permit is obtained for the second floor office space. The CITY shall have 3 weeks starting from the issuance of the occupancy permit to move out of the trailers and relocate their Staff to the new second floor office space.
- E. Relocate conflicting storage trailers.
- F. Rough grade the site and provide liquefiable soils mitigations.
- G. Receive Authority to Construct (ATC) from San Diego Air Pollution Control District (SDAPCD) for the four new engines.
- H. Concurrent Work:
 - i. Re-route conflicting fiber optics at the site.
 - ii. Provide all electrical duct banks.
 - iii. Provide necessary underground piping.
 - iv. Provide assorted subgrade work and building foundations.
- I. Concurrent Work:
 - i. Provide new Power Generation Facility.
 - ii. Provide new Fuel/Oil Storage Area.
 - iii. Provide new outdoor load bank.
 - iv. Provide interim engine cooling water systems.

- v. Provide upgrades within the existing switchgear building.
 - vi. Provide improvements within the existing USS-1 associated room.
 - vii. Provide improvements within the existing DCS room.
- J. FAT-RAT Commissioning Phase 1: Partially commission the new Power Generation Facility systems and interim cooling systems and fully commission the Fuel/Oil Storage Area systems. See Section 13350 for details.
 - K. Salvage the two 2,000KW emergency generators and apparatus.
 - L. Demolish engine 4 and provide new VFD-400 and Motor-400 systems.
 - M. FAT-RAT Commissioning Phase 2: Commission new VFD-400 and Motor-400 systems. See Section 13350 for details.
 - N. Demolish engine 5 and provide new VFD-500 and Motor-500 systems.
 - O. FAT-RAT Commissioning Phase 3: Commission new VFD-500 and Motor-500 systems. See Section 13350 for details.
 - P. Demolish old lube oil systems buried at the site.
 - Q. Provide final improvements to the old engine room and existing MCC room.
 - R. Provide control room PLC panel modifications.
 - S. Provide final engine cooling water systems configuration.
 - T. FAT-RAT Commissioning Phase 4: Final commissioning of Power Generation Facility and final engine cooling water systems configuration. (Main purpose is to assure operational conformance with the final engine cooling water system configuration and conformance with the two new operational VFDs powering two of the main sewage pumps). See Section 13350 for details.
 - U. Final miscellaneous civil site improvements.
 - V. Provide site paving.
- 3.2 ITEMS NOT TIED TO SEQUENCE OF WORK: Not all items are listed, and the detailed schedules shall be provided by the CONTRACTOR per the Contract Requirements. WORK shall be done in a logical sequence coordinated with the overall WORK required per the Contract Documents.
- A. Provide landscaping improvements.
 - B. Provide security upgrades.
 - C. Provide site drainage improvements.

3.3 AIR PERMITTING SEQUENCE OF WORK:

The first step is to obtain an Authority to Construct (ATC) permit for each of the four new engine units. SDAPCD has 30 days to deem the application complete and 180 days (26 weeks) to evaluate the application and issue an ATC. After the ATC is granted, a year is typically allowed to install the units. The engines could then be released for fabrication after the ATC is approved, and all directly related submittals are approved; including all exhaust treatment. It is anticipated that this one year duration will not likely be enough time for the Contractor to complete the work, thus a one year extension may be requested by the CITY.

A Construction Completion Notice (CCN) must be submitted prior to the units beginning operation. After review of the CCN, SDAPCD issues a Start-up Authorization (SA). Lastly, a Permit to Operate (PTO) is issued once all the conditions outlined in the SA are worked out between the CITY and SDAPCD. The PTO would be issued after the FAT-RAT Commissioning Phase 1 is complete and approved, the CITY will then operate and maintain the commissioned portions of the new Power Generation Facility. Related CONTRACTOR's warranty period required in the Contract Documents that apply to the commissioned equipment shall start upon PTO.

Permitting Schedule

Task / Activity	Duration (weeks)	Weeks from Construction NTP to Complete the Task
CONTRACTOR shall provide engine submittals approved to a level required for SDAPCD permitting application. Includes CITY review time and any CONTRACTOR required resubmittals.	16	16
City shall submit application to SDAPCD for permitting of natural gas engines and diesel engines.	12	28
Draft "Authority to Construct" (ATC) permit process. Public review and comment period: CITY to negotiate permit conditions with SDAPCD. Obtain ATC.	26	54
Installation of engines; submit CCN prior to operation of engines.	52-104*	106-158*
Obtain Start-up Authorization (SA)	N/A	158 max
Obtain Permit to Operate (PTO) from SDAPCD	N/A	158 max

*The City may apply for a one year extension for the installation of the engines once ATC has been granted.

****END OF SECTION ****

SECTION 01025 – MEASUREMENT AND PAYMENT

PART 1 -- GENERAL (Not Used)

PART 2 -- MATERIALS

2.1 GENERAL (MEASUREMENT)

- A. Measurement for unit price quantities shall be based upon the appropriate bid item in the proposal. The actual quantity of measurement shall be as constructed by the Contractor in place in conformance with the Plans and Specifications.

2.2 LINEAR MEASUREMENTS

- A. Pipeline and related facility measurements shall be made horizontally along the centerline of the pipeline and related facilities through tees, bends, valves, fittings, and as shown on the Plans for its limits or as otherwise specified in the Special Technical Provisions.

2.3 AREA MEASUREMENTS

- A. Measurement for bid items involving area units shall be based upon the surface area measured in acres, square yards, square feet, or as indicated in the bid item.

2.4 VOLUME MEASUREMENTS

- A. Measurement for bid items involving volume units shall be based upon the volume measured in cubic yards, tons, or as indicated in the bid item.

2.5 UNIT MEASUREMENTS

- A. Measurement for bid items involving units of the item shall be based upon the number of units counted as indicated in the bid item.

2.6 LUMP SUM MEASUREMENT

- A. Lump sum items shall include all labor, delivery, materials, equipment and testing services as required by these Specifications for the complete installation of the bid items described in this Section. No separate payment shall be made for items not included by the Contractor in the total contract Bid Price as described in Part 3 herein.

PART 3 -- EXECUTION

3.1 GENERAL

- A. This section covers methods of measurement and payment for items of work under this Contract. The total Bid Price shall cover all work required by the Contract Documents. All costs in connection with the proper and successful completion of the work, including furnishing all materials, equipment, tools and incidentals; and performing all necessary labor and supervision to fully complete the work, shall be included in the unit (linear, area, volume) and lump sum prices bid. All

work not specifically set forth as a pay item in the Bid Form shall be considered a subsidiary obligation of Contractor and all costs in connection therewith shall be included in the prices bid.

3.2 ESTIMATED QUANTITIES

- A. All estimated quantities stipulated in the Bid Form or other Contract Documents are approximate and are to be used only (a) as a basis for estimating the probable cost of the work and (b) for the purpose of comparing the bids submitted for the work. The actual amounts of work done and materials furnished under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished. Contractor agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts therefor.

3.3 BID ITEMS

- A. MOBILIZATION/DEMobilIZATION - Lump Sum Bid Item shall include full compensation for mobilization and demobilization including and not limited to furnishing and installing, complete and in place all the necessary site preparatory work and operations, including those necessary for movement of personnel, equipment, supplies, and incidentals to the project site for the establishment and upkeep of temporary facilities, sanitary facilities, permits (unless otherwise specified in other Bid Items), traffic control plans, maintenance of project site including trash and litter pickup, offices, buildings, and other facilities necessary for work on the project, final project close-out and cleanup operations, including, but not limited to, those necessary for the removal of equipment, supplies, incidentals and debris from the project site, cleaning the streets and sidewalks of all soils and construction debris, record drawings, correction of deficiencies in the work, and for all other work required as indicated in the CONTRACT DOCUMENTS.
- B. SHEETING AND SHORING - Lump Sum Bid Item shall full compensation for all equipment, materials, labor to install sheeting and shoring complete and in place as required in contract documents including but not limited to, meeting all OSHA requirements and as required for all construction operations including site improvements, yard piping, drainage piping, site improvements, protection of off-site properties, and preparation and approved sheeting and shoring plan, and any other work as required by the CONTRACT DOCUMENTS.
- C. CIVIL - SITE IMPROVEMENTS - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Civil - Site improvements complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Site Preparation, Storage & Staging, Clearing and Grubbing, Civil Site work demolition, Excavation and Shoring, Hauling soil offsite, Aggregate Base, crushed stone base, Finish Grading, Fine Grading for Over Excavation Subgrade, AC Paving Binder Course, Topping Course, Injection Grouting, and Site Drainage Improvements.
- D. STRUCTURAL - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Structural complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Loading/Unloading Rack Area, Generator Building: wall footings, generator pads & floor Slab-On-Grade, Concrete pipe trench, Concrete walls, Concrete Corbels, Concrete Composite Roof Slab, Runway Beams for Bridge Crane Support, Roof Beams, Roof Metal Decking, and Steel Stairs. Electrical Building: Concrete Wall Footings, Equipment Pads and Floor Slab-on-Grade, Concrete walls, Concrete Elevated slab for Stairway Steps, Concrete Composite Roof Slab, Roof Beams, Roof Metal Decking, Steel Roofing Panels, Trench Cover, and Architectural Finishes.
- E. MECHANICAL - Lump Sum Bid Item shall include full compensation for all equipment, materials,

and labor to install the Mechanical complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Mechanical/HVAC/Equipment Demolition, 4MW diesel generators including exhaust after treatment, 3MW natural gas engines including exhaust after treatment engines & blowers, Engine-Generator Manufacturers Project Management & Engineering, Engine-Generator Manufacturers Startup & Testing, Miscellaneous spare parts (engine/generators), Initial fill lube oil generator/engines reservoirs, Lube Oil Pump + Spare, 20,000 gal horizontal diesel fuel tank including Initial fill, 330 gal diesel fuel day tank including Initial fill, 3,000 gal lube oil tank (diesel gensets), 1,500 gal lube oil tank (natural gas gensets), Initial fill lube oil tanks, 2,000 gal waste lube oil tanks, 3,000 gal Urea tank with Initial fill, Air Compressor, Air Receiver, Building AHU's, Ductwork, Sewage Heat Exchangers, Pumping, Piping, Valving, Catwalks, & Appurtenances, Main electrical Building AC Units, Control Room AC Units, Existing Engine Room Improvements/Demolition, and Fire Protection Sprinkler System.

- F. INSTRUMENTATION & CONTROL - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Instrumentation & Control complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to EMERSON DCS Equipment (procurement/shipping/delivery and all other costs required to begin installation), DCS Panels Installation and Modifications, Commissioning Team, Field Instruments, Process Smoke and Fire Alarm System, PLC Modifications, and Fiber Optics to Power Generation Building.
- G. ELECTRICAL - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Electrical complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Electrical Demolition & Miscellaneous Modifications, 2,250 HP Electric Motors, Medium Voltage VFDs, Medium Voltage Switchgear No.3, Medium Voltage Switchgear No.1 & No.2 Modifications, USS-1 Modifications and new Controller, Low Voltage Unit Substation, MCCs, UPSs' (Uninterruptible Power Supply), Load Bank, Lighting, Duct Banks, Cable & Conduit, SDG&E ISO Meters & Aux Meters, Miscellaneous Electrical.
- H. ARCHITECTURAL - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Architectural complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Misc. Metal Fabrication: Flashing, downspouts, gutter, and etc., Exterior lighting, Mechanical unit curbs, Splash blocks, Building Signage, Cage ladders, Guard Rails, Metal roofing at Fuel Tank Canopy, Restriping the parking lot and adding proper signage, Fire Extinguishers, Acoustical panels.
- I. FINAL OPERATIONS & MAINTENANCE (O&M) MANUALS - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to complete all approvals of the O&M Manuals as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Final acceptance and approvals of O&M Manuals as described in Section 13350.
- J. MISCELLANEOUS - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Miscellaneous complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to the Area 6 Miscellaneous Modifications & ADA Improvements, Fuel Polishing System, 10 Ton Bridge Cranes, Rollup Door, Decorative Fence, Motorized Access Gate, Doors, Roof Waterproofing, Painting and Coating, Water Conditioning, Relocation of conflicting fiber optic lines, and all remaining items per the CONTRACT DOCUMENTS.

- K. SDGE – NEW GAS SERVICE – Preset \$1,000,000 budget by the CITY and is to pay SDG&E for the new gas service. This is a pass through cost to pay for CITY approved SDG&E invoices. The CONTRACTOR shall pass through the invoice with no markups allowed.

**** END OF SECTION ****

SECTION 01640
SEISMIC DESIGN OF EQUIPMENT AND ANCHORAGE

PART 1—GENERAL

1.01 REFERENCES

A. General

1. The publications listed below form a part of this section to the extent referenced.
2. Where a date is given for referenced standards, the edition of that date shall be used. Where no date is given for referenced standards, the latest edition available on the date of the Notice Inviting Bids shall be used.

B. California Building Standards Commission

1. California Building Code (CBC)

1.02 SUBMITTALS

- A. The Contractor shall submit calculations and shop drawings of equipment design and equipment anchorage layout and details.

1.03 DEFINITIONS

- A. Equipment—Equipment shall include, but not be limited to, electrical, mechanical, and plumbing equipment machinery, tanks and vessels (including contents).

1.04 EQUIPMENT LOCATIONS AND DETAILS

- A. Equipment layout, dimensions, details, and anchorage shown on the drawings shall be verified by the Contractor for agreement with manufacturer's information and shop drawings.
1. If required by the specifications or if the Contractor desires to revise the layout or anchorage details shown on the design drawings, the Contractor shall prepare detailed submittal drawings of the desired revision to be approved by the Engineer. The Contractor's submittal shall include the necessary detailed drawings and design calculations prepared and stamped by a civil or structural engineer currently registered in the State of California.
 2. Where anchorage details are not shown on the design drawings, the Contractor shall submit structural calculations and details of the proposed anchorage prepared and stamped by a civil or structural engineer currently registered in the State of California. The structural calculations and details of the proposed anchorage shall be included in the submittal for the associated equipment.
 3. The installation of the equipment shall not be performed and supporting concrete shall not be placed until details of the anchorage have been approved by the Engineer.
 4. Floor mounted electrical equipment shall be installed on an equipment pad at least 4 inches higher than adjacent grade or floor.

1.05 DESIGN CRITERIA

- A. All equipment furnished by the Contractor shall be designed to adequately resist static loading as well as loading due to system operations and vertical and lateral dynamic forces imposed by wind or seismic events.
- B. Unless otherwise specified, all equipment shall be designed and installed to resist seismic and wind forces which are determined in accordance with the CBC.
- C. The following coefficients shall be used in determining the lateral seismic forces for the CBC formulas:
 - 1. Seismic Design Category : **D**
 - 2. Site Class: **D**
 - 3. CBC Seismic Design Spectral Acceleration Parameters:
 $S_{DS}=1.040$ $S_{D1}=0.614$
- D. Unless otherwise specified, the Occupancy Category shall be **IV** and the work shall be considered as an “Essential Facility” and the appropriate importance factors (I , I_p or I_w) specified on drawing or as defined by the CBC, the more restrictive requirements shall be used.
- E. Anchorage design shall consider vertical seismic force per CBC. Horizontal **and** vertical seismic forces shall be considered to act concurrently.
- F. Wind loading shall be determined using minimum basic wind speed (V) of **115 mph** and CBC Exposure **C**.
- G. Friction shall not be used to resist sliding due to seismic forces.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-END OF SECTION-

SECTION 02050 - DEMOLITION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes furnishing materials, equipment and labor necessary to perform and complete demolition per Contract Documents.
- B. In areas indicated to be remodeled, cut back flush and seal any pipe stub-outs remaining, and remove exposed piping, conduits, fixtures, junction boxes, light fixtures, water fixtures, and supports. Switches, receptacles, and boxes shall also be removed. Concealed piping and conduits shall be removed or capped and abandoned as necessary to facilitate the remodeling work. All other items shall be removed as shown.

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 02200 Earthwork

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).

1.4 CODES

- A. The 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. California Building Code

1.5 SUBMITTALS

- A. The following shall be submitted:
 - 1. Demolition Schedule: The CONTRACTOR shall submit a complete coordination schedule for demolition work including shut-off and continuation of utility services prior to start of the WORK. The schedule shall indicate proposed methods and operations of facility demolition, and provide a detailed sequence of demolition and removal work to ensure uninterrupted operation of occupied areas.

1.6 ASBESTOS REMOVAL

- A. Per reference document on Lead Abatement, asbestos was not identified during investigation of the property. CONTRACTOR shall immediately inform OWNER if asbestos is found. The OWNER is responsible for the removal and disposal of any asbestos found in structures scheduled for demolition, prior to commencement of demolition work by the CONTRACTOR.

- B. If, during demolition work, any additional asbestos materials are being discovered, the CONTRACTOR shall stop the work immediately and notify the CONSTRUCTION MANAGER for further instructions.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 GENERAL

- A. Structures shall be demolished and removed in compliance with SSPWC subsection 306-5 and the requirements indicated herein.

3.2 POLLUTION CONTROL

- A. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used for dust suppression.
- B. Water shall not be used when it creates hazardous or objectionable conditions such as flooding, erosion, sedimentation, or pollution.

3.3 PROTECTION

- A. Safe passage of persons around the area of demolition shall be provided. Operations shall be conducted to prevent injury to people and damage to adjacent buildings, structures, and other facilities.
- B. Interior and exterior shoring, bracing, or supports shall be provided to prevent movement, settlement or collapse of structures to be demolished.
- C. Existing landscaping materials, structures, and appurtenances which are not to be demolished shall be protected and maintained as necessary.
- D. Unless otherwise indicated, the CONTRACTOR shall protect and maintain all utilities in the proximity of the facilities to be demolished.
- E. The CONTRACTOR shall protect the nearby existing equipment such as control panels and others from dust caused by demolition activities by covering, drop-curtains and other similar methods.

3.4 STRUCTURE DEMOLITION

- A. Building structures and appurtenances shall be demolished, as shown and required to complete work, in compliance with governing regulations.
- B. Small structures may be removed intact when approved by authorities having jurisdiction.
- C. Demolition shall proceed in a systematic manner, from top of structure to ground.
- D. Concrete and masonry shall be demolished in small sections. Use bracing and shoring to prevent collapse.

- E. Demolition equipment shall be dispersed throughout structure and demolished materials removed to prevent excessive loads on supporting walls, floors or framing.

3.5 BELOW-GRADE DEMOLITION

- A. Footings, foundation walls, below-grade construction and concrete slabs on grade shall be demolished and removed to a depth which will not interfere with new construction, but not less than 12 inches below existing ground surface or future ground surface, whichever is lower. All floors of basements, vaults, and other underground structures shall be broken up.
- B. Below-grade areas and voids resulting from demolition of structures shall be completely filled to a minimum compaction of 95%.
- C. All fill and compaction shall be in accordance with Section 02200.
- D. After fill and compaction, surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as indicated.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Demolition and removal of debris shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the OWNER. Alternate routes shall be provided around closed or obstructed traffic ways.
- B. Site debris, rubbish, and other materials resulting from demolition operations shall be removed and disposed of in compliance all laws and regulations. Burning of removed materials from demolished structures shall not be permitted.

3.7 PATCHING AND REPAIRING

- A. The CONTRACTOR shall provide patching, replacing, repairing, and refinishing of damaged areas involved in demolition as necessary to match the existing adjacent surfaces.
- B. The CONTRACTOR shall repair all damages caused to adjacent facilities by demolition at no additional cost to the OWNER.
- C. After patching and repairing has been completed, the CONTRACTOR shall carefully remove splatterings of mortar from adjoining work (plumbing fixtures, trim, tile, and finished metal surfaces) and repair any damage caused by such cleaning operations.

3.8 CLEANING

- A. During and upon completion of work, the CONTRACTOR shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by work in a clean condition.
- B. Clean adjacent structures and facilities of dust, dirt, and debris caused by demolition and return adjacent areas to condition existing prior to start of work.
- C. The CONTRACTOR shall clean and sweep the affected portions of roads, streets, sidewalks and passageways daily.

** END OF SECTION **

SECTION 02100 - SITE PREPARATION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes site preparation, clearing and grubbing.

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 02050 Demolition
 - 2. Section 02140 Dewatering
 - 3. Section 02200 Earthwork
 - 4. Section 16400 Low Voltage Electrical Service and Distribution

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).

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 GENERAL

- A. **Existing Conditions:** The site shall be examined and the CONSTRUCTION MANAGER notified of any conditions which affect the WORK of this Section.
- B. **Utility Interference:** Where existing utilities interfere with the WORK of this Section, the CITY's CONSTRUCTION MANAGER shall be notified of interferences.

3.2 CLEARING AND GRUBBING

- A. Clearing and grubbing shall comply with SSPWC Subsection 300-1 and the following:
1. The site shall be cleared of grass and weeds to a depth of at least 6 inches and debris and obstructions including brush, trees, logs, stumps, roots, heavy sod, vegetation, rock, stones larger than 6 inches in any dimension, broken or old concrete and pavement.
 2. The site shall be grubbed to a depth necessary to remove objectionable material including stumps and roots.

3.3 SALVAGE AND DISPOSAL

- A. **Salvage:** Topsoil shall be salvaged and stored at a location which will not interfere with the WORK.
- B. **Disposal:** Waste material shall be disposed of in accordance with SSPWC Subsection 300-1.3.

**** END OF SECTION ****

SECTION 02140 - DEWATERING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes site dewatering necessary to lower and **control** groundwater levels and hydrostatic pressures to permit excavation and construction to be **performed** properly under dry conditions.
- B. Dewatering operations shall be adequate to assure the integrity of the **finished** project. The responsibility for conducting the dewatering operation in a manner which **will** protect adjacent structures and facilities rests solely with the CONTRACTOR. The cost of **repairing** any damage to adjacent structures and restoration of facilities shall be the responsibility of the CONTRACTOR.
- C. The CONTRACTOR shall bear the sole responsibility for the design, **installation**, and operation of the dewatering system to comply with the requirements of this section. The CONTRACTOR shall be required to install additional dewatering equipment as may be **required** throughout the duration of the project to maintain specified groundwater levels.

1.2 RELATED SECTIONS

- A. The WORK of the following Section 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 02200 Earthwork

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).

1.4 SCHEDULE AND PLAN

- A. The following shall be submitted and approved prior to commencement of **excavation**:
 1. The CONTRACTOR shall make an independent investigation of the **soil** and groundwater conditions at each site. The results of the CONTRACTOR's **independent** investigation shall include the results of any and all exploratory borings, laboratory **tests**, and analyses. The CONTRACTOR's independent investigation shall be in report form.
 2. Prior to commencement of excavation, a detailed plan and schedule, **with** description, for dewatering of excavations, piezometers, estimated dewatering rates, **volume** and equipment requirements shall be submitted with the dewatering plan. The plan shall be signed and sealed by a California registered Civil Engineer, Geotechnical **Engineer**, Engineering Geologist or Hydrogeologist with knowledge of at least one dewatering **operation** of similar magnitude and complexity in a recently completed construction project. The qualification of the dewatering system designer shall be submitted to CONSTRUCTION MANAGER for approval. The CONTRACTOR shall make an independent investigation of the soil

conditions to be dewatered. The dewatering plan shall be prepared specifically to accommodate soil materials and groundwater conditions of the site.

3. Demonstration of proposed system and verification that adequate personnel, materials and equipment are readily available, including standby equipment.
4. A copy of the executed industrial waste permit approved by the City of San Diego.

1.5 CONTROL AND OBSERVATION

- A. Adequate control shall be maintained to ensure that the stability of excavated and constructed slopes are not adversely affected by water, that erosion is controlled and that flooding of excavation or damage to structures does not occur.
- B. Where critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed daily to detect any settlement which may develop.
- C. A daily report shall be maintained recording the following:
 1. Groundwater elevations of ground water and piezometric water levels in observation wells (if any).
 2. Change in elevation of reference points as stated in subsection 1.5 to detect settlement in adjacent structures. CONSTRUCTION MANAGER may suspend work if any settlement exceeds 0.05 feet.
- D. After dewatering is discontinued, a weekly report shall be maintained for two months recording:
 1. Change in elevation of reference points as stated in subsection 1.5 to detect settlement in adjacent structures.

1.6 INSPECTION

- A. During or after trench excavation, when CONTRACTOR observes sufficient groundwater to be present that may prevent proper installation of pipe bedding, pipelines, backfill and compaction, then CONTRACTOR shall call for inspection of conditions by the CONSTRUCTION MANAGER. The CONSTRUCTION MANAGER shall inspect the conditions and determine if unacceptable conditions are present for pipe installation.
- B. If unacceptable trench conditions are found by the CITY's CONSTRUCTION MANAGER, then the CONTRACTOR will be authorized to mobilize and start dewatering operations of the pipeline trench.
- C. Damp soils or low volumes of groundwater in the bottom of trenches are not sufficient cause for trench dewatering.

1.7 MEASUREMENT AND PAYMENT

- A. Separate payments shall be made as specified in the contract for providing all dewatering equipment and apparatus, for mobilization/demobilization of dewatering equipment, and for all dewatering operations.

- B. The CONTRACTOR shall also be responsible for all costs associated with the discharge of dewatering effluent into the sanitary sewer system of the City.
- C. Storm water run-off flowing into the excavation site shall be minimized to the maximum extent possible. All water entering the excavation site shall be subject to all dewatering requirements specified in this documents.
- D. Protection of adjacent structures from adverse effects of dewatering shall be the responsibility of the CONTRACTOR.

1.8 PERMITS

- A. The CONTRACTOR shall obtain an Industrial Waste Discharge Permit from City of San Diego for discharging effluent from dewatering operations into the City sanitary sewer system.
- B. The CONTRACTOR shall be responsible for all costs associated with obtaining all proper permits and for maintaining permit compliance, including all costs associated with permit violations.

PART 2 -- PRODUCTS

2.1 EQUIPMENT

- A. Dewatering, where indicated, includes deep wells, well points, piezometers, sump pumps, temporary pipelines for water disposal, and rock or gravel placement, and other means including standby pumping equipment maintained on the jobsite continuously.

2.2 FOUNDATION ROCK

- A. Foundation rock shall be included in the dewatering system to replace weakened soil within the excavation. Rock shall be 1-1/2 inch maximum crushed stone placed in minimum 12-inch layers and completely wrapped in filter fabric. Foundation rock shall be used in addition to bedding material shown on the plans and shall be used at the CONTRACTOR'S discretion, or as directed by the CONSTRUCTION MANAGER. Foundation rock shall be considered to be part of the dewatering system.

PART 3 -- EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All water encountered in the trench shall be disposed by the CONTRACTOR in such a manner as will not damage public or private property or create a nuisance or health nuisance. The CONTRACTOR shall furnish, install, and operate pumps, pipes, appliances, and equipment of sufficient capability to keep trench excavation free from water until the trench is backfilled, unless otherwise authorized by the CONSTRUCTION MANAGER. No dewatering from inside the trench will be permitted while the pipeline is being installed, unless it is approved by the CONSTRUCTION MANAGER.
- B. Dewatering shall be performed in compliance with Subsection 307-2.3 of SSPWC and as specified herein.

C. An independent assessment of the subsurface conditions shall be performed **prior** to submitting a dewatering plan. The assessment shall be signed and sealed by a California registered Geotechnical Engineer, Engineering Geologist or Hydrogeologist. The plan shall include, but not be limited to:

1. Additional exploratory borings.
2. Laboratory testing.
3. Pump testing.

All boreholes and wells advanced by the CONTRACTOR shall be logged and submitted for review.

- D. An adequate system shall be designed, installed and maintained to lower and control the ground water to permit excavation, construction of structures, and placement of fill materials to be performed under dry conditions. The system shall include two piezometers at each structure and one piezometer at the midpoint of each pipeline reach. The piezometers shall be properly installed to accurately reflect the groundwater depth adjacent to the excavation.
- E. Sufficient dewatering equipment shall be installed to pre-drain the water-bearing strata below the bottom of foundations, sewers and other excavations.
- F. The hydrostatic head in water-bearing strata below foundations, drains, sewers and other excavations shall be reduced to ensure that the water level and piezometric water levels are below the excavation surface at all times. The piezometric water level shall be maintained a minimum of 3 feet below the excavation surface. No excavation shall be made without proof of required lowered groundwater levels.
- G. The system shall be placed into operation prior to excavation below ground water level to lower the ground water level and shall be operated continuously 24 hours a day, 7 days a week until drains, sewers and structures have been constructed and fill materials have been placed and dewatering is no longer required. Groundwater will need to remain depressed until adequate loading from proposed structures and uplift resistance to buoyant forces can be provided. All dewatering wells, well points and piezometers shall be installed under the supervision of a California registered Geotechnical Engineer, Engineer Geologist, or Hydrogeologist. The registered professional shall submit a written certificate that the system has been installed according to the dewatering plan.
- H. The site shall be graded to facilitate drainage. Surface runoff shall be diverted from excavations. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and then be pumped or drained by gravity away from the excavation and disposed of in compliance with the CWP Guidelines, and local, State and Federal regulations.
- I. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
- J. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with foundation rock completely wrapped in filter fabric at no additional cost to the OWNER.

- K. Flotation of structures and facilities shall be prevented by maintaining a positive and continuous removal of water. The dewatering system shall be in continuous operation until all structure and pipelines are properly backfilled.
- L. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sandpacked and/or other means used to prevent pumping of fine sands or silts from the subsurface. A continual check shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.
- M. An Industrial Waste Discharge Permit shall be obtained from City of San Diego to discharge dewatering effluent into the sanitary sewer system.

If the laboratory results of the independent assessment of subsurface conditions show contamination levels above what is acceptable, a treatment system shall be provided under the bid allowances in the Bid Schedule.

- N. The release of groundwater to its original level shall be performed in such a manner as not to disturb natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.

** END OF SECTION **

SECTION 02200 - EARTHWORK

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes all earthwork required for construction of the WORK. Such earthwork shall include the loosening, removing, loading, transporting, depositing, and compacting in its final location of all materials wet and dry, as required for the purposes of completing the WORK.
- B. Fill material is defined as material used to raise the level of a portion of the site to the line and grade indicated. Backfill material is defined as material used to refill an excavation.

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 02140 Dewatering

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).

1.4 REGULATORY REQUIREMENTS

- A. The WORK of this Section shall comply with current versions, with revisions, of the following:
 - 1. Construction Safety Orders, Division of Industrial Safety, State of California.
 - 2. California Department of Transportation Traffic Manual.

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. The CONTRACTOR shall comply with the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code. The CONTRACTOR, prior to beginning any trench or structure excavation 5 feet deep or over shall submit to the OWNER and shall be in possession of the OWNER's written acceptance of the CONTRACTOR's detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. If such plan varies from the shoring system established in the Construction Safety Orders of the State of California, such alternative system plans shall be prepared by a civil or structural engineer licensed in the State of California.
 - 2. Copy of the excavation permit issued by the California Department of Industrial Safety.

3. Samples of imported material. Samples shall be submitted in accordance with SSPWC, Subsection 217-2.3.
4. Such other samples of materials as the CONSTRUCTION MANAGER may require.

1.6 SOIL TESTING

- A. **General:** All soils testing shall be done in accordance with SSPWC, Section 211, and by a testing laboratory of the OWNER's choice at the OWNER's expense.
- B. **Compaction Tests:** Where soil material is required to be compacted to a percentage of maximum density, the maximum density shall be determined in accordance with the requirements of SSPWC, Subsection 211-2. In case the tests of the fill or backfill show non-compliance with the required density, the CONTRACTOR shall accomplish such remedy as may be required to insure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the OWNER and shall be at the CONTRACTOR's expense.

PART 2 -- PRODUCTS

2.1 FILL AND BACKFILL MATERIALS

- A. **General:** Fill and backfill material shall consist of select material obtained from the excavation, imported material, granular bedding material, or unclassified material. The CONTRACTOR shall import at his expense materials in excess of the approved material obtained from excavation as required to complete the fill, backfill, and grading WORK as indicated.
- B. **Select Material:** Select material shall consist of primarily granular material encountered in the excavation which is free of vegetation, organic matter, debris, rocks larger than 4 inches in diameter and other unsuitable material, and shall have an expansion index less than 30 (less than 20 for footings and floor slabs) as determined by UBC Standard No. 29-2, plasticity index of 10 or less, a liquid limit of 30 or less and shall be approved as select material by the CONSTRUCTION MANAGER.
- C. **Imported Material:** Imported material shall conform to the same specifications as select material defined above. In addition, the imported materials shall have a minimum sand equivalent of 15 as determined by California Test Method No. 217. Imported material placed in areas to be planted shall be able to support normal plant growth. Obtain approval by the CONSTRUCTION MANAGER prior to transporting imported material.
- D. **Bedding Material:** Bedding material, defined as that material supporting, surrounding and extending to 1 foot above the top of a pipe, shall be in accordance with SSPWC, Subsection 306-6.
- E. **Unclassified Material:** Unclassified material shall conform to SSPWC, Subsection 300-4.

2.2 ROCK PRODUCTS

- A. Rock products, consisting of crushed rock, rock dust, gravel, sand, and stone for riprap shall be clean, hard, sound, durable, uniform in quality and free of disintegrated material, organic matter, oil alkali, or other deleterious substance, and shall, unless otherwise specified, conform with the requirements of SSPWC, Subsection 200-1.

2.3 UNTREATED BASE MATERIALS

- A. Untreated base materials shall conform with the requirements of SSPWC, Subsection 200-2.

2.4 TOPSOIL

- A. Topsoil shall be designated as Class A (imported), Class B (selected), or Class C (unclassified), and shall conform with the requirements of SSPWC, Subsection 800-1.1. The CONSTRUCTION MANAGER shall determine the suitability of topsoil prior to use.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall perform earthwork as necessary to complete the WORK as shown on the Contract Drawings and specified herein. The CONTRACTOR shall take the necessary precautionary measures to prevent dust or other nuisances which might be created by reason of his activities. The necessary precautionary measures shall conform to the requirements of SSPWC, Subsection 7-8. The requirements specified in Subsection 7-8 shall be extended to include paved surfaces.
- B. All types of earthwork, including trench, structural and general excavation, fill, backfill and compaction, shall conform to applicable requirements of the SSPWC. Section 300, and to the requirements specified herein.

3.2 SITE PREPARATION

- A. Areas to be excavated, filled, graded, and to be occupied by permanent construction or embankments shall be prepared by clearing and grubbing. Clearing and grubbing shall conform to the applicable requirements of SSPWC, Subsection 300-1.

3.3 EXCAVATION

- A. **General:** Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the work. Unless otherwise directed, the removal of said materials shall conform to the lines and grades shown. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. The CONTRACTOR shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching, or other measures for the removal or exclusion of water as required by Section 02140. Excavations shall be sloped or otherwise supported in a safe manner in accordance with the rules, orders, and regulations of the Division of Industrial Safety of the State of California.
- B. **Unclassified Excavation:** Unclassified excavation shall consist of all excavation, including roadways, unless separately designated.
 - 1. Unsuitable material shall be excavated and disposed of in accordance with the requirements of SSPWC, Subsection 300-2.2.
 - 2. Wet material, if unsatisfactory for the specified use on the project solely because of high moisture content, may be processed to reduce the moisture content, or may be required to be

removed and replaced with suitable material in accordance with the requirements of SSPWC, Subsection 300-2.2.2.

3. The removal and disposal of slide and slipout material shall be in accordance with SSPWC, Subsection 300-2.4.
4. Excavation slopes shall be finished in conformance with the lines and grades shown, and in accordance with SSPWC, Subsection 300-2.5.
5. Surplus material shall be disposed of off-site, and in accordance with SSPWC, Subsection 300-2.6.

C. **Structure Excavation:** Structure excavation shall consist of the removal of material for the construction of foundations for bridges, retaining walls, headwalls, culverts, buildings, or other structures, and shall be in accordance with SSPWC, Subsection 300-3.

1. Cofferdams for foundation construction shall be constructed in accordance with SSPWC, Subsection 300-3.2.
2. The treatment of foundation material shall be in accordance with SSPWC, Subsection 300-3.3.

D. **Underground Conduit Excavation:**

1. **General:** Excavation for underground conduits shall be in accordance with SSPWC, Subsection 306-3 and the requirements contained herein. Unless otherwise shown or ordered, excavation for pipelines and utilities shall be open-cut trenches. Trench widths shall be kept as narrow as is practical for the method of pipe zone densification selected by the CONTRACTOR, but shall have a minimum width at the bottom of the trench equal to the outside diameter of the pipe plus 24 inches for mechanical compaction methods and 18 inches for water consolidation methods. The maximum width at the top of the pipe shall be equal to the outside diameter of the pipe plus 36 inches for pipe diameters 18 inches and larger and to the outside diameter of the pipe plus 24 inches for pipe diameters less than 18 inches.
2. **Bracing Excavations:** The manner of bracing excavations shall be as set forth in the rules, orders and regulations of the Division of Industrial Safety of the State of California, and in accordance with the requirements of SSPWC, Subsection 306-4.
3. **Trench Bottom:** Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe. The trench bottom shall be given a final trim, using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Rounding out the trench to form a cradle for the pipe will not be required.
4. **Open Trench:** The maximum amount of open trench permitted in any one location shall be 500 feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The above requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure. In such cases, however, barricades and warning lights conforming to requirements set forth in the California Department of Transportation Traffic Manual shall be provided and maintained.
5. **Trench Over-Excavation:** Where the Drawings indicate that trenches shall be over-

excavated, they shall be excavated to the depth required, and then backfilled to the grade of the bottom of the pipe.

6. Where pipelines are to be installed in embankment fills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

E. Over-Excavation Ordered by CONSTRUCTION MANAGER:

1. Trenches shall be over-excavated beyond the depth shown when required by the CONSTRUCTION MANAGER. Such over-excavation shall be to the depth ordered. The trench shall then be backfilled to the grade of the bottom of the pipe. All work specified in this Section shall be performed by the CONTRACTOR at no additional cost to the OWNER when the over-excavation ordered by the CONSTRUCTION MANAGER is less than 6 inches below the limits shown. When the over-excavation ordered by the CONSTRUCTION MANAGER is 6 inches or greater below the limits shown, additional payment will be made to the CONTRACTOR for that portion of the work which is located below said 6-inch distance.

F. Over-Excavation not Ordered or Indicated:

1. Any over-excavation carried below the grade ordered or indicated shall be backfilled to the required grade with the specified material and compacted. Such work shall be performed by the CONTRACTOR at no additional cost to OWNER.

G. Excavation in Lawn Areas:

1. Where excavation occurs in lawn areas, the sod shall be carefully removed and stockpiled to preserve it for replacement. Excavated material may be placed on the lawn; provided, that a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of pipeline testing and backfilling, the sod shall be replaced in a manner so as to restore the lawn as near as possible to its original condition. CONTRACTOR shall provide new sod if removed sod has remained stockpiled for more than 72 hours.
2. The CONTRACTOR shall restore the lawn irrigation system removed or damage due to excavation operations to a condition equal to the previous condition.

H. Excavation in Vicinity of Trees:

1. Except where trees are shown to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without written permission of the CONSTRUCTION MANAGER. Trees shall be supported during excavation by means previously reviewed by the CONSTRUCTION MANAGER.

I. Rock Excavation:

1. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and blasting.
2. Said rock excavation shall be performed by the CONTRACTOR; provided that should the

quantity of rock excavation be affected by any change in the scope of the WORK, an appropriate adjustment of the contract price will be made.

3.4 FILL AND BACKFILL

A. General:

1. Fill and Backfill shall be placed in accordance with the applicable provisions of SSPWC, Section 300, and the requirements stated herein.
2. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has been properly cured in accordance with the requirements of Section 03300 and has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.
3. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall not be placed until all water is removed from the excavation.

B. Placing and Spreading of Materials:

1. Materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment the layers shall be evenly spread so that when compacted, each layer shall not exceed 8 inches in thickness. When compaction is achieved using flooding and jetting methods, each layer shall not exceed 3 feet in thickness after compaction.
2. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Bedding materials shall be brought up evenly around the pipe so that when compacted, the material will provide uniform bearing and side support.
3. Where the material moisture content is below the optimum moisture content water shall be added before or during spreading until the proper moisture content is achieved.
4. Where the material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

C. Compaction Requirements

1. Compaction tests shall be performed in accordance with SSPWC, Subsection 211-2.
2. The relative compaction of fill, backfill, and base material shall be in accordance with SSPWC, Section 300, with the following exceptions:
 - a. Subgrade where trench has been overexcavated 95%
 - b. One foot layer of crushed aggregate backfill in overexcavated trench. Where trench is overexcavated more than 2 feet, minimum of 2 layers shall be compacted. 95%
 - c. Pipe zone for flexible and rigid pipe : 95%
 - d. Fill beneath structures, including water containing structures: 95%

e Backfill on underground structure roof:

90%

D. Unclassified Fill:

1. All fill shall be of unclassified material unless separately designated. Construction of unclassified fill, including preparing the area on which fill is to be placed, and the depositing, conditioning, and compacting of fill material shall be in accordance with SSPWC, Subsection 300-4.

E. Structure Backfill:

1. Backfill at structure shall be placed in accordance with SSPWC, Subsections 300-3.5 and 300-4.5.

F. Underground Conduit Backfill:

1. Bedding around pipe shall be bedding material placed in accordance with the requirements of SSPWC, Subsection 306-6.
2. Backfill above shall be considered as starting 1 foot above the pipe or conduit, or at the subgrade for cast-in-place structures such as manholes, transition structures, junction structures, vaults, and valve boxes.
3. Backfill at underground conduits shall be placed and densified according to SSPWC, Subsection 306-12.

3.5 PREPARATION OF SUBGRADE UNDER IMPROVEMENT

- A. The preparation of subgrade for pavement, curbs and gutters, driveways, sidewalks and other roadway structures shall be in accordance with SSPWC, Subsection 301-1.

3.6 UNTREATED BASE

A. Spreading and Compacting:

1. Aggregate base material shall be spread and compacted in accordance with SSPWC, Subsection 301-2.

**** END OF SECTION ****

SECTION 02390 - SHEET PILES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing steel sheet piles as indicated. Temporary sheet piling installed by the CONTRACTOR to facilitate the installation or construction of other features of the WORK is not covered by this Section.

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 02200 Earthwork
- 2. Section 02400 Temporary Shoring

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).

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

ASTM A 328 Specification for Steel Sheet Piling.

ASTMA 690 Specification for High-Strength Low-Alloy Steel H-Piles and Sheet Piling for Use in Marine Environments.

1.5 SHOP DRAWINGS AND SAMPLES

- A. In addition to General Requirement, the following shall be submitted:
 - 1. Drawings indicating sheet pile configuration, material specifications and complete layout plan including the proposed method of installation.

1.6 SUBSURFACE CONDITIONS

- A. The following are reports of explorations and tests of subsurface conditions at the site of the WORK:

Report dated November 17, 2014 prepared by Allied Geotechnical Engineers, Inc. entitled "Updated Final Report of Geotechnical Investigation Pump Station No. 2 Power Reliability and Surge Protection, City of San Diego, Contract No. H115417" consist of 122 pages. The CONTRACTOR shall understand and conform to all recommendations and criteria associated with sheet piling given in this report. The Report is included as an Appendix in the Contract

Documents.

- B. The CONTRACTOR shall visit the site and shall satisfy itself as to all existing surface and subsurface conditions affecting the work. The information provided in the geotechnical engineering report is available to the CONTRACTOR at its own risk, in the assessment of subsurface conditions at the site. Prior to bidding, bidding contractors may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions, but such subsurface investigations shall be performed only under time schedules and arrangements approved in advance by OWNER.

1.7 NOTIFICATION OF SCHEDULE

- A. The CONTRACTOR shall give written notification to the CONSTRUCTION MANAGER of the scheduled date for installation of sheet piling at the site at least one week in advance of that date.

PART 2 – PRODUCTS

2.1 STEEL SHEET PILES

- A. Steel sheet piles shall be rolled steel sections of the weight, shape, and length indicated. The material in steel sheet piles to be used shall meet the requirements of ASTM A 690 .
- B. Other requirements for sheet piles shall comply with SSPWC subsection 205-2.

PART 3 – EXECUTION

3.1 DRIVING SHEET PILES

- A. Sheet piles shall be driven with hammers adequate to drive the piles to the required depths.
- B. To maintain satisfactory alignment, sheet piles shall be driven in increments of penetration necessary to prevent distortion, twisting out of position, or pulling apart at interlocks.

3.2 JETTING SHEET PILES

- A. Sheet piles may be installed with water jets at locations where stability of embankments or other improvements will not be endangered.
- B. The CONTRACTOR shall supply and operate one or more high pressure jetting systems to erode material adjacent to the pile when needed and permitted to facilitate driving sheet piling to the desired penetration.
- C. Jetting may be done either ahead of or simultaneously with driving operations. If jets and hammer are used simultaneously, jets shall be withdrawn and final penetration of sheet piles obtained by driving with the hammer alone for at least the last foot of penetration.

3.3 CUTOFFS

- A. Tops of sheet piling shall be cut off or driven down to a straight line at the elevation shown, or as directed. If a cutting torch is used on steel sheet piling, the cut surface shall be made as

smooth as practicable by grinding or other approved methods.

- B. If heads of sheet piles are appreciably distorted or otherwise damaged below cut-off level, damaged portions shall be removed and replaced, or repaired to the satisfaction of the CONSTRUCTION MANAGER.
- C. Sheet piles damaged during driving, or driven out of proper position, or below cut-off elevation, shall be withdrawn and replaced with new piles.

**** END OF SECTION ****

SECTION 02400 - TEMPORARY SHORING AND BRACING

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing temporary shoring as determined by the CONTRACTOR in the locations indicated on the Drawings for the excavation near the existing utilities and in other locations deemed necessary by the CONTRACTOR. The work of this Section also includes temporary bracing to protect existing structures that are adjacent to the work, where it may not be practical to provide temporary shoring. Temporary sheet piling installed by the CONTRACTOR to facilitate the installation or construction of other features of the WORK is not covered by this Section.
- B. This section is intended to be general in scope and is applicable to all work of this Contract, including principally the following items as may be required in the performance of the Work:
 - 1. Trenches and excavation.
 - 2. Structural excavation.
 - 3. Protecting existing facilities, including aboveground structures and utilities below ground.
 - 4. Maintaining construction activities within Owner's property and easement areas

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 02200, Earthwork

1.3 SPECIFICATIONS AND STANDARDS

- A. All excavations shall be properly shored to furnish safe working conditions and the shoring shall be so arranged as not to place any stress on existing structures and existing utilities and portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength. Any damage to structures occurring through settlements, water or earth pressures, slides, caves, or other causes; due to the failure or lack of shoring; or due to improper shoring; or occurring through negligence or fault of the CONTRACTOR or in any other manner shall be repaired by the CONTRACTOR at the CONTRACTOR'S expense.
- B. No temporary shoring, sloping or protective systems are allowed which are less stringent than that required by the Construction Safety Orders of the Division of Industrial Safety and the Occupational Safety and Health Act. All excavations shall be performed, protected and supported as required for safety and in the manner set forth in the operation rules, orders and regulations prescribed by the Division of Industrial Safety of the State of California.

1.4 SHOP DRAWINGS AND SAMPLES

- A. In addition to General Requirements, the following shall be submitted:

1. The CONTRACTOR shall comply with the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code. The CONTRACTOR, prior to beginning any trench or structure excavation 5 feet deep or over shall submit to the OWNER and shall be in possession of the OWNER's written acceptance of the CONTRACTOR's detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. If such plan varies from the shoring system established in the Construction Safety Orders of the State of California, such alternative system plans shall be prepared by a qualified civil or structural engineer licensed in the State of California and employed by an independent DESIGN CONSULTANT firm insured against errors and omissions to the extent required by the ENGINEER.
2. The submittal(s) shall include a site location map referencing existing features; detailed plans; elevations, and various sections indicating all excavation slopes, shoring components and connections of shoring, trenching or structure excavation along with supporting calculations; notes including sequence of construction, materials, and other clarification as required by the California Labor Code, SSPWC, and the contract documents.
3. Trench and excavation safety plan must meet the minimum requirements of the Cal/OSHA Construction Safety Order Section 1539-1543.
4. Copy of the excavation permit issued by the California Department of Industrial Safety.

1.5 SUBSURFACE CONDITIONS

- A. The following are reports of explorations and tests of subsurface conditions at the site of the WORK:

Report dated November 17, 2014 prepared by Allied Geotechnical Engineers, Inc. entitled "Updated Final Report of Geotechnical Investigation Pump Station No. 2 Power Reliability and Surge Protection, City of San Diego, Contract No. H115417" consist of 122 pages. The CONTRACTOR shall understand and conform to all recommendations and criteria associated with sheet piling given in this report. The Report is included as an Appendix in the Contract Documents.

- B. The CONTRACTOR shall visit the site and shall satisfy itself as to all existing surface and subsurface conditions affecting the work. The information provided in the geotechnical engineering report is available to the CONTRACTOR at its own risk, in the assessment of subsurface conditions at the site. Prior to bidding, bidding contractors may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions, but such subsurface investigations shall be performed only under time schedules and arrangements approved in advance by OWNER.

1.6 NOTIFICATION OF SCHEDULE

- A. The CONTRACTOR shall give written notification to the CONSTRUCTION MANAGER of the scheduled date for installation of temporary shoring and/or bracing at the site at least one week in advance of that date.

PART 2 – PRODUCTS

2.1 MATERIAL

- A. Use new or used materials complying with provisions of the approved support system design drawings. Materials shall be free from defects and damage that might in any way impair their protective function. Wood materials shall be pressure treated and be suitable for the application.

PART 3 – EXECUTION

3.1 TEMPORARY SHORING

- A. Soldier piles shall be used for temporary shoring. Sheet piles shall not be driven with hammers or installed with water jets due to possible damage to adjoining structures.

3.2 CUTOFFS

- A. Tops of temporary shoring shall be cut off to a straight line at the elevation shown, or as directed. If a cutting torch is used, the cut surface shall be made as smooth as practicable by grinding or other approved methods.
- B. If heads of temporary shoring are appreciably distorted or otherwise damaged below cut-off level, damaged portions shall be removed and replaced, or repaired to the satisfaction of the CONSTRUCTIONMANAGER.
- C. Temporary shoring damaged during placement, or driven out of proper position, or below cut-off elevation, shall be withdrawn and replaced.
- D. After construction of the new facilities, temporary shoring shall be removed.

3.3 LAGGING

- A. Timber lagging that is to remain in place shall be treated timber.

3.4 TIE-BACKS

- A. Tie-backs, where required by the CONTRACTOR, shall be cased to prevent cave-ins.

**** END OF SECTION ****

SECTION 02510 - A.C. PAVEMENT AND BASE

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing asphalt concrete pavement, cement-treated base, and associated materials.

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 02100 Site Preparation
- 2. Section 02200 Earthwork

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).

PART 2 -- PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. Base: Materials for aggregate base shall be crushed rock and rock dust complying with SSPWC Subsection 301-2.1.
- B. Tack Coat: Tack coat material shall comply with SSPWC Subsection 302-5.4.
- C. Asphalt Concrete: Asphalt concrete shall comply with SSPWC Subsection 400-4. Where construction of the pavement is to be accomplished in a single course, Class C2 grading shall be used. Where construction consists of 2 or more courses, the surface course shall be Class C2 grading and the lower courses shall be Class B3 grading. Paving asphalt of viscosity grade AR 8000 shall be used.
- D. Pavement Marking Paint: Pavement marking paint shall comply with SSPWC Subsection 210-1.6.
- E. Emulsified Asphalt Slurry Coat: The slurry coat shall meet the requirements of SSPWC Subsection 203-5, and shall have the composition and grading indicated for Type II material.

PART 3 -- EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Subgrade Preparation: The subgrade shall be prepared as specified in Section 02200 as applicable to roadways and embankment. Two-inch by 4-inch redwood headers shall be firmly staked in the proper positions along all edges other than those where the pavement is to be placed against existing concrete or paved surfaces.

- B. Cement-Treated Base: Cement-treated base shall be installed where indicated and to the thickness indicated. Construction of the cement-treated base shall comply with SSPWC Subsection 301-3.3.
- C. Tack Coat: A tack coat shall be applied in accordance with the requirements of SSPWC Subsection 302-5.4.
- D. Asphalt Concrete: Asphalt concrete paving shall be constructed in accordance with SSPWC Subsection 302-5.
- E. Traffic Marking: Application of paint shall comply with SSPWC Subsection 310-5.6.
- F. Emulsified Asphalt Slurry Coat: An emulsified asphalt slurry coat shall be applied to surfaces of existing asphaltic-concrete pavement as indicated. Mixing and spreading of the slurry coat shall conform to applicable portions of SSPWC Subsection 302-4. Slurry shall be applied at the rate of 1350 square feet per extra long ton.

** END OF SECTION **

SECTION 02575 - PAVEMENT

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes removal and rehabilitation of pavement affected by CONTRACTOR'S operations such as trenching, modification to facilities or as otherwise indicated.

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 02200 Earthwork
 - 2. Section 02510 AC Pavement and Base
 - 3. Section 03280 Joints in Sitework Concrete
 - 4. Section 03310 Cast-in-Place Sitework Concrete

1.3 STANDARD SPECIFICATIONS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

1.4 PROJECT RECORD DRAWINGS

- A. The following shall be included in the PROJECT RECORD DRAWINGS in compliance with the General Requirement:
 - 1. Drawings indicating the exact extent of pavement removed and rehabilitated.

PART 2 -- PRODUCTS

2.1 ASPHALT CONCRETE

- A. Asphalt concrete shall conform to the requirements of SSPWC subsection 203-6. Composition and grading of the asphalt concrete mixture shall conform to SSPWC subsection 203-6.4.3, class F.
- B. Tack coat shall comply with subsection 302-5.4 of SSPWC.

2.2 PORTLAND CEMENT CONCRETE

- A. Portland cement concrete shall comply with the requirements of subsection 201-1 of SSPWC; class 560-C-3250 per subsection 201-1.1.2 of SSPWC.
- B. Curing compound for concrete that is to be topped by an asphaltic wearing course shall comply

with SSPWC subsection 201-4 and shall be asphaltic type. Pigmentation is not required.

PART 3 -- EXECUTION

3.1 REMOVAL OF PAVEMENT

- A. Existing AC pavement shall be sawcut to a minimum depth of 1-1/2 inches or 25 percent of its thickness, whichever is greater.
- B. Removal of the existing cement concrete pavement for trench excavation shall be done in accordance with subsection 300-1.3 of SSPWC.

3.2 PLACEMENT OF PORTLAND CEMENT CONCRETE PAVEMENT

- A. Subgrade preparation shall be done in accordance with subsection 301-1 of the SSPWC.
- B. Prior to placing concrete, pavement edges shall be trimmed to neat horizontal and vertical lines. In case of AC pavement, a tack coat shall be applied to the existing pavement prior to placing cement concrete; while in the case of concrete pavement, the surface of edges shall be thoroughly wetted with water.
- C. Portland cement concrete pavement shall be reconstructed in accordance with the applicable provisions of SSPWC subsection 302-6.

3.3 PLACEMENT OF WEARING SURFACE COURSE FOR AC PAVEMENT

- A. In the case of rehabilitation of AC pavement, use only asphaltic type concrete curing compound.
- B. Apply tack coat, to cement concrete pavement surface after it has cured, in accordance with SSPWC subsection 302-5.4.
- C. Install asphaltic concrete, Class F, wearing course in accordance with the applicable provisions of SSPWC subsection 302-5.

**** END OF SECTION ****

SECTION 02600 - PIPELINE CONSTRUCTION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing general requirements for pipelines, including pipe, joints, specials, and appurtenances, complete and in place.

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 02140 | Dewatering |
| 2. | Section 02200 | Earthwork |
| 3. | Section 02666 | Water Pipeline Testing and Disinfection |

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).

1.4 SHOP DRAWINGS AND SAMPLES

- A. In addition to the requirements of Section 02200 and the pipe material specifications, the following shall be submitted and approved prior to construction.

1. Post-installation videotape and inspection reports.
2. Line layout and marking diagrams which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; the station and invert elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained and/or welded joints, or of concrete encasement.
3. Shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.
4. Drawings and calculations for thrust blocks.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer. Materials delivered onsite without an approved submittal for verification shall be rejected and payment withheld.
- B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that

is protected from the elements.

- C. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weather tight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings. Gears and bearings to be stored for extended periods shall be containerized suitable for export shipment.

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 [two] OWNER-designated inspectors for the number of days indicated to complete such inspections or observations, 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.

PART 2 -- PRODUCTS

2.1 PIPE AND APPURTENANCES

- A. Provide pipe materials, coatings and linings, and appurtenances of the sizes and types indicated on the Drawings and Contract Documents.

2.2 FILL AND BACKFILL MATERIAL

- A. Fill and backfill materials shall be in accordance with Section 02200.

PART 3 -- EXECUTION

3.1 PREPARATION

- A. Utility Relocation: Notify the CONSTRUCTION MANAGER of property which must be relocated of existing public utilities and franchise holders which must be relocated and the reasonable time for doing so. The OWNER will contact the utility or franchise holder and request relocation. Relocation and protection of existing utilities which are the CONTRACTOR's responsibility.
- B. Before submitting joint shop drawings, where the proposed piping will connect to existing piping, the CONTRACTOR shall excavate the point of connection to verify size, layout, and depth. Prepare a sketch of the proposed point of connection for submittal with the joint shop drawings. The CONTRACTOR shall give the CONSTRUCTION MANAGER a minimum of two hours to inspect the existing piping before backfilling.

3.2 DEWATERING

- A. Install and operate according to Section 02140 a continuous dewatering system capable of maintaining the ground water level 2 feet below the excavated trench bottom. Only well points located on both sides of the trench shall be used for dewatering, unless otherwise approved by the CONSTRUCTION MANAGER.

- B. Operate the dewatering system 7 days per week, 24 hours per day with water level as indicated above until backfilling is completed.
- C. Field-determined departures from the dewatering plans may necessitate adjustments to the trench shoring and bracing methods to achieve soil stability. Adjustment shall be at no additional cost to the OWNER.
- D. Dewatering shall prevent softening of the bottom of excavations or formation of "quick" conditions. Dewatering shall not remove native soils. All loose soil shall be removed and recompact in accordance with Section 02200.

3.3 EXCAVATION

- A. Unless indicated otherwise, excavation and overexcavation shall be in accordance with Section 02200.
- B. Trench width shall be as indicated.
- C. Stabilize the trench subgrade by compaction to 95 percent relative density. Where trench bottom has been over-excavated, compact the bedding to 95 percent in 1-foot thick layers.

3.4 LAYOUT AND HANDLING

- A. Handling of Pipe and Accessories: Pipe shall be lifted in such a manner as to minimize bending and prevent damage to the pipe. During transport, pipe shall be supported to prevent distortion or damage to the pipe. When not being handled, pipe shall be stockpiled on timber cradles or properly prepared ground with all rocks larger than 3 inches eliminated. All pipe, fittings valves and accessories shall be carefully lowered into the trench in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. The CONTRACTOR shall smooth out any burrs, gouges, or weld splatter and repair other defects prior to laying the pipe. Any pipe section, including coatings and linings, that becomes damaged as a result of handling or stockpiling shall be replaced with a new unit or repaired at the discretion of the CONSTRUCTION MANAGER at no additional cost to the OWNER.

3.5 INSTALLATION

- A. General: Pipe shall be installed in accordance with the pipe manufacturer's recommendations and the applicable provisions of SSPWC Subsection 306-1.2, and the requirements herein.
- B. Interferences
 - 1. CONTRACTOR shall protect and maintain all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the WORK . Where indicated that the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, or pipes, the obstruction shall be supported until it is relocated, removed, or reconstructed by the CONTRACTOR in cooperation with owners of such utility structures. Unless otherwise indicated, this WORK shall be performed at no additional cost to the OWNER.
 - 2. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the CONSTRUCTION MANAGER may direct a change in the alignment or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum

deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and integrity of the finished joint.

- C. Line and Grade Tolerance: Each section of pipe shall be laid in the order and position shown on the laying schedule. Unless indicated otherwise, the pipe shall be laid to the design line and grade, within approximately one inch plus or minus. No tolerance is permitted on pipes designed for zero slope.
- D. Curved Alignments: Where curved alignments are indicated, deflecting the joints will be allowed only in accordance with the written instructions of the pipe manufacturer and these specifications. Where a smaller radius of curvature is required than can be accommodated by deflecting the joints, sections of pipe with beveled ends may be laid unless fabricated bends are indicated. Maximum joint deflection and maximum bevel for different pipe sizes and joint designs shall be in accordance with the pipe manufacturer's recommendations and these specifications.
- E. Cutting and machining of the pipe shall only be in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe, produce ragged, uneven edges, or otherwise impair the condition of the pipe.
- F. The CONTRACTOR shall install all pipe, fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as indicated and as required to provide a complete and workable installation. No pipe or appurtenance shall be installed when the interior or exterior surfaces show cracks or other defects that may be harmful as determined by the CONSTRUCTION MANAGER. Damaged interior and exterior surfaces shall be repaired to the satisfaction of the CONSTRUCTION MANAGER or a new undamaged pipe or appurtenance shall be provided.
- G. Pipe laying operations shall be stopped and dewatering operations shall be adjusted to prevent the pipe from floating due to water entering the trench from any source. The CONTRACTOR shall reinstall all affected pipe to its specified condition and grade.
- H. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- I. Immediately before placing each section of pipe in final position for jointing, the bedding shall be checked for firmness and uniformity of surface.
- J. Pipe shall be laid directly on the bedding material. No blocking will be permitted and the bedding shall form a continuous, solid bearing for the full length of the pipe. Excavate to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings and to facilitate placement of grout bands. Excavation shall be adequate to permit access to the joints for bonding operations and for application of coating on field joints.
- K. Backfilling and compaction shall comply with Section 02200 and the pipe specifications.
- L. Sheet piling used for shoring shall extend at least 2 feet below the bottom of the trench. After completion of the pipe, it may be removed by cutting at least 12 inches above the top of the pipe. No vibratory methods for pile removal will be accepted, and piling lower than 12 inches above the

top of the pipe shall be left in place.

- M. Lay section of pipe with the bell end upgrade.
 - N. Except for short runs which may be permitted by the CONSTRUCTION MANAGER, sections of pipe shall be laid in a sequence moving in an upgrade direction on grades exceeding 10 percent. Pipe which is laid in a downgrade direction shall be blocked and held in place until sufficient support is furnished by the following pipes to prevent movement.
 - O. Where indicated, concrete thrust blocks shall be provided.
- 3.6 FIELD TESTING
- A. Field testing shall be in accordance with Section 02666.
- 3.7 SITE RESTORATION
- A. Backfill and compact soil in accordance with Section 02200.
 - B. Place subgrade and base materials in accordance with Section 02200.
 - C. Replace damaged pavement, curbs, gutters, and sidewalks, shrubs, and trees as indicated in SSPWC Subsection 306-1.5.2.

****END OF SECTION****

SECTION 02644 - PVC NON-PRESSURE PIPE

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing underground PVC non-pressure pipe for gravity flow and all appurtenant work, complete in place.

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 02140 Dewatering
- 2. Section 02200 Earthwork
- 3. Section 02600 Pipeline Construction
- 4. Section 03310 Cast-in-Place Sitework Concrete

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).

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 D 2321 Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Samples of all the materials proposed for use on the WORK. The samples shall be clearly marked to show the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and installation instructions.
 - 2. Shoring and bracing drawings in accordance with the requirements of Section 02200.
 - 3. Shop drawings and laying diagrams of all pipe, joints, bends, special fittings, and piping appurtenances.

1.6 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL:

1. Manufacturer's certificates of compliance indicating that all materials furnished under this Section meet the requirements of the Contract Documents.

1.7 FACTORY TESTING

- A. The manufacturer shall perform all tests and submit the test results data and certification in compliance with SSPWC Subsection 207-17.4.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. PVC pipe, fittings, couplings and appurtenances shall comply with SSPWC Subsection 207-17.
- B. In addition to the identification marks specified in SSPWC 207-17.2.1, the CONTRACTOR shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.
- C. All PVC pipe shall be suitable for joining by compression joints unless otherwise shown or indicated.

2.2 BEDDING MATERIAL

- A. Unless otherwise indicated, all material used for pipe bedding shall conform to the requirements of SSPWC Subsection 306-1.2.13, and the trench backfill material shall comply with Section 02200.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the CONSTRUCTION MANAGER, and shall be subject to his approval before acceptance
- B. Installation shall conform to the recommendations of pipe manufacturer, the requirements of ASTM D 2321, SSPWC Subsection 306-1.2.13, Section 02600, and as indicated herein.

3.2 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Sections 02200, 02600, and SSPWC Subsection 306-1.3.
- B. The minimum depth of cover over the top of the pipe shall be 36 inches unless otherwise shown. The width of the trenches shall be as indicated on the Drawings.

3.3 FIELD JOINTING

- A. Pipe shall be jointed in compliance with manufacturer's printed instructions.

3.4 COMPACTION OF PIPE BEDDING AND BACKFILL

- A. Compaction of pipe bedding and backfill material shall conform to the requirements of Sections 02200 and 02600.

**** END OF SECTION ****

SECTION 02646 - PVC PRESSURE PIPE

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing polyvinyl chloride (PVC) pressure pipe and all appurtenant work, complete in place.

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, also apply to the extent required for proper performance of this WORK.

1. Section 02140 Dewatering
2. Section 02200 Earthwork
3. Section 02600 Pipeline Construction
4. Section 02666 Water Pipeline Testing and Disinfection
5. Section 03310 Cast-In-Place Sitework Concrete

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).

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current additions of the following apply to the WORK of this Section:

1. ANSI/AWWA C104/A21.5 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings 3-in Through 48-in for Water and Other Liquids
3. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
4. ANSI/AWWA C600 Installation of Ductile-Iron Water Mains and Appurtenances
5. ANSI/AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe 4-in Through 12-in for Water Distribution
6. ANSI/AWWA C905 Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch Through 36-inch

- | | | |
|----|-----------------------------|---|
| 7. | ASTM D2584 | Test Method for Ignition Loss of Cured Reinforced Resins |
| 8. | PPI Technical Report TR 3/4 | Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials |
| 9. | AWWA Manual M23 | PVC Pipe - Design and Installation |

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
1. Shop drawings and laying diagrams of all pipe, joints, bends, special fittings, and piping appurtenances.
 2. Shoring and bracing drawings in accordance with Section 02200.
 3. Manufacturer's technical data and installation instructions plus samples of all materials proposed for use on the WORK. Samples shall be clearly marked to show the manufacturer's name and product identification.
 4. Test Reports from:
 - a. Hydrostatic proof testing
 - b. Sustained pressure testing
 - c. Burst strength testing

1.6 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL:
1. Manufacturer's certificates of compliance indicating that all materials provided under this Section meet the requirements of the Contract Documents.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. PVC pressure pipe in sizes 4 through 12 inches shall conform to the applicable requirements of ANSI/AWWA C900 and pipe in sizes 14 through 24 inches shall conform to ANSI/AWWA C905. Pipe in both pipe size ranges shall also be subject to additional requirements indicated herein.

2.2 PIPE DESIGN CRITERIA

- A. Pipe wall thickness for internal pressure shall be the greater of those calculated for the pressure type and safety factor combination below.
1. Pipe in sizes from 4 inches to 12 inches shall be designed for a minimum wall thickness, t , or dimension ratio, DR, in accordance with paragraph A3 in Appendix A of ANSI/AWWA

C900. Safety factors of 3.0 for sustained working pressures and 4.0 for total system pressure shall be considered.

2. Pipe in sizes from 14 inches to 24 inches shall be designed for a minimum wall thickness, t , or dimension ratio, DR, in accordance with paragraph A3 of Appendix A of ANSI/AWWA C905. Safety factors of 3.0 for sustained working pressures and 4.0 for total system pressure shall be considered.

- B. **Determination of Earth Loads:** Earth loads on pipe from 4 inches to 24 inches shall be computed using the prism formula:

$$W_c = HwB_c$$

Where:

W_c	=	Earth load in pounds per linear foot
H	=	Depth of cover, feet
w	=	[120] lb/ft ³
B_c	=	Outside diameter of pipe, feet

- C. **Determination of Live Loads:** In lieu of the method in paragraph A.4 of both standards, the truck live loads shall be determined using the method recommended by AASHTO in "Standard Specifications for Highway Bridges." For depths of cover less than 10 feet HS-20 live loads shall be added to the earth loads to determine the total load. For depths of cover 3 feet or less, HS-20 live load plus impact shall be included.
- D. **Deflection Control:** With reference to paragraph A.5 in both standards, the deflection of the pipe after installation shall not exceed 0.03 times the outside diameter. If the calculated deflection exceeds 0.03 times the outside diameter, the pipe class shall be increased or the quality of the pipe zone backfill shall be improved to achieve a higher modulus of soil reaction, E' . For purposes of calculation, values of E' shall be 1100 psi at 90 percent Standard Proctor; 1500 psi at 95 percent Standard Proctor; and 2500 psi at 100 percent Standard Proctor. Similarly, the deflection lag factor for dead loads shall be 1.5 and the bedding constant shall be 0.1.

2.3 PIPE

- A. The pipe shall be of the diameter and pressure class or pressure rating indicated, shall be provided complete with rubber gaskets, and all specials and fittings shall be provided as required in the Contract Documents. The dimensions and pressure classes for Dimension Ratios shall conform to the requirements of AWWA C900 or AWWA C905, as appropriate.
- B. **Additives and Fillers:** Unless otherwise required in alternate qualification procedures of PPI-TR3, compounds which have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F for water shall not contain additives and fillers that exceed the recommended values in Table 1, Part Y of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin). If requested by the CONSTRUCTION MANAGER, the additive and filler content shall be determined using the pyrolysis method as specified in ASTM D 2584.
- C. **Joints:** As indicated, all joints for the pipe shall be either an integral bell manufactured on the pipe or a restrained joint employing a harness, coupling, or gland type restraint. The bell and coupling shall be the same thickness as of the pipe barrel, or greater thickness. The sealing ring groove in the coupling shall be of the same design as the groove in cast iron fittings and valves available from local water works supply distributors.

- D. **Joint Deflection:** Deflection at the joint shall not exceed 1.5 degrees or one-half the maximum deflection recommended by the manufacturer, whichever is less. No deflection of the joint shall be allowed for joints which are over-belled or not belled to the stop mark.

2.4 FITTINGS

- A. Fittings shall be ductile iron and shall conform to the requirements of AWWA C110, Class 350. Fittings shall be mechanical joint.
- B. Fittings shall be lined with cement mortar of double thickness as defined in ANSI/AWWA C104. Fittings shall be coated with two 8 to 10 mil field coats (min. total DFT = 16 mils) of Carboline Kopcoat Bitumastic Super Tank Solution - High Solids, or equal.

2.5 MARKING

- A. Pipe shall be identified in conformance with ANSI/AWWA C900 or C905, as appropriate, and the following additional requirements:
- B. Pipe used for reclaimed water distribution systems shall be identified by one of the following methods:
 - 1. PVC compounds are colored by addition of a purple colored agent.
 - 2. Pipe is either embossed or stamped or printed with "Caution: Reclaimed Water - Do Not Drink" and "Peligro: Agua Impura - No Beber."
 - 3. Pipe will be laid under a continuous, full length, 3-inch wide, polyethylene or vinyl tape imprinted with the warnings in English and Spanish above. Tape shall be purple with black lettering.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All laying, jointing, and testing for defects and for leakage shall be performed in the presence of the CONSTRUCTION MANAGER, and shall be subject to approval before acceptance.
- B. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, ASTM D 2321, SSPWC Subsection 306-1.2.13 and Supplement Amendments, and to the supplementary requirements or modifications specified herein. Wherever the requirements of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.2 PIPE STORAGE

- A. Storage: Pipe should be stored at the job site in unit packages provided by the manufacturer. Caution shall be exercised to avoid compression damage or deformation to bell ends of the pipe. Pipe shall be stored in such a way as to prevent sagging or bending and shall be protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

3.3 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Sections 02200 and 02600 and as specified herein.

3.4 INSTALLATION OF BENDS, TEES, AND REDUCERS

- A. Ductile iron fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into the trench by means of rope, cable, chain, or other acceptable means without damage to the fittings or linings or coating. Cable, rope, or other devices used for lowering fittings into trench shall be attached around the exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the interior for handling. Fittings shall be carefully connected to the pipe or other facility, and joints shall be checked to insure a sound and proper joint. Recoat damaged coatings.

3.5 COMPACTION OF PIPE BEDDING AND BACKFILL

- A. Compaction of pipe bedding and backfill material shall conform to the requirements of Sections 02200 and 02600.

3.6 INSTALLATION OF TAPE

- A. Purple warning tape shall be placed on the backfill above reclaimed water distribution pipelines, 2 feet below finished grade. Tape shall be continuous and shall not deviate outside the horizontal profile of the pipe.

3.7 FIELD TESTING AND DISINFECTION

- A. Field testing and disinfection shall conform to the requirements of Section 02666 - Water Pipeline Testing and Disinfection.

- END OF SECTION -

SECTION 02666 - WATER PIPELINE TESTING AND DISINFECTION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes flushing and testing of all pressure pipelines and appurtenant piping for potable water and disinfection of all pipelines and appurtenant piping for potable water, complete, including providing test water and all disposal thereof.

1.2 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).

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

- | | | |
|----|---------------------|--|
| 1. | ANSI/AWWA B300 | Hypochlorites |
| 2. | ANSI/AWWA B301 | Liquid Chlorine |
| 3. | ANSI/AWWA C651 | Disinfecting Water Mains |
| 4. | APHA, AWWA, and WEF | Standard methods for the Examination of Water and Wastewater |

1.4 TESTING SCHEDULE

- A. The following shall be submitted:
 - 1. A testing schedule, including proposed plans for water conveyance, control, and disinfection shall be submitted in writing for approval a minimum of 48 hours before testing is to start. The submittal shall also include the CONTRACTOR'S plan for the release of water from pipelines after testing and disinfection has been completed.

PART 2 -- PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. All test equipment, chemicals for chlorination, temporary valves, temporary blow-offs, bulkheads, or other water control equipment and materials shall be determined and furnished by the CONTRACTOR. No materials shall be used which would be injurious to the pipeline or its future function.
- B. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

- C. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301. Liquid chlorine shall be used only:
 - 1. In combination with appropriate gas flow chlorinators and ejectors;
 - 2. Under the direct supervision of a knowledgeable technician;
 - 3. When appropriate safety practices are observed.
- D. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Unless otherwise indicated, potable water for testing and disinfecting water pipelines will be furnished by the CONTRACTOR. The CONTRACTOR shall also make all necessary arrangements for conveying the water to the points of use.
- B. All pressure pipelines shall be tested. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be performed in the presence of the CITY's CONSTRUCTION MANAGER.
- C. Disinfection operations shall be scheduled by the CONTRACTOR as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the WORK is accepted by the OWNER.

3.2 HYDROSTATIC TESTING OF PIPELINES

- A. Prior to hydrostatic testing, all pipelines shall be flushed or blown out as appropriate. The CONTRACTOR shall test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 14 days. The test shall be made by opening valves and by placing temporary bulkheads in the pipe and filling the line slowly with water. Pressure testing against closed valves shall not be allowed. The CONTRACTOR shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment. The CONTRACTOR shall provide sufficient temporary air tappings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air vents are open during filling.
- B. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb water and to allow the escape of air from

any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the CONSTRUCTION MANAGER shall be taken.

- C. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 4 hours. Test pressure of pipe and fittings at the lowest elevation shall be 150% of pipe pressure classification and no less than 100% of pipe pressure classification at the highest elevation. The test pressure for yard piping shall be as indicated on the Piping Schedule measured at the lowest point of the pipeline section being tested. No pressure test will be required for a reservoir overflow line. All visible leaks shall be repaired in a manner acceptable to the CONSTRUCTION MANAGER.
- D. No leakage is allowed for steel (flanged or welded) and ductile iron (flanged) pipe. The Contractor shall provide accurate means for measuring the quantity of water lost. The allowable leakage shall be 15 gallons per inch of diameter per mile of pipeline in accordance with 24 hours. In the case of pipelines that fail to pass the prescribed leakage test, the CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines.

3.3 DISINFECTING PIPELINES

- A. General: All potable water pipelines except those appurtenant to hydraulic structures shall be disinfected in accordance with the requirements of ANSI/AWWA C651 using the Continuous-Feed Method as modified herein. Preliminary and final flushing shall be done at the ends of mains which have been hydrostatically tested.
- B. Chlorination: A chlorine-water mixture shall be uniformly introduced into the pipeline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be approximately 50 mg/l. Care shall be taken to prevent the strong chlorine solution in the line being disinfected from flowing back into the line supplying the water.
- C. Chlorine Residual Test: The OWNER will make 24-hour chlorine residual tests. The OWNER will notify the CONTRACTOR of the chlorine test result. Chlorinated water shall be retained in the pipeline for at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 25 mg/l.
- D. Repetition of Test: The disinfection testing procedure shall be repeated if the initial tests fail to produce satisfactory results. Two consecutive satisfactory test results shall be required after any unsatisfactory test. The tablet method shall not be used for repeated disinfection.
- E. Chlorinating Valves: During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily-chlorinated water.
- F. Final Flushing: Final Flushing shall be done by the CONTRACTOR after he has been notified of a satisfactory chlorine residual test by the OWNER. After the applicable

retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for the intended use. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to neutralize thoroughly the chlorine residual remaining in the water at no additional cost to the OWNER.

- G. Disinfection of Connections: Pipe and appurtenances used to connect the newly installed water main shall also be disinfected in accordance with AWWA C651.
- H. Neutralization of Chlorinated Water: Neutralizing and disposing of chlorinated water shall be in accordance with Appendix "B" of AWWA Standard C651.

3.4 BACTERIOLOGICAL TESTING OF DISINFECTED PIPELINES

- A. The CONSTRUCTION MANAGER will collect 2 sets of samples at least 24 hours apart after completion of final flushing as indicated above. Samples will be taken at locations indicated in ANSI/AWWA C651 and will be tested for coliform organisms and standard plate count according to the latest edition of the Standard Methods for the Examination of Water and Wastewater. Laboratory costs of initial testing will be the OWNER's responsibility.
- B. If disinfection fails to produce satisfactory bacteriological counts, the pipe shall be reflashed and will be resampled and retested. If counts from analysis of the second samples exceed the criteria in Standard methods, the pipe shall be re-disinfected and will be resampled and retested until satisfactory results are obtained. The CONTRACTOR shall be responsible for all repeat bacteriological testing costs.

** END OF SECTION **

SECTION 02831-INDUSTRIAL ORNAMENTAL METAL FENCING

PART 1-GENERAL

1.1 DESCRIPTION

- A. The Contractor shall provide all labor, materials and appurtenances necessary for installation of permanent industrial ornamental steel fence system defined herein.
- B. The manufacturer shall supply a total industrial ornamental steel fence system. The system shall include all components (i.e., pickets, rails, posts, gates and handrails) required.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 Earthwork
- B. Section 03310 Cast-in-Place Sitework Concrete

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. American Society for Testing and Materials:

A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-iron Alloy Coated (Galvanized) by the Hot-Dip Process.
ASTM B117	Practice for Operating Salt-Spray (Fog) Apparatus
ASTM D523	Test Method for Specular Gloss.
ASTM D714	Test Method for Evaluating Degree of Blistering Paint.
ASTM D822	Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
ASTM D1654	Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
ASTM D2244	Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
ASTM D2794	Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
ASTM D3359	Test Method for Measuring Adhesion by Tape Test.
ASTM F2408	Ornamental Fences Employing Galvanized Steel Tubular-Pickets.

1.4 SUBMITTALS

- A. Manufacturer's catalog data showing all fencing components and details of fencing, gates, tension bands and bars, sleeves, ties, connectors, bolts, and color palette.

- B. Certificates of Compliance from the manufacturer attesting that all materials meet the requirements specified herein.
- C. A layout drawing showing the final spacing of posts and locations of gates, corner and end posts, and details for post mounting plates.
- D. Provide details for gate door frames, door latches, stop posts, lock assemblies, and hinges.
- E. The manufacturer's submittal package shall be provided for review and approved prior to installation.

1.5 QUALITY ASSURANCE

- A. The Contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.6 DELIVERY, STORAGE AND HANDLING

- A. 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. Refer to project specific requirements for storing materials on-site.

PART 2 - MATERIALS

2.1 MANUFACTURER

- A. The industrial ornamental 3-rail steel fence system shall be Aegis II – Invincible as manufactured by Ameristar Fence Products, Inc., or equal.

2.2 FENCING MATERIALS

- A. Steel material for fence framework (i.e. tubular pickets, rails, posts and mounting brackets), shall be galvanized prior to forming in accordance with the requirements of ASTM A653/A653M, with minimum yield strength of 50,000 psi (344 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.90 Oz/ft² (276 g/m²), Coating Designation G-90.
- B. Material for fence pickets shall be 1" square x 14 Ga. tubing. The fence system shall have an internal retaining rod, picket-to-rail joining system. The cross-sectional shape of the rails shall have outside cross-section dimensions of 1.75" square and a minimum thickness of 14 Ga. Picket holes in the rail shall be spaced 4.72" o.c., or as required by code. Picket retaining rods shall be 0.125" diameter galvanized steel. Posts shall be a minimum of 3" square x 12 Ga. High quality PVC grommets shall be supplied to seal all picket-to-rail intersections.

2.3 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets. Pickets shall be pre-drilled to accept retaining rods.
- B. Grommets shall be inserted into the pre-punched holes in the rails and pickets shall be

inserted through the grommets so that predrilled picket holes align with the internal upper raceway of the rails (Note: This can best be accomplished by making an alignment jig). Retaining rods shall be inserted into each rail so that they pass through the predrilled holes in each picket.

- C. The manufactured galvanized framework shall be subjected to the PennaCoat® thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including, as a minimum, a six-stage pretreatment/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 zinc-rich thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 - 4 mils (0.0508 - 0.1016 mm). The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 3 mils (0.0762 mm). The color shall be Black. The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 1.
- D. Completed sections (i.e., panels) shall be capable of supporting a 600 lb. load applied at mid-span without permanent deformation. Panels shall be biasable to a 25% change in grade. Greater slopes may require special assembly.
- E. Swing gates shall be fabricated using the same fence panel material and gate ends having the same outside cross-section dimensions as the rail. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined either by welding or by the same retaining rod process used for panel assembly.
- F. Gates shall have diagonal tension cables with tighteners and lock/latch assemblies as shown on the construction drawings.

2.4 POST CONCRETE

- A. Post concrete shall be Class C in accordance with Specification Section 03310 Cast-in-Place Sitework Concrete, with maximum slump of 5-inches. Grout shall be one part Portland cement to three parts clean, well-graded sand, with minimum amount of water added to produce a workable mix.

PART 3-EXECUTION

3.1 PREPARATION

- A. All new installation shall be laid out by the contractor in accordance with the construction plans.

3.2 INSTALLATION

- A. Fence posts shall be set in accordance with the spacing shown on the construction drawings, plus or minus 1/2", depending on the nominal span specified. Gateposts shall be spaced according to the gate openings specified in the construction drawings.
- B. The "Concrete" sections of this specification shall govern post base material requirements.
- C. Fence posts mounted to concrete structures using mounting plates shall be constructed as shown on drawings and specifications in section 2.2 above.
- D. Fence panels shall be attached to posts using mechanically fastened panel brackets supplied

by the manufacturer. When cutting rails immediately seal the exposed steel surfaces by 1) Removing all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate manufacturer's warranty. Contractor shall use all parts and components from the same manufacturer.

3.3 GATE INSTALLATION

- A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.4 CLEANING

- A. The contractor shall clean the jobsite of excess materials.
- B. Soil from post-hole excavations shall be scattered uniformly away from posts.
- C. Removed concrete and/or asphalt paving shall be removed and disposed of by contractor.

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 3,500 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 ^U 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 03100 - CONCRETE FORMWORK

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing concrete formwork, bracing, shoring, and supports.

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 the WORK.

1. Section 03200 Reinforcement Steel
2. Section 03121 Formliners for Architectural Concrete
3. Section 03290 Joints in Concrete Structures
4. Section 03300 Cast-in-Place Structural Concrete
5. Section 03310 Cast-in-Place Sitework Concrete
6. Section 03331 Cast-in-Place Architectural Concrete
7. Section 03315 Grout

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).

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

PS 1	U.S. Product Standard for Concrete Forms, Class I.
ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 347	Recommended Practice for Concrete Formwork

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
- B. **Falsework Calculations and Drawings:** The CONTRACTOR's attention is directed to the provisions of Section 1717 of the Division of Industrial Safety, Construction Safety Orders, as revised November 1973, which requires that all falsework or vertical shoring installations where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a civil engineer, registered in the State of

California; provided further, that a copy of the falsework plan or shoring layout shall be available on the job site at all times.

- C. Detailed plans of the falsework proposed to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, means of protecting existing construction which supports falsework, and typical soil conditions.
- D. **Catalog information on:**
 - 1. Form ties and all related accessories, including taper tie plugs, if taper ties are used.
 - 2. Form gaskets.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Materials for concrete forms and falsework shall conform to SSPWC Subsection 303-1.3 and the requirements herein. Concrete formwork for cast-in-place Architectural concrete shall comply with Section 03121 "Formliners for Architectural Concrete."
- B. Except as otherwise expressly accepted, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:
 - Walls - Steel or plywood panel
 - Columns - Steel, plywood, or fiber glass
 - Roof and floor - Plywood
 - All other work - Steel panels, plywood or tongue and groove lumber
- C. Form materials which may remain or leave residues on or in the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.2 FORM AND FALSEWORK MATERIALS

- A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
 - 1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20.
 - 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.
 - 3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown. Metal forms shall be an approved type that will accomplish such

results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

- B. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.
- C. Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 30 psf (minimum).

2.3 FORM TIES

- A. Form ties with integral waterstops shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.
- B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when approved. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie.

2.4 MANUFACTURERS

- A. Products of the type indicated shall be manufactured by one of the following (or equal):
 - 1. **Form Ties:**
 - Burke Penta - Tie System by the Burke Company
 - Snap Ties by Dayton Superior
 - 2. **Form ties with Integral Waterstops:**
 - Burke Taper - Tie System by the Burke Company
 - Taper Ties by Dayton Superior

PART 3 -- EXECUTION

3.1 GENERAL

- A. Forms and falsework shall be designed and constructed in accordance with ACI 347 and SSPWC Subsections 303-1.3, 303-1.6, and 303-5.2, and the requirements herein, except that the submittal of detailed falsework will not be required.
- B. **Tolerances:** The variation from established grade or lines shall not exceed 1/4-inch in 10 feet and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the tolerances of ACI 117.
- C. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all

forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced at the CONTRACTOR's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by CONTRACTOR's personnel and by the ENGINEER and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.

- D. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

3.2 FORM DESIGN

- A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1- to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the CONSTRUCTION MANAGER. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03300. The size, number, and location of such form windows shall be acceptable to the CONSTRUCTION MANAGER.

3.3 CONSTRUCTION

- A. **Vertical Surfaces:** All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- B. **Construction Joints:** Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the CONSTRUCTION MANAGER. When a second lift is placed on hardened concrete, special precautions shall be taken in the

way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. **Form Ties:**

1. **Embedded Ties:** Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as indicated in Section 03300. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.
2. **Removable Ties:** Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls which are dry on both sides. Exposed faces of walls shall have the outer 2 inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

3.4 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the CONSTRUCTION MANAGER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the CONSTRUCTION MANAGER.

3.5 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28-day strength specified in Section 03300; provided, that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the specified 28-day strength and has been in place for a minimum of 7 days. The time required to establish said strength shall be as determined by the CONSTRUCTION MANAGER who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7-day minimum, then that time shall be used as the minimum length of time. Forms for all

vertical walls and columns shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the WORK not specifically mentioned herein shall remain in place for periods of time as determined by the CONSTRUCTION MANAGER.

3.6 MAINTENANCE OF FORMS

- A. Forms shall be cleaned, treated with a releasing agent, and maintained in accordance with SSPWC Subsection 303-1.3 and the following. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant compatible with the waterproofing membrane material and acceptable to the CONSTRUCTION MANAGER. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the CONTRACTOR shall perform the oiling at least two weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.7 FALSEWORK

- A. Falsework, including staging, walkways, forms, ladders, and similar appurtenances, shall be designed, engineered, constructed, and maintained according to the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements of the Construction Safety Orders of the California Division of Industrial Safety.

** END OF SECTION **

SECTION 03121- FORM LINERS FOR ARCHITECTURAL CONCRETE

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing elastomeric form liners for texturing architectural concrete and form liner accessories as scheduled or required.

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 03300 Cast-In Place Structural Concrete.
 - 2. Section 03331 - Cast-In-Place Architectural Concrete.
 - 3. Section 03350 - Concrete Finishes.

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).
- B. American Concrete Institute (ACI):
 - 1. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary
 - 2. ACI 301 CH. 6 Specifications for Structural Concrete.
 - 3. ACI 303R Guide to Cast-in-Place Architectural Concrete Practice.
 - 4. ACI 309 CH. 7 Guide for Consolidation of Concrete.
 - 5. ACI 347 CH. 5 Guide to Formwork for Concrete

1.4 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Catalogue of the manufacturer of plastic liner, including complete data indicating the physical properties and chemical resistance properties as described in Subsection 210-2 of SSPWC, and all details and dimensions per Subsection 210-2.4 of SSPWC.
 - 2. Shop drawings indicating the installation procedures and dimensions and location of all joints or weld strips.
 - 3. Results of all tests made on plastic liner material as indicated herein.
 - 4. Product Data: Installation instructions and product data verifying compliance with specifications.
 - 5. Samples:
Formliners for textured cast-in-plate architectural concrete: The contractor shall submit a 24 inch by 24 inch sample of each type of textured formliner for approval by the

CONSTRUCTION MANAGER.

6. Field Examples: Provide formwork for mock-up of cast-in-place concrete. Construct forms using facing materials required to provide finishes and textures. Do not proceed with structure formwork until sample panels and forms have been approved by the CONSTRUCTION MANAGER.
7. See section 03331 cast-in-place Architectural Concrete for Field Sample and mock-up requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inspect the materials upon delivery to assure that specified products have been received.
- B. Cover form liners to protect from oil, dirt and UV exposure.
- C. Do not use damaged products. Do not install products not bearing product trade name and manufacturer's name.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Materials for plastic liner and its installation shall comply with SSPWC, Subsection 210-2.

2.2 MANUFACTURER

- A. Acceptable Manufacturer: Nawkaw Corporation., which is located at: 370 Commerce Blvd., Athens, GA 30606; Tel: 706-355-3217; Fax: 706-355-9199; Email: info@nawkaw.com; Web: www.nawkaw.com or Equal.
- B. Must also manufacture complete system accessory line of products, in addition to the elastomeric formliners, to include release agent formliner adhesive and repair kit.

2.3 FORM LINER MATERIALS

- A. Elastomeric form liner for creating textures in poured-in-place or precast concrete.
 1. Pattern and Texture:
 - a. Custom Patterns for Panel Type A, B, C, D, E: RECKLI®, Custom-made formliners or Equal.

- b. Standard Pattern for Panel F: RECKLI[®], 2/32 Inn formliners or Equal.
- c. Form liners for Textured Finish Concrete: Provide special forming materials to produce form surfaces with face design, texture, arrangement, and configuration as shown on drawings.
- d. Liners to accommodate form pressures to a maximum 1000 psf. Comply with manufacturer's recommendations for support of large or deep patterns which may deform under pressure.

2.4 FORM LINER ACCESSORIES

- A. Provide Manufacturer recommended Release Agent or equal, verified to be compatible with the form liner material.
- B. GREENSTREAK Chamfer Triangle continuous PVC Strip w/ 3/4 inch leg or Equal.
- C. GREENSTREAK Reveal StiX profile # 1, single-use plastic and foam composite.
- D. Proper Stripping Wax, Mould Wax and Adhesives for the complete form liner system.

2.5 TESTS

- 1. Tests shall be made on samples taken from plastic sheets, joints or weld strips in compliance with SSPWC, Subsection 210-2.3. However, before testing in conformance with SSPWC, Subsection 210-2.3, the CONSTRUCTION MANAGER, will visually and manually inspect the lining with a putty knife or a similar instrument. Any imperfections found as a result of all of the above tests shall be repaired per manufacturer's instruction and CONSTRUCTION MANAGER's approval, and surfaces restored before placing the lining in service.

PART 3 -- EXECUTION

3.1 FORM LINER PREPARATION

- A. Verify lines and levels of formwork and form liner patterns are within allowable tolerances.
- B. On multiple use liners, clean liner before each use. Do not use damaged liner when continued use or repair would diminish the aesthetics of the Work.
- C. The release agent to be used with the formliners should be solvent or water-based depending upon conditions. Please take care that all sections, angles of the pattern are covered with the release agent. The formliners should have 2 applications of the wax. The first coat of wax should be dry before applying the second coat.
- D. Drying time for the release agents depends on ambient temperatures and air movement. Consumption is approx. 100 - 150 g/m² depending on the type of pattern. The applied wax film must be protected against rain and other damaging weather conditions by covering with polyethylene sheets.

3.2 FORM LINER INSTALLATION

- A. Store and use form liner panels at temperatures between 40 degrees F and 140 degrees F.
- B. Seal form liner joints, form liner accessories' joints, and tie holes to prevent cement paste from bleeding.
- C. Provide solid backing at form liner butt joints to prevent deflection.
- D. Construct form liner and accessories to sizes, shapes, lines and dimensions shown.
- E. Provide openings, offsets, keyways, recesses, chamfers, blocking, and screeds as required to achieve architectural concrete textured finish.
- F. Anchor liner to form on centers not to exceed 18 inches. Decrease centers as necessary to accommodate form stripping pressures without damaging liner intended for multiple use.
- G. Install backup strips as required to prevent deflection of the liner due to form pressures.

3.3 CONCRETE PLACEMENT

- A. The heat resistance of the formliner is approx. +60°C. If you expect concrete temperatures to exceed +60°C at the formliner face, for whatever reason, it will be necessary to reduce the temperature by suitable methods.
- B. Form pressures not to exceed 1000 psf.
- C. Keep concrete lifts less than 24 inches. Thoroughly vibrate concrete to achieve good consolidation, and eliminate entrapped air thereby minimizing voids. Internally vibrate through to previous lift to avoid lift lines. Avoid vibrator contact with the form liner.

3.4 FORM LINER ACCESSORY INSTALLATION

- A. Form rustication lines located as indicated by nailing formliner strips to formwork within tolerances indicated by the ACI.
- B. Tightly form corners indicated to be chamfered corners to be smooth, solid, unbroken, continuous lines, which are uniformly straight.

3.5 FORM LINER MAINTENANCE

- A. Proper cleaning and storage of form liner is required to obtain acceptable results. Prevent matrix build-up on the liner surface. All excess release agent shall be blown or wiped off before the form and liner is put back into service.
- B. Storage of form liner shall be out of direct sunlight and in temperatures below 140 degrees F (60 degrees C). Store formliner in rolled up position.
- C. Formliners must be stored dry. If building storage is not available make sure they are raised from the ground and covered securely with black polythene or other non-transparent covers. The hardboard backing must be protected from rain and dampness.

- END OF SECTION -

SECTION 03200 - REINFORCEMENT STEEL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all concrete reinforcement steel, welded wire fabric, couplers, and concrete inserts for use in reinforced concrete and masonry construction, including all the wires, clips, supports, chairs, spacers, and other accessories.

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 03100 Concrete Formwork
2. Section 03300 Cast-in-Place Structural Concrete

1.3 CODES

- A. The 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. California Building Code, the 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.

ACI 315	Details and Detailing of Concrete Reinforcement.
ACI 318	Building Code Requirements for Structural Concrete.
ACI 350	Code Requirements for Environmental Engineering Concrete Structures.
CRSI MSP-1	Concrete Reinforcing Steel Institute Manual of Standard Practice.
WRI	Manual of Standard Practice for Welded Wire Fabric.
AWS D1.4	Structural Welding Code - Reinforcing Steel.
ASTM A 82	Specification for Steel Wire, Plain, for Concrete Reinforcement.
ASTM A 185	Specification for Welded Steel Wire Fabric For Concrete Reinforcement.
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
ASTM A 775	Specification for Epoxy-Coated Reinforcing Steel Bars.

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
1. Shop bending diagrams, placing lists, and drawings of all reinforcement steel prior to fabrication.
- B. Details of the concrete reinforcement steel and concrete inserts shall be submitted by the CONTRACTOR at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed. Details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.
- C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, manufacturer's literature shall be submitted which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which show the location of each coupler with details of how they are to be installed in the formwork.
- D. If reinforcement steel is spliced by welding at any location, the CONTRACTOR shall submit mill test reports which shall contain the information necessary for the determination of the carbon equivalent as specified in AWS D1.4. The CONTRACTOR shall submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; merely a statement that AWS procedures will be followed is not acceptable.
- E. Mill certificates shall be delivered with each shipment of reinforcing bars.

1.6 FACTORY TESTING

- A. If requested by the CONSTRUCTION MANAGER, the CONTRACTOR shall provide samples from each heat of reinforcement steel delivered in a quantity adequate for testing. Costs of initial tests and sample materials will be paid by the OWNER. Costs of additional tests due to material failing initial tests shall be paid by the CONTRACTOR.
- B. If reinforcement steel is spliced by welding at any location, the CONTRACTOR shall submit certifications of procedure qualifications for each welding procedure used and certification of welder qualifications, for each welding procedure, and for each welder performing the work. Such qualifications shall be as specified in AWS D1.4.

1.7 FIELD TESTING

- A. Products shall be field tested for compliance with the indicated requirements. If requested by the CONSTRUCTION MANAGER, the CONTRACTOR shall provide samples of each type of welded splice used in the work in a quantity and of dimensions adequate for testing. At the discretion of the CONSTRUCTION MANAGER, radiographic testing of direct butt welded splices will be performed. The CONTRACTOR shall provide assistance necessary to facilitate testing. The CONTRACTOR shall repair any weld which fails to meet the requirements of AWS D1.4. The costs of testing will be paid by the OWNER; except, the

costs of all tests which fail to meet specified requirements shall be paid by the CONTRACTOR at no additional cost to the OWNER.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Materials specified in this Section which may remain or leave residues on or within the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.2 REINFORCEMENT STEEL

- A. Reinforcement Steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement with supplementary requirement S-1, or as otherwise indicated.
2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185 and as indicated; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.
3. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82.

- B. **Accessories:**

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. All bar supports shall meet the requirements of the CRSI Manual of Standard Practice including special requirements for supporting epoxy coated reinforcing bars. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.
2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.
3. Tie wire shall be a minimum 14 gauge annealed steel wire.

- C. Epoxy coating for reinforcing and accessories, where specified or shown, shall conform to ASTM A 775, but its usage shall be subject to City approval.

2.3 MECHANICAL COUPLERS

- A. Mechanical couplers shall be provided where shown and where approved by the CONSTRUCTION MANAGER. The couplers shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.
- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.
- C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.

2.4 WELDED SPLICES

- A. Welded splices shall be provided where shown and where approved by the CONSTRUCTION MANAGER. All welded splices of reinforcement steel shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars which are connected.
- B. All materials required to conform the welded splices to the requirements of AWS D1.4 shall be provided.

2.5 EPOXY GROUT

- A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements found in Section 03315.

2.6 MANUFACTURERS

- A. Products of the type indicated, shall be manufactured by one of the following (or equal):

1. Couplers:

Lenton Form Saver by Erico Products
Dowel Bar Splicer System by Dayton Superior.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the supplementary requirements specified herein.

3.2 FABRICATION

A. **General:**

1. Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as indicated. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1-1/2-inch for No. 3 bars, 2-inch for No. 4 bars, and 2-1/2-inch for No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than 6 times the bar diameter, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bent cold.
2. The CONTRACTOR shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings.

B. **Fabricating Tolerances:** Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:

1. Sheared length: ± 1 inch
2. Depth of truss bars: + 0, - 1/2 inch
3. Stirrups, ties, and spirals: $\pm 1/2$ inch
4. All other bends: ± 1 inch

3.3 PLACING

A. Reinforcement steel shall be accurately positioned and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.

B. Limitations on the use of bar support materials shall be as follows.

1. **Concrete Dobies:** Permitted at all locations except where architectural finish is required.
2. **Wire Bar Supports:** Permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
3. **Plastic Bar Supports:** Permitted at all locations except on grade.

C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

- D. Bars additional to those shown which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at no additional cost to the OWNER.
- E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the CBC.
- F. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to the approval of the CONSTRUCTION MANAGER.
- G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters. Slab bolsters shall be spaced not more than 30 inches on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane indicated.
- H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.
- I. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Non-abrasive slings made of nylon and similar materials shall be used. Specially coated bar supports shall be used. All chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete.
- J. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

3.4 SPACING OF BARS

- A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.
- B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.
- C. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.
- D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

3.5 SPLICING

- A. **General:**

1. Reinforcement bar splices shall only be used at locations indicated. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the CONSTRUCTION MANAGER.

B. Splices of Reinforcement:

1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318.
2. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.
3. Splices in column spiral reinforcement, when necessary, shall be made by welding or by a lap of 1-1/2 turns.

C. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the CONSTRUCTION MANAGER. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the CONSTRUCTION MANAGER.

D. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface. After the concrete is placed, the coupler shall be plugged with plastic plugs which have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged.

E. Unless indicated otherwise, mechanical coupler spacing and capacity shall match the spacing and capacity of the reinforcing shown for the adjacent section.

F. Tack welding of reinforcing bars is prohibited.

3.6 CLEANING AND PROTECTION

A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary recleaned.

3.7 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Hole Preparation:

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.
2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless noted otherwise.
3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.
4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.
5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.
6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that insures that excess material will be expelled from the hole during dowel placement.
7. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.

** END OF SECTION **

SECTION 03280 - JOINTS IN SITEWORK CONCRETE

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing expansion joints, contact joints, and weakened plane joints in concrete pavement, sidewalk, curb and gutter.

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 03100 Concrete Formwork
- 2. Section 03310 Cast-in-Place Sitework Concrete

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).

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 D 1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- 2. ASTM D 994 Preformed Expansion Joint Filler for Concrete (Bituminous Type)

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:

- 1. Placement shop drawings showing the location and type of all joints.
- 2. Catalog cuts and samples of the preformed expansion joint filler material including complete product data.

1.6 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL:

- 1. Manufacturer's certification indicating that the preformed expansion joint material meets or exceeds the requirements of these Specifications.

PART 2 -- PRODUCTS

2.1 PREMOLDED JOINT FILLER

- A. Premolded joint filler shall be in conformance with SSPWC subsection 201-3.2 and shall be either Preformed Expansion Joint Filler (ASTM D994) or Nonextruding and Resilient Filler (ASTM D 1751) as indicated.

2.2 STEEL BARS AND DOWELS

- A. Steel bars used in construction joints or contact joints shall conform to SSPWC subsection 201-2.2.

2.3 CONCRETE CURING COMPOUND

- A. Curing compound shall comply with SSPWC subsection 201-4.

PART 3 -- EXECUTION

3.1 EXPANSION JOINTS

- A. Expansion joints in sitework concrete shall be constructed in accordance with SSPWC subsection 302-6.5.3 except that the configuration of the joint shall be as indicated on the drawings.
- B. Expansion joints in concrete curbs, sidewalk and gutter shall comply with SSPWC subsection 303-5.4.2 except that the joint configuration shall be as indicated on the drawings.

3.2 CONSTRUCTION JOINTS

- A. Construction joints in sitework concrete shall comply with SSPWC subsection 302-6.5.2.

3.3 WEAKENED PLANE JOINTS

- A. Weakened plane joints in sitework concrete shall comply with SSPWC subsection 302-6.5.4 except that the configuration of the joint shall be as indicated on the drawings.
- B. Weakened plane joints in concrete curbs, sidewalks and gutters shall comply with SSPWC subsection 303-5.4.3 except that the joint configuration shall be as indicated on the drawings.

3.4 CONTACT JOINTS

- A. Contact joints in concrete pavement shall be made by placing fresh concrete against hardened concrete. A moisture barrier consisting of curing compound conforming to SSPWC subsection 201-4 shall be applied to the face of any contact joint and allowed to dry prior to placing fresh concrete against that joint face. This provision is also applicable to existing portland cement concrete pavement not constructed as part of the WORK performed under the contract. Application rate shall be as specified in SSPWC subsection 302-6.6 for the compound used.

**** END OF SECTION ****

SECTION 03290 - JOINTS IN CONCRETE STRUCTURES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing the construction joints, contraction joints, expansion joints, and control joints in structural concrete, including waterstops, joint fillers, and joint sealants.

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 03100 Concrete Formwork
2. Section 03121 Formliners for Architectural Concrete
3. Section 03200 Reinforcement Steel
4. Section 03300 Cast-in-Place Structural Concrete
5. Section 03331 Cast-in-Place Architectural Concrete
6. Section 03310 Cast-in-Place Sitework Concrete
7. Section 07920 Sealants and Caulking
8. Section 07905 Joint Sealers

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section.

ASTM C 920	Specification for Elastomeric Joint Sealants.
ASTM D 412	Test Methods for Rubber Properties in Tension.
ASTM D 624	Test Method for Rubber Property -- Tear Resistance.
ASTM D 638	Test Method for Tensile Properties of Plastics.
ASTM D 746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
ASTM D 747	Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
ASTM D 1056	Specification for Flexible Cellular Materials -- Sponge or Expanded Rubber.
ASTM D 1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
ASTM D 2240	Test Method for Rubber Property -- Durometer Hardness.
CRD-C572	PVC Waterstop.
TT-S-00227E(3)	Sealing Compound, elastomeric type, Multi-component for Caulking, Sealing, and Glazing Buildings and Other Structures).

1.4 TYPES OF JOINTS

- A. **Construction Joints:** When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint. Unless otherwise specified, all joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape specified and shown. The surface of the first pour may also be required to receive a coating of bond breaker as shown.
- B. **Contraction Joints:** Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4-1/2 inches from the joint; which is provided with a sleeve-type dowel, to allow shrinkage of the concrete of the second pour. Waterstop and/or sealant groove shall also be provided when specified or shown.
- C. **Expansion Joints:** To allow the concrete to expand freely, a space is provided between the two pours, the joint shall be formed as shown. This space is obtained by placing a filler joint material against the first pour, which acts as a form for the second pour. Unless otherwise specified, all expansion joints in water bearing members shall be provided with a center-bulb type waterstop as shown.
- D. Premolded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.
- E. The space so formed shall be filled with a joint sealant material as indicated below. In order to keep the two walls or slab elements in line the joint shall also be provided with a sleeve-type dowel as shown.
- F. **Control Joints:** The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions shown, is formed or saw-cut in the concrete. This groove is afterward filled with a joint sealant material.

1.5 SHOP DRAWINGS AND SAMPLES

The following shall be submitted:

- A. **Waterstops:** Prior to production of the material required under this contract, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be furnished under this contract. The balance of the material to be used under this contract shall not be produced until after the CONSTRUCTION MANAGER has reviewed the qualification samples.
- B. **Waterstop Samples:** Prior to use of the waterstop material in the field, a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used shall be submitted. These samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be furnished under this contract.

- C. Field samples of fabricated fittings (crosses, tees, etc.) will be selected at random by the CONSTRUCTION MANAGER for testing by a laboratory at the OWNER's expense. When tested, they shall have a tensile strength across the joints equal to at least 600 psi.
- D. **Joint Sealant:** Prior to ordering the sealant material, the CONTRACTOR shall submit sufficient data to show general compliance with the requirements of the Contract Documents. Submit sample of colored joint sealant(s) to match approved color of integrally colored cast-in-place architectural concrete.
- E. **Joint Location:** The CONTRACTOR shall submit placement shop drawings showing the location and type of all joints for each structure.
- F. Certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with the above requirements shall be furnished before the sealant is used on the job.

1.6 OWNER'S MANUAL

- A. **Shipping Certification:** The CONTRACTOR shall provide written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meets or exceeds the physical property requirements of the Contract Documents. Supplier certificates are not acceptable.

1.7 SERVICES OF MANUFACTURER

- A. Before work is commenced, the CONTRACTOR shall arrange for a representative of the sealant manufacturer to instruct the crew doing the WORK on the proper methods of mixing and applying the sealant.
- B. When requested by the CONSTRUCTION MANAGER, the CONTRACTOR shall arrange for field technical assistance from the bentonite manufacturer.

1.8 INSPECTION AND TESTING

- A. **Waterstop Inspection:** It is required that all waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without having made prior arrangements with the CONSTRUCTION MANAGER to provide for the required inspections. Not less than 24 hours' notice shall be provided to the CONSTRUCTION MANAGER for scheduling such inspections.
- B. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the site and disposed of by the CONTRACTOR at its own expense.
- C. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:
 - 1. Offsets at joints greater than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.

2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.
 3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15 percent of material thickness at any point, whichever is less.
 4. Misalignment of joint which result in misalignment of the waterstop in excess of 1/2-inch in 10 feet.
 5. Porosity in the welded joint as evidenced by visual inspection.
 6. Bubbles or inadequate bonding which can be detected with a penknife test. (If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)
- D. **Construction Joint Sealant:** The CONTRACTOR shall prepare adhesion and cohesion test specimens as specified herein, at intervals of 5 working days while sealants are being installed.
- E. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:
1. Sealant specimen shall be prepared between 2 concrete blocks (1-inch by 2-inch by 3-inch). Spacing between the blocks shall be 1-inch. Coated spacers (2-inch by 1-1/2-inch by 1/2-inch) shall be used to insure sealant cross-sections of 1/2-inch by 2 inches with a width of 1-inch.
 2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall not exceed 24 hours.
 3. Following curing period, the gap between blocks shall be widened to 1-1/2-inch. Spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

1.9 GUARANTEE

- A. The CONTRACTOR shall provide a 5-year written guarantee of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the OWNER, at no additional cost to the OWNER, any such defective areas which become evident within said 5-year guarantee period.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All joint materials specified herein shall be classified as acceptable for potable water use, by the Environmental Protection Agency, within 30 days of application.

2.2 PVC WATERSTOPS

- A. **General:** Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used. The CONTRACTOR shall obtain from the waterstop manufacturer and shall furnish to the CONSTRUCTION MANAGER for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD-C572 and those listed herein.
- B. **Flatstrip and Center-Bulb Waterstops:** Flatstrip and center-bulb waterstops shall be as indicated; provided, that at no place shall the thickness of flat strip waterstops, including the center bulb type, be less than 3/8-inch.
- C. **Multi-Rib Waterstops:** Multi-rib waterstops, where required, shall be as indicated. Prefabricated joint fittings shall be used at all intersections of the ribbed-type waterstops.
- D. **Other Types of Waterstops:** When other types of waterstops, not listed above, are required, they shall be subjected to the same requirements as those listed herein.
- E. **Waterstop Testing Requirements:** When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

<u>Std.</u>	<u>Physical Property, Sheet Material</u>	<u>Value</u>	<u>ASTM</u>
	Tensile Strength-min (psi)	1750	D 638, Type IV
	Ultimate Elongation-min (percent)	350	D 638, Type IV
	Low Temp Brittleness-max (degrees F)	-35	D 746
	Stiffness in Flexure-min (psi)	400	D 747
	Accelerated Extraction (CRD-C572)		
	Tensile Strength-min (psi)	1500	D 638, Type IV
	Ultimate Elongation-min (percent)	300	D 638, Type IV
	Effect of Alkalies (CRD-C572)		
	Change in Weight (percent)	+0.25/-0.10	-----
	Change in Durometer, Shore A	+5	D 2240
	Finish Waterstop		
	Tensile Strength-min (psi)	1400	D 638, Type IV
	Ultimate Elongation-min (percent)	280	D 638, Type IV

2.3 JOINT SEALANT

- A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.

B. Joint sealant material shall meet the following requirements (73 degrees F and 50 percent R.H.):

Work Life	45 - 180 minutes
Time to Reach 20 Shore "A" Hardness (at 77 degrees F, 200 gr quantity)	24 hours, maximum
Ultimate Hardness (ASTM D 2240)	20 - 45 Shore "A"
Tensile Strength (ASTM D 412)	200 psi, minimum
Ultimate Elongation (ASTM D 412)	400 percent, minimum
Tear Resistance (Die C ASTM D 624)	75 pounds per inch of thickness, minimum
Color	Light Gray except color of sealant to match color of integrally-colored concrete at cast-in-place architectural concrete.

C. All polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:

1. Sealant shall be 2-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ANSI/ASTM C 920 Type M or Federal Specification TT-S-00227E(3) for 2-part material, as applicable.
2. For vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 25, Grade NS, or Federal Specification TT-S-00227 E(3), Type II, Class A.
3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-00227E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.
4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.

D. Sealants for non-waterstop joints in concrete shall conform to the requirements of Section 07920.

2.4 JOINT MATERIALS

A. **Bearing Pad:** Bearing pad to be neoprene conforming to ASTM D 1752 Type I, 40 durometer hardness unless otherwise noted.

- B. **Neoprene Sponge:** Sponge to be neoprene, closed-cell, expanded, conforming to ASTM D 1056, type RE-45-E1, with a compression deflection, 25 percent deflection (limits), 119 to 168 kPa (17 to 24 psi) minimum.
- C. **Preformed Joint Filler:** Preformed joint filler material for water retaining applications shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 for Type I, except as otherwise specified herein.

2.5 BACKING ROD

- A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8-inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

2.6 BOND BREAKER

- A. Bond breaker shall contain a fugitive dye so that areas of application will be readily distinguishable.

2.7 BENTONITE WATERSTOP

- A. Where called for, bentonite type waterstop, which shall expand in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast, shall be provided.
- B. The bentonite waterstop shall be composed of 75 percent bentonite. The balance of the material shall be butyl rubber-hydrocarbon with less than 1.0 percent volatile matter. The waterstop shall contain no asbestos fibers or asphaltics.
- C. The manufacturer's rated application temperature range shall be from 5 to 125 degrees F. The service temperature range shall be from -40 to 212 degrees F.
- D. The cross sectional dimensions of the unexpanded waterstop shall be one inch by 3/4-inch.
- E. The waterstop shall be provided with an adhesive backing which will provide excellent adhesion to concrete surfaces.

2.8 SLIP DOWELS

- A. Slip dowels in joints shall be A36 smooth epoxy-coated bars, conforming to ASTM A 775.

2.9 PVC TUBING

- A. PVC tubing in joints shall be Sch. SDR 13.5, conforming to ASTM D 2241.

2.10 MANUFACTURERS

- A. Products shall be manufactured by one of the following (or equal):

1. **Flatstrip and Center-Bulb Waterstops:**

Kirkhill Rubber Company
Progress Unlimited, Incorporated
Greenstreak Plastic Products Company

2. **Multi-Rib Waterstops:**

Progress Unlimited, Incorporated
Greenstreak Plastic Products Company

3. **Sealants:**

Permapol RC-270 by Products Research
Elastothane 227R by Pacific Polymers
Sikaflex 2C by Sika Corporation

4. **Bond Breaker:**

Super-Lift J-6 WB by Dayton Superior

PART 3 -- EXECUTION

3.1 WATERSTOPS - GENERAL

- A. Waterstops of the type specified herein shall be embedded in the concrete across joints as shown. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The CONTRACTOR shall take suitable precautions and means to support and protect the waterstops during the progress of the work and shall repair or replace at its own expense any waterstops damaged during the progress of the work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.2 SPLICES IN WATERSTOPS

- A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:
 - 1. The material not be damaged by heat sealing.
 - 2. The splices have a tensile strength of not less than 60 percent of the unspliced materials tensile strength.
 - 3. The continuity of the waterstop ribs and of its tubular center axis be maintained.

- B. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.
- C. All joints with waterstops involving more than 2 ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be prefabricated by the CONTRACTOR prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.
- D. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.3 JOINT CONSTRUCTION

- A. **Setting Waterstops:** In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support and anchor the waterstops during the progress of the WORK and to insure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.
- B. In placing flat-strip waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise shown, all waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.
- C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to for a future concrete placement.
- D. **Joint Location:** Construction joints, and other types of joints, shall be provided where shown. When not shown, construction joints shall be provided at 25-foot maximum spacing for all concrete construction, unless noted otherwise. The location of all joints, of any type, shall be submitted to the CONSTRUCTION MANAGER for acceptance.
- E. **Joint Preparation:** Special care shall be used in preparing concrete surfaces at joints where bonding between 2 sections of concrete is required. Unless otherwise shown, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300. Except on horizontal wall construction joints, wall to slab joints or where otherwise shown or specified, at all joints where waterstops are required, the joint face of the first pour shall be coated with a bond breaker as specified herein.

- F. **Construction Joint Sealant:** Construction joints in water-bearing floor slabs, and elsewhere as shown, shall be provided with tapered grooves which shall be filled with a construction joint sealant. The material used for forming the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sand-blasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove, and filled with the construction joint sealant. The primer used shall be supplied by the same manufacturer supplying the sealant. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the tapered grooves, prior to application of the sealant.
- G. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant. All sealant shall achieve final cure at least 7 days before the structure is filled with water.
- H. All sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations.
- I. Thorough, uniform mixing of 2-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application.
- J. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the WORK hereunder, fails to fully and properly cure shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be re-sealed with the specified joint sealant. All costs of such removal, joint treatment, re-sealing, and appurtenant work shall be at the expense of the CONTRACTOR.
- K. **Bentonite Waterstop:**
1. Where a bentonite waterstop is called for, it shall be installed with the manufacturer's instructions and recommendations; except, as modified herein.
 2. Bentonite waterstop shall only be used where complete confinement by concrete is provided. Bentonite waterstop shall not be used in expansion or contraction joints nor in the first 6 inches of any intersecting joint.
 3. The bentonite waterstop shall be located as near as possible to the center of the joint and it shall be continuous around the entire joint. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.
 4. Where the thickness of the concrete member to be placed on the bentonite waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete. The groove shall be at least 3/4 inch deep and 1-1/4 inches wide. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2.5 inches.

5. Where a bentonite waterstop is used in combination with PVC waterstop, the bentonite waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be placed in contact with the PVC waterstop.
6. The bentonite waterstop shall not be placed when the temperature of the waterstop material is below 40 degrees F. The waterstop material may be warmed so that it shall remain above 40 degrees F during placement; however, means used to warm the material shall in no way harm the material or its properties. The waterstop shall not be installed where the air temperature falls outside the manufacturer's recommended range.
7. The concrete surface under the bentonite waterstop shall be smooth and uniform. The concrete shall be ground smooth if needed. Alternately, the bentonite waterstop shall be bonded to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material. Prior to installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.
8. The bentonite waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing. This shall be in addition to the adhesive backing provided with the waterstop.

** END OF SECTION **

SECTION 03300 - CAST-IN-PLACE STRUCTURAL CONCRETE

PART 1. -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing finished cast-in-place structural concrete including forming, mixing, placing, curing, repairing, and finishing.
- B. The following types of concrete shall be covered in this Section:
 - 1. **Structural Concrete:** Concrete to be used in all cases except where indicated otherwise.
 - 2. **Lean Concrete:** Concrete to be used for thrust blocks, pipe trench cut-off blocks and cradles, where the preceding items are indicated as unreinforced. Lean concrete shall be used as protective cover for dowels intended for future connection.
- C. The term "hydraulic structure" used in these specifications shall refer to environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, or other fluids.

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 03100 Concrete Formwork
 - 2. Section 03121 Formliners for Architectural Concrete
 - 3. Section 03200 Reinforcement Steel
 - 4. Section 03290 Joints in Concrete Structures
 - 5. Section 03315 Grout
 - 6. Section 03331 Cast-in-place Architectural Concrete
 - 7. Section 03350 Concrete Finishing
 - 8. Section 07920 Sealants and Caulking
 - 9. Section 09970 Concrete Floor Sealer

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section.
- B. **Federal Specifications:**
 - UU-B-790A (Int.Amd. 1) Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant).
- C. **Commercial Standards:**

ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete for Buildings
ACI 309	Consolidation of Concrete
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ASTM C 31	Practices for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	Specification for Concrete Aggregates
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C40	Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C 88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 94	Specification for Ready-Mixed Concrete
ASTM C 131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 143	Test Method for Slump of Portland Cement Concrete
ASTM C 150	Specification for Portland Cement
ASTM C 157	Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
ASTM C 172	Standard Method of Sampling Freshly Mixed Concrete
ASTM C 192	Method of Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete
ASTM C 289	Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM C 309	Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Specification for Chemical Admixtures for Concrete
ASTM C 535	Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction & Criteria for Laboratory Evaluation
ASTM D 175	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM E 119	Method for Fire Tests of Building Construction and Materials

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. **Mix Designs:** Prior to beginning the WORK and within 14 days of the notice to proceed, preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete. The mix designs shall be checked by an independent testing laboratory acceptable to the CONSTRUCTION MANAGER. All costs related to such checking shall be borne by the CONTRACTOR.
2. Provide the following submittals in accordance with ACI-301:
 - a. Mill tests for cement.
 - b. Admixture certification. Chloride ion content must be included.
 - c. Aggregate gradation and certification.
 - d. Materials and methods for curing.
3. **Certified Delivery Tickets:** Where ready-mix concrete is used, the CONTRACTOR shall provide certified weighmaster delivery tickets at the time of delivery of each load of concrete. CONTRACTOR'S certificate with each delivery ticket shall show the public weighmaster's signature, and the total quantities, by weight of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate and added at the batching plant as well as the amount of water allowed to be added at the site for the specific design mix. Each certificate shall, in addition, state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to when the batch was dispatched, when it left the plant, when it arrived at the job, the time that unloading began, and the time that unloading was finished.

1.5 CONCRETE CONFERENCE

- A. A meeting to review the detailed requirements of the CONTRACTOR's proposed concrete design mixes and to determine the procedures for producing proper concrete construction shall be held no later than 14 days after the notice to proceed.
- B. All parties involved in the concrete work shall attend the conference, including the following:
- CONTRACTOR's representative
 - Independent Testing laboratory representative
 - Concrete subcontractor
 - Reinforcing steel subcontractor and detailer
 - Concrete supplier
 - Admixture manufacturer's representative
- C. The conference shall be held at a mutually agreed upon time and place. The CONSTRUCTION MANAGER shall be notified no less than 5 days prior to the date of the conference.

1.6 TESTING

A. **General**

1. Tests on component materials and for compressive strength and shrinkage of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.
2. The cost of all laboratory tests on cement, aggregates, and concrete, will be borne by the OWNER. However, the CONTRACTOR shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The laboratory must meet or exceed the requirements of ASTM C 1077.
3. Concrete for testing shall be supplied by the CONTRACTOR at no cost to the OWNER, and the CONTRACTOR shall provide assistance to the CONSTRUCTION MANAGER in obtaining samples, and disposal and cleanup of excess material.

B. Field Compression Tests:

1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the CONSTRUCTION MANAGER to insure continued compliance with these specifications. Each set of test specimens will be a minimum of 4 cylinders.
2. Compression test specimens for concrete will be made and cured in accordance with ASTM C 31. Specimens will be 6-inch diameter by 12-inch high cylinders.
3. Compression tests will be performed in accordance with ASTM C 39. One test cylinder will be tested at 7 days and 2 at 28 days. The remaining cylinder will be held to verify test results, if needed.

C. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, Chapter 5 "Concrete Quality," and as specified herein.
2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214. The standard deviation of the test results shall not exceed 640 psi.
3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
4. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any 3 consecutive tests being below the specified compressive strength is 1 in 100. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard of deviation.
5. All concrete which fails to meet the ACI requirements and these specifications, is subject to removal and replacement at no additional cost to the OWNER.

D. Shrinkage Tests:

1. Drying shrinkage tests will be made for the trial batch indicated below, the first placement of each class of concrete, and during construction to insure continued compliance with these Specifications.
2. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gauge length of 10 inches, fabricated, cured, dried and measured in accordance with ASTM C 157 modified as follows: specimens shall be removed from molds at an age of 23 ± 1 hours after trial batching, shall be placed immediately in water at $70 \text{ degrees F} \pm 3 \text{ degrees F}$ for at least 30 minutes, and shall be measured within 30 minutes thereafter to determine original length and then submerged in saturated lime water at $73 \text{ degrees F} \pm 3 \text{ degrees F}$. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7 days. This length at age 7 days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens then shall be stored immediately in a humidity control room maintained at $73 \text{ degrees F} \pm 3 \text{ degrees F}$ and 50 percent ± 4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.
3. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004-inch, the results obtained from that specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be as indicated below.

E. Construction Tolerances: The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 117.

1. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 1/4-inch; In 20 feet or more: 1/2-inch
Variation from the level or from the grades shown.	In 10 feet: 1/4-inch; In 20 feet or more: 1/2-inch
Variation from the plumb	In 10 feet: 1/4-inch; In 20 feet or more: 1/2-inch
Variation in the thickness of slabs and walls.	Minus 1/4-inch; Plus 1/2-inch
Variation in the locations and sizes of slabs and wall openings	Plus or minus 1/4-inch

PART 2. -- PRODUCTS

2.1 CONCRETE MATERIALS

A. General:

1. All materials specified herein shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application.
 2. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished for the work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.
- C. Storage of materials shall conform to the requirements of Section 205 of ACI 301.
- D. Materials for concrete shall conform to the following requirements:
1. Cement shall be standard brand Portland cement conforming to ASTM C 150 for Type II or Type V, including Table 1A optional requirements. A minimum of 85 percent of cement by weight shall pass a 325 screen. A single brand of cement shall be used throughout the work, and prior to its use, the brand shall be acceptable to the CONSTRUCTION MANAGER. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the CONSTRUCTION MANAGER if requested regarding compliance with these Specifications.
 2. Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of

the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.

3. Aggregates shall be obtained from pits acceptable to the CONSTRUCTION MANAGER, shall be non-reactive, and shall conform to ASTM C 33. Maximum size of coarse aggregate shall be as specified herein. Lightweight sand for fine aggregate will not be permitted.
 - a. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. The coarse aggregates shall be prepared and handled in two or more size groups for combined aggregates with a maximum size greater than 3/4-inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined. See the requirements below for the use of the size groups.
 - b. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable. When tested in accordance with ASTM D2419, the sand equivalency shall not be less than 75 percent for an average of three samples, nor less than 70 percent for an individual test. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.
 - c. Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
 - d. When tested in accordance with ASTM C 289, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
 - e. When tested in accordance with ASTM C 40, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
 - f. When tested in accordance with ASTM C 131 or ASTM C 535, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.
 - g. When tested in accordance with ASTM C 88, the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using sodium sulfate.
4. Ready-mix concrete shall conform to the requirements of ASTM C 94.
5. **Admixtures:** All admixtures shall be compatible and by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior end result, the CONTRACTOR shall discontinue use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be non-toxic after 30 days.

- a. Air-entraining agent meeting the requirements of ASTM C 260 shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent. The OWNER reserves the right, at any time, to sample and test the air-entraining agent received on the job by the CONTRACTOR. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. Air content shall be tested at the point of placement.
- b. Set controlling and water reducing admixtures: Admixtures may be added at the CONTRACTOR's option to control the set, effect water reduction, and increase workability. The addition of an admixture shall be at the CONTRACTOR's expense. The use of an admixture shall be subject to acceptance by the CONSTRUCTION MANAGER. Concrete containing an admixture shall be first placed at a location determined by the CONSTRUCTION MANAGER. Admixtures specified herein shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.
 - (1) Concrete shall not contain more than one water reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the CONSTRUCTION MANAGER.
 - (2) Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture shall be used.
 - (3) Normal range water reducer shall conform to ASTM C 494, Type A. The quantity of admixture used and the method of mixing shall be in accordance with the Manufacturer's instructions and recommendations.
 - (4) High range water reducer shall conform to ASTM C 494, Type F or G. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating water cement ratio.
 - (5) If the high range water reducer is added to the concrete at the job site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3 inches +/- 1/2-inch prior to adding the high range water reducing admixture at the job site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by a knowledgeable technician. A standby system shall be provided and tested prior to each day's operation of the job site system.
 - (6) Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.

- (7) Flyash shall not be used.

2.2 CURING MATERIALS

- A. Materials for curing concrete as specified herein shall conform to the following requirements and ASTM C 309:
 1. All curing compounds shall be white pigmented, resin based; Sodium silicate compounds shall not be allowed. Only water based resin curing compounds shall be used.
 2. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.
 3. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A (Int. Amd. 1). The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.
 4. Polyethylene-coated burlap for use as concrete curing blanket shall be 4-mil thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.
 5. Curing mats for use in Curing Method 6 as specified herein, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.

2.3 NON-WATERSTOP JOINT MATERIALS

- A. Materials for non-waterstop joints in concrete shall conform to the following requirements:
 1. Preformed joint filler for non-water retaining applications shall be a non-extruding, resilient, bituminous type conforming to the requirements of ASTM D 1751.
 2. Elastomeric joint sealer shall conform to the requirements of Section 07920.
 3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants.

2.4 MISCELLANEOUS MATERIALS

- A. Dampproofing agent shall be an asphalt emulsion.
- B. Bonding agents shall be epoxy adhesives.

2.5 CONCRETE DESIGN REQUIREMENTS

- A. **General:** Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the work will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. In mix designs, the percentage of sand of the total weight of fine and coarse aggregate shall not exceed 41 for hydraulic structures or 50 for all other structures, unless noted otherwise. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the OWNER. All changes shall be subject to review by the CONSTRUCTION MANAGER.

Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than that specified in the following tabulation.

Type of Work	Min 28-Day Compr. Strength (psi)	Max Size Aggregate (in)	Minimum Cement per cu yd (lbs)	Max W/C Ratio (by weight)
Structural Concrete:				
Roof, floor slabs, columns, walls and all other concrete items not specified elsewhere	4,000	1	611	0.45
12" and thicker walls, slabs on grade and footings. (optional)	4,000	1-1/2	611	0.45
Pea Gravel Mix. Thin sections and areas with congested reinforcing, at the CONTRACTOR'S option and with the written approval of the CONSTRUCTION MANAGER for the specific location. Maximum fine aggregate 50% by weight of aggregate.	4,000	3/8	752	0.40
Lean concrete	2,000	1	376	0.60

Type of Work	Min 28-Day Compr. Strength (psi)	Max Size Aggregate (in)	Minimum Cement per cu yd (lbs)	Max W/C Ratio (by weight)
<p>Note: The CONTRACTOR is cautioned that the limiting parameters specified above are not a mix design. Additional cement or water reducing agent may be required to achieve workability demanded by the CONTRACTOR'S construction methods and aggregates. The CONTRACTOR is responsible for any costs associated with furnishing concrete with the required workability.</p>				

- B. **Adjustments to Mix Design:** The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish and the CONTRACTOR shall be entitled to no additional compensation because of such changes.
- C. **Quick Set Concrete Mix:** Due to the limitation of pumping the ready mix concrete, quick set concrete mix package can be replaced with ready mix concrete. The products shall be the following, or approved equal: Quikrete 5000 Concrete Mix by Quikrete, Rapidset Concrete Mix by RapidSet. The mixing, curing, and finishing shall be in accordance with manufacturer's installation instructions.

2.6 CONSISTENCY

- A. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

Part of Work	Slump (in)
All concrete, unless noted otherwise	3 inches +- 1 inch
With high range water reducer added	7 inches +- 2 inches
Pea gravel mix	7 inches +- 2 inches
Ductbanks	5 inches +- 1 inch

2.7 TRIAL BATCH AND LABORATORY TESTS

- A. Before placing any concrete, a testing laboratory designated by the CONSTRUCTION MANAGER shall prepare a trial batch of each class of structural concrete, based on the preliminary concrete mixes submitted by the CONTRACTOR. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the CONTRACTOR. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the CONTRACTOR's preliminary mix design, or whether the proportions have been

adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage, and 6 compression test specimens from each batch. The cost of not more than 3 laboratory trial batch tests for each specified concrete strength will be borne by the OWNER but the CONTRACTOR shall furnish and deliver the materials in steel drums at no cost. Any additional trial batch testing required shall be performed at the expense of the CONTRACTOR at no increase in cost to the OWNER.

- B. The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Three compression test cylinders will be tested at 7 days and 3 at 28 days. The average compressive strength for the 3 cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.
- C. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136. Values shall be given for percent passing each sieve.

2.8 SHRINKAGE LIMITATION

- A. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age shall be 0.036 percent or 0.042 percent, respectively. The CONTRACTOR shall only use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to structural concrete.
- B. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.
- C. If the required shrinkage limitation is not met during construction, the CONTRACTOR shall take any or all of the following actions, at no additional cost to the OWNER, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement and/or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

2.9 MEASUREMENT OF CEMENT AND AGGREGATE

- A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the CONSTRUCTION MANAGER.
- B. **Weighing tolerances:**

Material	Percent of Total Weight
Cement	1
Aggregates	3
Admixtures	3

2.10 MEASUREMENT OF WATER

- A. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the CONSTRUCTION MANAGER and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any specified amount of water to each batch of concrete. A positive quick-acting valve shall be used for a cut-off in the water line to the mixer. The operating mechanism must be such that leakage will not occur when the valves are closed.

2.11 READY-MIXED CONCRETE

- A. At the CONTRACTOR'S option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94, including the following supplementary requirements.
- B. Ready-mixed concrete shall be delivered to the site of the work, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.
- C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
- E. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- F. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a delivery ticket furnished to the CONSTRUCTION MANAGER.
- G. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the CONSTRUCTION MANAGER.

2.12 MANUFACTURERS

A. Products shall be manufactured by one of the following (or equal):

1. **Air Entraining Agent:**

Micro-Air by Master Builders
Daravair by W.R. Grace
Sika AEA-15 by Sika Corporation

2. **Set Retarding Admixture:**

Plastocrete by Sika Corporation
Pozzolith 300R by Master Builders
Daratard by W.R. Grace

3. **Set Accelerating Admixture:**

Plastocrete 161FL by Sika Corporation
Pozzutec 20 by Master Builders
Daraset by W.R. Grace

4. **Normal Range Water Reducer:**

WRDA 79 by W.R. Grace
Pozzolith 322-N by Master Builders
Plastocrete 161 by Sika Corporation

5. **High Range Water Reducer:**

Daracem 100 or WRDA 19 by W.R. Grace
Sikament FF or Sikament 86 by Sika Corporation
Rheobuild 1000 or Rheobuild 716 by Master Builders

6. **Curing Compound:**

Aqua Resincure by Burke
Aqua-cure by Euclid Chemical Company
Masterkure-W by Master Builders

7. **Evaporation Retardant:**

Confilm by Master Builders
Eucobar by Euclid Chemical Company

8. **Dampproofing Agent:**

Hydrocide 600 by Sonneform
Sealmastic by W.R. Meadows

Damp proofing Asphalt Coating by Euclid Chemical Company

9. **Agents for Bonding Freshly-Mixed Plastic Concrete to Hardened Concrete:**

Sikadur 32 Hi-Mod Epoxy Adhesive by Sika Corporation
Concresive liquid (LPL) by Master Builders
BurkEpoxy MV by Burke

10. **Agents for Bonding Hardened Concrete to Steel:**

Sikadur 31 Hi-Mod Gel by Sika Corporation
BurkEpoxy NS by Burke
Concresive Paste (LPL) by Master Builders

11. **White Portland Cement:**

Atlas White

PART 3. -- EXECUTION

3.1 PROPORTIONING AND MIXING

- A. **Proportioning:** Proportioning of the concrete mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.
- B. **Mixing:** Mixing of concrete shall conform to the requirements of Chapter 7 of ACI 301.
- C. **Slump:** Maximum slumps shall be as indicated.
- D. **Retempering:** Retempering of concrete or mortar which has partially hardened shall not be permitted.

3.2 PREPARATION OF SURFACES FOR CONCRETING

- A. **General:** Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. **Joints in Concrete up to 60 Days Old:** Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by the CONSTRUCTION MANAGER, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, foreign material, and roughened to a minimum 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.

- C. After the surfaces have been prepared all approximately horizontal construction joints shall be covered with a 6-inch lift of the pea gravel mix indicated above. The mix shall be placed and spread uniformly. Wall concrete shall follow immediately and shall be placed upon the fresh pea gravel mix.
- D. **Placing Interruptions:** When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent work; provided that construction joints shall be made only where acceptable to the CONSTRUCTION MANAGER.
- E. **Embedded Items:** No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the CONSTRUCTION MANAGER at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
- F. All inserts or other embedded items shall conform to the requirements herein.
- G. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the CONSTRUCTION MANAGER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.
- H. **Casting New Concrete Against Concrete over 60 Days Old:** Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting or sandblasting (exposing aggregate). The joint surface shall be coated with an epoxy bonding agent unless indicated otherwise by the CONSTRUCTION MANAGER.
- I. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the CONSTRUCTION MANAGER.
- J. **Corrosion Protection:** Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- K. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.

- L. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
- M. **Cleaning:** The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.3 HANDLING, TRANSPORTING, AND PLACING

- A. **General:** Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. **Non-Conforming Work or Materials:** Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced by the CONTRACTOR at no additional cost to the OWNER.
- C. **Unauthorized Placement:** No concrete shall be placed except in the presence of duly authorized representative of the CONSTRUCTION MANAGER. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing at least 24 hours in advance of placement of any concrete.
- D. **Placement in Wall Forms:** Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- E. **Conveyor Belts and Chutes:** All ends of chutes, hopper gates, and all other points of concrete discharge throughout the CONTRACTOR'S conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of an acceptable type. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered.
- F. **Placement in Slabs:** Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. As the work progresses, the concrete

shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.

- G. **Temperature of Concrete:** The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 55 degrees F for sections less than 12 inches thick nor less than 50 degrees for all other sections. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. When the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The CONTRACTOR shall be entitled to no additional compensation on account of the foregoing requirements.
- H. **Cold Weather Placement:** Remove all snow, ice and frost from the surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches. All reinforcement and embedded items shall be warmed to above 32 degrees F prior to concrete placement.

3.4 PUMPING OF CONCRETE

- A. **General:** If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. **Pumping Equipment:** The pumping equipment must have 2 cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the site during pumping.
- C. The minimum diameter of the hose (conduits) shall be in accordance with ACI 304.2R.
- D. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced.
- E. Aluminum conduits for conveying the concrete shall not be permitted.
- F. **Field Control:** Concrete samples for slump, air content, and test cylinders will be taken at the placement (discharge) end of the line.

3.5 ORDER OF PLACING CONCRETE

- A. The order of placing concrete in all parts of the work shall be acceptable to the CONSTRUCTION MANAGER. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7 days for hydraulic structures and 3 days for all other structures before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for all other structures.

- B. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.

3.6 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be Group 3 (per ACI 309) high speed power vibrators (8000 to 12,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required. Group 2 vibrators may be used only at specific locations when accepted by the CONSTRUCTION MANAGER.
- B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.7 FINISHING CONCRETE SURFACES

- A. **General:** Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions shown are defined as tolerances and were indicated above. Tolerances are to be distinguished from irregularities in finish as described below. Aluminum finishing tools shall not be used.
- B. **Formed Surfaces:** No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects. Where architectural finish is required, it shall be as indicated and as per Specifications Section 03350.

1. Surface holes larger than ½ inch in diameter or deeper than ¼ inch are defined as surface defects in basins and exposed walls.
- C. **Unformed Surfaces:** After proper and adequate vibration and tamping, all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each work operation as necessary to prevent drying shrinkage cracks. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:
1. **Finish U1** - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.
 2. **Finish U2** - After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where shown or as determined by the CONSTRUCTION MANAGER.
 3. **Finish U3** - After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.
 4. **Finish U4** - Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a nonskid finish.

D. Unformed surfaces shall be finished according to the following schedule:

1. Refer to Section 03350 "Concrete Finishing" paragraph 3.1.D. for additional concrete slab finish requirements.

UNFORMED SURFACE FINISH SCHEDULE

Area	Finish
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Slabs which are water bearing with slopes 10 percent and less	U3
Sloping slabs which are water bearing with slopes greater than 10 percent	U4
Slabs not water bearing	U4
Slabs to be covered with built-up roofing	U2
Interior slabs and floors to receive architectural finish	U3
Top surface of walls	U3

E. Floor Sealer/Hardener (Surface Applied):

1. Concrete floor slabs shall receive sealer/hardener as schedule in Section 03350 "Concrete Finishing" paragraph 3.1.D.

F. Sandblasted Concrete Finish

1. Sandblasting shall be done in a safe manner acceptable to local authorities and per OSHA requirements. The sandblasting shall be a light sandblast to remove laitance and to produce a uniform fine aggregate surface texture with approximately 1/32- to 1/16-inch of surface sandblasted off. Corners, patches, form panel joints, and soft spots shall be sandblasted with care.
2. Protection against sandblasting shall be provided on all surfaces and materials not requiring sandblasting but within or adjacent to areas being sandblasted. After sandblasting, the concrete surfaces shall be washed with clean water and excess sand removed

3.8 ARCHITECTURAL FINISH: Architectural finishing requirement shall be per Specifications Section 03350 in addition to the requirements of this section.

3.9 CURING AND DAMPPROOFING

- A. General:** All concrete shall be cured for not less than 14 days after placing, in accordance with the methods specified herein for the different parts of the work, and described in detail in the following paragraphs:

Surface to be Cured or Dampproofed	Method
Unstripped forms	1
Wall sections with forms removed	4 or 6
Construction joints between footings and walls, and between floor slab and columns	2

Surface to be Cured or Dampproofed	Method
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	4
Floor slabs on grade in hydraulic structures	5
Slabs not on grade	6

- B. **Method 1:** Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 6, herein.
- C. **Method 2:** The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.
- D. **Method 3:** The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.
- E. **Method 4:** The surface shall be sprayed with a liquid curing compound.
1. Curing compound shall not be used on concrete surfaces to be coated, waterproofed, moistureproofed, or where any coverings are to be bonded.
 2. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film which will seal thoroughly.
 3. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
 4. Wherever curing compound may have been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, said compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.
 5. Where curing compound is specified, it shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound, following which repairs shall be made as specified herein.

6. At all locations where concrete is placed adjacent to a panel which has been coated with curing compound, the previously coated panel shall have curing compound reapplied to an area within 6 feet of the joint and to any other location where the curing membrane has been disturbed.
7. Prior to final acceptance of the WORK, all visible traces of curing compound shall be removed from all surfaces in such a manner that does not damage surface finish.

F. Method 5:

1. Until the concrete surface is covered with curing compound, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed. The concrete shall be given a coat of curing compound in accordance with Method 4, herein. Not less than one hour nor more than 4 hours after the coat of curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs. The curing blankets shall be polyethylene sheet, polyethylene-coated waterproof paper sheeting or polyethylene-coated burlap. The blankets shall be laid with the edges butted together and with the joints between strips sealed with 2-inch wide strips of sealing tape or with edges lapped not less than 3 inches and fastened together with a waterproof cement to form a continuous watertight joint.
2. The curing blankets shall be left in place during the 14-day curing period and shall not be removed until after concrete for adjacent work has been placed. Should the curing blankets become torn or otherwise ineffective, the CONTRACTOR shall replace damaged sections. During the first 3 days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8-inch minimum thickness, laid over the curing blanket. The CONTRACTOR shall add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.

G. Method 6:

1. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 14 consecutive days beginning immediately after the concrete has reached final set or forms have been removed.
2. Until the concrete surface is covered with the curing medium, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed.
3. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held in place to prevent being dislodged by wind or any other causes and to be substantially in contact with the concrete surface. All edges shall be continuously held in place.
4. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.

5. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, any dry spots shall be rewetted, and curing compound shall be immediately applied in accordance with Method 4, herein.
6. The CONTRACTOR shall dispose of excess water from the curing operation to avoid damage to the work.

H. Dampproofing

The exterior surface of all buried roof slabs shall be dampproofed as follows:

1. Immediately after completion of curing the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion. Application shall be in 2 coats. The first coat shall be diluted to 1/2 strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the specified material, undiluted, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Dampproofing material shall be as specified herein.
2. As soon as the asphalt emulsion, applied as specified herein, has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used which produces a uniformly coated white surface and which so remains until placing of the backfill. Should the whitewash fail to remain on the surface until the backfill is placed, the CONTRACTOR shall apply additional whitewash

3.10 PROTECTION

- A. The CONTRACTOR shall protect all concrete against injury until final acceptance by the OWNER.
- B. Fresh concrete shall be protected from damage due to rain. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

3.11 CURING AND THERMAL PROTECTION IN COLD WEATHER

- A. The CONTRACTOR shall be prepared to protect all concrete against freezing. After the first frost or when the mean daily temperature in the vicinity of the worksite falls below 40 degrees F for more than one day, the concrete shall be maintained at a temperature not lower than 50 degrees F for at least 72 hours after it is placed.
- B. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the worksite is less than 40 degrees F. The concrete shall be maintained at not less than 50 degrees F for the entire curing period.
- C. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 degrees F for more than 3 successive days, the specified 72-hour protection at a temperature not lower than 50

degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.

- D. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications.

3.12 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the CONSTRUCTION MANAGER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the CONTRACTOR at its own expense.
- B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32-inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair proposed shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white Portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.
- D. All repairs shall be built up and shaped in such a manner that the completed work will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.
- E. Prior to filling any structure with water, all cracks that may have developed shall be "vee'd" as shown and filled with sealant conforming to the requirements of Section 03290. This repair

method shall be done on the water bearing face of members. Prior to backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane, shall also have cracks repaired.

3.13 PATCHING HOLES IN CONCRETE

A. Patching Small Holes:

1. Holes which are less than 12 inches in their least dimension and extend completely through concrete members, shall be filled as specified herein.
2. Small holes in members which are water-bearing or in contact with soil or other fill material, shall be filled with non-shrink grout. Where a face of the member is exposed to view, the non-shrink grout shall be held back 2 inches from the finished surface. The remaining 2 inches shall then be patched according to the Paragraph above.
3. Small holes through all other concrete members shall be filled with non-shrink grout, with exposed faces treated as above.

B. Patching Large Holes:

1. Holes which are larger than 12 inches in their least dimension, shall have a keyway chipped into the edge of the opening all around, unless a formed keyway exists. The holes shall then be filled with concrete as specified herein.
2. Holes which are larger than 24 inches in their least dimension and which do not have reinforcing steel extending from the existing concrete, shall have reinforcing steel set in grout in drilled holes. The reinforcing added shall match the reinforcing in the existing wall unless indicated otherwise.
3. Large holes in members which are water bearing or in contact with soil or other fill, shall have a bentonite type waterstop material placed around the perimeter of the hole as specified in the Section 03290 unless there is an existing waterstop in place.

3.14 CARE AND REPAIR OF CONCRETE

- A. The CONTRACTOR shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the OWNER. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the CONTRACTOR'S expense.

**** END OF SECTION ****

SECTION 03310 - CAST-IN-PLACE SITEWORK CONCRETE

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing finished cast-in-place lean concrete, site work concrete, minor non-hydraulic concrete structures, air placed concrete, including formwork, steel reinforcement, mixing, placing curing, and repairing, all in conformance with SSPWC.
- B. Site work concrete includes curbs, gutters, catch basins, sidewalks, pavements, fence and guard post embedment, underground duct bank encasement, and all concrete WORK indicated to be site work concrete.

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 03280 Joints in Site work Concrete

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).

1.4 SHOP DRAWINGS AND SAMPLES

- A. Submittals shall be made in accordance with the requirements of SSPWC, Section 201.

1.5 TESTS

- A. Tests on component materials, for the compressive strength of concrete, and for construction tolerances shall be performed in accordance with the requirements of SSPWC, Section 201.

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

- A. Concrete component materials, including curing materials and joint materials shall be in accordance with SSPWC, Subsections 201-1, 201-4, and 201-5.

2.2 FORMWORK

- A. Concrete formwork shall comply with SSPWC Subsection 204-1.

2.3 STEEL REINFORCEMENT

- A. Reinforcing steel shall conform to SSPWC Subsection 201-2.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Proportioning and mixing, preparation of surfaces for concreting, handling, transporting and placing concrete, finishing and curing concrete surfaces and related procedures shall be performed in accordance with SSPWC, Subsections 303-1 and 303-5.

3.2 AIR-PLACED CONCRETE

- A. Air-placed concrete construction (Guniting and Shotcrete) shall be in accordance with SSPWC, Subsection 303-2 and the applicable provisions of Subsection 303-1.

- END OF SECTION -

SECTION 03315 – GROUT

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing grout other than that required for masonry work, complete.
- B. The following types of grout are included in the WORK of this Section:
 - 1. Non-Shrink Grout: This type of grout shall be used wherever grout is required, unless another type is specifically indicated.
 - 2. Cement Grout
 - 3. Epoxy Grout
 - 4. Topping Grout and Concrete Fill

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 03300 Cast-in-Place Structural Concrete

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current versions of the following apply to the WORK of this Section:

CRD-C 621	Corps of Engineers Specification for Non-shrink Grout
ASTM C 109	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens)
ASTM C 531	Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing
ASTM C 579	Test Methods for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing
ASTM C 827	Test Method for Early Volume Change of Cementitious Mixtures
ASTM D 696	Test Method for Coefficient of Linear Thermal Expansion of Plastics

1.4 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grouts proposed for use in the WORK.
 - 2. Certified test results verifying the compressive strength, shrinkage, and expansion properties for proposed non-shrink and epoxy grouts.

1.5 TESTING DURING CONSTRUCTION

A. Field Tests:

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the CONSTRUCTION MANAGER to insure continued compliance with these specifications. The specimens will be made by the City's designated testing lab.
2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the CONSTRUCTION MANAGER. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.
3. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the CONSTRUCTION MANAGER. A set of three specimens will be made for testing at 7 days, and each earlier time period as appropriate.
4. All grout, already placed, which fails to meet the requirements of these specifications, is subject to removal and replacement at the cost of the CONTRACTOR.
5. The cost of all laboratory tests on grout will be borne by the OWNER, but the CONTRACTOR shall assist the CONSTRUCTION MANAGER in obtaining specimens for testing. However, the CONTRACTOR shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The CONTRACTOR shall supply all materials necessary for fabricating the test specimens.

PART 2 -- PRODUCTS

2.1 CEMENT GROUT

- A. **Cement Grout:** Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4000 psi.
- B. Cement grout materials shall be as indicated in Section 03300.

2.2 PREPACKAGED GROUTS

A. Non-Shrink Grout:

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout indicated herein shall be that recommended by the manufacturer for the particular application.
2. Class A non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621.

3. Class B non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi and shall meet the requirements of CRD C 621.
4. **Application:**
 - a. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is specified in the contract documents; except, for those applications for Class B non-shrink grout and epoxy grout indicated herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.
 - b. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, non-shrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.
2. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.
3. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 F.
4. The epoxy grout shall develop a compressive strength of 5000 psi in 24 hours and 14,000 psi in seven days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C 827.
5. The epoxy grout shall exhibit a minimum effective bearing area of 95 percent. This shall be determined by a test consisting of filling a 2-inch diameter by 4-inch high metal cylinder mold covered with a glass plate coated with a release agent. A weight shall be placed on the glass plate. At 24 hours after casting, the weight and plate shall be removed and the area in plan of all voids measured. The surface of the grout shall be probed with a sharp instrument to locate all voids.
6. The peak exotherm of a 2-inch diameter by 4-inch high cylinder shall not exceed 95 degrees F when tested with 75 degree F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30×10^{-6} inches/inch/degree F when tested according to ASTM C 531 or ASTM D 696.
7. **Application:** Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for all other applications required in the Contract Documents.

2.3 TOPPING GROUT AND CONCRETE FILL

- A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as indicated herein. All materials and procedures specified for concrete in Section 03300 shall apply except as indicated otherwise herein.
- B. Topping grout and concrete fill shall contain a minimum of 611 pound of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, structural concrete as indicated in Section 03300 may be used when accepted by the CONSTRUCTION MANAGER.
- C. Coarse aggregate shall be graded as follows:

<u>U.S. STANDARD SIEVE SIZE</u>	<u>PERCENT BY WEIGHT PASSING</u>
1/2"	100
3/8"	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

- D. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.
- E. **Strength:** Minimum compressive strength of topping grout and concrete fill at the end of 28 days shall be 3000 psi.

2.4 CURING MATERIALS

- A. Curing materials shall be as indicated in Section 03300 for cement grout and as recommended by the manufacturer of prepackaged grouts.

2.5 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as required for the particular application.
- B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.6 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

2.7 MANUFACTURERS

- A. Products shall be of the following manufacture (or equal):
 - 1. **Epoxy Grout:** Epoxy Grout J55 by Dayton Superior
Sikadur 42 Grout-Pak by Sika Corporation

PART 3 -- EXECUTION

3.1 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be as specified in Section 03300. The finish of the grout surface shall match that of the adjacent concrete.
- B. The manufacturer of Class A non-shrink grout and epoxy grout shall provide on-site technical assistance upon request.
- C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the CONSTRUCTION MANAGER.

3.2 GROUTING PROCEDURES

- A. **Prepackage Grouts:** All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. **Base Plate Grouting:**
 - 1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for an one-inch thickness of grout or a thickness as indicated.
 - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by the CONSTRUCTION MANAGER, alternate grouting methods shall be submitted for acceptance.
- C. **Topping Grout:**
 - 1. All mechanical, electrical, and finish work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting exposing the aggregates to ensure bonding to the base slab.
 - 2. The minimum thickness of grout topping and concrete fill shall be one inch. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2-inches deep.
 - 3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping concrete shall be placed until the slab is complete free from standing pools or ponds

of water. A thin coat of neat Type II cement grout shall be broomed into the surface of the slab just before topping of fill placement. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

3.3 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

**** END OF SECTION ****

SECTION 03331- CAST-IN-PLACE ARCHITECTURAL CONCRETE

PART 1 – GENERAL

1.1. WORK OF THIS SECTION

- A. The WORK of this Section cast-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes.

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 the WORK.

1. Section 03200 Reinforcement Steel
2. Section 03121 Formliners for Architectural Concrete
3. Section 03290 Joints in Concrete Structures
4. Section 03300 Cast-in-Place Structural Concrete
5. Section 03315 Grout
6. Section 07905 Joint Sealers

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).

1.4. DEFINITIONS

- A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. Cementitious Materials: Comply with the requirements of Section 03300 Cast-in-Place Structural Concrete.

1.5. SUBMITTALS

- A. All information below shall be submitted and approved prior to construction.
- B. Product Data: For each type of product indicated.
- C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

- E. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.
- F. Product Samples: For each of the following products:
 - 1. Form-facing panel.
 - 2. Form ties.
 - 3. Form liners. See requirements of Section 03121 "Formliners for Architectural Concrete."
 - 4. Coarse- and fine-aggregate gradations.
 - 5. Chamfers, custom patterns and rustications.
 - 6. Samples for Color Verification: Submit sample chip(s) of specified color(s) indicating color additive number(s) and required dosage rate(s).
 - 7. For custom color integrally colored concrete submit paint and draw-downs of colors selected by architect.
 - 8. Joint Sealant
- G. Field Samples, cast vertically, approximately 24 by 24 by 9 inches, of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics and Mock-ups: See paragraph 1.6 Quality Assurance of this section.
- H. Qualification Data: See Division 1 Section "Quality Requirements."
 - 1. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - a. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
 - 2. Material Certificates: For each of the following, signed by manufacturer:
 - a. Cementitious materials.
 - b. Admixtures.
 - c. Form materials and form-release agents.
 - d. Repair materials.
 - 3. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm knowledgeable in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

2. Personnel performing laboratory tests shall be an 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. Source Limitations for Cast-in-Place Architectural Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from one manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5 and Section 6, "Architectural Concrete".
 2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete".
- E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- F. Field Samples and Mock-ups: Before casting architectural concrete, produce field samples and mock-ups for review and approval by the Architect.
1. Integrally colored cast-in-place architectural concrete: After approval of color(s) per paragraph 1.5.E. of this section, prepare site-cast architectural concrete samples, cast vertically, approximately 24 by 24 by 9 inches of up to 4 different color options as selected by Architect. Forming surface and concrete texture shall be as specified.
 2. Field Sample Panels: After approval of site-cast color samples prepare field sample panels, cast vertically, approximately 48 inches wide by 96 inches high by 6 inches minimum to demonstrate the expected range of surface finish, color, texture, joints, tolerances, and standard of workmanship. Prepare up to six field samples to demonstrate each form texture and color. Prepare field samples to comply with the following requirements using materials and products indicated for the completed work:
 - a. Build field samples on site in the location as directed by the Architect.
 - b. Use form liner patterns and textures as shown in the Drawings and based on approved products per paragraph 1.5.e. of this Section.
 - c. Demonstrate release agent, curing, cleaning, and protecting of cast-in-place architectural concrete.
 - d. Demonstrate the following types of joints as specified:
 - 1) Construction joint
 - 2) Expansion joint
 - 3) Control joint
 - e. In presence of Architect, damage part of the exposed face surface for each finish, color, and textures, and demonstrate material, and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
 3. Full Height Mock-up: After approval of Field Sample Panels prepare full height mock-up, approximately 6'-0" wide by 36'-0" high by 12 inches minimum to demonstrate the approved range of selections made. Prepare mock-up to comply with the following requirements:
 - a. Build mock-up on site in the location as directed by the Architect.
 - b. Prepare mock-up using materials, products, finishes, colors, techniques, and workmanship per the approved field samples.

- c. Failure to prepare mock-up according to approved field samples shall be grounds for rejection of the mock-up. Upon rejection of the mock-up as such the contractor shall prepare additional mock-up(s) without additional cost to owner.
 - d. Build mock-up of typical exterior wall of cast-in-place architectural concrete to demonstrate full range of surface texture and color as shown on drawings.
 - e. Maintain mock-up during construction in an undisturbed condition as a standard for judging the completed work.
4. General Requirements for Field Samples and Mock-ups:
- a. Construct mock-ups and field samples using processes and techniques intended for use on the permanent work.
 - b. Mock-ups and field samples shall be produced by the individual workers who will perform the work on the project.
 - c. For accurate color, the quantity of concrete mixed to produce field samples and mock-ups shall not be less than 3 cubic yards (or not less than 1/3 the capacity of the mixing drum on the ready-mix truck) and should always be in full cubic yard increments. Excess material shall be discarded according to local regulations.
 - d. Retain samples of cements, sands, aggregates, and color additives used in field samples and mock-ups for comparison with materials used in remaining work.
 - e. Accepted field samples and mock-ups provided visual standard for the work of this section.
- G. Field samples and mock-ups shall remain through completion of work for use as a quality Preinstallation Conference: Conduct conference at Project site to comply with the following:
- 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place architectural concrete subcontractor.
 - 2. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural concrete.

PART 2 -- PRODUCTS

2.1. FORM-FACING MATERIALS

- A. General: Comply with Section 03121 "Formliners for Architectural Concrete".
- B. Form-Facing Panels for As-Cast Finishes: Steel, glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that will provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- C. Form-Facing Panels for As-Cast Finishes: Exterior-grade plywood panels, nonabsorptive, that will provide continuous, true, and smooth architectural concrete surfaces, high-density overlay, Class 1, or better, complying with DOC PS 1.

- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Form Liners: Units of face design, texture, arrangement, and configuration indicated.
- F. All concrete surfaces designated in the engineering plans or specifications as "custom cast-in-place concrete", Panel Design Types A,B,C,D & E, shall be formed using "Custom-Made Formliner" by RECKLI or Equal per 3-D CAD model to be provided by Architect.
- G. Formliners for Panel Design Types F designated in the engineering plans or specifications shall be formed using Formliner, Model No. 2/32 Inn by RECKLI or Equal.
- H. Not Used
- I. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch, minimum; nonstaining; in longest practicable lengths.
- J. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch thick.
- K. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or S, Grade NS, that adheres to form joint substrates.
- L. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.
- M. Form-Release Agent: Commercially formulated colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces. Form-release agent shall be approved by color pigment manufacturer.
- N. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- O. Surface Retarder: Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
- P. Form ties:
 - 1. Form ties with integral waterstops shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.
 - 2. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2. MANUFACTURERS

- A. Products of the type indicated shall be manufactured by one of the following (or equal):
 - 1. Form Ties: Burke Penta - Tie System by the Burke Company
Richmond Snap Tys by the Richmond Screw Anchor Company

2. Form ties with Integral Waterstops: Burke Taper - Tie System by the Burke Company
Taper Ty by the Richmond Screw Anchor Company
3. Pigments for Integrally Colored Concrete by L.M. Scofield Company, Davis Colors, or Equal

2.3. STEEL REINFORCEMENT AND ACCESSORIES

- A. General: Comply with Division 3 Section "Cast-in-Place Structural Concrete" for steel reinforcement and other requirements for reinforcement accessories.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."
 1. Where legs of wire bar supports contact forms, use gray, all-plastic bar supports.

2.4. CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C 150, Type White.
 2. Blended Hydraulic Cement: ASTM C 595, Type HS cement.
- B. Normal-Weight Aggregates: ASTM C 33. For Class Specification, See Section 03300, Cast-In Place Structural Concrete.
 1. Maximum Coarse Aggregate Size: See Section 03300, Cast-In Place Structural Concrete.
 2. Gradation: See Section 03300, Cast-In Place Structural Concrete.
- C. Normal-Weight Fine Aggregate: See Section 03300, Cast-In Place Structural Concrete.
- D. Water: Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

2.5. ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

- C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis. Custom Color as selected by Architect at no additional cost.
 - 1. Color-1
 - a. Option A: Custom Color as selected by Architect to match existing pump station building.
 - b. Option B: Custom Color as selected by Architect to match existing pump station building.
 - 2. Color-2
 - a. Option A: "Quarry Red" by L.M. Scofield, or equal.
 - b. Option B: Custom color as selected by Architect to match existing pump house brick color.

2.6. CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
 - 1. For integrally colored concrete, curing compound shall be approved by color pigment manufacturer.
 - 2. For concrete indicated to be sealed, curing compound shall be compatible with sealer. Sealing compound shall be approved by color pigment manufacturer.

2.7. REPAIR MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8. CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.
- B. Proportion concrete mixtures as follows:
 - 1. Compressive Strength (28 Days): See Section 03300, Cast-In Place Structural Concrete.

2. Maximum Water-Cementitious Materials Ratio: See Section 03300, **Cast-In Place Structural Concrete**.
 3. Slump Limit: See Section 03300, **Cast-In Place Structural Concrete**.
 4. Air Content: See Section 03300, **Cast-In Place Structural Concrete**.
- C. Cementitious Materials: For cast-in-place architectural concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.
- D. Limit water-soluble, chloride-ion content in hardened concrete to **0.15 percent by weight** of cement.
- E. Admixtures: Use admixtures according to manufacturer's written instructions.
- F. Color Pigment: Add color pigment to concrete mixture according to **manufacturer's** written instructions and to result in hardened concrete color consistent with approved **mockup**.
- 2.9. CONCRETE MIXING
- A. Ready-Mixed Architectural Concrete: Measure, batch, mix, and deliver **concrete** according to ASTM C 94/C 94M and furnish batch ticket information.
1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
 2. When air temperature is between 85 and 90 deg F, reduce mixing and **delivery** time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce **mixing** and delivery time to 60 minutes.

2.10. ACCESSORIES

- A. Joint Sealants: As specified in Section 03290 "Joints in Concrete Structures". **Color to match** approved color of integrally-colored cast-in-place architectural concrete.

PART 3 -- EXECUTION

3.1. FORMWORK

- A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for **formwork**, embedded items, and shoring and reshoring. Comply with Section 03121 "Formliners for Architectural Concrete".
- B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.
- C. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347R as abrupt or gradual, **as follows**:
1. Class B, 1/4 inch
- D. Fabricate forms to result in cast-in-place architectural concrete that **complies** with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.
 - 1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
 - 2. Do not use rust-stained steel form-facing material.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of cast-in-place architectural concrete.
- H. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- M. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.
- N. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.2. REINFORCEMENT AND INSERTS

- A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.
- B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.3. REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours

after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Schedule form removal to maintain surface appearance that matches approved mockups.
 2. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.
- B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4. JOINTS

- A. Construction Joints: Install construction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete. Align construction joint within rustications attached to form-facing material.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- B. Contraction Joints: Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5. CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- D. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

- E. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
 4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.6. FINISHES, GENERAL

- A. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
- C. Maintain uniformity of special finishes over construction joints, unless otherwise indicated.

3.7. AS-CAST FORMED FINISHES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding specified limits on formed-surface irregularities.

- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing **material**, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. **Repair** and patch **tie holes** and defects.
- C. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, **moisten** concrete surfaces and rub with carborundum brick or another abrasive until producing a **uniform** color and texture. Do not apply cement grout other than that created by the **rubbing process**.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to **one** and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add **white portland cement** in amounts determined by trial patches so color of dry grout will match **surrounding concrete**. Scrub grout into voids and remove excess grout. When grout whitens, **rub** surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix **one** part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of **dry grout** will match surrounding concrete. Compress grout into voids by grinding surface. **In a swirling motion**, finish surface with a cork float.
- D. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and **honeycombs**, and of uniform appearance, color, and texture.

3.8. EXPOSED-AGGREGATE FINISHES

- A. Abrasive-Blast Finish: Perform abrasive blasting after compressive strength of concrete exceeds 4000 psi. Coordinate with formwork removal to ensure that surfaces to be **abrasive blasted** are treated at same age for uniform results.
 - 1. Surface Continuity: Perform abrasive-blast finishing in as **continuous** an operation as possible, maintaining continuity of finish on each surface or area of **Work**. Maintain required patterns or variances in depths of blast to match design reference sample or **mockup**.
 - 2. Abrasive Blasting: Abrasive blast **corners** and edges of patterns **carefully**, using backup boards, to maintain uniform corner or edge line. Determine type of **nozzle**, nozzle pressure, and blasting techniques required to match design reference sample or **mockup**.
 - 3. Depth of Cut: Use an abrasive grit of proper type and gradation to **expose** aggregate and surrounding matrix surfaces to match design reference sample or **mockup**, as follows:
 - a. Light: Expose fine aggregate with occasional exposure of **coarse** aggregate and uniform color; with maximum reveal of 1/16 inch (1.5 mm).

3.9. CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and **excessive** cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and **with** ACI 301 for hot-weather protection during curing.
- B. Begin curing cast-in-place architectural concrete immediately after removing **forms** from concrete. Cure according to ACI 308.1, by one or a combination of the following **methods** that will not mottle, discolor, or stain concrete:

1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural concrete continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.
3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.10. FIELD QUALITY CONTROL

- A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for field quality-control requirements.

3.11. REPAIRS, PROTECTION, AND CLEANING

- A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
- B. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.
- C. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- D. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.
- E. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- F. Wash and rinse surfaces according to concrete finish applicator's written recommendations. Protect other Work from staining or damage due to cleaning operations.
 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

- END OF SECTION -

03350 - CONCRETE FINISHING

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Concrete finishing of slabs and flatwork.
- B. Related Sections:
 - 1. Section 03300: Cast-In-Place Structural Concrete
 - 2. Section 03331: Cast-In-Place Architectural Concrete
 - 3. Section 09970: Concrete Floor Sealer
 - 4. Section 09680: Carpeting

1.2 SUBMITTALS

- A. General: Submittals involving exposed concrete finishes require approval of the Architect before they may be incorporated in the Work.
- B. Shop Drawings: Submit shop drawings, or diagrams to scale, that indicate the location in plan and elevation of all concrete finishes.
- C. Product Data: Submit manufacturers' product data for manufactured products.

1.3 QUALITY ASSURANCE

- A. Comply with the provisions of Sections 03300 Cast-In-Place Structural Concrete & 03331 Cast-In-Place Architectural Concrete.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Furnish materials, tools and equipment in accordance with Sections 03300 Cast-In-Place Concrete & 03331 Cast-In-Place Architectural Concrete.

PART 3 – EXECUTION

3.1 SLABS AND FLATWORK

- A. Placement and Finishing Standards: Slabs and flatwork shall be placed, consolidated, and finished in accordance with Section 03300 Cast-In-Place Concrete.
- B. Placement:
 - 1. Whether indicated or not, in areas where drains occur, slope finished slab to drains. Slope shall be 1/8 inch minimum to 1/4 inch maximum per foot unless otherwise indicated.
- C. Curing, Protection & Tolerances of concrete shall be in accordance with Section 03300 Cast-In-Place Concrete.
- D. Slab Finishes: Unless otherwise indicated, slabs and flatwork shall receive the following finishes as specified in Section 03300 Cast-In-Place Concrete:

LOCATION	FINISH	SEALER	FLOOR COVERING
ENTRY HALL #200 Floor:	Existing	N/A	Per Section 09680 Carpeting
OPEN WORK AREA #201 Floor:	Existing	N/A	Per Section 09680 Carpeting
CONFERENCE ROOM #202 Floor:	Existing	N/A	Per Section 09680 Carpeting
OFFICES #203, 204 & 205 Floor:	Existing	N/A	Per Section 09680 Carpeting
HALL #206 Floor:	Existing	N/A	Per Section 09680 Carpeting
NORTH GENERATOR BUILDING #100 Floor:	U3	Per Section 09970 Concrete Floor Sealer	Exposed to view
NORTH GENERATOR BUILDING #101 Floor:	U3	Per Section 09970 Concrete Floor Sealer	Exposed to view
CONTROL ROOM #102 Floor:	U3	Per Section 09970 Concrete Floor Sealer	Exposed to view
ELECTRICAL SWITCHGEAR BUILDING #103 Floor:	U3	Per Section 09970 Concrete Floor Sealer	Exposed to view

END OF SECTION

SECTION 05120 - STRUCTURAL STEEL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing structural steel and related appurtenances.

1.2 RELATED SECTIONS

- A. The WORK of the following Section 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 09800 Protective Coating

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).

1.4 CODES

- A. The 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. California Building Code

1.5 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the applicable sections of the current editions of the documents indicated apply to the WORK of this Section.

AISC M011	Manual of Steel Construction for Shop and Field Welding
AISC S326	Design, Fabrication and Erection of Structural Steel for Buildings
ASTM A36 / A992	Structural Steel for 36 KSI / Structural Steel for 50 KSI
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, Grade B
ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A307	Carbon Steel Externally Threaded Standard Fasteners, Grade A
ASTM A320	Alloy-Steel Bolting Materials for Low Temperature Service, Type 304
ASTM A325	High-Strength Bolts for Structural Steel Joints
ASTM A490	Heat-Treated Structural Steel Bolts
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, Grade B

ASTM A501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A666	Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar for Structural Applications, Grade A, Type 304
AWS-B3.0	Welding Procedures and Performance Qualifications
AWS-D1.1	Structural Welding Code—Steel
AWS-W1	Welding Metallurgy

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Shop drawings, including details, dimensions, details of match markings and all information necessary for fabrication.
2. Welding procedures and welder qualifications.

1.7 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. Certificates that steels comply with the indicated standards.
2. Certificates that welding operators and procedures comply with the indicated requirements.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. Materials for structural steel members and connection, unless otherwise indicated, shall comply with the following:

1. Rolled shapes

Wide flanges	ASTM A992 Grade 50
Channels, angles & others	ASTM A36
2. Pipe

	ASTM A53, Grade B
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3. Structural steel tubing

	ASTM A500, Grade B, or ASTM A501
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4. Structural plates

Beam cover/side plates	ASTM A572 Grade 50
Column continuity plates	ASTM A572 Grade 50
Column base plates	ASTM A572 Grade 50
Other, unless noted otherwise	ASTM A36
5. Stainless steel

	ASTM A666, Grade A, Type 316L (Fy = 35 ksi)
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6. Stainless steel bolts, nuts and washers

	ASTM A320, Type 316
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| 7. | High strength steel bolts | ASTM A325 or ASTM A490 |
| 8. | Machine bolts | ASTM A325 or ASTM A490 |
| 9. | Anchor bolts | ASTM F1554, Grade 36 unless otherwise noted |
| 10. | Threaded and hanger rod | ASTM A307 |
| 11. | Welded shear connectors | ASTM A108 Grade 1015 through 1020 |
| 12. | Galvanizing | ASTM A123 |

B. Corrosion Protection:

Unless otherwise indicated, all structural steel shall be Hot-Dip Galvanized after fabrication and coated per Specification Section 09800.

2.2 FABRICATION

- A. Fabrication shall be in accordance with AISC S326 and indicated requirements. All structural steel welding in off-site fabrication shops shall be continuously inspected by a City of San Diego Certified Special Inspector. The continuous inspection will be waived if the work is done in a shop certified by the International Code Council (ICC), or listed by the International Code Council Evaluation Services (ICC-ESR), Inc. This shall be at no extra cost to the OWNER.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. General:

1. Structural assemblies and shop and field welding shall meet the requirements of AISC M011 and AISC S326.
2. Measurements and dimensions shall be verified at the site.
3. Bolt holes shall be 1/16 inch larger than the nominal size of bolts. Where thick metals are indicated, holes shall be sub-punched and drilled or reamed.
4. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators.
5. Bolts shall not be permitted to drift and holes shall not be enlarged to correct misalignment. In the event of mismatching of holes, new materials shall be provided.
6. Structural steel completely encased in concrete shall not be galvanized or painted and shall have a clean surface for bonding to concrete.
7. Damaged structural steel shall be replaced. Use of salvaged, reprocessed, or scrap materials shall not be permitted.
8. Post installed anchor bolts are not permitted on new pads. Post installed anchor bolts are allowed on existing equipment pads only.

B. Welding:

1. Welding shall be performed by operators who have been qualified by tests as prescribed by AWS-W1 Sect. 7, to perform the type of welding indicated. Welding shall comply with AWS Code for Arc Welding in Building Construction, Section 4, Workmanship. Electrodes shall be matching per AWS.
2. Continuous seal welds shall be applied on structural steel designed to be exposed to weather or submerged in water or wastewater. Continuous seal welds shall be applied on both sides of structural steel designed to be submerged in water or wastewater.

C. Bolted Connections:

1. Where bolted connections are indicated, they shall comply with AISC Specifications for Framed Beam Connections for bearing type connections. The threaded portion of bolts shall not occur at shear planes.

3.2 CORROSION PROTECTION

- A. Unless otherwise indicated, all structural steel, including that used in the fabrication of process equipment, shall be surface prepared and coated in accordance with Section 09800 and shall include the following operations:
 1. Exterior and interior edges of flame-cut pieces shall be ground smooth.
 2. Sharp edges and punched holes shall be ground smooth.
 3. Uneven or rough welds shall be ground smooth.
- B. Seal weld open ends of hollow structural section (HSS) with ¼" closure plates. Provide continuous seal welds at angle to gusset-plate connections and similar locations where steel is exposed to weather.

3.3 TOUCH-UP AND REPAIR

- A. After installation, damaged surfaces of shop-primed structural steel shall be cleaned and touched-up with same material used for shop coat.

**** END OF SECTION ****

SECTION 05300 - METAL DECKING

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all metal decking, accessories and complete appurtenant work.

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 05120 Structural Steel
2. Section 05500 Miscellaneous Metalwork
3. Section 07540 Single-Ply Adhered Membrane Roofing
4. Section 07600 Flashing and Sheet Metal
5. Section 09800 Protective Coating

1.3 CODES

- A. The 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 California Building Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

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|----|------------|---|
| 1. | ASTM A 446 | Specification for Steel Sheet, Zinc Coated (Galvanized) by Hot-Dip Process, Structural (Physical) Quality |
| 2. | ASTM A 525 | Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process |
| 3. | ASTM A 611 | Specification for Steel, Cold-Rolled Sheet, Carbon, Structural |
| 4. | AWS D1.3 | Specifications for Welding Sheet Steel in Structures |

- | | | |
|----|-------------------------------|---|
| 5. | AISI
Structural Members | Specification for the Design of Cold-Formed Steel |
| 6. | AISC | Light Gauge Steel Design |
| 7. | ICBO | Research Report (on Metal Decks) |
| 8. | Steel Deck Institute
(SDI) | Design Manual for Composite Decks, Form Decks and
Roof Decks |

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in addition to General Requirements:

1. Deck manufacturer's affidavit certifying to the yield strength, design thickness, and section properties of the metal deck.
2. Diaphragm shear values for the deck, supplied by the manufacturer, using the welding pattern and shear capacity indicated.
3. Erection layout drawing showing the location of deck sheets, end laps, side laps, location and sizes of all openings, types and locations of welds.
4. The location, type, size, spacing and sequence of the connections and the methods of fastening the decking and installing the accessories.
5. Erection marks. Mark each bundle to correspond to the shop drawings.
6. Certification from the Steel Deck Institute (SDI) that the steel roof deck is designed in accordance with SDI standards.
7. Certifications that welders are qualified in accordance with AWS D1.3 for each process, position, and joint configuration, on the shop and field welding procedures to be used.
8. Written Welding Procedure Specifications (WPS's) in accordance with AWS D1.3 and SDI requirements for each different welded joint proposed for use whether prequalified or qualified by testing.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Steel decking shall be delivered, stored, handled, and installed in a manner to protect it from corrosion, deformation, and other damage. Special care shall be exercised not to damage the material or overload the deck during the entire construction period.
- B. The deck shall not be used as a working platform until the units have been welded in position and shall not be used for storage of materials without authorization by the CONSTRUCTION MANAGER. All damaged material shall be removed and restoration made with new material by

the CONTRACTOR at no additional cost to the OWNER.

PART 2 -- PRODUCTS

2.1 STEEL DECK

- A. Unless noted on the drawings, all metal decking and accessories shall be manufactured from steel conforming to ASTM Designation A 653 SS, having a minimum yield strength of 38,000 psi. The maximum design working stress in the deck shall not exceed 0.6 times the yield strength.
- B. The metal decking structural properties shall be as indicated. These shall include minimum thickness of steel before coating, minimum depth of deck, minimum moment of inertia, and minimum section modulus. The moment of inertia and section modulus of the metal decking unit shall be computed in accordance with the Steel Deck Institute specifications, and in accordance with the American Iron and Steel Institute, "Specification for the Design of Cold- Formed Steel Structural Members."
- C. Galvanized steel decking shall comply with ASTM A 446 and the galvanizing shall conform to ASTM A 525, Class G90 and the applicable requirements of Section 05500.
- D. Painted steel deck shall conform to ASTM A 611 and shall receive a shop coat of primer and shall be painted in accordance with the applicable requirements of Section 09800.
- E. The metal decking shall have sufficient sheet length to cover 3 or more spans of supports.
- F. The metal decking sheets shall be formed at the longitudinal sides in such a manner that they will overlap and interlock. Where the end of sheets overlap, they shall be die-formed in such a manner that the sheet in the next row telescopes and snugly overlaps the sheet laid previously.

PART 3 -- EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. The CONTRACTOR shall inspect supporting members for correct layout and alignment, and shall not proceed with installation until defects are corrected and supporting members are completely installed and secured.
- B. Metal deck sheets and accessories shall be placed in accordance with manufacturer's recommendations and shop drawings. Roofs having a slope of 1/4-inch per foot or more shall be erected starting at the lowside to ensure that end laps are shingle fashion.
- C. Metal deck sheets shall be positioned on supporting steel framework and adjusted to final position with ends bearing a minimum of 2 inches on supporting members. Units shall be placed end to end with all ribs aligned over entire length of run before being permanently fastened.
- D. Special care shall be exercised not to damage or overload the deck during installation. The deck

shall not be used for storage or working platforms until permanently secured in position. Construction load shall not exceed deck carrying capacity.

- E. All openings in the deck shall be cut and fitted neatly and shall be reinforced with structural steel members to distribute the load.
- F. Edges of any cut openings or any minor surface damage areas shall be repaired in accordance with applicable requirements of Section 09800 and Section 05500.

3.2 WELDING

- A. Care shall be exercised in the selection of electrodes and an amperage to provide positive welds and to prevent high amperage blow holes. Welds shall be made from the top side of the deck immediately after alignment.
- B. The metal decking shall be welded to all supporting members with 1/2-inch effective diameter puddle welds spaced as indicated. Welding washers shall be used when welding steel decking of less than 0.028-inch thickness. Welding washers shall not be used when welding steel decking of 0.028 inches or greater.
- C. Side laps shall be welded with either 1/2-inch effective diameter puddle welds or 1-1/4-inch long seam welds, spaced as indicated.
- D. Any weld found to be defective shall be replaced.
- E. All welds shall be free of sharp points or edges. All welds shall be cleaned immediately by chipping or wire brushing and shall be coated with an organic zinc primer as recommended by the metal deck manufacturer.
- F. Welding shall conform to the applicable requirements of AISC "Light Gauge Steel design." Welders shall be AWS certified.

** END OF SECTION **

SECTION 05400 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section Includes: Provision of light gauge steel stud and joist framing. Work includes, but is not necessarily limited to the following:
 - 1. Non-load bearing steel stud framing at exterior walls.
 - 2. Interior stud wall and ceiling framing with studs.
 - 3. Framing accessories.
- B. Related Sections:
 - 1. Section 05500- Miscellaneous Metalwork.
 - 2. Section 09100 - Metal Support Assemblies.

1.2 REFERENCES

- A. Requirements of the GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.
- B. Published specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work of this Section where cited by abbreviations noted below (latest editions apply).
 - 1. California Code of Regulations, Title 24, Part 2, also known as the California Building Code (CBC), Current Edition.
 - 2. American Society for Testing and Materials (ASTM).
 - 3. Federal Specifications (FS).
 - 4. American Welding Society (AWS) D1.3: "Structural Welding Code - Sheet Steel."
 - 5. American Iron and Steel Institute (AISI): "Specifications for the Design of Cold-Formed Steel Structural Members."
 - 6. Steel Stud Manufacturer's Association (SSMA).
 - 7. Metal Lath Association (MLA): "Specifications for Metal Lath and Furring."
 - 8. Society of Protective Coatings (SSPC).

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with fire-resistance ratings as indicated and as required by governing authorities and codes.
 - 2. Provide materials, accessories, and application procedures which have been listed by an approved testing agency or tested according to ASTM E119 for the type of construction shown.
 - 3. Comply with CBC Section 2203A.3 and AISI requirements for design and identification of cold-formed steel.
 - 4. Framing shall conform to the ICC Report for stud gauge and spacing for all wall conditions.

- B. Steel stud system shall conform to referenced AISI documents.
- C. Installer: Company specializing in performing the work of this Section with minimum 3 years' documented knowledge.
- D. Welders: Qualified in accordance with AWS D1.3 for welding process, position, type of weld and type of steel.

1.4 SUBMITTALS

- A. Submit in accordance with provisions of Section 01300, "Submittals."
- B. Product Data: Manufacturer's ICC report, specifications and installation instructions for steel studs, fasteners, and accessories.
- C. Knowledge of installer if requested by Architect.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect framing from rusting and damage.
- B. Deliver in manufacturer's unopened containers or bundles fully identified with name, brand, type and grade.
- C. Store inside a dry, ventilated space, and protect framing from rust and damage.

1.6 JOB CONDITIONS

- A. Coordinate stud sizes and layouts with the work of the various trades. Where ductwork, conduit, piping, casework, and other such items exceed indicated available space, increase stud sizes or make other minor modifications as necessary to accommodate the work at no change in cost of the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Any member of Steel Stud Manufacturer's Association (ICC ER-4943P).

2.2 MATERIALS

- A. Sheet Steel: ASTM A653, A1008 or A1011.
- B. Studs and tracks:
 1. See drawings for size and gauge.
 2. Galvanization per ASTM A653 with G60 minimum.
- C. Cold-Rolled Furring Channels: As specified in Section 09100, "Metal Support Assemblies."
- D. Vertical Deflection Clips (non-load-bearing framing): Manufacturer's standard bypass and head clips as required, capable of isolating wall stud from upward and downward vertical displacement of primary structure using mechanical fasteners. Acceptable Manufacturer: The Steel Network, Inc. Connections must be tested in accordance with ICC AC261 criteria and hold a valid ICC ERS evaluation service report to be accepted, such as ICC ESR-1903, or equivalent. Provide clips with attached bushing and screw of the series, size and configuration as required by the structural design calculations.
 1. VertiClip® or VertiTrack® series or equal to. Mechanical attachment to structure and screw attachment to stud web using step-bushings to permit frictionless vertical movement.

- E. Drift Clips® (non-load-bearing framing): Manufacturer’s standard bypass and head of wall clips (as required), capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure using mechanical fasteners. Acceptable Manufacturer: The Steel Network, Inc. Connections must be tested in accordance with ICC AC261 criteria and hold a valid ICC ERS evaluation service report to be accepted, such as ICC ESR-1903, or equivalent.
 - 1. DriftClip® series or equal to. Mechanical attachment to structure and screw attachment to stud web using step-bushings to permit frictionless vertical and lateral movement.
- F. Sliptrack: as indicated on approved drawings. Acceptable Manufacturers: Sliptrack Systems (ICC ESR-2049) or engineer approved equal.
- G. Partition Stiffeners or Bridging: Unpunched channel shape, formed of 16-gauge steel to required dimensions.
- H. Welding Electrodes: AWS low hydrogen, rod number and diameter as approved by the Owner’s Testing Agency.
- I. Touch-up Primer for Galvanized Surfaces: SSPC Paint 20 zinc rich.
- J. Metal Screws: Screws shall be self-drilling and self-tapping. Screws shall penetrate substrate by a minimum of three full threads exposed. Use low profile heads as required by architectural finish.
 - 1. Sheet Metal Screw (SMS): No. 8 and larger as noted on Drawings.
 - 2. Heavy Gauge Screws: Size as noted on Drawings. Use “TEKS” screws by ITW Buildex (ICC ESR-1976) or equal product.
 - 3. Hex Head Screws: Size as noted on Drawings. Use “Kwik-Flex” screws by Hilti or equal product.

PART 2 - EXECUTION

3.1 PREPARATION

- A. Coordinate details and requirements of other Work which adjoins or fastens to studs and requires backing or special support framing included in this Section.
 - 1. Items requiring backing or support include, but are not necessarily limited to casework, wall-specialties, and similar items.
 - 2. Obtain Architect’s approval of backing method proposed to satisfy requirements of this Section which differs from methods noted or shown.

3.2 EXAMINATION

- A. Examine all parts of the supporting structure and the conditions under which studs will be installed.
- B. Notify the Architect, in writing, of any conditions detrimental to the proper and timely completion of the Work.
- C. Do not proceed with the installation of steel studs until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Tracks shall be securely anchored to supporting structure, with fasteners specified at not more than 24-inches on center.

- B. Complete, uniform, and level bearing support shall be provided for the bottom track at each bearing-stud location. Install full metal shims below bottom track at stud locations as needed, or set bottom track in high-strength grout.
- C. Abutting or intersecting pieces or track shall be securely anchored to a common structural element or spliced together.
 - 1. Splices or butt welds shall be used at all butt joints in the runner track.
 - 2. Do not splice studs.
- D. Wall studs shall sit in top and bottom track with 1/16" maximum gap between wall stud and track web.
 - 1. Studs shall be aligned or plumbed and securely fastened to the flanges of both top and bottom track.
 - 2. Space studs 16-inches on center maximum unless otherwise noted on Drawings.
- E. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Connect vertical (and/or drift) deflection clips to studs and anchor to primary building structure in accordance with manufacturer's recommendations.
- F. Framed wall openings shall include a header and multiple studs at each edge of opening as indicated on Drawings. Contractors option to built-up jambs, headers, and sills: JamStud® by The Steel Network, Inc. ASTM A653/A653M, Grade 50 (340) 50ksi (340MPa), minimum yield strength 65ksi (450MPa), minimum tensile strength, G-60 (Z180) hot-dipped galvanized coating.
- G. Diagonal bracing shall be installed at locations indicated for frame stability.
- H. Install bridging as indicated on Drawings.
- I. Form corners and intersections of partitions with three studs as shown on Drawings. Provide additional studs as indicated or required.
- J. Joining of members shall be made with welding; wire tying of framing members shall not be permitted.
- K. Welded connections shall be made by resistance spot fusion welding, fillet welding, or plug welding and shall be done in accordance with the latest recommended procedures and practices of the American Welding Society.
- L. Do not cut or notch stud flanges.
- M. Where exposed to weather, field abrasions and welds shall be touched up with zinc rich primer.
- N. Erection Tolerances: Install cold formed metal framing to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8-inch in 10 feet as follows:
 - 1. Space individual framing members no more than plus or minus 1/8-inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
- O. Provide all angles, clips and other miscellaneous pieces necessary to attach light gauge framing to building structure or to attach other materials to light gauge framing.
- P. Do not bridge building expansion and control joints with cold formed metal framing. Independently frame both sides of joints.

3.4 INSTALLATION OF FIRE-RATED ASSEMBLIES

- A. Install studs which are components of fire-rated wall assemblies as indicated.

3.5 BACKING IN STUD PARTITIONS

- A. Securely weld or screw cut sections of unpunched stud to at least three stud or furring supports, leaving flat surface of backing stud web to receive attachment of object to be secured.
- B. Verify that any pre-drilling of backing and attachment of spacers to prevent crushing of collateral material is done prior to application of collateral material.
- C. If it is determined by the Architect that backing was not provided for any items as required, the Contractor shall remove the finish material and install backing. The Contractor shall patch and refinish surface to match adjacent area and finish.

3.6 FIELD QUALITY CONTROL

- A. The Owner's Testing Agency will:
 - 1. Provide continuous inspection of welding, including prior fit-up, welding equipment, weld quality, and welder certification in accordance with AWS and CBC Section 1704A.3.
 - 2. Provide continuous inspection during installation as required to establish conformity of Work requirements.

END OF SECTION

SECTION 05500 - MISCELLANEOUS METALWORK

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing miscellaneous metalwork and appurtenances including the following:
1. Anchor Bolts
 2. Power Driven Pins
 3. Bolts
 4. Seat Angles, Supports and Brackets
 5. Iron Castings
 6. Gratings
 7. Pipe Columns
 8. Floor and Cover Plates
 9. Steel Stairs
 10. Safety Stair Treads
 11. Floor Hatches
 12. Fall Prevention System
 13. Manhole Frames and Covers
 14. Steel Channel Inserts

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 03300 Cast-in-Place Structural Concrete
 2. Section 03315 Grout
 3. Section 05120 Structural Steel
 4. Section 09800 Protective Coating

1.3 CODES

- A. The 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. California Building Code

1.4 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).

1.5 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. **Federal Specifications:**

QQ-F-461 C (1)	Floor Plate, Steel, Rolled
MIL-6-18015	(Ships) Aluminum Planks, (6063-T6)

2. **Commercial Standards:**

AISC MO11	Manual of Steel Constructions
AASHTO HS-20	Truck Loading
ASTM A36 / A992	Specification for Structural Steel
ASTM A 48	Specification for Gray Iron Castings
ASTM A 53	Specification for Pipe, Steel, Black and Hot- Dipped, Zinc-Coated Welded and Seamless
ASTM A 123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 125	Specification for Steel Springs, Helical, Heat Treated
ASTM A 153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 240	Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A 276	Specification for Stainless Steel Bars and Shapes
ASTM A 283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
ASTM A 320	Specification for Alloy-Steel Bolting Materials for Low-Temperature Service
ASTM A 489	Carbon Steel Eyebolts
ASTM A 569	Specification for Steel, Carbon, (0.15 Maximum Percent) Hot Rolled, Sheet and Strip, Commercial Quality
ASTM A 575	Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 666	Specification for Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar
ASTM B 98	Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
ASTM B 210	Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B 221	Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B 438	Specification for Sintered Bronze Bearings (Oil-Impregnated)
ASTM B 439	Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

ASTM B 695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
ASTM B695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
ASTM F436	Standard Specification for Hardened Steel Washers.
ASTM F594	Standard Specification for Stainless Steel Nuts.
ASTM F1267	Metal, Expanded, Steel
ANSI/AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code - Aluminum.
AWS D1.3	Structural Welding Code – Sheet Steel
AWS D1.6	Structural Welding Code – Stainless Steel
AWS D10.18	Pipe Welding Code – Stainless Steel
AWS A2.4	Standard Welding Symbols
NFPA 101	Life Safety Code
NAAMM	Metal Stairs Manual

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in addition to General Requirements:

1. Shop drawings showing connection details and locations proposed for power driven pins.
2. Shop drawings of miscellaneous metalwork including seat angles, supports and guides.
3. Shop drawings showing proposed use of adhesive anchors.
4. Data indicating load capacities, chemical resistance and temperature limitations of power driven pins.
5. Manufacturer's catalog data for manhole frame, covers, and each type of anchor.
6. Welding procedures and welder qualifications.
7. Submit samples of material or fabricated items if requested by the Engineer.

1.7 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. Manufacturer's installation instructions.

PART 2 -- PRODUCTS

2.1 MISCELLANEOUS METALWORK

- A. **Materials:** Except as otherwise indicated, products fabricated of structural steel shapes, plates and bars shall comply with the requirements of ASTM A 36 Grade 36 & A992 Grade 50.
- B. **Corrosion Protection:** Miscellaneous metalwork of fabricated steel, which will be used in a corrosive environment or will be submerged shall be stainless steel. Other miscellaneous

steel metalwork shall be hot-dip galvanized after fabrication and coated per Specification Section 09800 except as otherwise indicated.

- C. **Stainless Steel:** Stainless steel metalwork shall be of Type 316 L stainless steel. Stainless steel shall not be torch heated for welding. The CONTRACTOR shall submit welding methods and procedures. All welded stainless steel shall be passivated after welding by immersing in a pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid. Temperature and detention time for passivation shall be sufficient for removal of oxidation and ferrous contamination without etching of surface. The passivated steel shall undergo a complete neutralization by immersion in a detergent rinse followed by clean water wash, or shall be buffed with Scotch Brite EXL (or equal) for removal of weld discoloration and heat tint.
- D. **Welding:** Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" and supplemented by other standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards. In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with the AWS Code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.
- E. **Galvanizing:** Where galvanizing is indicated, structural steel plates shapes, bars and fabricated assemblies shall be thoroughly cleaned of rust and scale and shall be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts (except ASTM A325), anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153.

2.2 ANCHOR BOLTS

A **General:** Anchor bolts shall comply with the following:

1. Anchor bolts shall be fabricated of materials complying with SSPWC Subsections 206-1.4.1 and 209-2.2 and as follows:

Steel bolts	ASTM A325
Fabricated steel bolts	ASTM A36
Stainless steel bolts, nuts, washers	ASTM A320, Type 316

2. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a maximum oversizing of 1/4 inch. Unless otherwise indicated, minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts for equipment shall be 316 stainless steel and shall be provided with leveling nuts which shall be tightened against flat surfaces to not less than 10 percent of the bolt's safe tensile stress.

3. Tapered washers shall be provided where mating surface is not square with the nut.
 4. Expansion, wedge, or adhesive anchors set in holes drilled in the concrete after the concrete is placed is not permitted as substitution for anchor bolts except where otherwise indicated. Upset threads shall not be acceptable.
 5. ASTM A307 anchor bolts are prohibited.
- B. **Adhesive Anchors:** Unless otherwise indicated, drilled concrete or masonry anchors shall be adhesive anchors. Substitutions will not be considered unless accompanied with ICC report verifying strength and material equivalency and approved by the Engineer. Except as otherwise indicated, adhesive anchors shall comply with the following:
1. Epoxy adhesive anchors may be provided for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails and reinforcing bars. Threaded rod shall be stainless steel Type 316.
 2. Glass capsule, polyester resin adhesive anchors may be permitted in other locations.
- C. **Expanding-Type Anchors:** Expanding-type anchors, where indicated, shall be Type 316 stainless steel. Size shall be as shown. Expanding-type anchors are prohibited from use in corrosive areas and in deteriorating concrete.

2.3 POWER DRIVEN PINS

- A. **Materials:** Power-driven pins for installation in concrete or steel in interior locations of nonprocess areas shall be heat-treated steel alloy complying with AISI 1062 or 4063 and shall be zinc-plated. Pins shall have capped or threaded heads capable of transmitting the shank loads. Pins that are connected to steel shall have longitudinal serrations around the circumference of the shank.

2.4 BOLTS

- A. **Bolt Requirements:** Bolts shall comply with the following:
1. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
 2. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than 1/2-inch beyond the nut.
- B. **Standard Service Bolts (Not Buried or Inside Tanks or Channels):** Except where otherwise indicated, bolts and nuts shall be steel and shall be galvanized after fabrication. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated herein, steel for bolts, anchor bolts and cap screws shall be in accordance with the requirements of ASTM A 325, or threaded parts of ASTM A 36. ASTM A 325 bolts and nuts shall not be galvanized.

- C. **Bolts Buried or Inside Tanks or Channels:** Unless otherwise indicated, bolts, anchor bolts, nuts and washers which are buried, submerged, or below the top of the wall inside any hydraulic structure shall be of Type 316 stainless steel.
- D. Unless otherwise indicated, eyebolts shall conform to ASTM A 489.

2.5 SEAT ANGLES, SUPPORTS AND BRACKETS

- A. Seat angles over slide gate guides shall be welded to the guides. Seat angles for supports for floor plates, clips for precast panels and brackets for piping shall be steel, hot-dip galvanized after fabrication unless otherwise indicated. Over tanks and channels seat angles and brackets shall be Type 316 L stainless steel. Seat angles and supports for stainless steel floor plate shall be Type 316L stainless steel.
- B. Seat angles for grating shall be aluminum or steel as indicated, except that Type 316 L stainless steel shall be used over tanks and channels. Seat angles and supports for FRP grating shall be Type 316L stainless steel unless otherwise indicated. Guides for slide gates shall be Type 316 L stainless steel.

2.6 IRON CASTINGS

- A. Castings shall conform to the requirements of ASTM A 48 unless otherwise indicated. Castings weighing less than 100 pounds shall be hot-dip galvanized after machining. Castings weighing greater than 100 pounds shall be galvanized where indicated.

2.7 GRATINGS

- A. **General:** Both bearing bars and cross bars shall be continuous. Openings shall be banded with bars having the same dimensions as the bearing bars. Perimeter edges shall be banded with bars flush at the top surface of the grating and 1/4 inch clear of the bottom surface. Bars terminating against edge bars shall be welded to the edge bars when welded construction is used. When crimped or swaged construction is used, bars at edges shall protrude a maximum of 1/16 inch and shall be peened or ground to a smooth surface. No single piece of grating shall weigh more than 80 pounds unless otherwise indicated.

Rough weld beads and sharp metal edges on gratings and plates shall be ground smooth. Welds exposed to view shall be uniform and neat. Welds to be galvanized shall be sandblasted prior to galvanizing.

Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise indicated. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled. Cutting, drilling, punching, threading and tapping shall be performed prior to hot-dip galvanizing.

- 1. **Aluminum:** Aluminum grating bearing bars and aluminum floor plates and cover plates shall be of alloy 6061-T6 conforming to ASTM B221. Aluminum grating cross bars shall be of an alloy conforming to either ASTM B221 (extrusions) or B210 (drawn). Unless otherwise indicated, grating shall be fabricated of aluminum. Bearing bars shall be punched to receive the cross bars. After insertion in the bearing bars, cross bars shall be deformed by a hydraulic press or similar means to permanently lock the

bars into the bearing bar openings. Fabrication methods employing bending or notching of bearing or cross bars will not be permitted.

2. **Steel:** Steel grating bearing bars and cross bars shall be of welding quality mild carbon steel conforming to ASTM A569. Steel floor plates and cover plates shall be of structural quality steel conforming to ASTM A36. Steel grating shall be used only where indicated. Steel grating shall be hot-dip galvanized. Notching, slotting, or cutting the top or bottom edges of bearing bars to receive cross bars will not be permitted unless each intersection of bars is fully welded to restore each bearing bar to its full cross-sectional strength.

2.8 FLOOR AND COVER PLATES:

- A. Plates shall be set flush with surrounding floor. No single piece of floor and cover plate shall weigh more than 80 pounds unless specifically detailed otherwise. Floor and cover plates over tanks, channels and trenches shall be Type 316 stainless steel.

2.9 STAIRS

- A. Unless otherwise indicated, stairs shall be steel and shall be fabricated in accordance with standard practice of the National Association of Ornamental Metal Manufacturers, and as indicated. Steel stairs shall be hot-dip galvanized after fabrication.

2.10 SAFETY STAIR TREADS

- A. Safety stair treads shall be provided on stairs or where indicated and shall be 4 inches wide aluminum. Aluminum stair treads shall have isolation coating to prevent direct contact with concrete surfaces per Section 09800.

2.11 FLOOR AND ROOF HATCHES

- A. **General:** Floor and Roof hatches shall be of the design, sizes and types indicated.
- B. **Construction:** Hatches shall be single or double-swing as indicated, and shall be furnished with 2 stay bars designed to hold the cover in an open position and provide flush handles, joint gutter, and a moat-type edge drain complete with drain connection. Provide a railing around the opening where indicated.
 1. The hatch for fuel piping vault shall be 5' x 5' double leaf, rated for H-20 loading and shall be Bilco Type JDAL-H20, or equal.
 2. The hatch on the Generator Building roof shall be 4' X 4' single leaf, and shall be Bilco Type F50, or equal.
- C. **Material:** Hatches shall be of aluminum as indicated. No single hatch shall weigh more than 80 lb unless otherwise indicated. Aluminum shall be 6061T6 Alloy Bearing Bars and Cross Bars.
- D. **Finish:** Aluminum in contact with other metal or concrete shall be shop-painted with one coat of zinc chromate and 2 coats of approved aluminum metal-and-masonry paint.

2.12 PIPE COLUMNS

- A. Pipe column steel shall conform to the requirements of ASTM A 53, Grade B.

2.13 FALL PREVENTION SYSTEM

- A. The fall prevention system shall include safety belt and other components for a complete and fully operational fall prevention system.

2.14 MANHOLE FRAMES AND COVERS

- A. Except as otherwise indicated, manhole frames and covers shall comply with SSPWC Subsection 206-3.3 and shall be fabricated of cast iron complying with ASTM A48, Class 30 and shall be the heavy-duty type designed for H-20 highway loading, shall have a minimum 24-inch clear frame opening or as indicated and a minimum frame height of 4 ½ inches and shall be equipped with a continuous-ring type gasket designed to minimize surface water inflow. Cover pattern shall be checkered pattern design and shall have concealed or closed pick holes with sufficient dimensions to allow for removal without special equipment. Bearing and wedging surfaces shall be machined to ensure a tight fit and to prevent rocking. Frames shall be provided with four 1-inch diameter holes for anchor bolts. The use of salvaged or scrap materials will not be permitted.
- B. Covers shall be provided with a continuous, machined groove on either the underside bearing lip or the outer wedging edge of the cover. A groove on the bearing lip shall be fitted with a glued, continuous, low compression, set gasket; a groove on the outside edge shall be fitted with a neoprene O-ring seal.
- C. Locking type, nongasketed frames and covers shall be provided where indicated. Locking covers shall have two locking wedges in the frame. Covers shall have two fingers which engage the locking wedges when the cover is positioned in the frame and turned.

2.15 MANUFACTURERS

- A. Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):

- 1. **Epoxy Adhesive Anchors:**

- Hilti RE-500 or Hilti HY 200 Epoxy Anchor System
 - Red Head Epcon G5 Epoxy Adhesive

- 2. **Glass Capsule Polyester Resin Adhesive Anchors:**

- Hilti HY-150 Or Hilti HFX Injection Adhesive
 - Red Head Epcon A7 Acrylic Adhesive

- 3. **Expanding-Type Anchors:**

- Red Head Trubolt
 - Hilti Kwik-Bolt 3

- 4. **Steel Gratings:**

- Grating Pacific Type 19-4
 - McNichols Type GW

- 5. **Floor and Cover Plates:**

Alcoa C-102 Aluminum Tread Plate
Reynolds Diamond Tread Plate

6. **Field Repairs to Galvanizing:**

"Galvinox"
"Galvo-Weld"

7. **Aluminum Grating:**

Grating Pacific
Seidelhuber

PART 3 -- EXECUTION

3.1 GENERAL

- A. **Fabrication and Erection:** Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."
- B. **General:** Fieldwork, including cutting and threading, shall not be permitted on galvanized items. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators. Grouting of anchor bolts with nonshrink or epoxy grouts, where indicated, shall be in accordance with Section 03315.
1. Drilling of bolts or enlargement of holes to correct misalignment will not be allowed.
 2. Metalwork to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed or, if indicated, recesses or blockouts shall be formed in the concrete. The surfaces of metalwork in contact with or embedded in concrete shall be thoroughly cleaned. Recesses may be neatly cored in the concrete after it has attained its design strength and the metalwork grouted in place. Embedments shall comply with Section 03300.
 3. Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise indicated. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.
 4. Fabrication including cutting, drilling, punching, threading and tapping required for miscellaneous metal or adjacent work shall be performed prior to hot-dip galvanizing.

3.2 INSTALLATION OF ANCHOR BOLTS

- A. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.
- B. Installation of adhesive, capsule and expansion anchors shall comply with the following:

1. All installation recommendations by the anchor system manufacturer shall be followed carefully, including maximum hole diameter.
2. Use shall be limited to applications where exposure to fire or exposure to concrete or rod temperature above 120 degrees F is not indicated. Overhead applications (such as pipe supports) shall not be allowed.
3. Use shall be limited to locations where exposure to acid concentrations higher than 10 percent, to chlorine gas, or to machine or diesel oils, is not indicated.
4. Concrete temperature (not air temperature) shall be compatible with curing requirements recommended by adhesive manufacturer. Anchors shall not be placed in concrete below 25 degrees F.
5. Anchor diameter and grade of steel shall comply with equipment supplier specifications. Anchor shall be threaded or deformed full length of embedment and shall be free of rust, scale, grease, and oils.
6. Adhesive capsules of different diameters may be used to obtain proper volume for the embedment, but no more than two capsules per anchor may be used. When installing different diameter capsules in the same hole, the larger diameter capsule shall be installed first. Any extension or protrusion of the capsule from the hole is prohibited.
7. Holes shall have rough surfaces, such as can be achieved using a rotary percussion drill.
8. Holes shall be blown clean with compressed air and be free of dust or standing water prior to installation.
9. Anchor shall be left undisturbed and unloaded for full adhesive curing period.

3.3 INSTALLATION OF SEAT ANGLES, SUPPORTS AND GUIDES

- A. Seat angles shall be set flush with the floor.

3.4 INSTALLATION OF POWER DRIVEN PINS:

- A. Power-driven pins shall be installed by a craftsman who is certified by the manufacturer as being qualified to install the manufacturer's pins. Pins shall be driven in one initial movement by an instantaneous force that has been carefully selected to attain the required penetration. Driven pins shall conform to the following requirements where "D" = Pin's shank diameter:

Material Penetrated by Pin	Material's Minimum Thickness	Pin's Shank Penetration in Supporting Material	Minimum Space From Pin's CL to Edge of Penetrated Material	Minimum Pin Spacing
Concrete	16D	6D minimum	14D	20D
Steel	1/4-inch	Steel thickness	4D	7D

3.5 INSTALLATION OF GRATING, FLOOR AND COVER PLATES

- A. Grating, floor and cover plates shall be field measured for proper cutouts and proper sizes.

3.6 INSTALLATION OF STAIRS AND LADDERS

- A. Stairs and ladders shall be fitted accurately and field measured where necessary.

3.7 INSTALLATION OF SAFETY STAIR TREADS

- A. Unless otherwise indicated, safety stair treads shall be installed on all concrete stairs. Treads shall be secured to concrete with suitable anchors at 15 inches on centers and not more than 4 inches from the ends. Rubber tape, 1/8-inch thick, shall be provided at both ends and cut to fit shape of tread prior to concrete placement.

3.8 INSTALLATION OF FLOOR HATCHES

- A. Unless otherwise indicated, the WORK of this Section includes a ½-inch drain line to the nearest floor drain for all floor hatches.

3.9 INSTALLATION OF DRILLED ANCHORS

- A. Drilled anchors shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, cleaned and dry. Drilled anchors shall not be installed until the concrete has reached the indicated 28-day compressive strength. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

3.10 INSTALLATION OF MANHOLE FRAMES AND COVERS

- A. The installation of manhole frames and covers shall comply with SSPWC Subsection 301-1.6.

**** END OF SECTION ****

SECTION 05515 – ALUMINUM LADDERS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing aluminum cage ladders.

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 05500 Miscellaneous Metalwork
 - 2. Section 16170 Grounding System

1.3 CODES

- A. The 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. California Code of Regulations, Title 24, Part 2, also known as the California Building Code (CBC).

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. Aluminum Association (AA).
 - 2. Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (ASTM B 209).
 - 3. Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (ASTM B 221).
 - 4. Fixed Ladders (OSHA 1910.27).

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Manufacturer's specifications, literature, and published installation instructions for each roof accessory, product, or system.
 - 2. Detail fabrication and erection of each ladder indicated. Include plans, elevations, sections, and details of metal fabrications and their connections.
 - 3. Provide templates for anchors and bolts specified for installation under other Sections.
 - 4. Provide reaction loads for each hanger and bracket.
- B. Qualification Data:
 - 1. Refer to Quality Assurance provisions for submittal requirements evidencing knowledge, certifications and resources.

- C. Selection Samples: For each finish specified, two complete sets of color chips representing manufacturer's full range of available colors.
- D. Verification Samples: For each finish specified, two samples, minimum size 6 inches (150 mm) square, represent actual product color.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm knowledgeable in producing aluminum metal ladders similar to those indicated for this Project.
 - 1. Record of successful in-service performance.
 - 2. Sufficient production capacity to produce required units.
 - 3. Professional engineering competent in design and structural analysis to fabricate ladders in compliance with industry standards and local codes.
- B. Installer Qualifications: Competent and knowledgeable firm capable of selecting fasteners and installing ladders to attain designed operational and structural performance.
- C. Product Qualification: Product design shall comply with OSHA 1910.27 minimum standards for ladders.
- D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Install ladder in area designated by Architect.
 - 2. Do not proceed with remaining work until workmanship and installation are approved by Architect.
 - 3. Rework mock-up as required to produce acceptable work.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken, packages, containers, or bundles bearing the name of the manufacturer.
- B. **Storage:** Products shall be carefully stored on wood blocking in an area that is protected from all deleterious elements. Storage shall be in a manner that will prevent damage or marring of the products and their finishes.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurement before fabrication.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, indicate established dimensions on shop drawing submittal and proceed with fabrication.

1.9 WARRANTY

- A. Manufacturer has responsibility for an extended Corrective Period for work of this Section for a period of 5 years commencing on the shipment date of the product against all the conditions

indicated below, and when notified in writing from Owner, manufacturer shall promptly and without inconvenience and cost to Owner correct said deficiencies.

1. Defects in materials and workmanship.
2. Deterioration of material and surface performance below minimum OSHA standards as certified by independent third party testing laboratory. Ordinary wear and tear, unusual abuse or neglect excepted.
3. Within the warranty period, the manufacturer shall, at its option, repair, replace, or refund the purchase price of defective ladder.

B. Manufacturer shall be notified immediately of defective products, and be given a reasonable opportunity to inspect the goods prior to return. Manufacturer will not assume responsibility, or compensation, for unauthorized repairs or labor. Manufacturer makes no other warranty, expressed or implied, to the merchantability, fitness for a particular purpose, design, sale, installation, or use, of the ladder; and shall not be liable for incidental or consequential damages, losses of or expenses, resulting from the use of ladder products.

1.10 EXTRA MATERIALS

- A. Furnish touchup kit for each type and color of paint finish provided.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Roof Ladders and their installation shall be in accordance with the manufacturer's literature and published specifications for the products indicated.

2.2 MANUFACTURERS

- A. Acceptable Manufacturer: O'Keeffe's, Inc.; 100 N Hill Drive, Suite 12, Brisbane, CA 94005. Toll Free Tel: (888) 653-3333. Tel: (415) 824-4900. Fax: (415) 824-5900. Email: info@okeeffes.com. Web: <http://www.okeeffes.com> or Equal.

2.3 APPLICATION AND SCOPE

- A. Fixed and Cage Ladder Design:
 1. Safety cages are required on ladders over 20 feet (6096 mm)
 2. Safety cages are required on all ladders in high or hazardous areas.
 3. Landing platforms are required at 30 feet (9144 mm) above the bottom of the ladder.
 4. Rail and harness fall arrest system as alternate to safety cage and landing platforms shall be a permissible manufacturer's option.
 - a. Fixed Ladder Bottom Bracket:
 - b. Bottom floor supported bracket.
 - c. Bottom wall supported bracket.

d. Bracket as drawn.

B. Cage Ladder with Low Parapet Access, Platform and No Return:

1. Model 533A as manufactured by O'Keeffe's Inc or Equal.

2.4 FINISHES

A. Clear Anodic Finish: AA-M10C22A41 Mechanical finish as fabricated. Architectural Class I, clear coating 0.7 mil.

2.5 MATERIALS

A. Aluminum Sheet: Alloy 5005-H34 to comply with ASTM B209.

B. Aluminum Extrusions: Alloy 6063-T6 to comply with ASTM B221.

2.6 FABRICATION

A. Rungs: Not less than 1-1/4 inches (32 mm) in section and 18-3/8 inches (467mm) long, formed from tubular aluminum extrusions. Squared and deeply serrated on all sides.

1. Rungs shall withstand a 1,500 pound (454 kg) load without deformation or failure.

B. Channel Side Rails: Not less than 1/8 inch (3 mm) wall thickness by 3 inches (76 mm) wide.

C. Heavy Duty Tubular Side Rails: Assembled from two interlocking aluminum extrusions no less than 1/8 inch (3 mm) wall thickness by 3 inches (76 mm) wide. Construction shall be self-locking stainless steel fasteners, full penetration TIG welds and clean, smooth and burr-free surfaces.

D. Ship Ladders: Not less than 1-1/4 inches (32mm) high, 4-1/8 inch (105 mm) deep and 2 feet (610 mm) wide; tread spacing shall be 1 foot (305 mm) on center. Handrails shall be aluminum pipe, not less than 1-1/2 inches (38 mm) in diameter with hemispheric end caps.

E. Walk-Through Rail and Roof Rail Extension: Not less than 3 feet 6 inches (1067 mm) above the landing and shall be fitted with deeply serrated, square, tubular grab rails.

F. Landing Platform: 1-1/2 inches (38 mm) or greater diameter, tubular aluminum guardrails and decks of serrated aluminum treads.

G. Security Doors: Formed 1/8 inch (3 mm) thick aluminum sheet. Security panels shall extend on both sides, perpendicular to the door face, to within 2 inches (51 mm) of the wall. Security door shall be furnished with continuous aluminum piano hinge and heavy duty forged steel locking hasps.

H. Ship Ladder Seismic Bottom Support: Manufacturer's standard; two isolation bearings per stringer.

I. Ladder Safety Post: Retractable hand hold and tie off.

J. Rail and Harness Fall Arrest System: Supplied where specified as alternate to safety cage and landing platforms, in accordance with OSHA regulation 1910.27; permanently mounted to ladder rungs and complete with necessary components.

K. Safety Cages:

1. Fabricate ladder safety cages to comply with authority having jurisdiction. Assemble by welding. Spacing of primary hoops, secondary hoops and vertical bars shall not exceed that required by code.
2. Safety cage hoops and vertical bars: 3/16 inch (5 mm) by 2 inches (51 mm) aluminum bar.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The installation shall conform to applicable codes and the manufacturer's published or written recommendations, specifications, and installation instructions for the type of work being performed.
- B. Coordinate anchorages. Furnish setting drawings, templates, and anchorage structural loads for fastener resistance.
- C. Do not begin installation until supporting structure is complete and ladder installation will not interfere with supporting structure work.

If supporting structure is the responsibility of another installer, notify Architect of unsatisfactory supporting work before proceeding.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

3.3 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**** END OF SECTION ****

SECTION 05520 - HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the work as indicated on the drawings and specified herein.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Comply with the current provisions of the following codes and standards.
 - 1. Commercial Standards
 - a. ASTM A320 - Alloy-Steel Bolting Materials for Low-Temperature Service
 - b. ASTM B241 - Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
 - 2. California Building Code (CBC) Latest Edition
 - a. General Industrial Safety Order (Title 8) Cal-OSHA
 - b. Standard Specifications
 - c. SSPWC Sections 304-2 - Metal Railings

1.3 SUBMITTALS

- A. The following submittals and specific information shall be provided:
 - 1. Shop Drawings
 - 2. Layout plan showing post location and spans, and removable railing sections.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken packages, containers, or bundles bearing the label of the manufacturer.
- B. Storage: All materials shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Railings shall comply with SSPWC Subsection 304-2.1 unless indicated otherwise.
- B. The aluminum railings shall be pipe railing system unless otherwise indicated. Railing system shall be side bracket-mounted unless indicated otherwise.
- C. Railing systems shall meet CBC and Cal-OSHA requirements.
- D. Railings and handrail brackets shall be capable of withstanding either of the following loading conditions without exceeding the allowable working stress of the material and without permanent deformation: (1) a 200-pound concentrated load applied to any point in any direction, (2) a 50-pound per linear foot loading applied perpendicular to the top rail.
- E. The allowable working stress shall be 60 percent of the material yield stress for materials that are more than 3 inches from a weld and 40 percent of the yield stress for all materials within 3 inches of any weld.
- F. Railing shown at curved structures, elements or other areas such as the following: tanks, retaining walls, stairs, process units and ramps shall be bent to the radius necessary to install where indicated.
- G. Railings shall be stainless steel where shown in drawings.

2.2 MATERIALS

- A. Stainless Steel guardrails and handrails shall be of shape, style, and design shown in drawings.
- B. Rails Sections: Railings and handrails shall be round pipe-design railing system unless otherwise indicated.
- C. Rail Material: Aluminum shall be U.S. Alloy 6005-T5 or 6061-T6. Aluminum pipe rail shall be not less than 1-1/2-inch diameter, Schedule 40 pipe minimum.
- D. Welding Rods: Aluminum welding rods shall be of type recommended by the aluminum manufacturer for anodized finished products.
- E. Protective Coating: Electrolysis protective material shall comply with Section 09800.
- F. Sleeves: Sleeves for grout pockets shall be formed with EZ type removable plastic insert sleeves. Sleeves for removable posts shall be of 316 stainless steel. Sleeves for removable railings at indicated corrosive environment locations shall be similar to the railing system used there. EZ type removable plastic insert sleeves shall be EZ Sleeves as manufactured by Auciello Iron Works, Inc., (508) 568-8382, or equal.
- G. Fasteners: Fasteners, screws, and bolts shall be concealed and shall be of 316 stainless steel or aluminum. Handrail bracket fasteners and fasteners over water basins shall be of 316 stainless steel.
- H. Brackets: Handrail brackets shall be aluminum with a finish that matches the handrail or railings of which they are a part.
- I. Toeboards: Toeboards shall match railing system and shall be fabricated of 3/16-inch (minimum) aluminum and not less than 4 inches in height. Toeboards for pipe railing shall be channel section for strength and stiffness.
- J. Socket Grout: Non-shrink grout for handrail post sockets shall consist of an inorganic, non-metallic, premixed grout with a minimum 28-day compressive strength of 4,000 psi.

2.3 FINISHES

- A. Stainless steel railing systems shall be of finish as shown in drawings.
- B. Pipe Railing System: Pipe railing system including handrails, railings, tube caps, and other miscellaneous parts of rails shall be provided with a 0.7 mil clear anodized finish, AA-M12-C21-A41.

2.4 SUB-ASSEMBLIES

- A. Height Requirements: Top of upper guard railing shall be 42 inches minimum above the working surface or finish grade. Toeboards shall be installed not more than 1/4-inch off the working surface and shall be provided where indicated and/or required by codes or standards. Handrail heights shall be per standards.
- B. Round Sections: Round tube posts shall be not less than 1-1/2-inch diameter, Schedule 40 pipe or 1-1/2-inch x 2-inches oval section. The posts shall be evenly spaced at not less than 4 feet nor more than 6 feet on centers. Field conditions may require some adjustment of spacing. Top rails and railings shall be not less than 1-1/2-inch OD pipe or 2-inch oval section. Rails may be type with bottom enclosures. Bottom rails shall be not less than 1-1/2-inch OD pipe or 1-7/8-inch diameter extrusion with bottom enclosures. The top railings shall be as long as possible and the post shall not project through the top rails.
- C. Round Pipe Railing System (Guardrails): Railing guardrail systems shall have rails spaced equally with equal open spaces between rails (and toeboard where required) with no open space larger than the following:

- D. Work areas and surfaces, such as rails around tanks, bridges to equipment and walkways at process units (not used as exit ways from any building), shall have no spaces larger than 15 inches. The railing shall be not less than a three railing system meeting Cal-OSHA requirements.

PART 3 - EXECUTION

3.1 COMPONENT SYSTEMS

- A. Unless otherwise indicated, aluminum handrails and railings shall be component systems, installed complete and ready for use with all sleeves, grout, sealants, anchors, attachments, balusters, brackets, caps, fasteners, posts, sleeves, and all other related items required or necessary for the complete installation.

3.2 CRAFTSMANSHIP

- A. Work shall be performed by craftsmen knowledgeable in the fabrication of architectural metal work. Exposed surfaces shall be free from defects or other surface blemishes. All dimensions and conditions shall be verified in the field in advance. All joints, junctions, miters, and butting sections shall be precision-fitted, with no gaps occurring between sections, and all surfaces shall be flush and aligned.

3.3 ALIGNMENT

- A. Extruded, case, molded, or bent work shall be straight and with true edges. Railings and handrails shall be installed with continuous top rails, without post projections or other obstructions.

3.4 FABRICATION

- A. Pipe cuts shall be clean, straight, square and accurate for minimum 1/8-inch joint gap. Work shall be done in conformance with the handrail manufacturer's instructions. Work shall be free from blemishes, defects, and misfits of any type which can affect durability, strength, or appearance.
- B. Railing and handrail brackets shall be connected by screws or bolts. Holes shall be punched 1/16-inch larger than the nominal size of the fasteners, unless otherwise indicated. Wherever needed because of the thickness of the metal, holes shall be subpunched and reamed or drilled. Handrail components with mismatched holes shall be replaced. No drifting of bolts nor enlargement of holes will be allowed to correct misalignment.
- C. Aluminum items in contact with concrete or steel or embedded in concrete shall be provided with an electrolysis protective material. The protective material shall be applied to the aluminum surface which will be in contact with the dissimilar material. Protection material shall be pressure tapes, coatings, or isolators.
- D. Metal to be embedded in concrete shall be placed accurately and held in correct position while the grout is placed. Railing post shall not be installed until after concrete has attained its design strength.
- E. Posts, except for removable railings, shall be provided with weep holes for condensation drainage within 3/16-inch of the finish deck.

3.5 WELD FINISH

- A. Exposed welds shall be ground smooth and flush and shall be polished and anodized. Discoloration of exposed aluminum surfaces, whether or not due to welding, shall constitute a basis for rejection of the entire assembly.

3.6 EXPANSION/CONTRACTION

- A. Exterior railing systems shall provide for 1/4-inch expansion and contraction per 20 linear feet of railing. Interior railing systems shall provide for 1/8-inch expansion or contraction per 20 linear feet of railing.

3.7 FASTENER FINISH

- A. Stainless steel fasteners shall be painted to match adjacent aluminum finishes, except fasteners at clear anodized or stainless steel railings or elements shall not be painted.

3.8 RAILING CONTINUITY AND END TREATMENT

- A. Handrails and railings shall be designed to form a continuous run system with elbow turns and bends that do not have interferences with hand movement. Handrails shall be continuous for the full length of the stairs and landings. The handrail shall extend no less than 12 inches beyond the top riser and one tread plus 12 inches beyond the bottom riser. At work areas and surfaces, handrail extensions need only meet the Cal-OSHA requirements where extensions cannot be provided as a straight run. The ends of handrails shall be returned to wall or shall be terminated in newel posts or safety terminals.

3.9 REMOVABLE SECTIONS

- A. Removable handrail sections shall be provided where indicated. The removable railing hardware's color shall match that of the railing system of which it is a part.

END OF SECTION

SECTION 06400 - ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Architectural woodwork, casework, trim, hardware, countertops, and shelving as indicated on Drawings.

B. Related Requirements:

1. Section 05400: Cold Formed Metal Framing
2. Section 08800: Glazing
3. Section 09900: Architectural Paint Finishes

1.2 DEFINITIONS

- A. "Sustainably managed" is defined as "forests that are being managed through a professionally administered forestry management plan in which timber growth equals or exceeds harvesting rates in both quantity and quality, protecting rivers and streams from degradation, minimizing damage to the forest when harvesting and promoting biodiversity".

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide wood products from certified sustainably harvested sources.

1.4 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings of casework indicating materials and hardware, details of construction, dimensions, methods of fastening and installation details. Shop Drawings shall bear a AWI Certified Compliance Label indicating that Shop Drawings fully meet requirements of AWI Architectural Woodwork Standards (AWS) grade specified. Shop Drawings shall indicate grounds, backing, blocking, sleepers and other items required for installation of casework, which are to be provided and installed as part of the Work.
- B. Certificates: Provide AWI Certified Compliance Certificate certifying that materials, fabrication and installation will comply with the specified requirements.
- C. Material Samples: Submit 2-inch by 3-inch plastic laminate and solid surfaces color Samples of manufacturer's entire color range.

- D. Submit manufacturer's product data for adhesives and finishes. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
- E. Forest Stewardship Council (FSC): Provide letter of certification signed by lumber supplier. Indicate compliance with FSC "Principles for Natural Forest Management" and identify certifying organization.
- F. Closeout Submittals: Provide a AWI Certified Compliance Certificate for Installation.

1.5 QUALITY ASSURANCE

- A. Comply with AWI Architectural Woodwork Standards (AWS), latest edition, published jointly by the Architectural Woodwork Institute, the Architectural Woodwork Manufacturer's Association of Canada, and the Woodwork Institute of California, grades as specified herein.
- B. Each elevation of casework shall bear AWI Certified Compliance Label indicating that casework fully meets requirements of AWI grade specified.
- C. Each plastic laminate countertop shall bear AWI Certified Compliance Label indicating tops fully meet requirements of AWI grade specified.
- D. Mock-ups: When required by the Architect, submit a full-scale base cabinet, countertop, and wall-hung cabinet, illustrating joinery and plastic laminate finish. Base cabinet shall incorporate a drawer, an adjustable shelf, and a door. Wall-hung cabinet shall incorporate two doors, one adjustable shelf and finished end, including required hardware.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the Project site in undamaged condition, stored in fully covered, well ventilated areas, and protected from extreme changes in humidity and temperature. Refer to AWI Architectural Woodwork Standards for recommended care and storage.
- B. In event of damage immediately furnish necessary repairs or replacements.

1.7 PROJECT CONDITIONS

- A. Store indoors, in ventilated areas with constant but minimum temperature of 60 degrees F. and maximum relative humidity of 25 percent to 55 percent. At least seven days before installation, maintain temperature of 70 degrees F. and relative humidity of 50 percent to 55 percent. Acclimatize materials to the installation temperature and humidity for at least 72 hours prior to installation. Maintain conditions until Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Plastic Laminate Faced Cabinets:
 - 1. Plastic laminate: High pressure plastic laminate conforming to NEMA standard LD-3; 0.050 inches at horizontal surfaces, 0.028 inches at exposed

vertical surfaces and edge bands, and 0.042 inch minimum for post-formed countertops.

2. Particle Board Core Material: 45 lb. density, conforming to ANSI A208.1, Table 1, Grade 1-M-2.
 3. Solid Lumber:
 - a. Solid lumber for exposed members, drawers, trays and special details shall be Clear birch or maple.
 - b. Unexposed solid lumber for concealed webs or structural members shall be of Douglas Fir., alder or birch.
 4. Softwood Plywood: Rotary cut exterior type A-C grade softwood plywood complying with PS1.
 5. Hardboard: Factory finished pressure sealed hardboard conforming to the requirements of PS 58. Oil tempered hardboard shall conform to CS 251.
 6. Cabinet Liner: Semi-exposed surfaces shall be finished with 0.020 inch high-pressure laminate cabinet liner, conforming to NEMA Standard LD-3.
 7. Edge Banding:
 - a. 0.028 inch minimum thickness plastic laminate.
 8. Glass Doors: 1/4 inch laminated safety glass.
 9. Adhesive: Type II water-resistant, rigid type glue of formula conforming to PS 51.
 10. Sealer: Thompson Water Seal 101, Watco Oil, Zinsser, or equal.
 11. The Owner will supply tote trays unless otherwise indicated.
 12. Base: Cover toe spaces with typical wall base unless otherwise indicated.
- B. Wood Casework:
1. Sheets:
 - a. Medium Density Fiberboard (MDF): ANSI A208.2.
 2. Solid Lumber:
 - a. Concealed portions: Any species of sound, dry, solid stock.
 - b. Semi-exposed portions: Hardwood veneer of the same species as exposed material with a specific gravity in excess of 0.37.
 - c. Exposed portions: Select White Birch, well matched for color and grain.
 3. Hardboard: Factory finished, pressure sealed hardboard conforming to requirements of PS 58.
 4. Edge Banding: Same species of wood as adjacent to exposed surfaces.
- C. Countertops:
1. Medium Density Fiberboard (MDF): ANSI A208.2.

D. Hardware:

1. Drawer Slides for Custom Grade Cabinetry:
 - a. Pencil drawers: Partial extension type: Accuride 2006, Blum, Hafele, or equal.
 - b. Drawers and box drawers, up to 24 inches wide: Accuride 3832A, Blum, Hafele, or equal.
 - c. Lateral file drawers, up to 30 inches wide: Accuride 4034 overtravel or 4033 equal travel, Blum, Hafele, or equal.
 - d. Lateral file drawers, more than 30 inches wide: Accuride 3640, Blum, Hafele, or equal.
2. Drawer Slides for Premium Grade Cabinetry:
 - a. Pencil drawers: Full extension type: Accuride 2632, Blum, Hafele, or equal.
 - b. Drawers and box drawers, up to 24 inches wide: Accuride 7432, Blum, Hafele, or equal.
 - c. Lateral file drawers, up to 30 inches wide: Accuride 4034 overtravel or 4033 equal travel, Blum, Hafele, or equal.
 - d. Lateral file drawers, more than 30 inches wide: Accuride 3641, Blum, Hafele, or equal.
3. Flipper Door Slides for Premium and Custom Grade Cabinetry:
 - a. For vertically mounted retracting cabinet doors up to 75 pounds and 72 inches tall: Accuride 1432, Blum, Hafele, or equal, with hinge carrier strip.
4. Mutes: Rubber, approximately 1/4 inch diameter, colors to match adjacent finish.
5. Plastic Grommets: Doug Mockett, Alliance Express, Rockler, or equal; color as selected by Architect.
6. Adjustable Shelves with Clips: Adjustable shelf supports (EDP type, unless otherwise noted) set in 5 mm holes spaced 32 mm on center:
 - a. Hafele America, Co., No. 282.04.711, Blum, Hettich, or equal.
 - b. Hafele America, Co., No. 282.24.13, Blum, Hettich, or equal.
7. Cabinet Hinges: Concealed type, minimum 170 degree opening, self-closing:
 - a. Hafele America, Co. Euro/cup
 - b. Julius Blum, Inc. Modul.
 - c. Meplad. Equal.
8. Five-knuckle hinges, stainless steel, recessed, heavy duty. Required in all classrooms, optional at administrative and non-student areas.
9. Cabinet Locks:

- a. Door Locks: Pin tumbler type – National No. 3713 x 2475-172 strike , Olympus 100DR x 12-1 strike, CCL Security Products, or equal.
 - b. Locks for Sliding Doors: National No. C8142 x thimble strike, Olympus 300 SD x thimble strike, CCL Security Products, or equal.
 - c. Drawer Locks: National 68-3718 x 68-2480C brass strike, Olympus 200 DW x 12-1 strike, CCL Security Products, or equal.
 - d. Cabinet locks shall be flush with surface of door and protrude no greater than 3/16 inch.
10. Top-hung Hardware Assembly for Sliding Doors: Grant No. 6064, Hafele, Blum, or equal.
 11. Track for Sliding Doors: K & V 455 x or 455.55, Hafele, Blum, or equal.
 12. Pull Flush Ring at Drawers behind Doors: Safe No. 6116, Trimco 24, Quality, or equal.
 13. Pulls: Quality No. 179 x 180, Trimco No. 553P, Hafele, or equal.
 14. Catches: Magnetic type - Epco No. 592, Lawrence No. SC1364-AL, or equal.
 15. Four-way Tension Catch: Glynn-Johnson GJ21A, Trimco, Quality, or equal.
 16. Noiseless Catch:
 17. Elbow Catch: , Schlage SP2A3, or equal.
 18. Bolts: Surface type, Quality B6, Trimco No. 4856-6, or equal.
 19. Brackets and Shelf Strip for Glass Shelves: K & V No. 80 x 180, Garcy 604 x 686, or equal.
 20. Shelf Standards and Brackets: K & V No. 255 x 256, line bored holes for pins as approved by AWI Standards Stanley No. 798 x 799, steel zinc plated, or equal.
 21. Card Holders for Drawers: Corbin No. 1913-1/4H, Garcy No. 853, or equal.
 22. Hanger Rods: 1-1/16 inches minimum diameter metal tubing, aluminum or stainless steel clad, KV660; heavy wall steel tubing KV770, Stanley, or equal.
 23. Hanger Rod Flanges: KV757, or flanges KV734, KV735; Ronther Reiss R44-55; or equal.
 24. Hardware Finish: With exception of finish hardware items which have finishes specified, hardware shall be furnished with dull chrome US 26D or dull stainless steel US 32D finish.
 25. TV Pullout Extension and Swivel: Accuride Model CB360-258TV, Blum, Hafele, or equal or equal.
 26. Keying:
 - a. Key locks inside one room alike. Furnish three keys for each lock keyed separately, and 2 keys for each lock in keyed alike groups. Master keys shall be tagged and delivered to the Inspector. Locks and keys shall be stamped with coded set number / direct digit.

- b. Cabinet locks shall be master-keyed and keyed alike. Backside of cabinet lock bolts (on visible side following installation) and change keys shall be stamped with manufacturer's code, either direct digit or coded series. Change keys shall also be stamped with set numbers direct digit.
- c. Master keys shall be National GM2.

2.2

FABRICATION

- A. Plastic Laminated Casework: Construction of plastic laminated casework shall conform to the material and construction requirements for AWI Architectural Woodwork Standards Custom grade flush overlay construction, except, modified as follows:
 - 1. Panels and Doors: All components shall be 3 ply laminate construction consisting of plastic laminate or cabinet liner with particle board and a balancing sheet, bonded together under pressure with adhesive. Total nominal thickness of panels and doors shall be 0.75 inch unless otherwise indicated.
 - 2. Exposed surfaces shall be High Pressure Decorative Laminate.
 - a. Edge Band: PVC 1 mm. for cabinet body and 3 mm. at doors and drawer fronts.
 - 3. Exposed bottoms of wall-hung cabinets shall be furnished with plastic laminate finish.
 - 4. Exposed Interiors: Interior surfaces of open cabinets shall be laminated to match exteriors. Cabinets with glass doors shall use cabinet liner.
 - 5. Semi-exposed Surfaces: Cabinet liner and edges of panels shall be edge banded per 2.1 A.
 - 6. Webs: Stiles, rails and muntins of web frame shall be tongue and grooved at joints and glued. Top and bottom rails shall be continuous. Use of 8 mm wooden dowels, screws or biscuits shall be in accordance with AWI Standards.
 - 7. Cabinet bases may be integral or separate. Bases shall be 3/4 inch thick plywood securely jointed at four corners to a supporting block 1 1/2-inch thick.
 - 8. Ends: Cabinet ends shall be minimum 3/4 inch thick, lock-jointed, doweled, or screwed to webs or top and bottom of the cabinet. All joints shall be securely glued.
 - 9. Backs shall be 1/4 inch thick plywood or 1/4 inch thick particle board, and shall be plowed into sides and top (except countertops) glued and nailed on 4 inch centers. Back shall be braced with horizontal 3/4 inch by 3 1/2-inch backing strips on 3 feet centers maximum. Cabinets with exposed finish backs shall have 3/4 inch backs of laminate construction. Where exposed finished cabinet end and back form an external corner, plastic laminates shall meet at corner.
 - 10. Adjustable shelving shall be 3/4 inch thickness particleboard for spans up to 25 inches and one inch thickness for spans over 25 inches up to 34 inches. Adjustable shelving over 34 inches in span shall be one inch thick plywood

core with 0.020 inch cabinet liner both sides. Shelving hardware shall be adjustable to one inch centers. Faces of shelving shall be finished with 0.020 inch thickness cabinet liner both sides.

11. Drawers:

- a. Sides, backs, and sub-fronts of drawers shall be of dovetail or dowel construction and made of 1/2 inch thick clear birch or maple solid stock, or 9 ply plywood without knots. Drawer bottoms shall be in accordance with AWI requirements, glue blocked and nailed.
- b. Drawers shall be fitted with ball bearing slides accurately installed for smooth drawer operation.
- c. Drawer fronts shall be of 3/4 inch thick plastic laminate construction, fully edge-banded with plastic laminate T-banding to be used when matching existing. T-banding joint shall occur at center of bottom edge of panel.

12. Doors:

- a. Doors shall be of overlay type with flush exposed surfaces. Doors shall be fully edge-banded. Doors of cabinets within any group of adjacent units shall be in alignment.
- b. Wrap around hinges shall be routed into edge of door. Doors over 40 inches in height shall have three hinges.

13. Back Priming: Seal unfinished materials installed for backs, bases, self-edge backing, stripping and other concealed portions with a water-repellent sealer.

14. Banding:

- a. Exposed edges of interior and exterior laminates shall be edge banded.
- b. Edge banding shall be accurately fitted. Where edge band joins plastic surfaces, there shall be no open spaces, voids, or chipping of plastic laminate surface.
- c. Exposed cabinet surfaces shall be flush, and any protruding edges of banding shall be machined or trimmed to provide a flat smooth corner at intersection of banding and adjoining surfaces. Plastic laminate edge banding shall be installed on tops, webs, bottoms, ends, and inside partitions. T banding may only be installed on drawer fronts and door edges and when required to match existing.

B. Wood Casework: Manufacture in accordance with AWI Architectural Woodwork Standards, Custom Grade, except, modified as follows:

1. Casework bodies shall be 3/4 inch thick.
2. Exposed surfaces for transparent finish shall be plain sliced select white birch.
3. Exposed Interiors: surfaces at the interiors of open cabinets and cabinets with glass doors shall be of the same species and grade as exposed portions.
4. Semi-exposed surfaces shall be natural birch.

5. Edge banding shall be wood edge bands of same species as adjacent exposed faces.
6. Cabinet doors shall be particleboard core a minimum of 3/4 inch thickness, unless otherwise noted. Interior faces of cabinet doors shall be same species and grade as exposed surfaces. Cabinet doors shall be flush overlay.

C. Countertops:

1. Plastic Laminate Tops: Each plastic laminate countertop shall bear the AWI Certified Compliance Label.
 - a. Laminated plastic countertops shall be self-edged, except that plastic countertops containing sink cutouts shall have a no-drip tilt-front edge. Edge shall rise 1/8 inch above counter surface and back and return splashes shall be 6 inches high measured from exposed countertop surface, unless otherwise indicated.
 - b. Cove and roll front sticking, for plastic laminate back-up, shall be kiln dried clear sugar pine glued to core material. Cove sticking shall be secured in each direction with 2 1/2-inch long wood screws, 3 inches from each end and 10 inches on center.
 - c. Square butt splashes, including end splashes tops shall be Deck Mount. Splashes shall be end applied and be set in mastic and secured to top with screws 8 inches on centers. Splash edges shall be self-edged and scribed to wall.
 - d. Joints shall be splined and fastened with screw clip fasteners on at least 8 inch centers. Water resisting mastic or glue shall be applied in joints. Joints shall not occur at sink cutouts. Sink cutouts shall be sealed.
 - e. Core material for counters and splashes shall be 3/4 inch thick 1-M-2 grade particleboard.
 - f. Metal sink moldings shall be stainless steel, Hudee, Kintrim T-Type, Chromedge Sink-Lok, or equal, with bolts and lugs.
 - g. Mastic: Metal trim shall have a continuous layer of mastic in voids between metal and plywood and sink. Counter cutout edge shall be waterproofed to prevent delamination of countertop. Metal trim shall be applied over finished plastic surfaces without kerfing or routing of molding.
 - h. Installation of plastic laminate shall be in accordance with published specifications and recommended practices of the plastic laminate manufacturer.
2. Hardwood Countertops:
 - a. Hardwood counters shall be fabricated of Number One Clear birch or maple boards from 6 inches to 10 inches wide, of thickness indicated, tongued and grooved, and glued together with waterproof glue, reinforced with cleats or other method to prevent warping or opening of

joints. Top surfaces where indicated shall be shaped to drain towards sink, with slope of 1/4 inch.

- b. Back, ends and caps shall be 3/4 inch thick, with wide sections constructed same as top without reinforcing strips. Joints between top, back, and vertical corners of back where indicated, shall be fabricated of tongue and groove cove members and glued. Sinks, where indicated, shall be set flush with bottom of drainboards and caulked continuously.
3. Tempered Hardboard Tops: Countertops, backs and ends where indicated hardboard shall be covered with 1/8 inch thick tempered hardboard, installed on both sides of 1/2 inch softwood plywood core. Material shall be installed under pressure with waterproof cement of type recommended by hardboard manufacturer.
 4. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
 - a. Manufacturers:
 1. Avonite Surfaces.
 2. E. I. du Pont de Nemours and Company.
 3. Formica Corporation.
 4. Wilsonart International.
 5. Equal.
 - b. Type: Provide Standard Type.
 - c. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.
 - d. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 FINISHING

- A. Wood casework and wood components of laminated plastic casework shall be factory finished. Exposed surfaces shall be finished with one coat of lacquer sealer and 2 coats of finish lacquer. Unexposed materials such as backs, webs, back of tops, and the like, shall be sealed with one oil base prime coat. Semi-exposed wood surfaces such as drawers shall be finished with one coat of sanding sealer and one coat of clear gloss lacquer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Work of this section as specified in the AWI Architectural Woodwork Standards.
- B. Cabinets: Install cabinets level, plumb, and secure to walls. Exposed screws shall have finish washers.

- C. End Panels and Fillers: Furnish to match exposed surfaces and accurately scribe to walls and neatly and securely fit to cabinets.
 - D. Completion: Upon completion of installation, cabinets including drawers and shelves shall be cleaned. Doors and drawers shall operate easily and freely.
 - E. Scribe plastic laminated cabinets to walls. Installation of surface-applied moldings is not permitted.
 - F. Install solid surface countertops per AWI custom grade.
- 3.2 CLEAN UP
- A. Remove debris, rubbish and waste material and legally dispose of off the Project site.
- 3.3 PROTECTION
- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 06610 - GLASS FIBER AND RESIN FABRICATIONS, GENERAL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing products fabricated from fiberglass reinforced plastic (FRP) and bolts, nuts, washers, supports, and accessories.
- B. The WORK also provides quality standards for all fabricated fiberglass reinforced plastic equipment of this Section and any other Section containing FRP equipment.
- C. The WORK also requires that one manufacturer accepts responsibility for the WORK as indicated but without altering or modifying the CONTRACTOR'S responsibilities under the Contract Documents.
- D. The WORK also includes coordination of design, assembly, testing, and installation.
- E. This Section specifies general requirements for fiberglass reinforced plastic (FRP) fabrications. Equipment-specific requirements are detailed in other sections of the contract documents pertaining to the relevant equipment. This Section is intended to be used in conjunction with the other related equipment specification sections and design drawings. It is intended to specify materials, describe methods of work, and provide for documentation of quality and acceptance.

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 05500 Miscellaneous Metalwork
 - 2. Section 09800 Protective Coating
 - 3. Section 11000 Equipment General Provisions
 - 4. Section 13300 Instrumentation and Control
 - 5. Section 15000 Piping Components
 - 6. Section 16050 Basic Electrical Materials and Methods

1.3 CODES

- A. The 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. California Building Code
 - 2. California Mechanical Code
 - 3. California Fire Code
 - 4. National Electrical Code

1.4 QUALITY ASSURANCE

- A. Quality, as represented by raw materials used, manufacturing practices employed, and condition of the finished product, is of prime importance. Knowledge of new technology in the interest of improved quality and/or lower cost is welcomed. However, any change of raw materials, alteration of construction, or other deviations from the requirements of the Specification Sections or design drawings must be submitted in detail and approved in writing by the CONSTRUCTION MANAGER.

1.5 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
1. NBS PS 15 Custom Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment
 2. ASTM A 325 Specification for High-Strength Bolts for Structural Steel Joints
 3. ASTM A 490 Specification for Heat-Treated Steel Structural Bolts 150 ksi (1035 MPa) Tensile Strength
 4. ASTM C 581 Practice For Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures, Intended for Liquid Service
 5. ASTM D 638 Test Method for Tensile Properties of Plastics
 6. ASTM D 695 Test Method for Compressive Properties of Rigid Plastics
 7. ASTM D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 8. ASTM D 883 Definitions of Terms Relating to Plastics
 9. ASTM D 2563 Recommended Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts
 10. ASTM D 2583 Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
 11. ASTM D 2584 Test Method for Ignition Loss of Cured Reinforced Resins
 12. ASTM D 3299 Specification for Filament-Wound Glass Fiber Reinforced Thermoset Resin Chemical-Resistant Tanks
 13. ASTM D 3467 Test Method for Carbon Tetrachloride Activity of Activated Carbon
 14. ASTM E84 Standard Method of Test for Surface Burning Characteristics of Building Materials
 15. AISC Specification for the Design, Fabrication, and Erection of Structural Steel Buildings

- | | | |
|-----|----------------|---|
| 16. | NFPA 255 | Method of Test for Surface Burning Characteristics of Building Materials |
| 17. | ANSI/AWS D1.1 | Structural Welding Code -- Steel |
| 18 | ANSI/AWWA F101 | Contact-Molded, Fiberglass-Reinforced Plastic Wash Water Troughs and Launderers |
| 19. | ANSI/AWWA F102 | Matched-Die-Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles and Mounting Brackets |

1.6 MANUFACTURER REQUIREMENTS

- A. All items to be provided under this Section shall be furnished only by manufacturers having a minimum of ten (10) years of knowledge in the design and manufacture of similar products and systems.
- B. Manufacturer shall offer a 3 year limited warranty on all FRP products against defects in materials and workmanship.

1.7 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL in addition to General Requirements:
 1. Maintenance and repair instructions for fiberglass work.
 2. Name, address and telephone number of fiberglass fabricators and manufacturers.
 3. Certificate of compliance with the specifications and requirements of all fiberglass items of the WORK.
 4. Color samples for approval if requested by the Engineer.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **General:** Only products certified as complying with the indicated requirements shall be provided.
- B. **Products:** All items shall be new, of current design, from reputable manufacturers specializing in such products.
- C. **Manufacturer's Recommendations:** Products shall be recommended by the manufacturer for the application indicated.

2.2 GENERAL REQUIREMENTS

- A. **Quality:** Fiberglass items shall be constructed of new, filament-wound or fiberglass-fabric-reinforced polyester resin laminate material of the strength, thickness, and dimensions indicated, using the matched die-molded or contact molded method.

- B. **Finish:** Finished surfaces of fiberglass items and fabrications shall be smooth, resin-rich, free of voids, without dry spots and unreinforced areas, corrosion resistant and without exposed glass fibers.
- C. **Supports and Fasteners:** Bolts, anchor bolts, washers and supports shall be fabricated of Type 316 stainless steel, unless otherwise indicated.
- D. **Gasket:** Gaskets for use with FRP flanges shall be flat, full-faced, and drilled to match the drilling pattern of mating flanges. Gasket material shall be as specified in the pertinent product and/or equipment section.

2.3 FIBERGLASS GRATING

- A. **Construction:** Fiberglass grating shall be minimum one inch high with one inch by 4-inch grid, or 1-1/2 inch high with 1-1/2 inch by 6-inch grid, and cut edges shall be resealed. The maximum deflection under design load (200 psf) shall not exceed 1/8-inch at 24-inch span. The Contractor shall provide ADA compliant Fiberglass grating as indicated at no extra cost to the CITY. Fiberglass grating shall have a permanently slip-resistant Aluminum Oxide (AO) grit molded surface. Cut edges and openings shall be banded. Grating color shall be as directed by the CONSTRUCTION MANAGER. Non-standard color shall be provided at no extra cost to the CITY.

2.4 MANUFACTURERS

- A. Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):

- 1. Fiberglass Grating:

- Fibergrate Corp., "Fibergrate"
 - Chemical Proof Corp., "Chemi-Grate"

- 2. ADA Compliant Fiberglass Grating:

- Fibergrate Corp., "Micro-mesh Grating"

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Products shall be installed in accordance with the manufacturer's installation instructions.

** END OFSECTION**

SECTION 07100 - WATERPROOFING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing waterproofing and moistureproofing of concrete surfaces.

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 07920 Sealants and Caulking

1.3 CODES

- A. The 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. California Building Code

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 D 41 Specification for Asphalt Primer Used in Roofing and Waterproofing
 - 2. ASTM D 226 Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 - 3. ASTM D 312 Specification for Asphalt Used in Roofing

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Manufacturer's product data including catalogue cuts.
 - 2. Manufacturer's installation instructions.
 - 3. Polystyrene protection board.
 - 4. Subsurface drainage mat.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Products 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.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **General:** Only products certified as complying with the indicated requirements shall be provided.
- B. **Products:** Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.
- C. **Manufacturer's Recommendations:** Products shall be recommended by the manufacturer for the application indicated.

2.2 WATERPROOFING COATING

- A. **Product:** Waterproofing coating shall be a coal tar epoxy resin.

2.3 MOISTUREPROOFING COATING

- A. **Product:** Moistureproofing coating shall be a coal tar solution.

2.4 WATERPROOFING MEMBRANE

- A. **Product:** Waterproofing membrane shall be minimum 60-inch wide sheets of heavy-duty rubberized asphalt composite, consisting of 53 to 56 mils woven polypropylene geotextile with a release liner on the adhesive side. Puncture resistance of the textile shall be 200 pounds. Total thickness of the membrane shall be 65 mils.

2.5 WATERPROOFING MEMBRANE - ALTERNATIVE

- A. **Product:** Bentonite composition panels are acceptable alternatives except where membrane is required between concrete slabs or where there is concrete over waterproofing membrane.

2.6 WATERPROOFING PROTECTIVE BOARD

- A. **Product:** Protective board shall be ½-inch asphalt impregnated insulation board.

2.7 MOISTUREPROOFING UNDERLAY

- A. **Product:** Plastic membrane for moistureproofing underlay shall be polyethylene film with a thickness of 6 mils.

2.8 MOISTUREPROOFING UNDERLAY TAPE

- A. **Product:** Pressure sensitive tape shall be 2-inch wide polyethylene tape.

2.9 BELOW-GRADE WATERPROOFING

- A. Waterproofing materials for use below grade shall be a cold fluid applied, single coat, high build, water-based polymer-modified asphalt emulsion. For protection, use a 2-inch thick expanded polystyrene board for vertical surfaces or geotextile for horizontal surfaces. Subsurface

drainage mat shall be a formed plastic sheet with one side smooth with concave dimples and the other side bonded to a geotextile.

2.10 SHOWER PAN (NOT USED)

2.11 MANUFACTURERS

A. Products shall be of the type and manufacture as indicated below (or equal):

1. Waterproofing Coating:

Kopper's Bitumastic 300-M
Porter Maxi Build II

2. Moistureproofing Coating:

Kopper's Bitumastic 50
Porter Tarmastic 100

3. Waterproofing Membrane:

W.R. Grace and Company's "Bituthene"
Protecto Wrap Co.'s "Jiffy Seal"

4. Waterproofing Membrane Alternate:

Volclay Panels
Bentonize Bentonite

5. Waterproofing Protective Board:

Celotex Insulation Board

6. Below-Grade Waterproofing System:

Emulsion: LIQUID BOOT, LBI Technologies, Inc.
Geotextiles: Minadri 300 HV Protection Course

PART 3 -- EXECUTION

3.1 GENERAL

A. **General:** Products shall be installed in accordance with the manufacturer's installation instructions.

3.2 WATERPROOFING COATING

A. **Location:** Waterproofing coating shall be applied to the water side of walls and bottoms of channels or trenches or tanks/ vaults which are common with rooms, tunnels or galleries or trenches to be occupied by equipment, piping, conduit, or personnel.

B. **Surface Preparation:** New concrete to be waterproofed shall have aged at least 28 days and allowed to dry to a moisture content recommended by the coating manufacturer. Concrete surfaces shall be sandblasted. Voids and cracks shall be repaired.

- C. **Applications:** Prime coat shall be thinned and applied at the rate of approximately 200 to 300 square feet per gallon depending on surface condition. Finish coats shall be applied at the rate of 100 square feet per gallon. Final coat shall be black. Total dry film thickness shall be minimum 20 mils. Drying time between coats shall be as recommended by the coating manufacturer.

3.3 MOISTUREPROOFING COATING

- A. **Location:** Moistureproofing coating shall be applied to exterior of outside concrete walls which are below grade; unless a "below-grade waterproofing" system is indicated.
- B. **Surface Preparation:** Concrete surfaces shall be allowed to age for at least 28 days. Surface shall be clean, dry and free of voids, spalled areas, and loose aggregates. Concrete surfaces shall be sandblasted. Voids and cracks shall be repaired.
- C. **Application:** Each prime and finish coat shall be applied at the rate of 70 square feet per gallon. The number of finish coats shall be sufficient to produce a dry film thickness of at least 15 mils. Drying time between coats shall be as recommended by the coating manufacturer.

3.4 WATERPROOFING MEMBRANE

- A. **Location:** Waterproofing membrane shall be applied to surfaces indicated.
- B. **Surface Preparation:** Concrete surfaces shall be clean, dry and free of voids, spalled areas, loose aggregate, and sharp protrusions, with no coarse aggregate visible.
- C. **Application:** Waterproofing membrane shall be applied in accordance with the manufacturer's recommendations. Surfaces shall be clean and primed prior to application of the membrane.
- D. **Waterproofing Protective Board:** Pipes or conduits entering structures shall be watertight. The protective board shall be placed directly against membrane prior to backfilling. Where the membrane is turned up from the base of the walls, at angles in walls, and at any other place where the membrane may be subjected to unusual strain, strips, consisting of two additional plies of membrane shall be applied.

3.5 MOISTUREPROOFING UNDERLAY

- A. **Location:** Unless otherwise indicated, moistureproofing underlay shall be provided under all concrete slabs-on-grade.
- B. **Surface Preparation:** Backfilled surfaces to receive moistureproofing underlay shall be leveled off and smoothed over to minimize contact with sharp edges.
- C. **Application:** At joints, moistureproofing membrane shall be lapped 6 inches and sealed with pressure sensitive tape. Where pipes and conduits pass through the membrane, they shall be wrapped tightly with separate sheets of membrane which shall then be sealed with tape to the main membrane. Reinforcing steel or wire mesh shall be supported to protect the membrane.

3.6 BELOW-GRADE WATERPROOFING

- A. The applicator shall be trained and approved by the manufacturer.
- B. **Surface Preparation:** Concrete surfaces shall be no rougher than light broom finish and shall

have no dirt, debris, loose material, or release agent or curing compound. Masonry joints shall be struck smooth. Provide a 3/4-inch cant of trowel grade waterproofing at vertical transitions and inside corners of less than 90 degrees. Allow cant to cure at least 24 hours.

- C. **Penetration:** Etch metal surfaces of penetrations with 10 percent muriatic acid 3 inches out from the concrete or block surface. Apply 80 mils nominal of trowel grade waterproofing in a 3-inch ring around the penetration and out 3 inches from the wall surface. After trowel grade material cures, spray apply 80 mils nominal on the penetration at least 4 1/2 inches from the wall surface and also spray apply material to the wall surface as indicated below. After sprayed material cures, wrap a polypropylene cable tie snugly around the base of the penetration 2 inches out from the wall surface.

D. Installation

1. Spray an 80-mil minimum coat, taking care to avoid puncturing the membrane. Test for membrane thickness and repair as necessary.
2. Apply the polystyrene protection board or geotextile. Subsurface drainage mat shall be applied with the geotextile facing the backfill after moisture has evaporated from the membrane.

E. Testing and Repair

1. Test the membrane for thickness with a light oiled needle nose depth gauge, taking 4 readings in a one square inch area for each 500 square feet of waterproofed area.
2. Areas thinner than 80 mils shall be built up to 80 mils extending at least 1-inch outside the perimeter of the defective area.

3.7 SHOWER PAN WATERPROOFING (NOT USED)

** END OF SECTION **

SECTION 07310 – METAL SHINGLE ROOFING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing factory formed metal shingle roof panels: diamond-shaped, flat metal shingle, hidden fastener

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 05120 Structural Steel
 - 2. Section 07600 Flashing and Sheet Metal

1.3 CODES

- A. The 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. California Building Code

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.
- B. Wind-Uplift Resistance: Capable of resisting design negative uplift pressures based upon maximum wind speeds of 120 mph. Provide clips, fasteners, and clip spacing of type indicated and with capability to sustain, without failure, a load equal to 2 times the design negative uplift pressure.
- C. Wind-Uplift Resistance: Capable of producing sheet metal roofing assemblies that comply with UL1897 UL Standard for Safety for Uplift Tests for Roof Coverings.

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roof panel and accessory, including each type of underlayment product indicated:
 - 1. Metal individual shingles and accessories.
 - 2. Underlayment.
- B. Shop Drawings: Show layouts of sheet metal roofing, including plans, elevations, and keyed

references to termination points. All fastening patterns shall be clearly designated to meet the specified wind speed requirements.

1. Include details for forming, joining, and securing sheet metal roofing, including pattern of seams, termination points, expansion joints, roof penetrations, edge conditions, special conditions, connections to adjoining work, and accessory items.
- C. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:
1. Roof panels and attachments.
 2. Purlins and rafters.
 3. Roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, snow guards, and items mounted on roof curbs.
- D. Samples: For each exposed finish.
- E. Field quality control inspection reports, to be submitted for warranty program level, if applicable.
- F. Product test reports. Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:
1. Metal Roof Panels: Include reports for UL 790/ASTM E 108, UL 580, ASTM E 283, ASTM E 331, Field Tested, PA 100-95 (R&D Only), UL 1897, UL 2218, ASTM E 84 Flame Spread Rating, Paint Performance Tests, ICBO AC166 Penetration.
 2. Insulation and Vapor Retarders: Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installer of sheet metal roofing for a minimum of 10 years.
- B. Roll-Formed Sheet Metal Roofing Fabricator Qualifications: Minimum of 10 years factory forming knowledge.
- C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.
- E. Sheet Metal Roofing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" and NRCA Waterproofing Manual and manufacturer's installation guidelines.
- F. Fire-Resistance Ratings: Where indicated, provide metal roof panels identical to those of assemblies tested for fire resistance that comply with ASTM E 108 in accordance with UL790.
- G. Pre-installation Conference: Conduct conference at project location with building owner, architect, installing contractor, general contractor and sheet metal roofing manufacturer a minimum of 10 days prior to start of work. All details shall be reviewed including; underlayments, substrates, fastening patterns, scheduling, trim and flashing components,

accessories such as fasteners and sealants.

1.7 DELIVERY, STORAGE & HANDLING

- A. Do not deliver materials of this section to project site until suitable facilities for storage and protection are available.
- B. Protect materials from damage during transit and at project site. Store under cover, but sloped to provide positive drainage. Do not expose materials with strippable protective film to direct sunlight or extreme heat.
- C. Do not allow storage of other materials or allow staging of other work on installed metal panel system.
- D. Upon receipt of delivery of metal panel system, and prior to signing the delivery ticket, the installer is to examine each shipment for damage and for completion of the consignment.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on Shop Drawings.

1.9 SCHEDULING

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations, which are specified in Division 7 Section "Roof Accessories."
- B. Coordinate metal panel roof assemblies with rain drainage work, flashing, trim, and construction of decks, purlins and rafters, parapets, walls, and other adjoining work to provide a leakproof, secure, and non-corrosive installation.

1.10 WARRANTY

- A. Special Warranty on Product: Manufacturer's standard form in which manufacturer agrees to repair or replace sheet metal roofing that shows evidence of deterioration within specified warranty period.
- B. Special Installer's Warranty: Specified form in which Roofing Installer agrees to repair or replace components of custom-fabricated sheet metal roofing that fail in materials or workmanship within 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer's Qualifications:

All panels are to be factory formed and packaged per job requirements.

- B. Manufacturer shall have a minimum of ten (10) years knowledge in the factory fabrication of metal roof panels.
- C. Manufacturer must be certified to ISO 9001:2008 with design.

2.2 METAL SHINGLES

- A. General: Provide factory-formed metal roof shingles, attaching shingles to supports using concealed fasteners. Include accessories required for weathertight installation.
- B. Diamond-shaped, flat, interlocking shingles with hidden fasteners.
 - 1. Basis-Of-Design Product: ATAS International, Inc.; Castle Top®, HCT160 or a comparable product.
 - 2. Manufacturer:
 - a. ATAS International, Inc. or Equal.
 - 3. Material: .028 Zinc
 - a. Texture: Smooth
 - b. Exposure: 13.5" by 13.5"
 - c. Seam Height: N/A
 - d. Natural - Unpainted

2.3 UNDERLAYMENT

- A. Self-Adhering, High-Temperature Sheet: 45 mil homogeneous rubberized asphalt waterproofing compound, glass fiber reinforced designed specifically for use under sheet metal roofing. Thermal Stability: Resistant to 240 deg F; ASTM D 1970. Low Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970. With Asphalt free felt: Conforming to ASTM D 226, polyolefin based, 100 percent asphalt free, high strength reinforced roofing underlayment.

2.4 MISCELLANEOUS MATERIAL

- A. Fasteners: Self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads. Manufacturer shall provide or authorize all fasteners utilized with the sheet metal roofing system.
 - 1. Exposed Fasteners: Heads matching color of sheet metal roofing by means of plastic caps or factory-applied coating.
 - 2. Fasteners for Flashing and Trim: Blind fasteners or screws spaced to resist wind uplift loads.
- B. Sealing Tape: Pressure-sensitive, 100 percent solid polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, non-sag, non-toxic, non-staining tape.
- C. Elastomeric Joint Sealant: ASTM C 920, of base polymer, type, grade, class, and use classifications required to produce joints in sheet metal roofing that will remain weathertight.

- D. Expansion-Joint Sealant: For hooked-type expansion joints, which must be free to move, provide non-setting, non-hardening, non-migrating, heavy-bodied polyisobutylene sealant.
- E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15 mil dry film thickness per coat.

2.5 ACCESSORIES

- A. Sheet Metal Roofing Accessories: Provide components required for a complete sheet metal roofing assembly including trim, copings, fascia, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of sheet metal roofing, unless otherwise indicated. All trim and flashing components shall be supplied in a minimum of 12'-0" lengths and shall conform to manufacturer's standard part dimensions and details.
- B. Closures: Closed-cell, expanded, cellular, rubber or cross linked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match sheet metal roofing profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Sealants as recommended by manufacturer.
- D. Fasteners as recommended by manufacturer.
- E. Flashing and Trim: Formed from matching materials as sheet metal roof panel in gauges noted. Provide flashing and trim in heavier gauge materials as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fascia, and fillers. Finish flashing and trim with same finish system as adjacent sheet metal roofing.

2.6 EQUIPMENT

- A. Manufacturer must maintain quality control and maintenance procedures of all equipment. Verification of quality control procedures must be validated by a 3rd party entity.
 - 1. 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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ATAS International, Inc. or Equal.

2.7 FABRICATION

- A. General: Fabricate sheet metal roofing and components to comply with details shown, manufacturers installation details and recommendations in SMACNA's "Architectural Sheet Metal Manual" and NRCA Waterproofing Manual that apply to the design, dimensions (pan width and seam height), geometry, metal thickness, and other characteristics of installation indicated. Fabricate sheet metal roofing and accessories at the manufacturer's location to the greatest extent possible.

- B. General: Fabricate sheet metal roofing panels to comply with details shown and sheet metal roofing manufacturer's written instructions.
- C. Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work. Form exposed sheet metal work to fit substrates without excessive oil canning, buckling, and tool marks, true to line and levels indicated, and with exposed edges folded back to form hems.
 - 1. Fold and cleat eaves as required by manufacturer to insure weathertightness and wind uplift resistance.
 - 2. Form and fabricate sheets, seams, strips, cleats, valleys, ridges, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements shown and as required for leak proof construction and wind uplift resistance.
- D. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturers of dissimilar metals or by fabricator.
- E. Sheet Metal Accessories: Custom fabricate flashings and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before manufacturer fabrication.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.
 - 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 - 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - 3. For the record, prepare written report for the General Contractor, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Lay out and examine substrate before installation of sheet metal roofing. Space fasteners as required to resist design uplift, but not more than 24 inches o.c.
- B. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Flashing and Sheet Metal."

3.3 UNDERLAYMENT INSTALLATION

- A. Polyethylene Sheet Underlayment; ATA-GUARD™ or Equal: Install polyethylene sheet on roof sheathing under metal roof panels. Use adhesive for anchorage to minimize use of mechanical fasteners under metal roof panels. Apply at locations indicated on Drawings, in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches. With Self-Adhering Sheet Underlayment; ATA-SHIELD™ or Equal: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under sheet metal roofing. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply at locations noted on Drawings in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3.5 inches. Extend underlayment a minimum of 1.5 inches of fascia board. Roll laps with roller. Cover underlayment within 14 days.

3.4 INSTALLATION, GENERAL

- A. General: Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for a complete roofing system and as recommended by fabricator for sheet metal roofing.
 - 1. Field cutting of sheet metal roofing by torch is not permitted.
 - 2. Rigidly fasten ridge end of sheet metal roofing and allow for positive panel attachment as per manufacturer's recommendations. All flashing details shall accommodate thermal movement.
 - 3. Provide metal closures at peaks, ridge, gable and hip caps.
 - 4. Flash and seal sheet metal roofing with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 - 5. Locate roofing splices over, but not attached to, structural supports. Stagger roofing splices and end laps to avoid a four-panel lap splice condition.
 - 6. Lap metal flashing over sheet metal roofing to allow moisture to run over and off the material.
- B. Fasteners: Use fasteners of size and length as required for compatibility with substrate.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by fabricator of sheet metal roofing or manufacturers of dissimilar metals.
 - 1. Separate sheet metal roofing from bituminous coating where roofing will contact wood,

ferrous metal, or cementitious construction. Interlock and overlap shingles and stagger end joints from shingles above and below according to shingle manufacturer's written instructions.

- D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

3.5 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete sheet metal roofing assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 2. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual" and NRCA Waterproofing Manual. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Coordinate with installation of:
 - 3. Structural Steel in Section 05120
 - 4. Flashing and Sheet Metal in Section 07600

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as sheet metal roofing is installed. On completion of sheet metal roofing installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

**** END OF SECTION ****

SECTION 07410 - METAL ROOFING SYSTEM

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing a preformed metal roofing system and all appurtenant work necessary to a complete roofing enclosure.
- B. Types of metal panels required shall include formed sheet steel panels, intended for standing-seam installation.

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 05120 Structural Steel
 - 2. Section 05500 Miscellaneous Metalwork
 - 4. Section 07720 Roof Accessories

1.3. CODES

- A. The 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. California Building Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. American Iron and Steel Institute (AISI) Specification for the Design of Cold-Formed Steel Structural Members
 - 2. American Institute of Steel Construction (AISC) Manual of Steel Construction
 - 3. ASTM A 446 Grade A, Steel Sheet, Zinc-Coated (galvanized by the hot dip process, structural (physical) quality
 - 4. ASTM A 525 General requirements for Steel Sheet, Zinc-Coated (galvanized) by the hop dip process
 - 5. ASTM A 330 (modified) Test for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. **Product Data:** CONTRACTOR shall submit manufacturer's product specifications, standard details, certified product test results, installation instructions and general recommendations, as applicable to materials and finishes for each component and for the total system of preformed panels.
2. **Samples:** CONTRACTOR shall submit the following samples and accompanying descriptive data:
 1. **Roof panel:** full panel width, 12 inches long, including batten.
 2. **Anchor clips:** two required.
 3. **Fasteners:** two of each type to be used, with a statement regarding intended use.
 4. **Closures:** one metal closure with foam filler.
 5. **Sealant:** one sample of each sealant with a statement regarding intended use.
 6. **Insulation:** 12 inches square, full thickness.
 7. **Shop Drawings:** CONTRACTOR shall submit small-scale layouts of roof panels and large-scale details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim flashings, closures, and special details. Distinction shall be made between factory and field assembly work.
8. **Engineering Data:** ASTM E 330 Modified Test Reports, certified by a professional engineer, confirming that the proposed roofing system will meet the specified design uplift pressures.
9. **Written acceptance of installer from roofing manufacturer.**

1.6 QUALIFICATIONS

- A. **Installer's Qualification:** The installer shall be recognized and accepted by the manufacturer as qualified to install the roofing system indicated.

1.7 WARRANTY

- A. The Contractor shall provide a 20-year no limits roof leak warranty. Should the Contractor-furnished-roof develop any leaks (irrespective of cause of leak, except as hereafter provided) during the 20-year period after acceptance by OWNER, the Contractor, at its own expense, shall repair the roof, bringing the roof back to its watertight state. The Contractor shall effect required repairs within 48 hours of notification by OWNER of the existence of a roof leak.
1. Should, during the time that the roof leak warranty is in force, OWNER desires to modify roofing penetrations, the Contractor agrees to make the modifications at an agreed-upon price, and the roof leak warranty shall continue in effect should the Contractor make those modifications. Should OWNER elect to have another firm or its own forces modify roofing penetrations, the roof leak warranty shall continue in effect, except for roof leaks that trace their source to the modified roofing penetration.

PART 2 - PRODUCTS

2.1 GENERAL

- A. **Performance Test Standards:** CONTRACTOR shall provide preformed roof panel systems which have been pretested and certified by the manufacturer to provide the indicated resistance to air and water infiltration and structural deflection and failure when installed as indicated and when tested

in accordance with test procedures described herein.

2.2 SHEET MATERIALS

- A. **Steel to be Coated:** Sheet steel shall be hot-dip zinc coated, ASTM A 446, Grade A, designation G90 for maximum coating performance.

2.3 METAL FINISHES

- A. **General:** Coatings shall be applied either before or after forming and fabrication of panels, as required by the coating process and as required for maximum coating performance capability. Coating shall be protected promptly after application and cure, by application of strippable film or removable adhesive cover. Cover or film shall remain in place until after installation has been completed. Colors shall be provided to match colors selected by the CONSTRUCTION MANAGER from manufacturer's standard colors.
- B. **Fluoropolymer Coating:** Coating shall be full-strength 70 percent "Kynar 500" coating, baked-on for 15 minutes at 450 degrees F to a dry film thickness of 1.0 mil, 30 percent reflective gloss, ASTM D 523, over minimum 0.2 mil thick baked-on modified epoxy primer.
 - 1. **Durability:** Coating shall be provided which has been field tested under a normal range of weathering conditions for a minimum of 20 years without significant peel, blister, flake, chip, crack or check in finish, and without chalking in excess of Photographic Reference Standard No. 8 as described in ASTM D 659, and without fading in excess of 5 NBS units.
 - 2. **Color:** Selected by ARCHITECT from manufacturer's standard colors.

2.4 MISCELLANEOUS MATERIALS

- A. **Internal Panel Framing:** Framing shall be manufacturer's standard.
- B. **Fasteners:** Fasteners shall be manufacturer's standard noncorrosive types with exterior heads gasketed.
- C. **Accessories:** Except where indicated as WORK of another section, CONTRACTOR shall provide all components required for a complete roofing system, including trim, copings, fascias, ridge closures, clips, seam covers, battens, flashings, gutters, sealants, gaskets, fillers, closure strips and similar items. Match materials and finishes of preformed panels.
- D. **Bituminous Coating:** Coating shall be cold-applied asphalt mastic, SSPC paint 12, compounded for 15 mil dry film thickness per coat.

2.5 PANEL FABRICATION

- A. **General:** Panels and accessories shall be fabricated and finished at the factory to the greatest extent possible, in accordance with manufacturer's standard procedures and processes, and as required to fulfill the indicated performance requirements. CONTRACTOR shall comply with indicated profiles, dimensional requirements, and structural requirements.
 - 1. Panels shall be installed with concealed fasteners.
 - 2. Individual panels shall be removable for replacement of damaged material without disturbing adjacent panels.

3. Panels shall be fabricated in full length, with no endlaps.

B. The roofing panel system shall be designed to safely resist the positive and negative loads as specified below or as indicated on the drawings, in accordance with procedures defined in ASTM E 330:

Main Roof	20 PSF (Positive)	15 PSF (Negative)
Rood End, Eave, Rake	20 PSF (Positive)	15 PSF (Negative)

C. The panels shall withstand a 250 pound concentrated load applied to a 4-square inch area at the center of the panel at mid span between supports with no panel deformation, rib buckling, or panel sidelap separation that will adversely affect the weather-tightness of the system.

D. The roofing panel system shall be designed to conform to the following criteria for water penetration and air infiltration:

1. Water Penetration: No significant, uncontrolled leakage at 4 lbs per square foot pressure with spray test.

2. Air Infiltration: 0.02 cubic feet per minute per square foot for gross roof areas, with 4 lbs per square foot differential pressure.

2.6 MANUFACTURERS

A. Products of the type indicated shall be provided by the following manufacturers (or equal):

1. Steelite, Inc., "SRS Mechanically Seamed Standing Seam Roof System

2. ASC Pacific, Inc, Standing Seam Roofing System

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General:** CONTRACTOR shall comply with panel fabricator's and material manufacturer's instructions and recommendations for installation, as applicable to project conditions and supporting substrates.

1. Excess scrap shall be removed and working surfaces shall be kept free from debris on a daily basis.

2. Filings caused by drilling or cutting shall be removed immediately from finished surfaces to prevent rust stainings.

B. **Installation Tolerances:** Panel units shall be shimmed and aligned within an installed tolerance of 1/4-inch in 20 feet and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. **Joint Sealers:** Gaskets, joint fillers and sealants shall be installed where indicated and where required for weatherproof performance of the roofing system. Provide the types of gaskets and sealant or fillers indicated or, if not otherwise indicated, types recommended by the roofing manufacturer.

**** END OF SECTION ****

SECTION 07540 - SINGLE-PLY FULLY ADHERED MEMBRANE ROOFING

PART 1 GENERAL

1.1 APPLICATION

- A. This section includes the following:
1. Thermoplastic single-ply fully adhered membrane roofing system.
 2. Roof rigid board insulation.
 3. Insulation cover board.

1.2 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.
2. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.

B. American Society for Testing and Materials (ASTM)

1. ASTM C1289, Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
2. ASTM D4434, Standard for Polyvinyl Chloride Sheet Roofing Classification.
3. ASTM D1079, Standard Terminology Relating to Roofing and Waterproofing
4. ASTM D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
5. ASTM D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
6. ASTM C920, Standard Specification for Elastomeric Joint Sealants
7. ASTM G155, Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials
8. ASTM G7, Standard Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials
9. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials
10. ASTM E108, Test Methods for Fire Tests of Roof Coverings

C. Factory Mutual (FM)

1. FM 4450, Approval Standard for Class I Insulated Steel Deck Roofs
2. FM 4470, Approval Standard for Class I Roof Covers

D. National Roofing Contractors Association (NRCA)

1. NRCA Roofing and Waterproofing Manual

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

1. SMACNA, HVAC Air Duct Leakage Test Manual
2. SMACNA, HVAC Duct Construction Standards, Metal and Flexible

F. Single Ply Roofing Industry (SPRI)

G. Underwriters Laboratory (UL)

1. UL Class A assembly

H. ANSI/SPRI FX 1-2006, Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners

1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D1079 and SPRI for definitions of terms related to roofing work not otherwise defined in this section.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Install a watertight Single Ply PVC membrane roofing and base flashing system with compatible components that will not permit the passage of liquid water and will withstand wind loads, thermally induced movement, and exposure to weather without failure.
- B. Underwriters Laboratory Inc. Northbrook ,IL
 - 1. Class A assembly
- C. FM Listing: Provide single-ply membrane roofing system, base flashings, and component materials that meet requirements of FM 4450 and FM 4470 as part of a roofing system and that are listed in FM's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM markings.
- D. The installed roofing system shall have Factory Mutual I-90 wind-uplift resistance rating.
- E. Regulatory Requirements: The products and work specified in this section are subject to the rules and regulations of the local air quality management district (AQMD) and the California Air Resources Board (CARB). The roofing system specified is subject to change. In the event that a rule or regulation change makes the specified roofing system non-compliant, the Contractor shall notify the Engineer.

1.5 SUBMITTALS

- A. Product Data: For each type of roofing product specified, include manufacturer literature and product data substantiating those materials comply with requirements.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work, for the following:
 - 1. Base flashings, and membrane terminations.
- C. Samples: Submit the following product samples for verification:
 - 1. Field sheet of color specified.
 - 2. Flashing Membrane.
 - 3. Cover Boards
 - 4. Roofing insulation.
 - 5. Insulation fasteners of each type, length, and finish.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system and is eligible to receive the standard roofing manufacturer's warranty.
- E. Installer Qualification Data: Submit list of completed projects with project names and addresses, names and addresses of architects/engineer's and owners, completion dates and other information specified.
- F. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency, indicate compliance of components of roofing system with requirements based on comprehensive testing of current product compositions.
- G. Research/Evaluation Reports: Evidence of roofing system's compliance with building code in effect for Project from a model code organization acceptable to authorities having jurisdiction.
- H. Maintenance Data: Submit and include in the maintenance manuals.
- I. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roof installation.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Work for this section shall be performed by knowledgeable installers that are specialized in installing roofing similar to that required for this project; and are approved, authorized, or

licensed by the roofing system manufacturer to install manufacturer's product; and are eligible to receive the standard roofing manufacturer's warranty.

- B. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class A; complying with ASTM E108, for application and slopes indicated.
- C. Pre-installation Conference: Before installing roofing system, conduct conference at Project site. Notify participants at least 7 calendar days before conference.
 - 1. Meet with Engineer, roofing installer; roofing system manufacturer's representative; deck installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing removal and installation, ventilation ducting removal and installation, including manufacturer's written instructions.
 - 3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and attachment to structural members.
 - 4. Review loading limitations of deck during and after roofing.
 - 5. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
 - 6. Review governing regulations and requirements for insurance, certifications, and inspection and testing, if applicable.
 - 7. Review temporary protection requirements for roofing system during and after installation.
 - 8. Review roof observation and repair procedures after roofing installation.
 - 9. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Store roofing materials in a dry, well ventilated, weathertight location to ensure no significant moisture pickup and maintain at a temperature exceeding roofing system manufacturer's written instructions. Store rolls of felt and other sheet materials on end on pallets or other raised surfaces. Do not double-stack rolls.
 - 1. Handle and store roofing materials and place equipment in a manner to avoid significant or permanent damage to deck or structural supporting members.
- B. Protect roofing insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- C. Do not leave unused membranes and other sheet materials on the roof overnight or when roofing work is not in progress unless protected from weather and moisture.
- D. Deliver and store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
- E. Deliver sealants used for ductwork in original unopened containers, clearly labeled with product description and identification. Labeling shall include expiration date for use, pot life, curing time, and mixing instructions when applicable. Store and handle per manufacturer's instructions.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to manufacturers' written instructions and warranty requirements.

1.9 SITE CONDITIONS

A. Environmental Requirements

1. All products and equipment shall comply with SDAPCD.
2. Roofing materials shall not be applied during inclement weather or when air or surface temperature is below 50° F.
3. Roofing materials shall not be applied to the roof surface with any unsettled deficiency that could impair the quality of the roofing system.

1.10 WARRANTY

- A. The Contractor shall provide a 20-year no limits roof leak warranty. Should the Contractor-furnished-roof develop any leaks (irrespective of cause of leak, except as hereafter provided) during the 20-year period after acceptance by OWNER, the Contractor, at its own expense, shall repair the roof, bringing the roof back to its watertight state. The Contractor shall effect required repairs within 48 hours of notification by OWNER of the existence of a roof leak.
1. Should, during the time that the roof leak warranty is in force, OWNER desires to modify roofing penetrations, the Contractor agrees to make the modifications at an agreed-upon price, and the roof leak warranty shall continue in effect should the Contractor make those modifications. Should OWNER elect to have another firm or its own forces modify roofing penetrations, the roof leak warranty shall continue in effect, except for roof leaks that trace their source to the modified roofing penetration.

PART 2 PRODUCTS

2.1 ACCEPTABLE PRODUCTS AND MANUFACTURERS

- A. Sika Sarnafil 60-mil Fully Adhered Single-Ply PVC Roofing System over mechanically fastened rigid insulation.
- B. Johns Manville 60-mil Fully Adhered Single-Ply PVC Roofing System over mechanically fastened rigid insulation.
- C. Versico VersiFlex 60-mil Fully Adhered Single-Ply PVC Roofing System over mechanically fastened rigid insulation.

2.2 MEMBRANE MATERIALS

- A. Main Field Sheet: Thermoplastic PVC membrane (60-mil thick) with fiberglass or polyester reinforcement with no felt backing.
- B. Main Field and Flashings: White, minimum initial reflectivity of 0.83, minimum initial emissivity 0.90, minimum solar reflective index (SRI) of 100.
- C. Field Sheet Membrane shall conform to ASTM D4434 (latest version), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type II (Fiberglass Reinforced) and Type III (Polyester Reinforced).
- D. Flashing Membranes: Thermoplastic PVC membrane (60-mil thick) with no felt backing.

2.3 AUXILIARY MEMBRANE MATERIALS

- A. Membrane Adhesive water based and warranted and approved for use in this system by the manufacturer.
- B. Flashing Adhesive low VOC adhesive as recommended by manufacturer.
- C. Mastic Sealant: One-part polyurethane sealant as recommended by manufacturer.
- D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions of FM 4470; designed for fastening insulation, cover board, termination bars and roofing membrane to substrate; tested by manufacturer for required pullout strength; and acceptable to roofing system manufacturer.
- E. Pre-Molded Flashings:
 1. Corners: Pre-molded reversible corner manufactured with a non-reinforced thermoplastic membrane.
 2. Pipe Boots: Pre-molded pipe boot manufactured with a non-reinforced thermoplastic membrane.
 3. T-Patches: Pre-molded patch manufactured with a non-reinforced thermoplastic membrane.
 4. Penetration Pans: One-piece, molded unit with a square base flange slit on one side and with a welding tab.

2.4 RIGID BOARD INSULATION

- A. Rigid Uniform Thickness Insulation: where shown on the drawings, provide rigid closed-cell polyisocyanurate tapered insulation board with a thickness of 2 inches, integrally laminated to heavy black (non-asphaltic) fiber-reinforced felt facers, and complying with ASTM C1289, Type II, Class 1.
- B. Polyisocyanurate Board Insulation:
 - 1. Sika, Sarnatherm
 - 2. Johns Manville, Energy-3
 - 3. Or equal

2.5 ROOF COVER BOARD

- A. Cover boards for the roof shall be 1/4-inch over insulation and ½ inch thickness directly over metal decking. Provide roof boards with glass-mat facings bonded to water-resistant gypsum core and pre-primed with non-asphaltic coating as approved by insulation manufacturer.
- B. Roof Cover Board:
 - 1. DensDeck Prime by Georgia Pacific
 - 2. Securerock Gypsum Fiber by USG

2.6 DUCTWORK MATERIALS AND ACCESSORIES

- A. Sealant shall be non-hardening, water resistant, fire resistant, compatible with mating material, liquid used alone or with tape, or heavy mastic, meeting the fire hazard classification rating of 25/50 when tested in accordance with ASTM E84.
- B. Duct Sealer: Miracle #D-618, United McGill "UNI-WELD," United Sheet Metal "Duct-Sealer."
- C. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants; ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.7 JOINT SEALANTS

- A. Joint sealants shall be in accordance with Section 07920 and as recommended by roofing manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions under which roofing will be applied for compliance with requirements.
- B. Verify that roof openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.
- C. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at roof penetrations and terminations and match the thicknesses of insulation required.
- D. Do not proceed with installation until unsatisfactory conditions have been corrected.
- E. Determine the segments of above deck ventilation ducting that will need to be removed in order to remove the old roofing materials and/or install the new roofing materials. Immediately advise the Engineer if utilities that are not shown on the drawings are encountered. They shall not be disturbed until specific instructions are received from the Engineer.
- F. Verify drains are clear and functional prior to and after roof removal, correct any deficiencies before proceeding with roofing work.

3.2 PREPARATION

- A. At existing roof areas to be re-roofed, existing roofing shall be completely removed down to the steel metal decking substrate.
 - 1. The Contractor shall make use of a trash chute to remove the existing roofing from the buildings. Trucks or trash bins shall be parked or placed on areas designated by the Engineer. Prior to commencing demolition, all utilities and piping shall be located. Piping and utilities to remain in service shall be rerouted, supported and protected. Affected electrical equipment and circuits are to

be de-energized and locked out prior to demolition. Affected telephone, communications, and data lines shall be disconnected.

2. Throwing of roofing debris from the roofs shall not be allowed. Submit roof removal and disposal procedures to the Engineer for approval in the pre-installation conference.
 3. Properly dispose off-site all removed roofing debris. Items not designated to be salvaged shall be removed off site in a lawful manner.
 4. Roof removal shall be properly coordinated with the installation of all new work.
 5. Care should be taken to avoid any damage to the decks, curbs, flashings and/or walls during roof removal. Items damaged will be replaced in kind at contractor's expense.
 6. Roof decks shall not be left exposed overnight.
 7. Temporary protection of roof deck, in case of rain, is the Contractor's responsibility.
 8. The work area shall be cleaned at the end of each shift as directed by the Engineer.
- B. Existing Rooftop Equipment: Existing rooftop equipment and ventilation items (ventilators, exhaust fans, etc.) may be temporarily removed in order to facilitate the removal of the existing roof and the installation of the new roof. Prior to any removal, the Contractor shall isolate the ventilation control devices to prevent any damage to the ventilation system. If any ventilation ducting is removed, the Contractor shall ensure operation of the building's ventilation system to the maximum extent possible. The Contractor shall reinstall all temporarily removed rooftop equipment and validate that the ventilation system is fully operational to the engineer prior to completion of all work.
- C. Clean substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- D. Prevent materials from entering and clogging roof drains, ventilation ducting and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- E. Existing utilities, piping systems, and electrical and mechanical equipment to remain in place shall be adequately supported, protected, and maintained until work is complete. Potable water line can be removed and replaced if necessary.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install single-ply membrane roofing system according to roofing system manufacturer's written instructions and applicable recommendations of NRCA/SPRI.
- B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.
- C. Cooperate with inspecting and testing agencies engaged or required to perform services for installing single-ply membrane roofing system.
- D. Coordinate installing roofing system components so the interior of the building, insulation and deck is not exposed to precipitation or left exposed at the end of the workday or when rain is forecast. Only tear off as much roofing that can be covered in the same day, no phase roofing is allowed.
 1. Provide cutoffs at end of each day's work to cover exposed deck and insulation with an approved overnight tie in detail.
 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
 3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 COVERBOARD AND INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

- B. Install one or more layers of insulation under area of roofing to achieve required thickness. Where installing 2 or more layers creates overall insulation thickness, stagger the joints of each succeeding layer from joints of previous layer a minimum of 6 inches in each direction.
- C. Ensure perimeter mailers are flush or depressed approximately 1/8th inch to prevent restricting the flow of water into the gutters.
- D. Install insulation perpendicular to the metal roofing panels with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- E. Mechanical Attached Insulation: Mechanically fasten Coverboard into the roof deck through the insulation board with approved fasteners and plates at a rate of 12 fasteners/board (8 feet x 4 feet) in the central zone of the roof and 18 fasteners/board in the perimeter area. Increase the fastening rate to 32 in the corner zones. Coverboard and Insulation boards are to rest evenly on the roof deck avoiding air spaces between the boards and the substrate. Install each board tightly against the adjacent boards on all sides.

3.5 SINGLE-PLY MEMBRANE INSTALLATION

- A. The surface of the insulation or substrate shall be inspected prior to installation of the roof membrane. The substrate shall be clean, dry, free from debris and smooth with no surface roughness or contamination. Broken, delaminated, wet or damaged insulation boards shall be removed and replaced.
- B. Single-ply roofing membrane shall be attached with adhesive and perimeter fasteners according to Factory Mutual's requirements.
- C. Membrane overlaps shall be shingled with the flow of water where possible.
- D. Over the properly installed and prepared substrate, approved water based adhesive shall be poured out of the pail and spread using notched rubber squeegees. The adhesive shall be applied at a rate according to Manufacturers requirements. No adhesive is applied to the back of the membrane. Do not allow adhesive to skin-over or surface-dry prior to installation of membrane.
- E. The roof membrane is unrolled immediately into the wet adhesive. Adjacent rolls overlap previous rolls. This process is repeated throughout the roof area. Immediately after application into adhesive, each roll shall be pressed firmly into place with a water-filled, foam-covered lawn roller by frequent rolling in two directions.
- F. Weld cover strips at all seams that do not have a factory selvage edge.

3.6 MEMBRANE FLASHINGS

- A. All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary flashings shall be allowed without the prior written approval of the Engineer and Manufacturer's. Approval shall only be for specific locations on specific dates. If any water is allowed to enter under the newly completed roofing, the affected area shall be removed and replaced at the Contractor's expense. Flashing shall be adhered to compatible, dry, smooth, and solvent-resistant surfaces. Use caution to ensure adhesive fumes are not drawn into the building.
- B. Low VOC Adhesive for Membrane Flashings
 1. Over the properly installed and prepared flashing substrate, adhesive shall be applied according to instructions found on the Product Data Sheet. The adhesive shall be applied in smooth, even coats with no gaps, globs or similar inconsistencies. Only an area which can be completely covered in the same day's operations shall be flashed. The bonded sheet shall be pressed firmly in place with a hand roller.
 2. No adhesive shall be applied in seam areas that are to be welded. All panels of membrane shall be applied in the same manner, overlapping the edges of the panels as required by welding techniques.
 3. Install peelstop as required by the manufacturer with approved fasteners into the structural deck at the base of parapets, walls and curbs. Peelstop is required by manufacturer at the base of all tapered edge strips and at transitions, peaks, and valleys according to manufacturer's details.

4. Manufacturer's requirements and recommendations and the specifications shall be followed. All material submittals shall have been accepted by manufacturer prior to installation.
5. All flashings shall extend a minimum of 8 inches above roofing level unless otherwise accepted in writing by the Engineer and manufacturer technical department.
6. All flashing membranes shall be consistently adhered to substrates. All interior and exterior corners and miters shall be cut and hot-air welded into place. No bitumen shall be in contact with the roofing membrane.
7. All flashing membranes shall be mechanically fastened along the counter-flashed top edge.
8. Flashings shall be terminated according to manufacturer recommended details.
9. All flashings that exceed 30 inches in height shall receive additional securement as recommended by manufacturer.

3.7 METAL FLASHINGS

- A. Metal details, fabrication practices and installation methods shall conform to the applicable requirements of the following:
 1. Factory Mutual Loss Prevention Data Sheet 1-49 (latest issue).
 2. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - latest issue.
 3. Metal, other than that provided by Manufacturer, is not covered under the Manufacturer warranty.
 4. Complete all metal work in conjunction with roofing and flashings so that a watertight condition exists daily.
 5. Metal shall be installed to provide adequate resistance to bending to allow for normal thermal expansion and contraction.
 6. Metal joints shall be watertight.
 7. Metal flashings shall be securely fastened into solid wood blocking. Fasteners shall penetrate the wood nailer a minimum of 1 inch.
 8. Airtight and continuous metal hook strips are required behind metal fascias. Hook strips are to be fastened 12 inches on center into the wood nailer or masonry wall.
 9. Counter flashings shall overlap base flashings at least 4 inches.
 10. Hook strips shall extend past wood nailers over wall surfaces by 1- ½ inch minimum and shall be securely sealed from air entry.

3.8 PVC CLAD EDGE METAL

- A. All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary flashings shall be allowed without the prior written approval of the Engineer and Manufacturer. Acceptance shall only be for specific locations on specific dates. If any water is allowed to enter under the newly completed roofing due to incomplete flashings, the affected area shall be removed and replaced at the Contractor's expense.
- B. All metal flashings shall be fastened into metal base or solid wood nailers as recommended by manufacturer. Metal shall be installed to provide adequate resistance to bending and allow for normal thermal expansion and contraction.
- C. Adjacent sheets of PVC clad shall be spaced ¼ inch (6 mm) apart. The joint shall be covered with 2 inch (50 mm) wide aluminum tape. A 4 inch minimum (100 mm) wide strip of flashing membrane shall be hot-air welded over the joint. Exercise caution at perimeter of roof. Workers shall follow OSHA safety procedures.

3.9 TEMPORARY CUT-OFF

- A. All flashings shall be installed concurrently with the roof membrane in order to maintain a watertight condition as the work progresses. All temporary waterstops shall be constructed to provide a 100%

watertight seal. The stagger of the insulation joints shall be made even by installing partial panels of insulation. The new membrane shall be carried into the waterstop. The waterstop shall be sealed to the deck and/or substrate so that water will not be allowed to travel under the new or existing roofing. The edge of the membrane shall be sealed in a continuous heavy application of sealant. When work resumes, the contaminated membrane shall be cut out. All sealant, contaminated membrane, insulation fillers, etc. shall be removed from the work area and properly disposed of off-site. None of these materials shall be used in the new work.

- B. If inclement weather occurs while a temporary waterstop is in place, the Contractor shall provide the labor necessary to monitor the situation to maintain a watertight condition.
- C. If any water is allowed to enter under the newly-completed roofing, the affected area shall be removed and replaced at the Contractor's expense.

3.10 COMPLETION

- A. Prior to demobilization from the site, the work shall be reviewed by the Engineer and the Contractor. All defects noted and non-compliances with the Specifications or the recommendations of Manufacturer shall be itemized in a punch list. These items must be corrected immediately by the Contractor to the satisfaction of the Engineer and Manufacturer prior to demobilization.
- B. All Warranties referenced in this Specification shall have been submitted and have been accepted at time of contract award.

3.11 FIELD QUALITY CONTROL

- A. Upon completion of the installation and the delivery to Manufacturer by the Contractor of a certification that all work has been done in strict accordance with the contract specifications and Manufacturer's requirements, an inspection shall be made by a Technical Representative of Manufacturer to review the installed roof system.

3.12 PROTECTING AND CLEANING

- A. Protect roofing from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Engineer.
 - 1. Correct deficiencies in or remove membrane roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair base flashings to a condition free of damage and deterioration at the time of acceptance and according to warranty requirements.

END OF SECTION

SECTION 07600 - FLASHING AND SHEET METAL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all sheet metal work and appurtenant work, complete.
- B. The principal items of sheet metal work shall include sheet metal flashings, collars, pitch pockets, metal siding, equipment platforms, equipment supports at all roof penetrations, metal wall flashing and expansion joints, and miscellaneous sheet metal accessories.

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 07310 Metal Shingle Roofing System
 - 2. Section 07410 Metal Roofing System
 - 3. Section 07720 Roof Accessories
 - 4. Section 07920 Sealants and Caulking
 - 5. Section 09800 Protective Coating
 - 6. Section 09900 Architectural Paint Finishes
 - 7. Section 15430 Plumbing Specialties
 - 8. Section 16050 Basic Electrical Materials and Methods

1.3 CODES

- A. The 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. California Building Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. Federal Specifications:

QQ-T-201	Terneplate, For Roofing and Roofing Products
TT-P-641	Primer Coating, Zinc Dust-Zinc Oxide (For Galvanized Surfaces)
UU-B-790	Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellent and Fire Resistant)
 - 2. Commercial Standards:

ASTM A 176	Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 525	Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 526	Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM B 32	Specification for Solder Metal
ASTM B 209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM D 1187	Test Method for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D 2822	Specification for Asphalt Roof Cement

3. Trade Standards:

Sheet Metal and Air Conditioning Contractors National Association "Architectural Sheet Metal Manual" (ASMM)

The Aluminum Association "Specifications for Aluminum Sheet Metal Work in Building Construction"

American Welding Society (AWS)

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Color samples for color selection by the CONSTRUCTION MANAGER and product samples when requested by the CONSTRUCTION MANAGER for examination.
2. Shop drawings showing materials, gauges, finishes, layout, jointing, profiles, fabrication of special shapes, fasteners, and method of attachment to adjacent construction.
3. Manufacturers' catalogues indicating materials, finish, construction, and method of installation of prefabricated items and sealants.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. **Delivery of Materials:** Manufactured products shall be delivered in original, unbroken packages, containers or bundles bearing the name of the manufacturer in a manner that will prevent damage to the products.
- B. **Storage:** Products shall be carefully stored in a protected area that will prevent damage or marring of the products and their finishes.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Sheet metal shall be aluminum unless otherwise indicated. Sheet metal work in connection with roofing shall be in accordance with roofing manufacturer's published recommendations and specifications.
- B. All sheet metal flashings necessary to make building weathertight shall be provided, whether or not indicated.

2.2 ALUMINUM PRODUCTS

- A. Aluminum shall be 0.032-inch minimum thickness and shall conform to ASTM B 209, alloy 3003, temper H14, with dark bronze anodized finish AA-C12-A42 unless otherwise indicated. Thickness of aluminum to be welded shall be as necessary for the welding method used.
- B. Reglets shall be extruded aluminum with protective coating, of type and profile indicated, compatible with flashing indicated, non-corrosive.
 - 1. Manufacturer: Fry Reglets, "Spring Lok Flashing System Type SM or MA" as shown on the Drawings; MM Systems, Corp., or equal.
- C. Metal vent screeds shall be plaster channel screeds and shall be extruded aluminum with either clear plastic coating, clear anodized coating, or clear acrylic baked-on coating.

2.3 STAINLESS STEEL GUTTER AND DOWNSPOUT

- A. Terne-coated stainless steel for gutters and downspouts shall be 24 gage. The terne-coated stainless steel shall be marked by the manufacturer with indelible ink stamp stating the name of the manufacturer and the gage of each sheet.
- B. Nails shall be large-headed stainless steel nails not smaller than no. 12 stubs gage of sufficient length to firmly secure the materials in place without penetration of finished under surface of roof sheathing or lathing.
- C. Solder shall be 40% lead and 60% block tin.
- D. Flux shall be rosin.
- E. Sealant shall be ASTM C 920 or approved equal.

2.4 FERROUS METALS

- A. **Zinc-Coated Steel:** Zinc-coated steel shall be commercial quality with 0.20 percent copper, ASTM A 525 except ASTM A 527 for lock-forming, G90 hot-dip galvanized, mill phosphatized where indicated for painting; 0.0359-inch thick (20-gauge) except as otherwise indicated.
- B. Terne metal for roofing and roofing products shall be not less than 40 lb class conforming to Federal Specification QQ-T-201.

2.5 LEAD AND SOLDERING MATERIALS

- A. Lead shall be 4 to 6 percent antimony and the remainder shall be lead. Lead sheet shall be soft temper, except hard temper for flanges. Weight shall be not less than 4 lb/sq ft unless otherwise indicated.
- B. Solder shall conform to ASTM B 32 Alloy Sn50, 50 percent tin, 50 percent lead.
- C. Soldering flux shall not be injurious to metal surfaces being treated.

2.6 FASTENERS

- A. Fastening devices shall be of the same material as the sheet metal being used or corrosion-resistant metal compatible with sheet metal being used. Fasteners exposed to the weather shall have neoprene washers. Washers shall be 0.04-in minimum thickness. A rubber-type washer shall be used beneath the aluminum washer or fastener head where weathertightness is required.

2.7 PLASTIC CEMENT

- A. Plastic cement shall conform to ASTM D 2822.

2.8 SEALING MATERIALS

- A. Sealants shall be as indicated under Section 07920 or shall be of the silicone type. Colors shall be selected by the CONSTRUCTION MANAGER from manufacturer's standard colors.
- B. Sealer tape shall be polyisobutylene sealer tape specifically formulated for setting flanges on bituminous roofing.

2.9 COATING MATERIALS

- A. Primer coat for galvanized steel shall conform to Federal Specification TT-P-641G(1) Type II.
- B. Asphaltic coating compound shall conform to ASTM D 1187.

2.10 BUILDING PAPER OR FELT

- A. Building paper shall conform to UBC Standard 17-1 Class D for Kraft waterproof building paper.
- B. Asphalt or coal tar-saturated felt shall conform to UBC Standard 32-1.

2.11 SHOP FABRICATION REQUIREMENTS

- A. The WORK shall be shop-fabricated to greatest extent possible. Fabricator shall comply with details shown, and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. WORK shall be fabricated for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the WORK. The WORK shall be formed to fit substrates. Material manufacturer's instructions and recommendations for forming material shall be complied with. Exposed sheet metal work shall be formed without excessive oil-canning, buckling and too marks, true to line and levels indicated, with exposed edges folded back to form hems.
- B. **Seams:** Non-moving seams in sheet metal shall be fabricated with flat-lock seams.

For metal other than aluminum, tin the edges, form the seams, and **solder** them. Aluminum seams shall be formed with epoxy seam sealer; joints shall be riveted for **additional** strength where required.

- C. **Expansion Provisions:** Where lapped or bayonet-type expansion provisions in WORK cannot be used, or would not be sufficiently water/weatherproof, expansion joints shall be formed of intermeshing hooked flanges, not less than 1-inch deep, filled with mastic sealant within joints.
- D. **Sealant Joints:** Where movable, non-expansion type joints are indicated or required for proper performance of WORK, metal shall be formed to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.
- E. **Separations:** Separation shall be provided of metal from non-compatible metal or corrosive substrate by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.
- F. Gutters and downspouts shall be of sizes as shown with wire basket type strainers of 14-gauge stainless steel wire.
- G. All aluminum shall be welded unless otherwise indicated. Welding shall conform to the standards of the Aluminum Association and ASMM.
- H. Galvanized steel corner joints shall be soldered. Unless indicated otherwise, other joints shall be as required by the Reference Standards.
- I. All WORK and finishes shall be protected from scratches and abrasions.
- J. All flashings, reglets and counter-flashing and associated flashings shall be fabricated by the same manufacturer and be installed as a complete flashing system. All flashings shall be creased longitudinally or otherwise formed with sufficient spring action to hold the bottom edges firmly against the base flashing or similar material.
- K. Intersecting corners of copings shall be accurately fitted and welded. Corners may be shop-assembled, manufactured, or extruded units. Coping shall be per ASMM Plate 68 except modified as indicated, with Alternate 5 seams that allow for 1/4-inch expansion per each 10 ft of length.
- L. Access doors shall be provided as required or as indicated. Sizes and locations shall be as required by governing authorities, codes, and as indicated. Key-locked access doors shall be provided where indicated. Plumbing access doors shall conform to the requirements of Section 15430.
- M. Dryer vents shall be fabricated of aluminum dark bronze anodized or stainless steel and be provided with rain-hood and self closing flap, and interior and exterior escutcheon plates.
- N. Flashing required through concrete or clay tile shall be flexible flashing in order to assure against undue separation between tiles on account of rigidity of the flashing material. Flashing around pipes, vents, flues, chimneys, etc., shall be of lead, copper, or other flexible metal flashing material.

2.12 FABRICATED SHEET METAL WORK

- A. Scuppers in walls shall be constructed of 0.040-inch aluminum designed similar to ASMM Plate 26 with all joints welded. Scuppers without head through top course of masonry or concrete

shall be similar to ASMM Plate 29.

- B. Stamped sheet metal vents or louver-type vents (where indicated) shall be designed to provide watertight flush corners and shall be of size indicated. Each vent shall be equipped with 1/4-inch square galvanized or aluminum mesh hardware cloth insect screen. Stamped metal items shall be made of coated aluminum or galvanized sheet metal.
- C. Downspouts with conductor head 1/2-inch below gutter or scupper and hangers shall be designed similar to ASMM Plates 32 Fig. B and G, 25 Fig. C, and 35, Figure E, H or I. Connector shall be per Plate 33 Fig. B, Details 1 and 2 with funnel Fig. E (if possible) and with the joint between gutter and outlet welded or soldered. The downspout and conductor head shall be constructed of 1/16-inch aluminum and shall have all joints welded except the joint between head outlet pipe and downspout.
- D. Built-in gutter, downspout and hangers shall be designed similar to ASMM Plates 4 Gutter (similar), 9 and 10 Gutter Expansion Joint, 32 Fig. B Downspout, and Plate 35, Figure H for hangers. Downspout shall be constructed of 16 gauge metal and shall have all joints welded or soldered except the joint between the gutter outlet pipe and downspout. Gutter and gutter outlet pipe shall be fabricated from 40 lb terne metal, copper, and/or stainless steel. Expansion joints shall be spaced not more than 34-feet on centers, or as indicated. All joints shall be welded. Connector (outlet) shall be designed per Plate 33, Fig. B, detail 1 and 2 with funnel per Figure E if possible.
- E. All corners of vent screeds, reglets, and trim shall be mitered.
- F. Wall louvers shall be extruded aluminum louvers conforming to ASMM Plate 141, unless otherwise indicated. Louvers and screens shall have clear anodized finish. All exterior louvers shall be provided with 1/8-inch by 1/8-inch mesh bird screen and frame. Screen units shall be removable.
- G. Overflow scuppers in walls and parapets shall be constructed of 0.040-inch thick aluminum sheet similar to ASMM Plate 30. All joints shall be welded, and inlet shall be installed no more than 2 inches above roof drain rim (low point of roof).
- H. Access doors shall be of the types necessary to suit job conditions.
- I. Pitch pockets and equipment coping and support flashings shall conform to the reference standards and shall be provided where necessary.
- J. Sheet metal items at roof penetrations shall be provided and coordinated with the roofing system. The design and details shall conform to the standards unless otherwise indicated.
- K. The following flashings shall be provided at roof penetrations:
 - 1. Vent pipes: Lead collars vent pipe flashing with top of lead sleeve flashing bent into vent pipe. (ASMM. Plates 66 Fig. B and 71 Fig.A).
 - 2. Single pipes: Sheet metal or lead collars with sheet metal or lead draw band with sealant or cap top. (ASMM. Plates 65 and 66 Fig. C).
 - 3. Multi-pipes: Lead collars with caps.
 - 4. Multi-pipes w/curb: Sheet metal with sealant and draw bands. (ASMM. Plate 65, Fig. B, or Plate 66, Fig. A).

5. Equipment support: Sheet metal. (ASMM. Plate 68).
6. Roof penetrations: Sheet metal (ASMM Plate 67).
7. Sleeper covers: Sheet metal. (ASMM. Plate 66, Fig. C and D).
8. Pitch pockets for supports: Sheet metal with all joints welded or soldered. (ASMM. Plate 68, Fig. E).
9. Ducts with curb (1): Sheet metal. (ASMM. Plate 148, Fig. B).
10. Equipment platform (1): Sheet metal. (ASMM. Plate 136, Fig. B and Section A.A).

Note (1): Prefabricated products, curbs, supports, and platforms which are part of mechanical equipment indicated in other Sections of these Specifications shall be provided in compliance with those Sections.

- L. Work bench covering shall consist of tops, box curbs, splashes, edging, and end enclosures (where visible). Work bench top cover shall be 16-gage galvanized steel sheet metal formed over a solid core. The top, back, and edges shall have all joints butt welded and ground to provide a smooth finished unit with no sharp edges or corners.

2.13 MANUFACTURERS

- A. Products shall be of the following manufacture and model number (or equal):
 1. Reglets: Superior Concrete Accessories; Morrison and Company "Cushion-Lock"; Fry Reglet.
 2. Sealer Tape: Morrison and Company CL-50.
 3. Metal Siding: Reynolds Aluminum Co.; Smith Construction Products.
 4. Metal Vent Screed: Fry Reglet Corp., Model PCS-V-30; H.K. Porter Co.
 5. Access Doors: Milcor Division of Inryco, Inc.; Karp Associates, Inc.; Inland Ryerson Steel Corporation.
 6. Lead Collar: Stoneman Engineering and Mfg. Co.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Except as otherwise indicated, installer shall comply with manufacturer's installation instructions and recommendations, and with SMACNA "Architectural Sheet Metal Manual." Units of work shall be anchored securely in place by methods indicated, providing for thermal expansion of metal units; fasteners shall be concealed where possible, and units set true to line and level as indicated. WORK shall be installed with laps, joints and seams which will be permanently watertight and weatherproof.
- B. The CONTRACTOR shall coordinate the flashings and sheet metal WORK required with the

different trades to make sure all items which penetrate the roof are provided with all necessary sheet metal products. Sheet metal shop manufactured curbs, equipment supports, and equipment platforms shall be provided where prefabricated curbs, supports or platforms are not indicated to be provided in other Sections of these Specifications.

- C. All WORK shall conform to Trade Standards. Flashings shall be coordinated with roofing WORK. Sheet metal and roofing shall provide a weather-tight and watertight assembly.
- D. Sheet metal shall be accurately formed to the dimensions and shapes indicated. WORK shall be fitted snugly, with straight, true lines with exposed faces aligned in proper plane, free from waves and buckles. Arrises and angles shall have true and sharp lines, and surfaces shall be free from waves and buckles. All exposed edges shall be hemmed. Holes for fasteners within sheet metal WORK exposed to temperature changes shall be elongated holes for material expansion and movement.
- E. All sheet metal WORK shall be furnished complete with supports, hangers, bracing, anchors, and other devices as required for reinforcement and proper attachment to adjacent construction. Fastenings shall be concealed wherever possible. Joints, fastenings, reinforcements, and supports shall be sized and located as required to preclude distortion or displacement due to thermal expansion and contraction.
- F. All surfaces upon which sheet metal is to be placed shall be dry, smooth, even, and free of any projections and hollows. Sheet metal shall be laid with all joints true and even and firmly attached with all fastener heads flush with the top surface.
- G. The underlayment shall be overlapped at least 2 inches so as to shed water and shall be secured along the lapped edges. Aluminum or stainless steel fasteners shall be used with aluminum sheet metal.
- H. Dissimilar materials shall be isolated with 2 coats of asphaltic paint, asphaltic coating compound, or sealer tape. Only stainless steel fasteners shall be used to connect isolated dissimilar metals.
- I. Joints shall be sized and spaced to permit sheet movement for thermal expansion and contraction of 1/4-inch per 10-ft length, on 100 degree F temperature difference.
- J. Roofing sheet metal items shall be built into the roofing in strict accordance with directions of roofing manufacturer.

3.2 INSTALLATION

- A. Gutters shall be provided with baffle-type expansion joints with expansion caps over 1-1/2-inch baffle flanges at 40-ft centers. A 1-inch gap between the baffles shall be allowed.
- B. Flashings at vertical surfaces shall be installed at intersections of the roof with vertical surfaces and at projections through the roof. Corner units shall be factory-fabricated and shall have mitered soldered or welded corner joints, and shall be installed with 3-inch (min) lap joint over flashings on each side.
- C. Gutters shall be provided to the indicated cross-section, complete with shop-fabricated corners, outlet (nipple) sections, joining plates, concealed hangers and downspouts with standoff brackets.
- D. Gravel stops and copings shall have joints at 10-ft (max) spacing and at 2-1/2 feet from

corners. Joints shall be butted with 3/16-inch space centered over matching 8-inch long backing plate with sealer tape in laps. Corner units shall be welded units. All joints shall be provided with cover plates.

- E. Flanges of sheet metal items shall be set on continuous sealer tape on the top edge envelope ply of roofing. Flanges shall be nailed through sealer tape at 3-inch (max) spacing or otherwise securely fastened in an approved manner.
- F. Stainless steel wainscots shall be set in waterproof adhesive and surface screwed into blocking with countersunk flat head stainless steel screws at bottom. Top and sides shall have concealed hemmed edges and be concealed cleat fastened.
- G. Attachment of the metal top of work benches to the wood core shall be done by cementing the materials together under sufficient pressure to assure a complete bond and installation of No. 8 by 1-inch stainless steel flathead wood screws, countersunk at 8-inch centers. Top shall be cleaned of all rust, scale, and foreign substances and finished by oiling.
- H. Stamped sheet metal vents or louver-type vents shall be painted with a protective coating complying with Section 09800 after installation.

3.3 CLEANING AND PROTECTION

- A. Exposed metal surfaces shall be cleaned, removing substances which might cause corrosion of metal or deterioration of finishes.
- B. **Protection:** Installer shall advise CONTRACTOR of required procedures for surveillance and protection of flashings and sheet metal work during construction, to ensure that WORK will be without damage or deterioration, other than natural weathering, at time of substantial completion.

**** END OF SECTION ****

SECTION 07720 - ROOF ACCESSORIES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all roof accessories and appurtenant work as needed to construct a complete roofing system with the roof accessories.

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 07410 Metal Roofing System
 - 2. Section 07540 Single-Ply Fully Adhered Membrane Roofing
 - 4. Section 07600 Flashing and Sheet Metal
 - 5. Section 09800 Protective Coating

1.3 CODES

- A. The 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 Building Code
 - 2. Uniform Fire Code
 - 3. National Electrical Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. Trade Standards:
 - National Roofing Contractors Association (NRCA).

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Manufacturer's specifications, literature, and published installation instructions for each roof accessory, product, or system.
 - 2. Shop drawings for each product showing materials, gauges, sizes, finishes, profiles, fabrication of special shapes, fasteners, and method of attachment to adjacent construction shall be submitted.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken,

packages, containers, or bundles bearing the name of the manufacturer.

- B. **Storage:** Products shall be carefully stored on wood blocking in an area that is protected from all deleterious elements. Storage shall be in a manner that will prevent damage or marring of the products and their finishes.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Roof accessories and their installation shall be in accordance with the manufacturer's literature and published specifications for the products indicated.
- B. Sizes indicated are minimum throat size.
- C. Hatches, fire hatches, and openable fire and smoke hatch with skylights shall be provided complete with all necessary hardware. Hatch hardware shall be stainless steel products. Hardware for hatches shall include the following: inside-outside handles and latching hardware which is padlockable from either side, hinges, compression struts, and neoprene gaskets for weatherstripping.
- D. Roof hatches and openable fire and smoke hatches with skylights shall be insulation lined and weatherstripped metal covered designed hatch units with insulated metal integral flange curb (12-inch minimum height).

2.2 ROOF VENTS

- A. Roof relief vents with bird screens shall be provided, and shall be of the type recommended by the National Roofing Contractor's Association and approved by the roofing manufacturer.

2.3 ROOF HATCHES

- A. Roof hatches, scuttles, and equipment hatches shall be constructed of aluminum, unless otherwise indicated. Roof hatches shall be of the type and size indicated.

1. Roof hatch, single leaf, 3-ft x 3-ft

2.4 OPENABLE FIRE AND SMOKE HATCH WITH SKYLIGHT

- A. The fire and smoke hatch shall be a factory-assembled, mechanically-activated hatch with curb. The hatches shall consist of a double white translucent cast acrylic dome mounted on an extruded aluminum condensation gutter and curb frame, on an extruded aluminum retaining frame and shall be complete with all necessary hardware. The top shall open automatically when fusible link is broken.

2.5 BERMUDA-TYPE ROOF VENTILATOR (ATTIC VENT)

- A. Roof attic vents shall be fiberglass, bermuda-type roof ventilators complete with one-piece, molded vent hood with integral mounting frame in each corner braced vertically as well as horizontally. The ventilators shall include a one-piece molded curb with integral internal weather baffle, molded-in cant strip, and a plastic coated galvanized bird screen.

2.6 PREFABRICATED CURBS

- A. Opening dimensions shall be coordinated with skylight penetrations, duct penetration, and roof-mounted equipment sizes. Heights shall be as required to place top of curb not less than 8 inches above top of insulation unless otherwise indicated. Top of curb shall be level. Sides of curbs shall be adjusted in accordance with field conditions and roof slopes. Base flange shall be not less than 4 inches wide. Curbs shall be fabricated of 14 gauge or thicker galvanized steel with continuously welded corners and shall be provided with a pressure preservative treated, kiln dried, fire-treated wood nailer at top.

2.7 MANUFACTURERS

- A. Products shall be of the following manufacturer and type or model (or equal):
 - 1. Roof Hatches:
 - a. Single leaf: Bilco S-50; Milcor RDS-1; Babcock Davis 7-104
 - 2. Prefabricated Curbs:
 - a. Pate Company
 - b. S & L Manufacturing Company
 - c. Thybar Corporation

PART 3 -- EXECUTION

3.1 GENERAL

- A. The installation shall conform to applicable codes and the manufacturer's published or written recommendations, specifications, and installation instructions for the type of work being performed.
- B. All roof openings, roof-mounted equipment, duct openings and skylights shall be provided with a prefabricated curb unless the equipment above the roof opening is supplied with its own curb which extends to 8 inches or higher beyond the top of the roof insulation.

3.2 INSTALLATION

- A. Roof hatches, openable fire and smoke hatches, and roof ventilators shall be installed over prepared openings with their own curb or an prefabricated curbs, and shall be fastened to the roof deck in accordance with the manufacturer's printed directions. Lifting mechanisms and accessories shall be adjusted to insure proper operation. Abraded prime and finish coat surfaces shall be touched-up after completion of installation with the same type of finish and the same dry-film thickness. Primer coats of hatches and ventilators exposed to view after installation shall be primed with a primer coat that is compatible with the finish coating system.
- B. **Roof Hatches:** Dissimilar metals shall be properly isolated. Thermal movement for up to 100 degrees F change shall be accommodated without distress in assembly of fasteners.
- C. **Roof Vents:** Roof vents shall be provided on lightweight concrete or lightweight insulating concrete and shall be placed in such a manner so that one vent will be used for venting 1,000 square feet of roof fill. No area shall have fewer than 2 vents. Vents shall not be installed in walk pads or other traffic areas. Vent pipes shall have a coat of plastic cement applied at the joint between the vent pipe and the roofing before aggregate is applied. Roof insulation shall be removed from below each vent per NRCA instructions. Roof vents shall be painted to match roofing color.
- D. Roof accessory metal items exposed to the exterior atmosphere shall be painted with a protective coating complying with Section 09800.

** END OF SECTION **

SECTION 07905 - JOINT SEALERS

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing joint sealers and appurtenant WORK, complete.

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 07920 Sealants and Caulking
2. Section 03280 Joints in Sitework Concrete
3. Section 03290 Joints in Concrete Structures

1.3 CODES

- A. The 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. California Building Code

1.4 SPECIFICATIONS AND STANDARDS

Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

ASTM C 719	Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement
ASTM C 790	Recommended Practices for Use of Latex Sealing Compounds
ASTM C 804	Recommended Practices for Use of Solvent-Release Type Sealants
ASTM C 834	Specification for Latex Sealant Compounds
ASTM C 919	Practice for Use of Sealants in Acoustical Applications
ASTM C 920	Specification for Elastomeric Joint Sealants
ASTM C 962	Guide for Use of Elastomeric Joint Sealants
ASTM D 412	Test Methods for Rubber Properties in Tension
ASTM D 1056	Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 2628	Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete
ASTM D 3405	Specification for Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements
ASTM D 3406	Specification for Joint Sealant, Hot-Poured, Elastomeric-Type, for Portland Cement Concrete Pavement

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
1. **Product Data:** Manufacturer's recommended applications and technical data for each joint sealer product required, including instructions for joint preparation and joint sealer application.
 2. **Samples for Initial Selection Purposes:** Submit manufacturer's standard bead samples consisting of strips of actual products showing the full range of colors available, for each product exposed to view.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken packages or containers bearing the manufacturer's label. Packages or containers shall be delivered to the site with seals unbroken.
- B. Manufacturer's labels shall bear name of manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multi-component materials.
1. **Storage:** All materials shall be carefully stored in an area that is protected from deleterious elements and in a manner recommended by the product manufacturer. Storage and handling of materials shall be in such a manner as to prevent deterioration or damage due to moisture, temperature changes, contaminants or other causes.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Manufacturer's Recommendations:** Only products recommended for the specific application indicated shall be used.
- B. **Single Source Responsibility:** All joint sealer materials for a specific application shall be obtained from a single manufacturer.
- C. **Compatibility:** Joint sealers, joint fillers, and other related materials shall be provided which are compatible with one another and with joint substrates under the indicated conditions of service and application, as demonstrated by manufacturer's testing and field knowledge.
- D. **Colors:** Colors of exposed joint sealers shall be provided as indicated or, if not otherwise indicated, as selected by the CONSTRUCTION MANAGER from manufacturer's standard colors. See Section 03290 "Joints in Concrete Structures" for color of sealant to match color of integrally colored concrete at cast-in-place architectural concrete.

2.2 ELASTOMERIC JOINT SEALANTS

- A. **Elastomeric Sealant Standards:** Manufacturer's standard chemically curing elastomeric sealant shall be of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.
1. **Two-Part Nonsag Polysulfide Sealant:** Type M; Grade NS; Class 12 1/2; Uses NT, M, G, A, and as applicable to the joint substrate indicated, Use O.
 2. **Two-Part Pourable Polysulfide Sealant:** Type M; Grade P; Class 12 1/2; Uses T, M, G, A, and, as applicable to the joint substrates indicated, Use O.
 3. **Two-Part Water Immersion Polysulfide Sealant:** Type M; Grade NS; Class 12 1/2; Uses T, M, G, A, and, as applicable to the joint substrates indicated, Use O; with a history of successful field knowledge in sealing joints immersed intermittently or continuously in water.
 4. **One-Part Polysulfide Sealant:** Type S; Grade NS; Class 12 1/2; Uses T, M, G, A, and, as applicable to joint substrates indicated, Use O.
 5. **One-Part Non-Acid-Curing Silicone Sealant:** Type S; Grade NS; Class 25; and complying with the following requirements for Uses NT, M, G, A, and, as applicable to joint substrates indicated, Use O. Modulus and additional joint movement capabilities as follows:
 - a. Low Modulus: Tensile strength of 45 psi or less at 100 percent elongation when tested after 14 days at 77 degrees F and 50 percent relative humidity per ASTM D 412.
 - b. Medium Modulus: Tensile strength of not less than 45 nor more than 75 psi or less at 100 percent elongation when tested after 14 days at 77 degrees F and 50 percent relative humidity per ASTM D 412.
 - c. Additional capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, withstand 50 percent increase and decrease of joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920.
 6. **One-Part Acid-Curing Silicone Sealant:** Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to joint substrates indicated, Use O.
 7. **One-Part Mildew-Resistant Silicone Sealant:** Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, Use O; formulated with fungicide for sealing interior joints with nonporous substrates around ceramic tile, showers, sinks and plumbing fixtures.
 8. **Two-Part Non-Acid Curing Silicone Sealant for Use T:** Type M; Grade NS; Class 25; Uses T, M, and, as applicable to joint substrates indicated, Use O; and complying with the following requirement for additional joint movement capability:
 - a. Additional capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand an increase and decrease of 50

percent of joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920.

9. **Multi-Part Nonsag Urethane Sealant:** Type M; Grade NS; Class 25; Uses NT, M, G, A, and, as applicable to joint substrates indicated, Use O.
10. **Two-Part Nonsag Low-Modulus Urethane Sealant:** Type M; Grade NS; Class 25; Uses NT, M, A, and as applicable to joint substrates indicated, Use O; with additional capability to withstand an increase and decrease of 50 percent of joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920, based on manufacturer's recommendations and testing.
11. **Two-Part Pourable Urethane Sealant:** Type M; Grade NS; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, Use O.
12. **Two-Part Nonsag Urethane Sealant for Use T:** Type M, Grade NS; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, Use O.
13. **One-Part Nonsag Urethane Sealant:** Type S; Grade NS; Class 25; Uses NT, M, A, and, as applicable to joint substrates indicated, Use O.
14. **One-Part Nonsag Low-Modulus Urethane Sealant:** Type S; Grade NS; Class 25; Uses NT, M, A, and, as applicable to joint substrates indicated, Use; with additional capability to withstand an increase and decrease of 50 percent of joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920, based on manufacturer's recommendations and testing.
15. **One-Part Pourable Urethane Sealant:** Type S; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, Use O.

2.3 SOLVENT RELEASE CURING JOINT SEALANTS

- A. **Acrylic Sealant:** Manufacturer's standard one-part, nonsag, solvent release curing, acrylic terpolymer sealant complying with ASTM C 920 for Type S; Grade NS; Uses NT, M, G, A, and, as applicable to joint substrates indicated, Use O; except for selected test properties which are revised as follows:
 1. Heat aged hardness - 40 to 50
 2. Weight loss - 15 percent
 3. Maximum cyclic movement capability (Class) - plus or minus 7-1/2 percent
- B. **Butyl Sealant:** Manufacturer's standard one-part, nonsag, solvent release curing, polymerized butyl sealant complying with FS TT-S-001657 for Type I and formulated with minimum of 75 percent solids to be nonstaining, paintable, and have a tack-free time of 24 hours or less.
- C. **Pigmented Small Joints Sealant:** Manufacturer's standard, solvent release curing, pigmented, synthetic rubber sealant formulated for sealing joints 3/16-inch or smaller in width.

2.4 LATEX JOINT SEALANTS

- A. **Acrylic-Emulsion Sealant:** Manufacturer's standard, one-part, nonsag, acrylic, mildew resistant, acrylic-emulsion sealant complying with ASTM C 834, formulated to be paintable

and recommended for exposed applications on interior and on protected exterior exposures involving joint movement of not more than plus or minus 7.5 percent.

2.5 MISCELLANEOUS JOINT SEALANTS

- A. **Acoustical Sealant for Concealed Joints:** Manufacturer's standard, **nondrying**, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmissions of airborne sound.
- B. **Butyl-Polyisobutylene Sealant:** Manufacturer's standard solvent release curing, butyl-polyisobutylene sealant recommended for concealed joints.
- C. **Butyl-Polyisobutylene Tape Sealant:** Manufacturer's standard, solvent-free, butyl-polyisobutylene tape sealants with a solids content of 100 percent; formulated to be nonstaining, paintable, and non-migrating in contact with nonporous surfaces; packaged on rolls with release paper on one side; with or without reinforcement thread to prevent stretching.

2.6 COMPRESSION SEALS

- A. **Preformed Foam Sealant:** Manufacturer's standard preformed, precompressed, impregnated open-cell foam sealant manufactured from high-density urethane foam impregnated with a nondrying, water repellent agent; factory-produced in precompressed sizes and in roll or stick form to fit joint widths indicated and to develop a watertight and airtight seal when compressed to the degree specified by the manufacturer. Provide products which are permanently elastic, mildew-resistant, non-migratory, nonstaining, compatible with joint substrates and other joint sealers, and comply with the following requirements:
 - 1. **Impregnating agent:** Manufacturer's standard
 - 2. **Density:** Manufacturer's standard
 - 3. **Backing:** Pressure sensitive adhesive, factory applied to one side, with protective wrapping or coated on one face with release agent serving as bond breaker for primary joint sealant.
- B. **Preformed Hollow Neoprene Gasket:** Manufacturer's standard preformed polychloroprene elastomeric joint seal of the open-cell compression type complying with ASTM D 2628 and with requirements indicated for size, profile and cross-section design.

2.7 JOINT SEALANT BACKING

- A. **General:** Provide sealant backings of material and type which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers.
- B. **Plastic Foam Joint-Fillers:** Preformed, compressible, resilient, non-waxing, non-extruding strips of either flexible, open cell polyurethane foam or non-gassing, closed-cell polyethylene foam, subject to sealant manufacturer's approval; and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

- C. **Bond-Breaker Tape:** Polyethylene tape or other plastic tape as recommended by the sealant manufacturer for preventing bond between sealant and joint filler or other materials at the back or third surface of the joint. Provide self-adhesive tape where applicable.
- D. **Elastomeric Tubing Joint Fillers:** Neoprene, butyl or EPDM tubing complying with ASTM D 1056, non-absorbent to water and gas, capable of remaining resilient at temperatures down to minus 26 degrees F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth and otherwise contribute to optimum sealant performance.

2.8 MISCELLANEOUS MATERIALS

- A. **Primer:** Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated.
- B. **Cleaners for Nonporous Surfaces:** Provide non-staining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials which are not harmful to substrates and adjacent nonporous materials.
- C. **Masking Tape:** Provide non-staining, non-absorbent type compatible with joint sealants and with surfaces adjacent to joints.

2.9 MANUFACTURERS

- A. Products of the type indicated shall be manufactured by one of the following (or equal):

- 1. **Two-Part Nonsag Polysulfide Sealant:**

- Bostik Construction Products Division, [Chem-Calk 200]
 - W.R. Meadows, Inc., [CM-60]

- 2. **Two-Part Pourable Polysulfide Sealant:**

- Bostik Construction Products Division, [Chem-Calk 250]

- 3. **Two-Part Water Immersion Polysulfide Sealant:**

- Bostik Construction Products Division, [Chem-Calk 400]

- 4. **One-Part Polysulfide Sealant:**

- Bostik Construction Products Division, [Chem-Calk 100]
 - Pecora Corp., [Synthacalk GC-9]

- 5. **One-Part Non-Acid Curing Low-Modulus Silicone Sealant:**

- Bostik Construction Products Division, [Chem-Calk 1000]
 - Dow Corning Corp., [Dow Corning 790]

- 6. **One-Part Non-Acid Curing Medium-Modulus Silicone Sealant:**

Dow Corning Corp., [Dow Corning 795]
General Electric Co., [Silpruf]

7. **One-Part Acid-Curing Silicone Sealant:**

Bostik Construction Products Division, [Chem-Calk 1200]
Dow Corning Corp., [Dow Corning 999]

8. **One-Part Mildew-Resistant Silicone Sealant:**

Dow Corning Corp., [Dow Corning 786]
General Electric Co., [SCS 1702]

9. **Two-Part Non-Acid Curing Silicone Sealant for Use T:**

Dow Corning Corp., [Dow Corning 888]

10. **Multi-Part Nonsag Urethane Sealant for Uses NT, M, G, A, and O:**

Bostik Construction Products Division, [Chem-Calk 500]
Pecora Corp., [Dynatrol II]

11. **Two-Part, Nonsag Low-Modulus Urethane Sealant:**

Mameco International, Inc., [Vulkem 922]

12. **Two-Part, Pourable, Urethane Sealant:**

Bostik Construction Products Division, [Chem-Calk 550]
Mameco International, Inc., [Vulkem 245]

13. **Two-Part Nonsag Urethane Sealant for Use T:**

Pecora Corp., [Dynatred]

14. **One-Part Nonsag Urethane Sealant:**

Pecora Corp., [Dynatrol II]

15. **One-Part Nonsag Low-Modulus Urethane Sealant:**

Mameco International, Inc., [Vulkem 921]
Sika Corp., [Sikaflex-15LM]

16. **One-Part, Pourable, Urethane Sealant:**

Mameco International, Inc., [Vulkem 45]
Pecora Corp., [NR-201 Urexpan]

17. **Acrylic Sealant:**

Bostik Construction Products Division, [Chem-Calk 800]
Pecora Corp., [60+Unicrylic]

18. **Butyl Sealant:**

Bostik Construction Products Division, [Chem-Calk 600]
Pecora Corp., [BC-158]

19. **Pigmented Small Joint Sealant:**

Protective Treatments, Inc., [PTI 200]
Tremco, Inc., [Tremco Seam Sealer]

20. **Latex Joint Sealers:**

Bostik Construction Products Division, [Chem-Calk 600]
Pecora Corp., [AC-20]

21. **Acoustical Sealants for Concealed Joints:**

Pecora Corp., [BA-98]
Tremco, Inc., [Tremco Acoustical Sealant]

22. **Butyl-Polyisobutylene Sealant:**

Protective Treatments, Inc., [PTI 404]

23. **Butyl-Polyisobutylene Tape Sealant:**

Pecora Corp., [Extru-Seal Tape]
Protective Treatments, Inc., [PTI 606]

24. **Compression Seals:**

Emseal Corp., [Emseal Greyflex]
Illbruck, [Will-Seal Tape Type 250]
Sandell Manufacturing Co., Inc., [Polytite Standard]

25. **Preformed Hollow-Neoprene Gasket:**

Acme Highway Products Corp.
Watson Bowman Associates, Inc.

PART 3 -- EXECUTION

3.1 PROJECT CONDITIONS

- A. **Environmental Conditions:** CONTRACTOR shall not proceed with installation of joint sealers under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by the joint sealer manufacturers.
 2. When joint substrates are wet due to rain, frost, condensation, or other causes.
- B. **Joint Width Conditions:** Installation of joint sealers shall not proceed when joint widths are less than, or more than, allowed by the joint sealer manufacturer for the application indicated.

3.2 PREPARATION

- A. **Surface Cleaning of Joints:** All joints shall be cleaned out immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers and the following requirements:
1. All foreign material shall be removed from joint substrates which could interfere with adhesion of joint sealer, including dust; paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer) oil; grease; waterproofing; water repellents; water, and surface dirt.
 2. Concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces shall be cleaned by brushing, grinding, blast cleaning, mechanical abrading, acid washing or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers. Loose particles remaining from the above cleaning operations shall be removed by vacuuming or blowing out joints with oil-free compressed air.
 3. Laitance and form release agents shall be thoroughly removed from all concrete surfaces.
 4. Metal, glass, porcelain enamel, glazed surfaces of ceramic tile and other non-porous surfaces shall be cleaned with chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.
- B. **Joint Priming:** Joint substrates shall be primed where indicated or where recommended by joint sealer manufacturer. Primer shall be applied so as to comply with joint sealer manufacturer's recommendations. Primers shall be confined to areas of joint sealer bond. Spillage or migration onto adjoining surfaces shall not be allowed.
- C. **Masking Tape:** Masking tape shall be used where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Tape shall be removed immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

- A. **General:** Unless otherwise indicated, comply with joint sealer manufacturers' printed installation instructions.

- B. **Elastomeric Sealant Installation Standard:** Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications and conditions indicated.
- C. **Solvent-Release-Curing Sealant Installation Standard:** Comply with requirements of ASTM C 804 for use of solvent-release-curing sealants.
- D. **Latex Sealant Installation Standard:** Comply with requirements of ASTM C 790 for use of latex sealants.
- E. **Acoustical Sealant Application Standard:** Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications and conditions indicated.
- F. **Installation of Sealant Backings:** Install sealant backings to comply with the following requirements:
 - 1. Install joint-fillers of the types indicated to produce support of sealants during application and at position necessary to produce the required cross-sectional shapes and depths.
 - a. Do not leave gaps between ends of joint-fillers.
 - b. Do not stretch, twist, puncture or tear joint-fillers.
 - c. Remove absorbent joint-fillers which have become wet prior to sealant application and replace with dry material.
 - 2. Install bond breaker tape between sealants and joint-fillers, compression seals or back of joints, where required to prevent third-side adhesion of sealant to back of joint.
 - 3. Install compressible seals serving as sealant backings to comply with requirements indicated above for joint-fillers.
- G. **Installation of Sealants:** Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.
- H. **Tooling of Nonsag Sealants:** Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by the sealant manufacturer.
 - 1. Concave joint configuration per Figure 6A in ASTM C 962, unless otherwise indicated.
 - 2. Flush joint configuration per Figure 6B in ASTM C 962, where indicated.

3. Recessed joint configuration per Figure 6C in ASTM C 962, of recess depth and at locations indicated.

a. Where necessary, use masking tape to protect adjacent surfaces of tooled joints.

I. **Installation of Preformed Foam Sealants:** Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and complying with sealant manufacturer's directions for installation methods, materials and tools which produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.

J. **Installation of Preformed Hollow Neoprene Gaskets:** Install gaskets, with minimum number of end joints, in joint recesses with edges free of spalls and sides straight and parallel, both within tolerances specified by gasket manufacturer. Apply manufacturer's recommended adhesive to joint substrates immediately prior to installing gaskets. For straight sections provide gaskets in continuous lengths; where changes in direction occur, adhesively splice gasket together to provide watertight joints. Recess gaskets below adjoining surfaces by 1/8 inch to 1/4 inch.

3.4 PROTECTION AND CLEANING

A. Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers and reseal joints with new materials to produce installations with repaired areas indistinguishable from original work.

B. Clean off excess sealants or sealant smears adjacent to joints as WORK progresses, by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

** END OF SECTION **

SECTION 07920 - SEALANTS AND CAULKING

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing sealants, caulking, and accessories.

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 03280 Joints in Sitework Concrete
 - 2. Section 03290 Joints in Concrete Structures
 - 3. Section 07905 Joint Sealers
 - 4. Section 08800 Glazing

1.3 CODES

- A. The 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. California Building Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

ASTM C 920	Elastomeric Joint Sealants
Fed. Spec. TT-S-001543A	Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Buildings and Other Structures).
Fed. Spec. TT-S-00230C(2)	Sealing Compound, Elastomeric Type, (For Caulking, Sealing, and Glazing in Buildings and Other Structures).

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Manufacturer's product data including catalogue cuts.
 - 2. Manufacturer's installation instructions.
 - 3. Certification that products comply with indicated requirements.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Products 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 deleterious elements.

1.7 PROJECT CONDITIONS

- A. **Environmental Limitations:** Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
- B. **Joint-Width Conditions:** Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

PART 2 - PRODUCTS

2.1 GENERAL

- A. **General:** Only products certified as complying with the indicated requirements shall be provided.
- B. **Products:** Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.
- C. **Manufacturer's Recommendations:** Products shall be recommended by the manufacturer for the application indicated.
- D. **Colors:** See Section 03290 "Joints in Concrete Structures" and Section 07905 "Joint Sealers".

2.2 SEALANTS AND CAULKING MATERIALS

- A. **Caulking and sealing materials shall conform to the following requirements:**
 - 1. Sealant for exterior and interior use shall be 2-part polyurethane, gun grade.
 - 2. Sealant for interior use shall be 1-part acrylic triopolymer sealant.
 - 3. Sealants used with aluminum doors, windows, storefronts, and frames shall be silicone sealant conforming to Federal Specifications TT-S-001543A (Class A) and TT-S-00230C(2) (Type II, Class A).
 - 4. Acoustic caulking compound shall be nonskinning synthetic polymer.
 - 5. Acoustic sheet caulking shall be resilient synthetic polymer, self-adhesive, 1/8-inch thick sheet acoustic sealer.

6. Fire-resistant penetration sealants shall be a medium density fire-resistant foam that retains form and stability at high temperature and meets UL test requirements for fire rating required at location used.
7. Caulking tapes shall be of the butyl-base, vulcanized type.
8. Filler material shall be resilient, closed-cell polyethylene foam and/or bond breakers of proper size for joint widths and shall be compatible with sealant manufacturer's product.
9. Primers shall be as recommended by the manufacturer for caulking and sealants.
10. Cleaning and cleanup solvents shall be as recommended by the manufacturer for caulking and sealants.

2.3 MANUFACTURERS

A. Products shall be of the type and manufacture as indicated below (or equal):

1. Sealant for Exterior and Interior Use:

Sika 15LM
Vulkem 931

2. Sealant for Interior Use:

Tremco's "Mono"
Sonneborn Sonolac
Dap "One-Part Acrylic"

3. Acoustic Caulking Compound:

Presstite "579.64"
Lowry "Acoustical Sealer"

4. Acoustic Sheet Caulking:

Lowry "Electrical Box Pad"
Presstite "579.6"

5. Fire-resistant Penetration Sealant:

Dow-Corning Corporation's "3-6548 Silicone RTV" foam
3M Corporation's "Fire Barrier Caulk CP 25"
Putty Corporation's "303"

6. Silicone Sealant:

General Electric 2000 Silpruf
Dow Corning 795

PART 3 - EXECUTION

3.1 GENERAL

- A. **General:** Products shall be installed in accordance with the manufacturer's installation instructions.
- B. **Authorized Installers:** Caulking and sealants shall be complete systems, and shall be installed only by installers authorized and approved by the manufacturer.
- C. **Acoustic Partition Joints:** Acoustic partition joints shall be made air and sound-tight with acoustic caulking material.

3.2 SEALANT FILLED JOINTS

- A. **Manufacturer's Representative:** The WORK includes the services of the sealant manufacturer's representative (prior to sealant work) for inspection of the joints and for instructing the installer in the proper use of the materials.
- B. **Surface Preparation:** Joints and spaces to be sealed shall be clean, dry, and free of dust, loose mortar, and other foreign materials. Ferrous metal surfaces shall be cleaned of rust, mill scale, and other coatings by wire brush, grinding, or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's recommendations. Protective coatings shall be removed from aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealants.
- C. **Sealant Depth:** Sealant depth in joints shall be 1/2 the width of joint, but not less than 1/8-inch deep and 1/4-inch wide nor more than 1/2-inch deep and 1-inch wide. Joints shall have a rigid filler material installed to proper depth prior to application of sealant.
- A. **Joints in Porous Materials:** Where required by the manufacturer, sides of joints of porous materials shall be primed immediately prior to caulking or sealing.
- D. **Applications:** A full bead of sealant shall be applied to the joint under sufficient pressure, with the nozzle drawn across sealant, to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. During application, the tip of the nozzle shall be kept at the bottom of the joint to ensure forcing the sealant to fill from the bottom to the top. Sealants shall be tooled immediately after exposure with caulking tool or soft bristled brush moistened with solvent. The finished sealant filled joint shall be slightly concave unless otherwise indicated.
- E. **Cleaning:** After application of sealant and caulking materials, adjacent materials which have been soiled shall be cleaned and left in a neat, clean, undamaged or unstained condition. On porous surfaces, excess sealant shall be removed in accordance with the sealant or caulking manufacturer's printed instructions.

3.3 ACOUSTIC CAULKING

- A. **Preparation:** Joints and surfaces shall be clean, dry, and free of loose materials.
- B. **Concealed Joints:** Concealed joints in acoustic partitions including perimeters, intersections of walls and penetrations through finish work, and at conduit ends with boxes shall be sealed with acoustic caulking compound. Backs of electrical boxes shall be sealed with acoustic sheet caulking installed over holes and knock-outs.

** END OF SECTION **

SECTION 08110 - STEEL DOORS AND FRAMES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing steel doors, frames, hardware and appurtenances.

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 08710 Finish Hardware
2. Section 08800 Glazing
3. Section 09800 Protective Coating
4. Section 09900 Architectural Paint Finishes

1.3 CODES

- A. The 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. California Building Code

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 A 366 | Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality |
| 2. ASTM B 117 | Method of Salt Spray (Fog) Testing |
| 3. ASTM D 1735 | Method for Water Fog Testing of Organic Coatings |
| 4. ASTM E 90 | Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions |
| 5. ANSI A115 Series | Door and Frame Preparation |
| 6. UL Standards | Underwriters' Laboratories, Inc. |

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 1. Manufacturer's product data including catalogue cuts.
 2. Manufacturer's maintenance procedures.
 3. Manufacturer's installation instructions.

4. Certification that products comply with the specifications indicated.
5. Door schedules showing sizes, types, louvers, and glass.
6. Certified Sound Transmission Coefficients.
7. Shop drawings showing frame jamb depths, trim profile, stops, and backbends.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Doors and frames shall be shipped and stored with temporary stiffeners and spacers in place to prevent distortion.
- B. Doors and frames shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **General:** Only products certified as complying with the indicated requirements shall be provided.
- B. **Products:** Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.
- C. **Manufacturer's Recommendation:** Products shall be recommended by the manufacturer for the application indicated.

2.2 MATERIALS AND FABRICATION

- A. **Factory Fabrication:** Steel doors and frames shall be factory fabricated and assembled. Temporary stiffeners, spacers, and other accessories necessary to facilitate handling and erection shall be included. After fabrication, tool marks and other surface imperfections shall be filled and ground smooth.
- B. **Fire Rating and Labelling:** Fire-rated doors and frames shall bear a UL label indicating the type of rating. Design and construction of fabricated products shall have UL approval for the fire rating indicated. Hollow steel doors and frames for fire-rated openings shall conform to Underwriters' Laboratories listing and shall be UL labeled.
- C. **Materials for Doors and Frames:** Exterior doors and frames shall be fabricated of galvanized steel. Other doors and frames shall be fabricated from commercial grade, cold-rolled steel conforming to ASTM A 366, Type II or III.
- D. **Priming and Painting:** Doors and frames shall be chemically treated to ensure maximum paint adhesion and exposed surfaces shall be painted with a rust-inhibitive primer after fabrication. Prime coat shall be capable of passing a 120-hour salt spray test in accordance with ASTM B 117 and a 250-hour humidity test in accordance with ASTM D 1735.
- E. **Hardware:** Doors and frames shall be reinforced and drilled or tapped for templated mortised hardware and shall be reinforced with plates for surface-mounted hardware complying with ANSI A115 Series requirements. Hardware shall comply with Section 08710.

2.3 METAL FRAMES

- A. **Pressed Metal Frames:** Types F-1 & F-2 as indicated in contract documents per Door Schedule on 6A-5 and on 7A-9. Pressed steel frames for doors, and other openings shall be combination buckled frame and trim of type and sizes indicated. Metal shall not be lighter than 16-gauge steel. Frames shall be of the welded unit type. Special frames, oversized frames, and frames with transom shall be provided where indicated.
- B. **Frame Jamb Depths, Trim Profile, Stops, and Backbends:** Frame jamb depths, trim profile, stops, and backbends shall be as shown on the shop drawings.

2.4 FRAME ANCHORS

- A. **Floor Anchors:** Floor anchors shall be welded inside each frame jamb head, and holes shall be provided for floor anchorage. Minimum thickness of floor anchors shall be 14-gauge.
- B. **Anchors for Masonry/Concrete Installations:** Frames for installation in masonry and concrete walls shall include adjustable jamb anchors of the T-strap, stirrups and strap, or wire type. The number of anchors provided for each frame jamb and head shall comply with the applicable standard and the following:
 - 1. Frames up to 7 feet 6 inches in height: 3 anchors.
 - 2. Frames over 7 feet 6 inches to 8 feet 0 inches in height: 4 anchors.
 - 3. Frames over 8 feet 0 inches in height: One anchor for each 2 feet or fraction in height.
- C. **Anchors for Stud Wall Installation:** Frames for installation in stud partitions shall include steel anchors of suitable design, and shall be not less than 18-gauge thickness securely welded inside each jamb and head. The number of anchors provided for each frame jamb shall comply with the applicable standard and the following:
 - 1. Frames up to 7 feet 6 inches in height: 3 anchors.
 - 2. Frames over 7 feet 6 inches to 8 feet 0 inches in height: 5 anchors.
 - 3. Frames over 8 feet 0 inches in height: 5 anchors plus one additional for each 2 feet 0 inches or fraction over 8 feet 0 inches.
- D. **Anchors to Existing Construction:** Frames to be anchored to existing concrete, masonry, or structural steel shall include anchors of proper design.

2.5 DUST COVER BOXES AND MORTAR GUARDS

- A. Dust cover boxes or mortar guards of not less than 24-gauge steel shall be provided at all hardware mortises on frames to be set in masonry, concrete, or plaster walls.

2.6 SILENCER HOLES

- A. Appropriate holes for silencers shall be provided in the door frames which are not designated to receive weatherstripping, seals, or sound seals.

2.7 STEEL DOORS

- A. **Design and Construction:** Steel doors shall be of hollow metal construction and shall be of full flush design with no visible seams. Face sheets shall be not less than cold-rolled, stretcher-levelled, 18-gauge steel. Doors shall have flush seamless face sheets with continuously and fully welded seam edges. Doors shall be rigid and neat in appearance, and shall be free from warpage or buckle. Corner bends shall be true and straight and shall be of not less than the minimum radius for the gauge of metal used. The door top and bottom shall be internally reinforced by steel members welded in place. Tops of exterior doors shall be provided with flush, water and weather tight, top enclosures.
- B. **Transom Panels:** Transom panels shall be provided where indicated and shall comply with the requirements for doors.
- C. **Door and Transom Cores:** Doors and transom cores shall be water-resistant honeycomb polystyrene with minimum R Factor: Calculated Value of 6.35 (ASTMC518). Fire rated doors shall be solid or fiber mineral core doors and shall comply with code requirements.
- D. **Monorail Doors:** Monorail doors shall comply with the requirements for steel doors and shall be notched for the monorail and include a T-type astragal. Doors shall include reinforcement for hardware and anchors and anchor sizing. Neoprene weatherstripping flaps shall be provided at the monorail penetration.
- E. **Louvers:** Door louvers for steel doors shall be of extruded aluminum of the type which integrally frames the opening and can be securely attached. Louvers shall be of the inverted "Y" blade type for exterior use and "V" blade for interior use. Exterior louvered openings shall be provided with removable type insect screens. Door louvers shall be uniformly located in doors and shall be of sizes indicated. Louvers at labeled doors shall be equipped with concealed fusible links. Extruded aluminum louvers shall be provided and be clear anodized.
- F. **Glazed Openings:** Glazed openings in doors shall be of sizes indicated, and shall include mitered metal stops. Glazed openings in fire-rated doors shall meet UL requirements. Glass shall be 1/4-inch clear, tempered plate unless at fire rated door then provide wire glass.
- G. **Double Doors:** Double doors shall be provided with a "T" type steel astragal unless otherwise indicated in Section 08710.

2.8 SOUND DOORS AND FRAMES

- A. **Door and Frame Assemblies:** Sound doors and frames shall be factory-fabricated with perimeter compression seals and automatic, door-bottom seals at sill.
- B. **STC Rating:** Sound door assemblies shall have a minimum STC rating of 47 dB, complying with ASTM E 90 as determined by a qualified acoustical products testing laboratory.
- C. **Door Construction:** Doors shall be formed of 16-gauge steel face sheets jointed by welding along the vertical edges. Door tops and bottoms shall be reinforced and completely closed with die-formed, 16-gauge steel channels welded in place. The core shall be incombustible, noncoupling filler. An astragal shall be provided at pairs of doors. Exterior doors shall include flush, water and weathertight, top enclosures.
- D. **Frame Construction:** Frames shall be fabricated from 14-gauge steel with the corners mitered, welded, and ground smooth. Strike, hinge, and other hardware reinforcement shall be of not less than 3/16-inch thick steel. The frame shall include welded floor anchors at each jamb with a minimum of 3 wall anchors per jamb.

- E. **Perimeter Seals:** Perimeter seals shall be made of sturdy vinyl with a magnetic tape insert. The hinge side shall be constructed so as to avoid pinching or other distortion of the seal from opening and closing of the door.
- F. **Automatic Door Bottoms:** Automatic door bottoms shall close the entire gap between the door and the floor. The seal shall be 50-60 durometer neoprene, and the actuating mechanism shall compress or retract the seal properly when the outer face of the door is within 2 inches of the strike jamb.
- G. **Half Lite:** Sound doors with half-lite shall be double-glazed with 2 panes of 1/4-inch clear, tempered float glass unless otherwise indicated.
- H. **Cleaning and Priming:** Doors, frames, and seal retainers shall be thoroughly cleaned, phosphatized, and factory primed with rust-inhibitive primer. The primer shall be compatible with the finish coatings complying with Sections 09800 and 09900.

2.9 MANUFACTURERS

- A. Products shall be manufactured by one of the following (or equal):

- 1. Steel doors:

- Krieger Steel Products Co.
 - Overly Manufacturing Co.
 - Trussbuilt, Inc.

- 2. Sound doors and frames:

- Krieger Steel Products Co.
 - Overly Manufacturing Co.
 - Sonicbar by Rysdon Products Co.

PART 3 -- EXECUTION

3.1 GENERAL

- A. **General:** Products shall be installed in accordance with the manufacturer's installation instructions.

3.2 FRAME INSTALLATION

- A. Frames shall be set plumb and square in a true plane, and shall be securely anchored to the adjoining construction. Steel shims shall be provided and shall be tight and rigidly attached between frame anchors and structure. Finished metal frames shall be strong and rigid, neat in appearance, and square, true, and free of defects, warpage, or buckling.
- B. Molded members, trims, and stops, shall be clean cut, straight, and shall be of a uniform profile throughout their lengths.
- C. Corner joints shall have all contact edges tightly closed with all trim faces mitered, welded, and finished smooth. The use of gussets shall not be permitted.

3.3 DOOR INSTALLATION

- A. Doors shall be installed plumb, square, and level. Doors shall operate freely, but not loosely. They shall be free from rattling while in a closed position.
- B. The door clearances shall be plus 3/32-inch or minus 1/32-inch and shall not exceed the limits recommended by the manufacturer.
- C. Doors shall not be installed with an out-of-plane warpage of more than 3/16-inch.
- D. Doors and finish hardware shall be removed and rehung prior to painting.

3.4 FINISH HARDWARE

- A. Finish hardware shall be installed in accordance with hardware manufacturer's standard templates. Operable parts shall be adjusted for proper function and operation.

3.5 EXISTING CONSTRUCTION

- A. Frames that are dimpled for fasteners required for installation into existing concrete, masonry, or steel structures shall have the fasteners and fastener frame dimples filled with auto putty or an equal filler material. The fasteners and fillers at dimple holes shall be ground smooth (non-visible) before painting. Fastener locations shall not be visible after the painting work is finished.

** END OF SECTION **

SECTION 08210 - WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood doors.

B. Related Sections:

1. Section 08110: Steel Doors and Frames
2. Section 08710: Door Hardware.
3. Section 08800: Glazing.
4. Section 09900: Architectural Paint Finishes.

1.2 SYSTEM DESCRIPTION

A. Design Requirements: Drawings indicate sizes, locations and general details of wood door construction and installation.

B. Regulatory Requirements:

1. Fire rated doors shall be listed by a nationally recognized testing and certification agency in accordance with local building codes and acceptable to the authorities having jurisdiction. The listed doors shall meet or exceed the requirements of UL10C, NFPA 101 and NFPA 80.
2. Comply with CBC requirements. Provide products that have been tested and passed as an assembly in compliance with CBC Standard 7-2 positive pressure smoke testing requirements.

1.3 SUBMITTALS

A. Shop Drawings: Submit plans, elevations and details indicating door construction details, opening identification symbols, sizes, door type and grade, fire classification, swing, light and louver cutout size and locations, and undercuts.

1.4 QUALITY ASSURANCE

A. Solid stave lumber core doors shall conform to the following:

1. Industry standard and all requirements of the American National Standards Institute, Inc., the Window & Door Manufacturers Association's Architectural Wood Flush Door Section standard I.S. 1A-97 including the latest revisions, and special requirements herein specified;
2. "Manual of Millwork" of Woodwork Institute of California, for grade or grades specified;
3. "Architectural Woodwork Quality Standards" of Architectural Woodwork Institute, for grade or grades specified.

- B. All doors shall be fabricated by the manufacturer to the dimensions specified.
- C. Doors shall be products of one manufacturer.
- D. Door modifications are not permitted, unless reviewed by the Architect.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Package and ship doors individually in protective packaging.
- B. Before installation, store doors flat in a clean, above grade and/or floor, dry and well-ventilated location.
- C. Deliver doors to the Project site after building has been provided with design temperature and humidity.

1.6 PROJECT CONDITIONS

- A. Do not install doors until building is enclosed and ambient conditions are within the temperature and humidity range recommended by door manufacturer.

1.7 WARRANTY

- A. Provide a 2 year material and labor warranty for exterior doors.
- B. Provide a life time material warranty for interior doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide products manufactured by one of the following or equal approved in advance by Architect:
 - 1. Algoma Hardwood Inc.
 - 2. Brentwood Manufacturing.
 - 3. Graham Manufacturing Corporation.

2.2 DOOR CONSTRUCTION

- A. Interior Doors
 - 1. Interior doors shall be furnished as follows:
 - a. OAK Hardwood Veneer:
Solid wood core flush veneered, 5 or 7 ply, faced both sides with rotary cut oak faced veneer to match existing, fully bonded to core.
 - 2. Core shall be low density, thoroughly kiln-dried wood blocks not more than 2-1/2 inches wide, with joints staggered, and random lengths.

3. Edge strips: Kiln-dried birch, maple or other materials as indicated.
4. Full stile edge strip shall be not less than 1-1/2 inches wide, 2 ply stile. Stiles shall be fully bonded to the core. The outer face stile shall be full length 3/4 inch birch or maple. The inner back stile shall be 3/4 inch of similar species which may have two finger joints or full length laminated strand lumber (LSL) fully bonded to core.
5. Top and bottom edge rails shall be full length and may be of glued up stock of similar species, laminated strand lumber, white fir or douglas fir, minimum density 24.33 pounds or higher per cubic foot.
6. Top rail shall be minimum of 2 inches. Bottom rail shall be minimum of 5 inches fully bonded to core.
7. Crossbanding: Doors shall be furnished with full width crossbanding of properly dried hardwood or engineered fiber composite material, 1/16 inch thick, with a density of 52 pounds or higher per cubic foot.
8. Face veneer: Premium grade veneer shall be Grade "AA". Minimum thickness shall be 0.0277 inches before sanding and 0.020 inches after sanding of specified face veneer.
9. Adhesive and Bonding: Bonding between veneer plies of wood face panel, and between door faces, frame and core unit shall be fabricated with type I or II waterproof adhesives for interior doors.
10. Openings: Openings for lights, louvers and grilles shall be performed by the manufacturer, or in a certified door service mill in accordance with manufacturer's details, and in compliance with testing agency requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Work of this section as specified in the WIC Manual of Mill Work, Section 26 and provide a WIC Certified Compliance Certificate for Installation at Substantial Completion.
- B. Provide each door accurately cut, trimmed, and fitted to its frame and hardware. Clearance at lock and hanging stile and at top shall be 1/8 inch, and bottom shall not exceed 1/4 inch except where otherwise indicated. Arises shall be rounded to a 1/16 inch radius, and lock rail edges shall be slightly beveled. Screws for hardware shall not be driven but screwed into pre-drilled holes.
- C. Doors shall operate freely, but not loosely, without sticking or binding, without hinge-bind conditions and with hardware properly adjusted and functioning.

3.2 CLEAN UP

- A. Remove rubbish, waste and debris and legally dispose of off the Project site.

3.3 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 08220 - FIBERGLASS REINFORCED PLASTIC DOORS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all fiberglass reinforced plastic (FRP) doors, frames, finish hardware, reinforcement and appurtenant work, complete.

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 08710 Finish Hardware
2. Section 09800 Protective Coating

1.3 CODES

- A. The 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. California Code of Regulations, Title 24, Part 2, also known as the California Building Code (CBC), Current 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. Commercial Standards:

ANSI/DHI A 115 Series	Doors and Frames
ANSI/NKCA A161.1	Construction and Performance Standards for Kitchen and Vanity Cabinets (Modified for Large Doors)
ASTM B 117	Standard Test Method of Salt Spray (Fog) Testing
ASTM D 570	Standard Test Method for Water Absorption of Plastics
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials

1.5. SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. **Product Data:** CONTRACTOR shall submit manufacturer's **technical** product data substantiating that products comply with requirements.
2. **Shop Drawings:** Shop drawings shall be submitted for both **fabrication and installation** of fiberglass reinforced plastic doors and frames. They shall include the following:
 - a. Details of each frame type and each variation of opening **condition** with specific information on connections to adjoining materials. **Show anchorage** and accommodation of accessory items as they occur.
 - b. Elevations of each door design and type with specific information defining glass lites, louvers and other accessory items.
 - c. Details of construction, joints, connections and location and installation requirements of finish hardware and any supplemental reinforcement which may be necessary.
 - d. A schedule shall be provided of all doors and frames, using **the same** reference numbers for details and openings as those on the contract **drawings**.
 - e. Schedules shall show hardware as indicated in Section 08710 or as indicated elsewhere.
3. **Samples:** A full range of samples shall be provided for the **CONSTRUCTION MANAGER'S** selection; two samples, 6 inches square minimum, of each color and texture selected for factory-finished doors and frames.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. **Product Data:** CONTRACTOR shall submit manufacturer's **technical** product data documenting maintenance and repair procedures. Calculations by a registered civil or structural engineer shall be submitted showing that the doors, frames, and their structural connections are designed to meet code requirements and loads. **CONSTRUCTION MANAGER** will review the calculations for **completeness** only.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Fiberglass reinforced plastic doors and frames shall be packaged in such a way as to prevent

damage and scratching during shipment and handling.

- B. Temporary stiffeners, spacers, and other accessories necessary to facilitate handling and accurate erection shall be provided.
- C. **Delivery of Materials:** Products shall be delivered in original, unbroken, packages or containers bearing the manufacturer's label. Packages or containers shall be delivered to the site with seals unbroken.
- D. **Storage:** Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the deleterious effects of the elements.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. General:

1. Doors, frames and accessory items shall be the products of a single manufacturer.
2. **Flame Spread:** All doors and frames shall be manufactured with fire retardant resins that have retained a Class 1 (UBC Classification) flame spread when tested in accordance with ASTM E 84 and NFPA by an independent laboratory. The entire door and frame assembly shall have a flame spread rating of 25 or less.
3. Doors, frames, transom panels and all related accessories shall be fabricated from premium grade, glass fiber reinforced, chemical resistant, flame retardant, isophthalic polyester resins. Components shall be fabricated to the greatest extent by "pultrusion" process where glass and synthetic filaments are saturated with polymer resins and pulled through steel dies to shape the profiles and control the reinforcement-to-matrix ratio.
4. Minimum physical properties for all components shall conform to the following:
 - a. Reinforcement to matrix ratio: 65 percent to 35 percent, by weight
 - b. Tensile strength: 55,000 psi
 - c. Compressive strength: 50,000 psi
 - d. Flexural strength: 50,000 psi
 - e. Modulus of elasticity: 3.5×10^6
 - f. Coefficient of thermal expansion: 5.5×10^{-5}
5. Door and frame assemblies may be used in an environment where exposure to sulfuric acid, chlorine, and other chemical agents are possible. The manufacturer shall select resins that are resistant to damage from such corrosive environments.
6. Door and frame assemblies shall meet or exceed the requirements of the following

tests:

ANSI/NKCA A 161.1	100,000 open-close cycles with no visible wear or distress
ASTM B 117	300 hours minimum with no visible surface effect
ASTM D 570	No more than 0.2 percent absorption
ASTM G 23 reduction of gloss	1,000 hours exposure with no visible surface effect or

B. Doors and Transoms:

1. Doors shall be full flush design and integral in every respect and have no visible seams or surface irregularities. Doors shall be rigid and neat in appearance and shall be free from warpage or buckle. Corner bends shall be true and straight and shall be of not less than the minimum radius for the door used. Tops of exterior doors shall be provided with flush weathertight construction.
2. Transom Panels: Transom panels shall be provided where indicated and shall be of the same construction as the doors.
3. Door and transom cores shall be isocyanurate/urethane, closed cell rigid foam, 2.0 lbs per cubic foot density, self-extinguishing, Class 1 flame retardant material.
4. Glass fiber reinforcements shall include continuous strand mats, continuous strand roving and woven roving. No chopped strand materials shall be used.
5. The resin matrix shall be a cross-linking polymer, flame-retardant isophthalic polyester.
6. All component parts shall be surfaced with a 10 mil polyester nexus veil.

C. Frames: Frames shall be custom profiles, similar to hollow metal configurations, of sizes and shapes as indicated. Frames shall be "pultruded" sections with typical 0.1875-inch wall thickness. Jambs and headers shall be joined with hairline mitered corners and reinforced as required for a structural connection.

D. Hardware:

1. All hardware and fasteners, including screws, nuts and bolts, hinges, locksets, closers, kickplates, panic bars and foot and head bolts, shall be completely fabricated of stainless steel.

E. Supports, Inserts, Anchors and Fasteners:

1. Metal: All metal occurring as a part of, or related to, the door and frame assembly,

shall be stainless steel.

2. Frames shall be provided with proper anchors as required and necessary for the specific installation.
3. Door frames for installation in masonry and concrete walls shall be provided with adjustable jamb anchors of the stainless steel T-strap, stirrup and strap, or wire type. The number of anchors provided per door jamb shall be as follows:
 - a. Frames up to 7-feet, 6-inches in height: 3 anchors
 - b. Frames 7-feet, 6-inches to 8-feet in height: 4 anchors
 - c. Frames over 8 feet in height: 4 anchors plus 1 additional anchor for each additional 2 feet or fraction thereof.
4. Door frames for installation in stud partitions shall be provided with stainless steel anchors of suitable design and shall not be less than 18 gauge thickness and shall be securely attached inside each jamb as follows:
 - a. Frames up to 7-feet, 6-inches in height: 3 anchors
 - b. Frames 7-feet, 6-inches to 8-feet in height: 5 anchors
 - c. Frames over 8 feet in height: 5 anchors plus 1 additional anchor for each additional 2 feet or fraction thereof.
5. Dust Cover Boxes and Mortar Guards: Dust cover boxes or mortar guards of not less than 24 gauge stainless steel or fiberglass shall be provided at all hardware mortises on frames to be set in masonry, concrete, or plaster walls.

2.2 FABRICATION

- A. Fabricate fiberglass reinforced door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant.
- B. Clearly identify work that cannot be permanently factory-assembled before shipment to assure proper assembly at the project site.
- C. **Imperfections:** After fabrication, all tool marks and other surface imperfections shall be filled, coated and made smooth.
- D. **Doors:** Doors shall be rigid structural assemblies fabricated to size required plus or minus 0.10 inches, with a squareness tolerance, expressed as the difference between the diagonal measurements from corner to corner of plus or minus 0.25-inches, and with a flatness tolerance of plus or minus 0.1876-inches measured on a diagonal across the face of the door surface.
- E. **Frames:** Frames shall be flush design, of profiles and sizes as indicated on the drawings. Frame wall thickness shall be no less than 0.1875-inch.

1. Assemblies: Frames shall be provided preassembled with doors prehung wherever practicable.
2. Door jamb depths, trim profile, and backbends shall be indicated on shop drawings.
3. Molded members shall be clean cut, straight, and shall be of uniform profile throughout their lengths.
4. Corner joints shall have all contact edges tightly closed with all trim faces mitered and finished smooth.
5. Reinforcing: Frames shall be provided with non-swelling polymer backing, corner reinforcement, anchor reinforcement and hardware reinforcement as required.
6. Mutes or Silencers: Appropriate holes for silencers shall be provided in those door frames which are not designated to receive weather-stripping or sound seals.

F. Finish Hardware Preparation:

1. Doors and frames to receive mortised and concealed finish hardware in accordance with final finish hardware schedule shall be prepared according to templates provided by the hardware supplier. Comply with applicable requirements of ANSI A 115 series specifications for door and frame preparation for hardware.
2. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at the project site.
3. Locate finish hardware as indicated on the final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware," published by the Door and Hardware Institute."

- G. Finishing:** Exterior surfaces of doors, frames and accessory products shall be factory finished with a pigmented resin gel coat with a textured semi-glass finish. Color shall be as selected by the CONSTRUCTION MANAGER from manufacturer's standard color selection.

H. Accessory Items:

1. Preparation of doors for louvers and glass lites shall be accomplished at the factory during manufacture and shall not be attempted in the field. Accessory cutouts shall be totally enclosed by pultruded shapes which shall be incorporated into the internal door subframe so that after molding and machining, the penetration is sealed and watertight to completely exclude moisture from the interior of the door. Accessory items shall only be installed after the cutout is so enclosed.
2. Louvers: Sightproof, stationary louvers shall be provided for interior doors in the sizes

and configurations indicated, constructed of inverted V-shaped or Y-shaped blades formed of fiberglass plastic set into reinforced plastic frames. Louvers shall be factory installed.

3. Glass Lites: Glass lites shall conform to the configurations indicated. Lites shall be factory installed and glazed prior to shipment. Single and/or Double lites shall be provided as indicated on drawings. Stainless steel shall be employed for glazing stops or moldings.

2.3 MANUFACTURERS

- A. Products of the type indicated shall be manufactured by one of the following (or equal):
 1. Chem-Pruf Door Co.
 2. Corrim Door Systems Division, Fenestra Corporation
 3. Fiberglass Technologies, Inc.
 4. Vega Technologies, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. **General:** Install fiberglass reinforced plastic doors, frames and accessories in accordance with manufacturer's recommendations.
- B. **Placing Frames:**
 1. Frames shall be set plumb and square in a true plane. Frames in new masonry construction shall be solid grouted. Stainless steel or fiberglass shims shall be provided and shall be set tight and rigidly attached between frame anchors and structure. All finished frames shall be strong and rigid, neat in appearance, and square, true, and free of defects, warp or buckle.
- C. **Door Installation:** Doors shall be installed plumb and square and level with the frames securely anchored to the adjoining construction. Doors shall operate freely, but not loosely, and shall not bind in operation nor rattle in a closed position.
- D. Finish hardware shall be installed in accordance with hardware manufacturer's standard templates and printed instructions. Operable parts shall be adjusted for correct function.

3.2 FINAL ADJUSTMENT

- A. **Protection Removal:** Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.
- B. **Final Adjustments:** Check and readjust operating finish hardware items, leaving fiberglass

reinforced doors and frames undamaged and in complete and proper operating condition.

- END OF SECTION -

SECTION 08340 - ACOUSTIC DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, equipment and incidentals required and install acoustic metal doors, frames, and appurtenances complete as shown on the Drawings, as specified herein, and as needed to complete the work.
- B. Provide metal doors, and metal door frames which are not specifically described in other Sections of these Specifications in accordance with this Section.

1.2 RELATED WORK

- A. Section 7920 Sealants and Caulking
- B. Section 8110 Steel Doors and Frames
- C. Section 08360 Overhead Doors
- D. Section 8710 Finish Hardware
- E. Section 08800 Glazing
- F. Section 09800 Protective Coating
- G. Section 09900 Architectural Paint Finishes

1.3 SUBMITTALS

- A. The following shall be submitted in addition to General Requirements:
 - 1. Product Data: Provide product data for each type of product to be furnished and installed under this Section. Product data shall include, but not be limited to sound ratings, construction details, material descriptions, fire-resistance ratings, finishes, and manufacturer's written instructions for adjusting acoustical seals.
 - 2. Shop Drawings:
 - a. Details of each frame type, including dimensioned profiles and metal thicknesses.
 - b. Elevations of door design.

- c. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - d. Details of sound control seals, door bottoms, and thresholds.
 - e. Locations of reinforcements and preparations for hardware.
 - f. Details of anchorages, joints, field splices, and connections.
3. Schedule: Provide a schedule of sound control door assemblies prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on drawings. Coordinate with the Door Hardware Schedule.
 4. Manufacturer's installation instructions.
 5. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 6. Color charts for Owner's approval.

1.4 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1. ANSI/ICC A117.1-2003 - Standard for Accessible and Usable Buildings and Facilities

B. American Society for Testing and Materials (ASTM)

1. ASTM A480/A480M-06b - General Requirements for Flat-Rolled Stainless Heat-Resisting Steel Plate, Sheet, and Strip
2. ASTM A653/A653M-06 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated by the Hot-Dip Process
3. ASTM E90-04 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
4. ASTM E413-04 - Classification for Rating Sound Insulation

C. Hollow Metal Manufacturers Association (HMMA)

1. HMMA 802 - Manufacturing of Hollow Metal Doors and Frames
2. HMMA 840 - Installation and Storage of Hollow Metal Doors and Frames
3. HMMA 865- Guide Specifications For Sound Control Hollow Metal Doors and Frames

D. National Fire Protection Association (NFPA)

1. NFPA 80 - Standard for Fire Doors and Other Opening Protectives

E. National Association of Architectural Metal Manufacturers (NAAMM)

F. Steel Door Institute (SDI)

1.5 QUALITY AND PERFORMANCE ASSURANCE

- A. Use adequate numbers of skilled workmen thoroughly trained and knowledgeable in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.
- B. Unless specifically otherwise approved by the Owner, provide all products of this Section from a single manufacturer.
- C. Comply with pertinent recommendations of the Hollow Metal Manufacturers' Association, Standard HMMA 862.
- D. Sound Rating: Sound control door assemblies shall be equal to those of assemblies tested as sound retardant units by an acoustical testing agency, and have the minimum rating as indicated in this Section as calculated by ASTM E90 and ASTM E2235.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sound control hollow metal doors and frames palletized, to provide protection during transit and project-site storage.
- B. Deliver welded frames with two removable spreader bars across the bottom of frames, tack welded to jambs and mullions.
- C. Store metal work under cover at Site. Do not store in a manner that traps excess humidity. Provide minimum ¼-inch space between each stacked door to permit air circulation. Doors and frames to be stacked in a vertical upright position.
- D. Adhere to manufacturer's instruction for delivery, handling, and storage.

PART 2 - PRODUCTS

2.1 METAL DOORS

- A. Provide in the dimensions and types shown on the Drawings, and with the following attributes:
 - 1. Face sheets:
 - a. Interior doors: 14 gauge minimum
 - b. Exterior doors: 14 gauge minimum, hot-dip galvanized, with embossed pattern style & rail pattern. If embossed pattern is not available for doors higher than 7', decorative "Plant On" embossing will be acceptable.
 - 2. Minimum thickness: 1-3/4"
 - 3. Stiffeners: 18 gauge

4. Vertical edges: Continuous weld
 5. Top and bottom edges: Closed with 12 gauge continuous recessed steel channel, spot-welded to face sheets
 6. Core: Manufacturer's sound control core as tested for the specified minimum STC rating.
 7. STC rating: 53 or better
- B. At the factory, pre-clean and shop prime each door for finish painting which will be performed at the Site under Section 09900 of these Specifications.
- C. Acceptable products:
1. As manufactured by Industrial Acoustic Co, Inc., Krieger Steel Products Co., Ambico, or approved equal meeting the requirements of these Specifications.

2.2 METAL FRAMES

- A. Acceptable products: See Paragraph 2.1C. above.
- B. Provide in the dimensions and types shown on the Drawings, and with the following attributes:
1. For interior openings: 14 gauge minimum, hot-dip galvanized
 2. For exterior openings: 14 gauge minimum, hot-dip galvanized
 3. Construction: Welded units, with integral stop and trim
 4. Floor anchors: 14 gauge, welded inside jambs
 5. Jamb anchors:
 - a. In masonry walls, provide with 0.156" thick wire-type or with adjustable 14 gauge T-strap not less than 2" x 10"
 - b. In stud partitions, provide 16 gauge steel anchors welded inside jambs
 6. Dust covers: 26 gauge, where required
 7. Loose glazing stops: 16 gauge cold-rolled steel
- C. At the factory, pre-clean and shop prime each frame for finish painting which will be performed at the Site under Section 09900 of these Specifications.

2.3 FINISH HARDWARE

- A. Secure templates from the finish hardware supplier, and accurately install, or make provision for, all finish hardware at the factory.

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 the work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of sound control door frame connections before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL

- A. Coordinate installation with work of other trades.
- B. Level subfloor and threshold so that they contact a straightedge for the length of the threshold.
- C. Install components to manufacturer's written instructions.

3.3 INSTALLATION

- A. General: Install sound control door assemblies plumb, rigid, properly aligned and securely fastened in place; comply with manufacturer's written instructions.
- B. Frames:
 - 1. Set frames accurately in position; plumb, aligned, and braced securely until permanent anchors are set.
 - 2. Where practicable, place frames prior to construction of enclosing walls and ceilings.
 - 3. At in-place construction, set frames and secure to adjacent construction with machine screws and suitable anchorage devices. Provide "Z" fillers at each screw location.
 - 4. Check square, twist, and plumb of frames as walls are constructed. Shim as necessary to comply with manufacturer's installation tolerances.
 - 5. Remove temporary braces only after frames or bucks have been properly set and secured.
 - 6. Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 7. Solidly fill space between frames and substrate with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
- C. Doors:
 - 1. Fit sound control doors accurately in frames, within clearances indicated below. Shim as necessary.
 - a. Jambs: 1/8 inch
 - b. Head with Butt hinges: 1/8 inch

- c. Sill: Manufacturer's standard
- d. Between edges of pairs of doors: 1/8 inch

D. Sound Control Seal:

- 1. Where seals have been factory pre-fit and preinstalled and subsequently removed for shipping reinstall seals and adjust according to manufacturer's written instructions.

E. Glazing:

- 1. Install glazing as per manufacturer's recommendations.

3.4 ADJUST AND CLEAN

- A. Immediately after erection, sand smooth all rusted and damaged areas of prime coat, and apply touchup of compatible air-drying primer.
- B. Clean grout off sound control door frames immediately after installation.
- C. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.
- D. Check and readjust operating finish hardware items in hollow metal work just prior to final inspection. Leave work in complete and proper operating condition.

** END OF SECTION **

SECTION 08360 - OVERHEAD DOORS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all overhead door assemblies and frames and all appurtenant work, complete and operable, including manual drive systems, locking hardware, and complete systems.

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 08110 Steel Doors and Frames
2. Section 08220 Fiberglass Reinforced Plastic Doors
3. Section 08710 Finish Hardware
4. Section 08800 Glazing
5. Section 09800 Protective Coating
6. Section 09900 Architectural Paint Finishes

1.3 CODES

- A. The 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. California Building Code
2. California Fire Code
3. California Electric Code
4. California Plumbing Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. Federal Specifications:

QQ-S-775 Steel Sheets, Carbon, Zinc-Coated (Galvanized) by the Hot-dip Process

2. Commercial Standards:

NEMA National Electric Manufacturers' Association

NEC National Electric Code

3. Trade Standards:

Aluminum Association Anodizing Systems

4. Manufacturers' Standards: In addition to the standards listed above, the overhead doors and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in addition to General Requirements:

1. Manufacturer's specifications, literature, installation instructions, along with any engineering calculations that may be required elsewhere in this Section shall be submitted. Calculations by a registered civil or structural engineer shall be submitted which show that the overhead door systems and their structural connections are designed to meet code requirements and loads.
2. Shop drawings showing details of the products and systems, fasteners, and connections to adjoining materials shall be submitted along with any manufacturer's installation instructions. Schedules showing sizes, types, and locations of louvers and glass shall be submitted.
3. Color samples of "Kynar" finish.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL in compliance with the General Requirements:

1. Upon completion, the CONTRACTOR shall deliver to the CONSTRUCTION MANAGER complete book containing the manufacturer's operation and maintenance instructions for the overhead door assemblies.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original and unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: All materials shall be carefully stored in an area that is protected from deleterious elements. Storage shall be in a manner that will prevent damage or marring of the door and its finish.

PART 2 -- PRODUCTS

2.1 ROLL-UP DOORS

- A. **General:** Roll-up doors shall be aluminum-slat curtain design, chain-operated, and shall be weather-resistant, dust-resistant and designed for exterior openings. Doors shall be provided complete with slats, guides, hoods, reduction gears, galvanized hand chain, operating mechanism, brackets, gears, head, bottom and side weather stripping, hardware, and all other items necessary for their installation and operation.

- B. **Wind Loading:** The doors shall be designed to withstand a wind load of 20 lb/sq ft.
- C. **Curtain Slats:** Curtain slats shall be interlocking, weather sealing, flat-profile slats.
 - 1. Curtains shall be fabricated from roll-formed aluminum sections of not less than 18 gauge with a height of approximately 2-5/8 inches.
- D. **Endlocks:** Endlocks shall be attached to each end of alternating slats to provide for curtain alignment and security against lateral movement.
- E. **Weather Seals:** Vinyl bottom and guide seals.
- F. **Bottom Bar:** The bottom bar shall consist of extruded aluminum section to suit the floor profile. A replaceable flexible vinyl or neoprene gasket or astragal shall be provided as a weather seal and cushion bumper.
- G. **Guides:** Aluminum guides per recommendation of the manufacturer.
- H. **Brackets:** Aluminum, or approved equal to support counterbalance, curtain and hood.
- I. **Counter Balanced Shaft Assemblies:** The barrel shall be a steel pipe of sufficient diameter and thickness to support the roll-up curtain and its design loads without distortion of slats, and to limit deflection of the barrel to not more than 0.03-inch per foot of span under full load. The barrel shall have a minimum diameter of 4 inches. The spring balance shall consist of one or more helical torsion springs designed for 50,000 cycle life.
- J. **Hood:** The hood shall be manufactured of aluminum with intermediate supports as required.
- K. **Chain Holder:** A chain holder shall be provided on wall with provision for padlocking.
- L. **Manual Operation Features:** Manual operation shall be accomplished by endless chain (crank operation).
- M. **Locking:** Interior bottom bar slide bolt. Chain keeper locks for chain hoist operation.
- N. **Vision lites:** (3" x 5/8") uniformly spaced opening with Plexiglas covers.
- O. **Finishes:** Aluminum curtains door shall be provided with an organic finish ("Kynar" finish). All other metal parts, exposed and concealed, and doors, shall be shop-primed with primer which is compatible with the finish paint indicated. The inside working area of the guides shall not be painted.
- P. **Organic Finish ("Kynar" finish):**
 - 1. Primer: Finish coating formulator's standard epoxy primer as recommended for the substrate and coating process used.
 - 2. Fluoropolymer 3-Coat Coating System: Manufacturer's standard 3-coat, thermocured system composed of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluorocarbon topcoat, with both color coat and clear coat, containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 505.2.

- a. Color and Gloss: Color shall match Frazee “Cayenne 62250” or as selected by the Architect.
3. Touch-up Paint: As recommended by the coating formulator for field application.

Q. Finish Materials:

1. Akzo; Trinar TMC
2. Glidden Coatings and Resins; Visular
3. Morton International; UltraMet 2
4. PPG Industries; Duranar XL
5. Valspar; Fluoropon Premiere

R. Application:

1. Surface Preparation: Thoroughly clean and etch surfaces to receive coating, and apply a chromate conversion pretreatment in accordance with the methods approved by the coating formulator.
2. Primer: Prime the cleaned and treated surfaces with baked-on epoxy primer applied to achieve a dry film thickness of not less than 0.2 mils.
3. Aluminum Extrusions: Electrostatically spray the primed surface with the color and clear finish coats applied to achieve a dry film thickness of not less than 0.8 mils and oven bake at a temperature of not less than 450 degrees F in accordance with coating formulators written procedures.
4. Aluminum Sheets: Finish the primed surface with color and clear finish coats using the coil coating process to achieve a dry film thickness of not less than 0.8 mils and oven bake at a temperature of not less than 475 degrees F in accordance with the coating formulators written procedures.

S. Finish the exposed fasteners to match the color finish of the adjacent material.

T. Field Touch-Up:

1. Surface Preparation
 - a. Surface shall be clean, dry and free of foreign contaminants.
 - b. Lightly scuff sand surfaces to be recoated, feathering edges at the damaged area.
 - c. Remove sanding dust and other contaminants with solvent dampened lint free cloth or use tack cloths.
 - d. Areas of bare aluminum shall be pretreated with conversion coatings such as Amchem “Alumiprep #33 and Alodine 1201” according to manufacturer’s directions.
 - e. Immediately prime all bare aluminum with primer equal to PPG2 component was primer (UC-40082/US-40083).

2. Application of Air Dry touch-Up Enamel.

2.2 OVERHEAD SECTIONAL DOORS (NOT USED)

2.3 MANUFACTURERS

A. Basis of Design: Series 620 Rolling Door with all Aluminum Options, Overhead Door Corporation, Lewisville Texas; Telephone 800-275-3290. Roll-up doors shall be this product of the following manufacturers and type or model (or equal):

1. Cookson, Type "FC"
2. Overhead Door Corporation, Series 620.

PART 3 – EXECUTION

3.1 GENERAL

A. Installation shall be in accordance with the manufacturer's printed recommendations and instructions.

3.2 INSTALLATION

A. Doors shall be accurately cut, fitted, and installed level, square, plumb, and in alignment. Fasteners shall be sized for loads imposed and shall be of sufficient length. Doors shall be provided with accurately made cutouts, and shall be reinforced for strength where necessary. Doors shall be adjusted to provide smooth, unbinding operation with all hardware fully operable.

**** END OF SECTION ****

SECTION 08520 - ALUMINUM WINDOWS, HORIZONTAL SLIDING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing aluminum windows with frames, bracing, glazing attachments, screens, hardware, accessories and attachments, erection and accessories.

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 07920 Sealants and Caulking
 - 2. Section 08800 Glazing

1.3 CODES

- A. The 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. California Building Code

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 E 283 Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors
 - 2. ASTM E 330 Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
 - 3. ANSI/AAMA 101 Voluntary Specification for Aluminum Sliding Doors and Windows
 - 4. ASTM E 331 Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
 - 5. AA-Finishes Aluminum Association, "Designation System for Aluminum Finishes"

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:

1. Manufacturer's catalog indicating the type of products proposed for installation
2. Elevations of each window type along with detailed cross references
3. Finish hardware literature and samples if required by CONSTRUCTION MANAGER
4. Details of window and frame construction along with metal gauges and fasteners
5. Methods of anchorage
6. Glazing and weather-stripping details
7. Drawings showing locations of hardware and provision and reinforcement for hardware
8. Schedule showing location and size of each window
9. Calculations by a registered civil or structural engineer showing that the window, window walls, entrances, and storefront systems and their structural connections are designed to meet code requirements and loads.
10. Material samples showing color and finish.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. Detail specifications and instructions for installation, adjustments, and cleaning and maintenance instructions.
2. Test report by certified independent testing laboratory verifying compliance with test requirements.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Products 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.

1.8 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 two OWNER-designated inspectors for 2 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. Windows and component structural tests shall conform to the "Voluntary Guide Specification for Aluminum Architectural Windows" as published by AAMA unless more stringent requirements are indicated.
- C. The windows shall equal or exceed the ANSI/AAMA 101 Class HS-HC-40 and/or HS-DW- HC40 specifications of the Architectural Aluminum Manufacturers Association.
- D. Testing shall comply with ASTM E 283 and E 330 and shall include:
 1. Air Infiltration Test (Perform before Water Test)(ASTM E 283) (0.37 max. @1.57 lbf/sq ft)
 2. Water Resistance Test (ASTM E 331) (@6.00 lbf/sq ft)

3. Uniform Load Deflection Test (ASTM E 330) (@60 lbf/sq ft)
4. Uniform Load Structural Test (ASTM E 330) (@60 lbf/sq ft)
5. Thermal Transmittance Test (AAMA 1503-1) ("U Value Class" U50 min.)
6. Condensation Factor (CRF-Class C-50) AAMA 1502.7

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Products: Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

2.2 MATERIALS

- A. Aluminum windows and components shall be:
 1. Extruded aluminum prime billet 6063T5.
 2. Aluminum sheet 5005 H34.
 3. Principal window member minimum wall thicknesses shall be as necessary to meet design force requirements.
- B. Hardware shall comply with the following:
 1. Steel components, shall be 316 stainless steel: strikes, pins, axles, screws, fasteners and similar products.
 2. Aluminum components, 6063T5.
 3. Locking handles and cases shall be dark oil rubbed bronze or stainless steel having a finish color similar to window units.
 4. Windows shall include inside locking (positive locking more than just latching) hardware or accessory hardware to prevent the window from being opened from outside if glass is broken.
- C. **Weather-stripping:** Weather-stripping shall be silicon coated, woven pile.
- D. **Screen:** Screens shall be removable aluminum frame with solar screen units along with all hardware necessary for an integral installation at all fixed and operable window units (fixed and operable portions of windows). Aluminum frame color shall be the same as window frame color. Solar screening shall be "Kool-Shade" of color selected by CONSTRUCTION MANAGER.
- E. **Manufacturers:** Windows, of the model indicated, shall be manufactured by the following (or equal):
 1. Acceptable Manufacturers

- a. Kawneer, Series 8400TL
- b. Efco, Series 3502/3902
- c. Traco, Series 6800
- d. Or Equal.

2.3 FABRICATION

- A. **General:** Frame and sash members shall be fabricated into complete windows under responsibility of one manufacturer. Window units shall bear Certification Label.
- B. **Sash:** Vertical sash members shall be hollow tubular extrusions to resist torsion. Sash corners shall be milled and telescoped for maximum strength. Vent sash shall roll on grease packed ball bearing rollers having nylon tires. Screws, fasteners, axles, and pins shall be stainless steel.
- C. **Frame:** Frames shall be constructed of continuous extrusions, with miter cut corners with each corner mechanically fastened with not less than two screws and sealed watertight.
- D. **Joinery:** Joinery methods shall not discolor finish or be unsightly.
- E. **Weather-stripping:**
 - 1. Sash shall be provided with double weather-stripping at head and sill.
 - 2. Weather-stripping shall be securely staked and joined at corners.
- F. **Hardware:**
 - 1. Interior sash meeting rail shall have a spring loaded stainless steel plunger lock that engages automatically with a stainless steel strike plate as the window is closed. The lock handle shall be applied to the interior face of the meeting rail, all interior meeting rails shall be continuous grip rail. Plastic hardware is not acceptable.
 - 2. Locks: Stainless steel strikes and keepers for manual and/or custodial key operation locking, to secure sash in closed position, shall be provided.
- G. **Finish:** Exposed surfaces of all aluminum windows and trim shall have an architectural Class IAA-M10-C22-A-42 dark bronze (0.7 mil minimum thickness) anodized finish.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Installation of window units and other components of the work shall comply with the manufacturer's specifications and written recommendations.
- B. Unit sets shall be set plumb, level, and true to line, without warp or rack of frames. Anchor shall be

securely in place. Aluminum and other corrodible surfaces shall be separated from sources of corrosion or electrolytic action at points of contact with other materials.

- C. Sill members shall be set in sill pan (seal edges) and other members in a bed of sealant with joint fillers to provide weathertight construction. The CONTRACTOR shall coordinate installation of the window units with wall flashings and other components of the WORK.
- D. The aluminum surfaces and glazing shall be cleaned prior to project acceptance.
- E. The WORK of this Section includes precautions required through remainder of the construction period, to ensure that window units will be without damage or deterioration, other than normal weathering, at time of acceptance.
- F. **Trademarks:** Trademarks, nameplates, or similar items shall not be visible nor attached to the installation.
- G. **Protection:** After installation and erection, exposed surfaces and finishes shall be protected from damage.

3.2 CLEANUP AND DISPOSAL

- A. After completion of the installation, the unit shall be tested for water leaks and protected.
- B. Prior to acceptance by the OWNER, the CONTRACTOR shall clean the WORK of this Section as recommended by the product manufacturer.

- END OF SECTION -

SECTION 08710 - FINISH HARDWARE

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all finish hardware and appurtenant work, complete.
- B. The WORK hereunder shall include all fabrication and mounting templates as needed for fabricators and for control of application of metal items.
- C. In addition thereto, the CONTRACTOR shall provide all trim, attachments, and fastenings indicated or required for proper and complete installation.
- D. The WORK of this Section shall include all hardware that is not indicated in other sections, whether or not such hardware is herein specifically scheduled.
- E. The CONTRACTOR shall coordinate hardware with the WORK of other Sections. 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 proper installation and function.

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 08110 Steel Doors and Frames
 - 2. Section 08210 Wood Doors
 - 3. Section 08220 Fiberglass Reinforced Plastic Doors
 - 4. Section 08340 Acoustic Doors

1.3 CODES

- A. The 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. California Building Code
 - 2. California Fire Code
 - 3. California Code of Regulations, Title 24

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. Commercial Standards:
 - Underwriters' Laboratories, Inc. requirements and approvals.

Hardware Institute (DHI)	"Recommended Procedure for Processing Hardware Schedules and Templates" and "Architectural Hardware Scheduling and Format"
BHMA	Builders' Hardware Manufacturers' Association
ANSI A156.1 through A156.8	Standards for various hardware items

1.5 HARDWARE SPECIFIED ELSEWHERE

A. Hardware for the following is indicated elsewhere:

1. Cabinetwork, including open wall shelving and locks.
2. Signs, except as noted.
3. Toilet accessories of all kinds including grab bars.
4. Rough hardware.
5. Folding partitions, except lock cylinders which are indicated herein.
6. Sliding aluminum doors.
7. Angle sill threshold.

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Schedules: Submit schedule at earliest possible date prior to ordering of hardware. Organize the schedule into "Hardware Sets" with an index of doors and a heading, indicating complete designations of every item required for each door or opening. Include the following information:
 - a. Type, style, function, size, quantity, and finish of each hardware item.
 - b. Name, part number and manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of hardware set, cross referenced to indications on drawings, both on floor plans and in door schedule.
 - e. Explanation of all abbreviations, symbols, and codes contained in the schedule.
 - f. Indicate specific locations and mountings heights of each type of hardware.
 - g. Indicate door and frame sizes and materials.
 - h. Include a list of all manufacturers used and their nearest representative, with name, address, and telephone number.
 - i. Submit manufacturer's complete technical data and installation instructions for electric and electronic hardware.
2. Templates: Where required, furnish hardware templates to each fabricator of doors, frames and other WORK where factory preparation is required for proper installation of hardware.
3. Product Data: Submit manufacturer's catalogue cuts, finishes, etc., for CONSTRUCTION MANAGER'S review.
4. Samples: Furnish a representative sample, in the correct finish and color, of each visible component of hardware.

- B. No hardware shall be ordered or delivered until the hardware schedule has been approved by the CONSTRUCTION MANAGER.

1.7 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL:

- 1. Extended warranty for all hardware.

1.8 SERVICES OF MANUFACTURER

- A. **Inspection, Field Adjustment, and Maintenance Instructions:** Authorized hardware suppliers or manufacturer's representatives shall visit the site for not less than 1 day to provide the indicated services.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. **Acceptance at the Site:** Individually package each unit of finish hardware, complete with proper fastening and appurtenances, clearly marked on the outside to indicate contents, item numbers, and names corresponding to those listed in the hardware schedule and specific locations in the WORK.
- B. Small miscellaneous items that would not require specific location identification, such as door stops, coat and hat hooks, and door silencers may be quantity packed if properly labeled with item numbers and other identification.
- C. Deliver hardware in manufacturer's original packages individually packaged and carefully marked for its intended opening and use. Pack complete with necessary screws, bolts, keys, instructions, and installation template, if necessary, for spotting mortising tools. Supplier shall furnish to CONTRACTOR with the delivery, a complete list of hardware clearly marked to correspond with marking on each package and with the hardware schedule. CONTRACTOR shall check the hardware upon delivery. The CONTRACTOR shall be responsible for the proper storage of all hardware until ready for installation.

1.10 QUALIFICATIONS

- A. **Hardware Supplier:** The hardware supplier shall be a direct factory contract supplier who has in his employ a certified architectural hardware consultant (AHC) who is available at all reasonable times during the course of the WORK for project hardware consultation to the CONTRACTOR.

1.11 EXTENDED WARRANTY

- A. The CONTRACTOR shall furnish a guarantee from the hardware supplier for all hardware work, as follows:
 - 1. Closers: Ten years, except electronic closers, two years.
 - 2. Exit Devices: Three years
 - 3. All other hardware: Two years

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All items of hardware shall be furnished as required to complete the WORK in accordance with these Specifications and the manufacturer's instructions. Items of hardware not specified shall be provided even though inadvertently omitted from this Specification. Items shall be of equal quality and type.
- B. Where the exact types of hardware specified are not adaptable to the finished shape or size of the members requiring hardware, supplier shall advise the CONTRACTOR and the CONSTRUCTION MANAGER in writing as a part of the submittal process. Supplier shall also provide suggestions of suitable alternatives having as nearly as practicable, the same operation and quality as the type specified.
- C. **Exit Doors:** The intent of the Specifications is that exit doors shall be openable at all times, from the inside, without the use of a key or any special knowledge or effort.
- D. **Fire-Rated Openings:** Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80. This requirement takes precedence over other requirements for such hardware. Provide only such hardware which has been tested and listed by UL for the type and size of each door required, and which complies with the requirements for the door and door frame labels. Latching hardware, door closers, ball bearing hinges, and seals are required whether listed in the Hardware Schedule or not.
 - 1. Where panic exit devices are required on fire-rated doors, provide supplementary marking on door UL label indicating "Fire Door to be Equipped with Fire Exit Hardware," and provide UL label on exit device indicating "Fire Exit Hardware."
- E. The WORK requires the CONTRACTOR to obtain each kind of hardware from only one manufacturer, although several may be indicated as offering products which comply with requirements.

2.2 KEYS AND KEYING

- A. CONTRACTOR shall provide temporary key cores and keys during construction at locations the CONTRACTOR selects. After substantial completion, the CONTRACTOR shall remove all temporary cores and furnish all permanent lock cylinders to the OWNER's designated locksmith for keying and installation by OWNER.
- B. CONTRACTOR shall provide all locks and cylinders of the same manufacturer. Each cylinder for each lockset and exit device shall have two "OO" bitted keys furnished.
- C. CONTRACTOR shall stamp all keys "Do Not Duplicate."
- D. Locks shall be interchangeable with the City's master system which uses only Best 7 pin patented key cores and shall conform to Federal Specifications FF-H-106A-87 Series.

2.3 FASTENERS

- A. Furnish screws, bolts, nuts, expansion shields, shim plates, anchors and other fasteners of suitable types and sizes recommended by manufacturer and as required to install hardware securely to withstand hard usage over long life. The fasteners shall match the hardware in material and finish.

- B. All hardware, such as expansion bolts, sex bolts, toggle bolts and other approved anchorages shall be coordinated with the job and to each setting condition.
- C. Screws for items applied on gypsum board shall be sufficiently long to provide solid connection to framing and backing behind the gypsum board.
- D. Phillips head screws shall be used at exposed conditions. Machine screws shall be used at metal doors and frames.

2.4 HINGES AND PIVOTS

- A. Two hinges or pivots shall be provided for each door leaf up to and including 5 feet in height, and an additional hinge shall be added for each 2-1/2 feet or fractions thereof of additional door height. Dutch doors shall be provided with not less than 2 pairs of hinges.
- B. Width of hinges shall be determined by trim conditions, but shall be of sufficient size to permit door to swing 180 degrees.
- C. Ball-bearing hinges shall be furnished on all doors having door closers and/or exit devices. All ball-bearing hinges shall have flush tips.
- D. All hinges on exterior doors shall be provided with non-removable pins and security studs.
- E. Hinges shall be 630 (brush finished) stainless steel unless otherwise indicated in the finish hardware schedule.
- F. Hinges and sizes shall be as follows:

<u>Door Thickness (inches)</u>	<u>Door Width (inches)</u>	<u>Hinge Weight</u>	<u>Hinge Height (inches)</u>
1-3/8	36 and under	Reg. Wt., interior use only	3-1/2
1-3/8	37 and over	Reg. Wt., interior use only	4
1-3/4	30 and under	Reg. Wt., exterior use	4-1/2
1-3/4	30 to 39	Reg. Wt., exterior use	4-1/2
1-3/4	40 and over	Extra Hvy Wt., 4 ball bearing, exterior use	4-1/2

- G. Hinges shall be plain bearing type (regular weight) conforming to BHMA No. A 2133; ball bearing hinges (regular weight) conforming to BHMA No. A 2112 or No. A 5112; and ball bearing hinges (heavy weight) conforming to BHMA No. A 2111 or No. A 5112. Hinge manufacturers design options such as 3-knuckle hinges and concealed ball bearing hinges are acceptable. Plain hinges shall be provided with self lubricating bushings.

2.5 FLOOR CLOSERS

- A. Floor closers shall be used on all aluminum doors.

2.6 OVERHEAD CLOSERS

- A. All overhead closers shall be the product of one manufacturer. Closers shall have high-strength cast-

iron bodies with rectangular, removable non-ferrous covers, adjustable spring power and adjustable back-check, and full rack and pinion action. Closers shall be non-handed and adjustable. Closers shall have back-check regulating screws, with separate screws for closing and latching speeds.

1. Furnish sizes as recommended by manufacturer except where schedule calls for larger size.
 - a. Provide size 2 through 6 unless otherwise indicated at exterior and interior fire rated doors.
 - b. Provide size 1 through 4 at interior non-rated doors.
 2. Exterior doors shall have 5 lbs maximum pressure to open.
 3. Interior doors shall have 5 lbs maximum pressure to open.
 4. Flush transom offset brackets shall be used where parallel arm closers are listed for doors with fixed panels above.
 5. Drop brackets are required at narrow head rails.
 6. Make labeled doors self-closing where indicated.
 7. Closers shall be adjusted by a factory authorized representative.
 8. Factory powder coated to match other hardware, unless otherwise noted.
- B. Locate closers on inside of building, stairs, and rooms.
- C. Surface door closers shall be spray painted to match door hardware.
- D. Soffit shoes shall be provided where corner brackets or regular arm closers are not used and where they are necessary for proper function of the hardware.
- E. Where door closers or other items have lever or similar arms, attachment to doors shall be with sex bolts only.
- F. Closers for outswinging exterior doors shall be top-jamb-mounted and furnished with adapter plates for doors under 7 feet-6 inches in height. If necessary, closers may be mounted on drop brackets on doors above 7 feet-6 inches in height.
- G. The CONTRACTOR and its hardware supplier shall be responsible to provide the right arm for all closer applications. Arms shall be parallel with the closed door whenever possible.
- H. Closers shall be provided with sex bolts for fastening through doors, frames and transoms.
- I. Closing Speed: To comply with CBC Chapter 11B.

2.7 LOCKSETS AND LATCHSETS

- A. All locksets and latchsets and their component parts shall be the product of a single manufacturer and shall be mortise type with anti-friction 2-piece latchbolts with a minimum 3/4-inch-throw and 1-inch-throw dead bolts with hardened roller inserts. Locksets and latchsets at fire rated doors shall meet California Building Code and California Fire Code requirements and shall be modified as necessary. All locksets, latchsets, privacy sets, and passage sets shall be provided with lever

handles conforming to handicapped person requirements unless indicated otherwise. All locksets and latchsets shall be provided with satin stainless steel finish 630 (US 32D) unless otherwise indicated.

- B. The function of each lockset or latchset shall be appropriate for the use of the door to which it is attached.
- C. Hardware for aluminum entrance doors shall be as indicated in schedule. The hardware face plate design shall be coordinated with doors provided.
- D. Where knob type trim is indicated for locksets, latchsets, and privacy sets, the trim shall be cast spherical knobs of 2-inch diameter minimum, 2-1/4-inch wrought roses, screwless attached, and thru-bolted trim. The knob and rose and escutcheon mounting shall be of shank spindle assembly designs.
- E. Mortise deadlocks shall be of weight and quality comparable to locksets and latchsets specified.
- F. Lock strikes shall be 16 gauge curved steel, 1 inch deep box type construction, of sufficient length to clear trim and having curved lips to protect the trim and jambs and be so shaped as to avoid the possibility of tearing clothing.
- G. All locks shall be provided with the same cylinder and keyway for master keying. They shall be the product of the same manufacturer as the locksets unless otherwise indicated. The correct cylinders with all necessary modifications and components such as cams, collars, rings, retainers, plates, fasteners, etc., shall be provided for other specialty hardware such as exit devices, store front locksets, and sliding door locks where the indicated hardware manufacturer is different from the cylinder manufacturer.
- H. Padlocks shall be heavy duty type and shall be of same manufacturer as locksets.
- I. Provide approved fusible links at levers for labeled doors.
- J. Verify whether standard or ANSI cutouts are provided in metal frames.

2.8 EXIT DEVICES

- A. All exit devices shall be the product of one manufacturer. The design of outside trim, inside trim, and crossbar shall match. Exit devices shall be (wherever possible) constructed of stainless steel unless otherwise indicated. The finish shall be 630 (US 32D) satin finish stainless steel unless otherwise indicated. Exit devices shall be UL labeled and shall be of corrosion-resistant hardware.
- B. The exit devices shall have side-mounted crossbars unless otherwise specified. They shall be provided with stainless steel lever arms and investment-cast cases. Where bronze or aluminum lever arms are required they shall be drop-forged with pressure-cast cases.
- C. The exit devices shall be provided with stainless steel latch bolt, tailpiece, latch bolt retractor and axle, compression springs, cylinder cam, and lever arm operating stand. Tail piece shall be cadmium plated steel of not less than 3/8-inch diameter. The cylinder shall be retained in the case by a threaded bronze ring. All other interior working members shall be drop-forged bronze. The back plate shall be constructed of stainless steel or bronze. All screws, pins, socket head retaining screws, and other fasteners shall be stainless steel unless otherwise specified.

2.9 PUSH PLATES AND PULLS

- A. Push plates shall be 4-inch by 16-inch by 0.050 thick.
- B. Pulls shall be thru-bolted.

2.10 KICKPLATES

- A. Kickplates shall be brushed brass or brushed stainless steel, 0.050-gauge, beveled on 4 sides, and 16 inches high, except where necessary to clear a louver in which case they shall be 10 inches high. Width shall be door width less 2 inches for single doors and door width less 1-1/2 inches for pairs of doors. Furnish with machine or wood screws of brass or stainless steel to match other hardware.

2.11 DOOR STOPS

- A. All doors shall be provided with door stops.
- B. Door stops shall be of the type indicated in the hardware schedule and shall be provided with the proper fasteners.
- C. Stops shall be provided with machine screws and anchors at concrete and masonry locations, and toggle bolts at plaster, gypsum board, and wood locations.
- D. Aluminum door stops shall be used with aluminum, chrome, and stainless steel finishes.
- E. Bronze door stops shall be used with brass and bronze finishes.
- F. Provide carpet risers at carpeted areas.

2.12 DOOR HOLDERS

- A. Overhead type door holders shall be concealed type of correct size for door, 90 degree openable unless 180 degree opening is indicated, and allowing for checkmating. Interior doors shall be provided with overhead stops if wall type stops can not be used and floor stops make a tripping hazard. Finish shall be chrome plated bronze with satin finish, US 26D, unless otherwise indicated.

2.13 DOOR SILENCERS OR MUTES

- A. All interior hollow metal frames shall be provided with rubber silencers, three for each single door and four for pairs of doors. Omit where sound or light seals occur, or where fire-resistive rated door assemblies are indicated.

2.14 THRESHOLDS

- A. Thresholds shall be provided as indicated and shall have a maximum of 1/2-inch rise at entry ways. Return miters shall be provided at thresholds on floor closers.

2.15 WEATHERSTRIPPING AND SEALS

- A. Exterior doors (except for roll-up doors and entrance doors) shall have head, jambs, and astragals weatherstripped with not less than 5/16-inch by 5/8-inch closed cell, neoprene sponge rubber, unless otherwise indicated.

- B. Interior doors shall have head, jambs, and astragals sealed with self-adhesive bubble configuration door seal designed against smoke, air, sound, and weather infiltration. The seals shall be fire tested and labeled as a gasketing for use on steel frames with wood or steel doors.
- C. **Seals:** All seals shall be furnished to match adjacent frame color. Solid neoprene shall comply with MIL Spec R6855-CL III, Grade 40. Sponge neoprene shall comply with MIL Spec R6130, Type II, Group C. Other seals and sweeps shall be polyurethane. UL label shall be applied to the seals on all rated doors.

2.16 TEMPLATES

- A. Hardware indicated for metal frames shall be made to template and secured with machine screws. Templates, or physical hardware items, shall be furnished to manufacturers sufficiently in advance to avoid delay in the WORK.

2.17 REINFORCING UNITS

- A. Reinforcing required for installation of hardware in metal jambs shall be furnished by jamb manufacturer, coordinated with hardware manufacturer and provided in time to be installed and welded within jamb during fabrication.

2.18 MANUFACTURERS

- A. **General:** Hardware items shall be products of the following manufacturers (or equal). Cylinder cores shall be compatible and interchangeable with existing City of San Diego Metropolitan Wastewater Department operations keying systems.

<u>Description</u>	<u>Manufacturer</u>	<u>Model #</u>	<u>Other Information</u>
Floor closers	Rixson-Firemark Dor-O-Matic	27 Series 2500	
Overhead closers	P & F Corbin Russwin Sargent LCN	120 Series 2820 Series 350 Series 4040	
Locksets and Latches (Lever Type Hardware Meeting Handicap Requirements)	Best	30 H Series	
Locksets and Latches	Arrow Falcon Best	H Series X Series 9 K Series	
Hardware for Aluminum Entrance Doors	Adams Rite		

Exit Devices	Von Duprin	3300 Series	Rim Type
	Von Duprin	9900 Series	Rim Type
	Sargent	60 Series	
	Russwin	372-LT 375-375	Rim Only, Single Doors
	Corbin	29 Series	Rim Only with Mullion
	Monarch	18 Series	
Hinges	Hager	BB1179	
Push Plates	Quality Hardware	40	
	Builders Brass	Wks	47E
	Rockwood	70	
Pulls	Quality Hardware	402	
	Builders Brass	Wks	47-255-1-E
Kickplates	Builders Brass Wks (BBW)	37 Series	
	Quality Hardware (QH)	48 Series	
Door Stops (Floor Type w/Holder)	Builders Brass Wks	F-823X	
	Quality Hardware	139	
Door Stops (Floor, Dome Type)	Builders Brass Wks	F-8061X	
	Quality Hardware	431 ES	
Door Stops (Floor Type w/Holder)	Builders Brass Wks	F-823X	
	Quality Hardware	139	
Door Stops (Wall Type w/Holder Expansion Bolt Mounted)	Builders Brass Wks	W-141X	
	Quality Hardware	36	
Door Stops (Wall Type w/Holder, Flat Head Wood Screw Mounted)	Builders Brass Wks	W-141X	
	Quality Hardware	36	
Door Bumpers (Wall Dome Type, Expansion Bolt Mounted)	Builders Brass Wks	W9X	
	Quality Hardware	W 207S	
Door Stops (Wall Base, Expansion Bolt Mounted)	Builders Brass Wks	W-146	
	Quality Hardware	138	
Door Stops (Wall Base)	Builders Brass Wks	W146	
	Quality Hardware	38	

Door Holders (Concealed Overhead Type)	P & F Corbin FS Type 1164 Glynn-Johnson	840 Series GJ 320 Series
Door Holders (Surface Overhead Type)	P & F Corbin FS Type 1161 Glynn-Johnson	1865 Series GJ 90M
Door Silencers or Mutes (Metal Frames)	Glynn-Johnson Hager 307D	64
Door Silencers or Mutes (Wood Frames)	Glynn-Johnson Hager 308D	65
Weatherstripping	Pemko Mfg. Co. National Guard Products, Inc. Lero Weatherstripping Co.	
Seals for Fire Rated Doors	Pemko S88D National Guard Products, Inc.	TM 181

PART 3 -- EXECUTION

3.1 GENERAL

- A. CONTRACTOR shall install finish hardware as required. Hardware shall be fitted prior to painting. Painting shall be completed before final installation of hardware. Finish hardware must be neatly and properly installed and secured firmly in place in accordance with best practices as prescribed by manufacturers. All hardware must be thoroughly cleaned prior to final acceptance by OWNER.
- B. No extra cost will be allowed because of changes or corrections necessary to facilitate installation of any hardware. CONTRACTOR shall be responsible for proper fabrication of all WORK or material to receive hardware.
- C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Installation shall conform to local governing agency security ordinances.

3.2 MOUNTING POSITIONS

- A. Heights given are centerline heights up from floor unless otherwise indicated and shall be subject to the Title 24 requirements; all similar items shall be at the same height. Heights of items not indicated shall be in accordance with recommendations of Builders Hardware Association.
 - 1. Top hinge: 5 inches from door top to top of hinge.
 - 2. Bottom hinge: 10 inches from door bottom to bottom of hinge.
 - 3. Intermediate hinges: Equally spaced between top and bottom hinges and from each other.
 - 4. Hinge mortise on door leaf: 1/4-inch to 5/16-inch from stop side of door.

5. Lock: 38 inches from finished floor to center lever or knob.
6. Push bar: 45 inches from bottom of door to center of bar.
7. Push plate: 48 inches from bottom of door to center of plate.
8. Pull plate: 42 inches from bottom of door to center of pull.
9. Panic: 38-13/16 inches from finished floor to center of pad.
10. Dead bolt: Not more than 72 inches from floor to operating knob or lever.
11. Door stops mounted on doors: Mount near floor so as to strike base, but not to rub carpet or flooring. 2-3/4-inch backset.
12. Deadlock strike: 44 inches from floor, centered.

3.3 ADJUSTMENT

- A. After installation of hardware and after air supply is turned on, qualified hardware supplier's or manufacturer's representatives of operating hardware shall inspect the installation, make adjustments and deliver instructions for maintenance and future adjustments to the OWNER.
- B. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly.
 1. Latches and bolts shall be installed to automatically engage in keepers, whether activated by closers or by manual push. In no case shall manual pressure be required to engage latch or bolt in keepers.
 2. Closers and hinges shall be carefully adjusted to operate the doors noiselessly and evenly and hinges shall be installed so as not to bind.
- C. **Inspection:** Hardware supplier shall inspect all hardware before final acceptance and include with his guarantee a statement that this has been accomplished. The supplier shall indicate that the hardware is complete and correctly installed and adjusted.

3.4 HARDWARE SCHEDULE

- A. The hardware schedule is arranged for convenience of locating hardware and does not preclude in any way the requirements that all necessary hardware shall be furnished and properly installed. Hardware not specifically called out shall be similar to that required for similar uses.
- B. The catalog numbers referred to in the hardware schedule are taken from catalogs of the manufacturers listed. They are used only to establish the quality and type of hardware to be used. All component parts of locksets shall be the product of one manufacturer.

FINISH HARDWARE SCHEDULE ABBREVIATIONS (Not Standard With Industry)

CA	=	Clear anodized BHMA 628
DBA	=	Dark bronze anodized (313)
PMD	=	Paint to match door and/or frame BHMA 600
F#	=	ANSI, hardware function number
W/SS	=	With security studs NRP

- = Non-removable pins
- DW+3 = Door width plus 3-inches
- DW-2 = Door width less 2-inches
- EB = Expansion bolts
- TB = Toggle bolts
- SB = Sex bolts
- Mfr = Manufacturer
- WS = Weatherstripping, 5/16-inch by 5/8inch closed cell sponge neoprene.
- F/S = Fire seals

FINISH HARDWARE TYPES

TYPE 1 - (Interior Single Door - Office)

1 1/2	Pair Hinges	BB1179 4.5 X 4.5 (Or per Sec. 2.18A)	626	HAG
1	Lockset	30H Series	626	BEST
1	Cylinder	To match system		
1	Kick Plate	48 Series 10" X 2" LDW	630	HQ

TYPE 2 - (Exterior Single Door - Entrance)

1 1/2	Pair Hinges	BB1191 4.5 X 4.5	626	HAG
1	Exit Device	98-L-03	630	VON
1	Lockset	LX253S626	626	GEN
1	Cylinder	To match system		
1	Astragal	357SS X S88	SS	PEM
1	Closer	4040	Sec. 2.6	LCN
1 set	Seals	S88D	DKB	PEM
1	Threshold – ADA Compliant	0"-1/4" max. vert. & 1/4"-1/2" at 1:2	628	PEM
1	Door Shoe	2221AV	AL	PEM
1	Kick Plate	48 10" X 2" LDW	630	QH

TYPE 3 - (Exterior 2-Hr Rated Double Door - Entrance)

2	Pair Hinges	BB1191 4.5 X 4.5	626	HAG
1	Exit Device	98-L-03	630	VON
1 set	Flush Bolt		626	IVE
1	Astragal	357SS X S88	SS	PEM
2	Rim Exit Device	99-RIM-NL-OP	626	VON
2	Closer	SC71 Heavy Duty	689	FCN
2 set	Seals	S88D	DKB	PEM
1	Threshold – ADA Compliant	0"-1/4" max. vert. & 1/4"-1/2" at 1:2	628	PEM

2	Door Shoe	2221AV	AL	PEM
2	Kick Plate	48 10" X 2" LDW	630	QH

Note: Requires Smoke-Labeled Gasketing

TYPE 4 - (Interior Single Door – 3Hr Labeled & Acoustical Door)

1 1/2	Pair Hinges	BB1179 4.5 X 4.5	626	HAG
1	Lockset	30H Series	626	BEST
1	Cylinder	To match system		
1	Closer	SC71 Heavy Duty	689	689
1	Seals	S88D	DKB	PEM
1	Kick Plate	48 Series 10" X 2" LDW	630	HQ

Note: Requires Smoke-Labeled Gasketing

TYPE 5 - (Interior Double Door)

2	Pair Hinges	BB1191 4.5 X 4.5	626	HAG
1	Astragal	357SS X S88	SS	PEM
2	Closer	SC71 Heavy Duty	689	FCN
2 set	Seals	S88D	DKB	PEM
1	Astragal	357SS X S88	SS	PEM
2	Door Shoe	2221AV	AL	PEM
2	Kick Plate	48 10" X 2" LDW	630	QH

Note: Requires Smoke-Labeled Gasketing

TYPE 6 - (Double Acoustical Doorw/ Man Door)

Hardware By Manufacturer of Acoustical Doors

TYPE 7 – (Overhead Door)

Hardware By Manufacturer of Manual Overhead Doors and as indicated in specification section 08360,

FINISH HARDWARE SCHEDULE

Per Door Schedule on 6A-5:

DOOR NUMBER	HARDWARE TYPE
#1	Reuse Existing w/ Panic Hardware Confirm 2 Hr Fire Rating
#2,3,4,5	TYPE 1
#6 & #7	TYPE 2

Per Door Schedule on 7A-8:

DOOR NUMBER	HARDWARE TYPE
#1	TYPE-3
#2,8,10,12	TYPE 2
#6 & #7	TYPE 2

**** END OF SECTION ****

SECTION 08800 - GLAZING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all glass, caulking materials, and appurtenant items required for all the glass and glazing work, complete.

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 07920 Sealants and Caulking
- 2. Section 08110 Steel Doors and Frames
- 3. Section 08520 Aluminum Windows, Horizontal Sliding

1.3 CODES

- A. The 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. California Building Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

- 1. Federal Specifications:

DD-G-451	Glass, Float or Plate, Sheet, Figured (Flat for Glazing, Mirrors and Other Uses)
DD-G-1403	Glass, Float, Sheet, Figured, Coated (Heat-Strengthened and Tempered)
TT-S-001543	Sealing Compound, Silicone Rubber Base (For Caulking, Sealing and Glazing in Buildings and Other Structures)

- 2. Commercial Standards:

ASTM C 1036	Primary Glass Standard
ASTM C 1048	Heat Treated Glass Standard
ASTM D 2287	Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 163 (UL 9)	Fire Resistance Rated Wire Glass

3. Trade Standards:

Glazing Standards: CONTRACTOR shall comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except as indicated herein.

Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, CONTRACTOR shall provide the type of products indicated which comply with ANSI Z 97.1 and testing requirements of 16 CFR Part 1201 for category II materials.

Subject to compliance with requirements, CONTRACTOR shall provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

"Glazing Specifications for Sealed Insulating Glass Units" by the Sealed Insulating Glass Manufacturers Association (SIGMA)

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. **Product Data:** Manufacturer's technical data shall be submitted for each glazing material and fabricated glass product required, including installation and maintenance instructions.
2. **Samples:** When requested by the CONSTRUCTION MANAGER, samples shall be submitted for verification purposes, 12-inch square samples of each type of glass indicated except for clear single pane units, and 12-inch long samples of each color required (except black) for each type of sealant or gasket exposed to view. Sealant or gasket sample shall be installed between two strips of material representative of adjoining framing system in color.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. **Certificate:** Certificates shall be submitted from respective manufacturers attesting that glass and glazing materials furnished for the project comply with requirements.
 - a. Separate certification shall not be required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authorities having jurisdiction.
2. **Compatibility and Adhesion Test Report:** A statement shall be submitted from the sealant manufacturer indicating that glass and glazing materials have been tested for compatibility and adhesion with glazing sealants, and interpreting test results of material performance for recommendations on primers and substrate preparation needed to obtain adhesion.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials:** Manufactured products shall be delivered in original, unbroken, packages, containers or bundles bearing the manufacturer's label.

- B. **Storage:** All products shall be carefully stored on wood blocking in an area that is protected from deleterious elements in a manner recommended by the product manufacturer. Storage shall be in a manner that will prevent damage to the material or marring of its finish.
- C. Glass and glazing materials shall be protected during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass and damage to glass and glazing materials from effects of moisture, including condensation, of temperature changes, of direct exposure to the sun, and from other causes.
 - 1. Where insulating glass units will be exposed to substantial altitude changes, hermetic seal ruptures shall be avoided through compliance with insulating glass fabricator's recommendations for venting and sealing.

1.8 SPECIAL WARRANTY

- A. **Manufacturer's Special Project Warranty on Laminated Glass:** A written warranty signed by manufacturer of laminated glass shall be provided agreeing to furnish f.o.b. point of manufacture, freight allowed to project site, within specified warranty period indicated below, replacements for those laminated glass units which develop manufacturing defects. Manufacturing defects shall be defined as edge separation or delamination which materially obstructs vision through glass.
 - 1. **Warranty Period:** Warranty period shall be manufacturer's standard, but not less than 4 years after date of substantial completion.
- B. **Manufacturer's Special Project Warranty on Coated Glass Products:** A written warranty shall be provided, signed by manufacturer of coated glass agreeing to furnish f.o.b. point of manufacture, freight allowed to project site, within specified warranty period indicated below, replacements for those coated glass units which develop manufacturing defects. Manufacturing defects shall be defined as peeling, cracking or deterioration in metallic coating due to normal conditions and not due to handling or installation or cleaning practices contrary to glass manufacturer's published instructions.
 - 1. **Warranty Period:** Warranty period shall be manufacturer's standard, but not less than 5 years after date of substantial completion.
- C. **Manufacturer's Special Project Warranty on Insulating Glass:** A written warranty shall be provided, signed by manufacturer of insulating glass agreeing to furnish f.o.b. point of manufacture, freight allowed to project site, within specified warranty period indicated below, replacements for those insulating glass units developing manufacturing defects. Manufacturing defects shall be defined as failure of hermetic seal of air space (beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coatings, if any, and other visual indications of seal failure or performance; provided the manufacturer's instructions for handling, installing, protecting, and maintaining units have been complied with during the warranty period.
 - 1. **Warranty Period:** Warranty period shall be manufacturer's standard, but not less than 10 years after date of substantial completion.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Manufacturer's Standards:** Glass and caulking materials shall be in accordance with the

manufacturer's published literature and specifications for the products indicated.

- B. **Single Source Responsibility for Glass:** Materials shall be provided which are produced by a single manufacturer or fabricator for each kind and condition of glass indicated. Primary glass shall be obtained from a single source for each type and class required.
- C. CONTRACTOR shall provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the WORK.
 - 1. Normal thermal movement shall be defined as that resulting from an ambient temperature range of 120 degrees F (67 degrees C) and from a consequent temperature range within glass and glass framing members of 180 degrees F (100 degree C).
 - 2. Deterioration of insulating glass shall be defined as failure of the hermetic seal due to other causes than breakage which results in intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coating, if any, resulting from seal failure, and any other visual evidence of seal failure or performance.
 - 3. Deterioration of laminated glass shall be defined as the development of manufacturing defects including edge separation or delamination which materially obstructs vision through the glass.
 - 4. Deterioration of coated glass shall be defined as the development of manufacturing defects including peeling, cracking or other indications of deterioration in metallic coating due to normal conditions of use.

2.2 GLAZING MATERIALS

A. Glass Specifications:

- 1. Primary Glass Standard: Primary glass shall comply with ASTM C 1036, including type, class, quality, and, if applicable, form, finish, mesh and pattern.
- 2. Glass shall conform to Federal Specifications DD-G-451.
- 3. Heat-Treated Glass Standard: Heat-treated glass shall comply with ASTM C 1048, including kind, condition, type, quality, class, and, if applicable, form, finish, and pattern.
- 4. Tempered glass shall also conform to Federal Specification DD-G-1403 (Tempered Glass).
- 5. Fire Resistance Rated Wire Glass: CONTRACTOR shall provide wire glass products that are identical to those tested per ASTM E 163 (UL 9) and are labeled and listed by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.
- 6. Insulating Glass:

Insulating glass units shall be provided which are permanently marked either on spacer's or at least one component pane of units with appropriate certification label of the Insulating Glass Certification Council (IGCC).

Insulating glass units shall conform to SIGMA 65-7-2 as well as the preceding Federal Specifications.

- B. **Sizes:** Glass shall be fabricated to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Thicknesses shall be provided as indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.
- C. **Glazing Thickness:** Thicknesses of glass indicated are minimum thicknesses. Thicker glass shall be provided when required by the Building Code.
- D. **Labelling:** Glass shall be factory-labeled. Non-labeled glass will be rejected.

2.3 GLASS TYPES

- A. All glass shall conform to the following requirements:
 - 1. Type GL-1 - Tinted, Colored, Fully-Tempered Float Glass: Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 2 (tinted heat absorbing and light reducing), Quality q3 (glazing select), with tint color and performance characteristics for 1/4-inch thick glass matching those indicated for non-heat-treated tinted float glass. Tinted, colored, insulating glass in horizontal sliding window shall be same as above, except that units shall be 5/8-inch thick, consisting of 3/16-inch thick glass and 1/4-inch air space. The glass color shall match existing window glazing and shall be as follows:
 - a. Gray: Manufacturer's standard tint, with visible light transmittance of 41-43 percent and shading coefficient of 0.67 - 0.69 percent for 1/4-inch thick glass.
 - b. Bronze: Manufacturer's standard tint, with visible light transmittance of 50-52 percent and shading coefficient of 0.69 - 0.71 for 1/4-inch thick glass.
 - c. Manufacture heat-treated glass by horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated.
 - d. Type A sealed insulating glass units shall comply with paragraph 2.3 A.3.
 - 2. Type GL-2 - Clear, Tempered, Insulating Glass: Units shall be 1-inch minimum thickness, consisting of an outside lite of 1/4-inch thick tempered, clear float glass; 1/2-inch air space; and an inside lite of 1/4-inch thick tempered, clear float glass.
 - 3. Sealed Insulating Glass Units - General: Preassembled units shall be provided consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E 774 for performance classification indicated as well as with other requirements for glass characteristics, air space, sealing system, sealant, spacer material, corner design, and desiccant.
 - a. Individual glass panes comprising sealed insulating glass units shall comply with product requirements specified elsewhere in this Section applicable to types, classes, kinds, and conditions of glass products indicated.
 - b. Fully-tempered panes shall be provided of kind and at locations indicated or, if not indicated, fully-tempered panes shall be provided where recommended by manufacturer

for application indicated, and where safety glass is designated or required.

- c. Performance Classification per ASTM E 774: Class A.
- d. Thickness of Each Pane: As indicated.
- e. Air Space Thickness: As indicated.
- f. Sealing System: Manufacturer's standard.
- g. Spacer Material: Manufacturer's standard metal.
- h. Desiccant: Manufacturer's standard; either molecular sieve or silica gel or blend of both.
- i. Corner Construction: Manufacturer's standard corner construction.

2.4 ELASTOMERIC GLAZING SEALANTS AND PREFORMED GLAZING TAPES

- A. **General:** Products shall be provided of type indicated and complying with the following requirements:
 - 1. **Compatibility:** Glazing sealants and tapes shall be selected of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field knowledge.
 - 2. **Suitability:** Recommendations of sealant and glass manufacturers shall be complied with for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.
 - 3. **Elastomeric Sealant Standard:** Manufacturer's standard chemically curing, elastomeric sealant shall be provided of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.
 - 4. **Colors:** Color of exposed sealants shall be provided as indicated or, if not otherwise indicated, as selected by CONSTRUCTION MANAGER from manufacturer's standard colors.
- B. **Two-Part Polysulfide Glazing Sealant:** Type M; Grade NS; Class 25; Uses NT, M, G, A, and as applicable, to uses indicated, O.
- C. **One-Part Non-Acid-Curing Silicone Glazing Sealant:** Type S; Grade NS, Class 25; Uses NT, G, A, and, as applicable, to uses indicated, O; conforming to Federal Specifications TT- S-001543A non-sag type, and complying with the following requirements for modulus and additional joint movement capability.
 - 1. **Low Modulus:** Tensile strength of 45 psi or less at 100 percent elongation when tested per ASTM D 412 after 14 days at 77 degrees F (20 degrees C) and 50 percent relative humidity.
- D. **Preformed Butyl-Polyisobutylene Glazing Tape:** Manufacturer's standard solvent-free butyl-polyisobutylene formulation shall be provided with a solids content of 100 percent; complying with AAMA A 804.1; in extruded tape form; non-staining and non-migrating in contact with nonporous

surfaces; packaged on rolls with a release paper on one side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application indicated.

- E. **View Window Gaskets:** Glazing gaskets for view windows in hydraulic structures shall be black neoprene having a 75 (plus or minus 5) Shore "A" Durometer hardness and be chemically compatible for the sealant used.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. **Compatibility:** Materials shall be provided with proven record of compatibility with surfaces contacted in installation.
- B. **Cleaners, Primers and Sealers:** Type recommended by sealant or gasket manufacturer.
- C. **Setting Blocks:** Neoprene, EPDM or silicone blocks shall be provided as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
- D. **Spacers:** Neoprene, EPDM or silicone blocks, or continuous extrusions shall be provided as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.
- E. **Edge Blocks:** Neoprene, EPDM or silicone blocks shall be provided as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement of glass.
- F. **Compressible Filler Rods:** Closed-cell or waterproof-jacketed rod stock shall be provided of synthetic rubber or plastic foam, flexible and resilient, with 5 to 10 psi compression strength for 25 percent deflection.

2.6 MANUFACTURERS

- A. Products of the type indicated shall be of the following manufacture (or equal):

1. Glazing Accessory Products:

- a. **Two-Part Polysulfide Glazing Sealant:**
"Chem-Calk 200"; Bastik Construction Products Div.
"Synthacalk GC-5"; Pecora Corp.
- b. **One-Part Non-Acid Curing Medium-Modulus Silicone Glazing Sealant:**
"Dow Corning 795"; Dow Corning Corp.
"Silpruf"; General Electric Corp.
"Gesil"; General Electric Corp.
"Spectrum 2"; Tremco, Inc.
- c. **Preformed Butyl-Polyisobutylene Glazing Tape without Spacer Rod:**
"Chem-Tape 40"; Bastik Construction Products Div.
"Extru-Seal"; Pecora Corp.
"PTI 303" Glazing Tape; Protective Treatments,
"Tremco 440 Tape"; Tremco, Inc.

2. Glass Products:

a. Clear and Tinted Float Glass:

AFG Industries, Inc.
Ford Glass Division
Guardian Industries Corp.
LOF Glass, Inc.
PPG Industries, Inc.
Saint-Gobain/Euroglass

b. Wire Glass:

AFG Industries, Inc.
Guardian Industries Corp.
Hordis Brothers, Inc.
Pilkington Sales (North American) Limited

c. Heat-Treated Glass:

AFG Industries
Cardinal IG
Environmental Glass Products
Falconer Glass Division
Ford Glass Division
Guardian Industries Corp.
Hordis Brothers, Inc.
LOF Glass, Inc. PPG
Industries, Inc. Saint-
Gobain/Euroglass
Spectrum Glass Prod. Div., H.H. Robertson Co.
Viracon, Inc.

d. Laminated Glass:

Advanced Coating Technology
Environmental Glass Products
Falconer Glass Industries
Ford Glass Division
Guardian Industries Corp.
Hordis Brothers, Inc.
PPG Industries, Inc. Saint-
Gobain/Euroglass
Viracon, Inc.

e. Insulating Glass:

Advanced Coating Technology
AFG Industries, Inc.
Cardinal IG
Environmental Glass Products
Falconer Glass Industries Ford
Glass Division Guardian
Industries Corp. Hordis

Brothers, Inc. Independent
 Insulating Glass PPG Industries,
 Inc.
 Spectrum Glass Prod. Div., H.H. Robertson Co.
 Viracon, Inc.

PART 3 -- EXECUTION

3.1 GENERAL

- A. **Reference Standards:** Products shall be installed in accordance with manufacturer's recommendations and referenced glazing standards except where more stringent requirements are indicated herein.
- B. **Complete System:** Glass and glazing system shall be installed complete with all stops, blocks, channels, beads, sealants, and glass to form a completely installed watertight installation.
- C. Glazing channel dimensions as indicated are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses with reasonable tolerances. Glazier shall adjust as required by job conditions at time of installation.
- D. **Pre-Inspection:** CONTRACTOR shall require glazier to inspect WORK of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. CONTRACTOR shall obtain glazier's written report listing conditions detrimental to performance of glazing WORK. CONTRACTOR shall not allow glazing WORK to proceed until unsatisfactory conditions have been corrected.

3.2 GLAZING APPLICATION SCHEDULE

- A. Glass types for the various locations shall conform to the following schedule:

1. Exterior Locations:	Glass Type
Windows of heated or cooled spaces, unless otherwise noted	G
Windows of unoccupied spaces, typical	A
Entrance doors	B
Window wall lites	B
Sliding glass doors	G
Door lites	B
2. Interior Locations:	
Windows, 18 inches above floor, typical	C
Windows and window wall lites within 18 inches of floor	D
Entrance doors	D
Door lites	D
Sound windows and door lites	E
View window glass in hydraulic structures	M

3.3 PREPARATION

- A. Preparation work such as priming and cleaning shall be done with materials and procedures specified in the printed recommendations of the manufacturer. Surfaces shall be dry and free from dust, dirt, and film. All priming shall be completed and thoroughly dried before glazing.
- B. Glazing channels and other framing members shall be thoroughly cleaned to receive glass, immediately before glazing. Coating which are not firmly bonded to substrates shall be removed. Lacquer shall be removed from metal surfaces where elastomeric sealants are indicated for use.

3.4 INSTALLATION

- A. Glass shall be protected from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Glass shall not be impacted against metal framing. Suction cups shall be used to shift glass units within openings; pry bar shall not be used to raise or drift glass. Glass shall be rotated with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening.
- B. Concealed edges of glass shall be clean, straight cut, and free from chips and fissures. All glass shall be shop-cut, with proper allowance of size for installed lite. Allow for maximum grip on all edges. Glass shall be set with equal bearing on entire width of pane. Nipping glass on the job site will not be allowed. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.
- C. **Weather and Temperature Limitations:** No WORK of this Section shall be performed in damp, foggy, or rainy weather. WORK shall not proceed unless temperatures are within manufacturer's printed recommendations.
- D. Units of glass shall be set in each series with uniformity of pattern, draw, bow and similar characteristics.
- E. **Glazing Beads:** Glass in glazing beads or channels shall be in accordance with manufacturer's printed installation instructions. Materials shall not be stretched.
- F. **Metal Glazing Beads:** Where metal glazing beads or stops occur and where vinyl glazing beads are not used, the glass shall be set on setting blocks and be completely bedded in glazing compound. Metal glazing beads furnished by the manufacturer shall be installed in accordance with manufacturer's printed instructions. Compound shall be trimmed flush to sight line.
- G. **Gasket Glazing:** Glass set in a reglet with gasket glazing shall be set on glazing tape. All voids around the perimeter and between glass and stop shall be filled with glazing compound to provide completely watertight installation. Tape and compound shall be trimmed flush to sight line.
- H. **Sealant Application:** Sealant shall be applied on the inside glass surface below the glazing bead. The void below vinyl to bottom of glazing reglet shall be filled to maintain a weathertight seal.
 - 1. Compressible filler rods or equivalent back-up material shall be provided as recommended by sealant and glass manufacturers to prevent sealant from extruding into glass channel weep systems and from adhering to joints' back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.
 - 2. Sealants shall be forced into glazing channels to eliminate voids and to ensure complete

"wetting" or bond of sealant to glass and channel surfaces.

3. Exposed surfaces of sealants shall be tooled to provide a substantial "wash" away from glass. Pressurized tapes and gaskets shall be installed to protrude slightly out of channel to eliminate dirt and moisture pockets.
 - I. Setting blocks of proper size shall be installed in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6 inches from corner, unless otherwise required. Blocks shall be set in a thin course of sealant which is acceptable for heel bead use.
 - J. Spacers shall be provided, inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing. 1/8-inch minimum bite of spaces shall be provided on glass and thickness equal to sealant width shall be used, except with sealant tape, thickness shall be employed which is slightly less than final compressed thickness of tape.
 - K. Edge blocking shall be provided to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.
 - L. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, adequate anchorage shall be provided to ensure that gasket will not "walk" out when installation is subjected to movement.
 - M. Wedge-shaped gaskets shall be miter-cut at corners and gaskets shall be installed in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
 - N. **View Window Watertightness:** The CONTRACTOR shall coordinate the WORK of all trades to ensure view windows in the hydraulic structures are watertight. The glazing gaskets at view window shall have corners vulcanized. Glass shall be set into a full sealant setting bed to prevent water from reaching laminations and causing delamination.
 - O. **Safety Markings:** Glass, glazing panels, and glazing shall be protected by markings or devices which clearly indicated the presence of glass to other workers and materials handlers. Taping or marking which would cause a permanent stain on the glass shall not be used. Labels shall remain on the glass until final cleaning.

3.5 TESTING

- A. After installation is complete, all exterior glazing, except for aluminum entrance doors, shall be given a leak test by flooding the installed surfaces from bottom to top, using 3/4-inch minimum hose with nozzle.

3.6 ACCEPTANCE AND CLEANING

- A. Glass shall be protected from contact with contaminating substances resulting from construction operations. If contaminating substances come into contact with glass, they shall be removed immediately by method recommended by glass manufacturer.
- B. Glass surfaces adjacent to or below exterior concrete and other masonry surfaces shall be examined at frequent intervals during construction, but not less often than once a month, for build-up of dirt, scum, alkali deposits or staining. When examination reveals presence of these forms of residue, they shall be removed by a method recommended by glass manufacturer.

- C. Glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period shall be removed and replaced.
- D. Not more than 4 days prior to final acceptance of the WORK, nonpermanent labels shall be removed and the surfaces shall be cleaned. Glass shall be washed on both faces by method recommended by glass manufacturer.

** END OF SECTION **

SECTION 09100 METAL SUPPORT ASSEMBLIES

PART 1 - GENERAL

1.1 APPLICATION

- A. This Section includes the following:
1. Metal studs and furring for support of gypsum board.
 2. Suspended framing system for interior suspended ceilings.
 3. Provision of backing for interior items to be attached to gypsum board and metal studs.

1.2 REFERENCES

- A. General
1. The publications listed below form a part of this Section to the extent referenced.
 2. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.
- B. American Society for Testing and Materials (ASTM)
1. ASTM A446, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
 2. ASTM A525, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 3. ASTM A568, Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
 4. ASTM A641, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 5. ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.
 6. ASTM C645, Standard Specification for Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
 7. ASTM C754, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
- C. California Building Code, (CBC)
- D. Gypsum Association (GA): GA 203, Installation of Screw-Type Steel Framing Members to Receive Gypsum Board.

1.3 SYSTEM DESCRIPTION

A. Design Requirements

1. Metal stud framing system for interior walls and ceilings and with gypsum board specified in Section 09250.
2. Plumb, true, straight and rigid framing for support of attached materials.
3. Design system to accommodate construction tolerances, deflection of building structural members, support of attached materials and clearances of intended openings in accordance with CBC.
4. Gypsum board ceilings shall not support materials or building components other than grilles, light fixtures, small electrical conduits and small ducts. Such components shall be supported by supplemental framing which is supported by main runners. No vertical loads other than gypsum board dead load shall be applied to cross-furring.

1.4 SUBMITTALS

- #### A. Shop Drawings:
- Submit shop drawings indicating component details, framed openings, anchorage to structure and accessories or items required of other related work. Include shop drawings for backing plates for cabinets, grab bars and other wall mounted items.

1.5 QUALITY ASSURANCE

- #### A. Perform work in accordance with GA 203 and ASTM C754, governing laws, building code requirements, manufacturer's printed recommendations and United States Gypsum Company, "Good Design Practices" systems folder SA-923.

1.6 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection

1. Deliver materials to job site and store in ventilated dry locations. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather.
2. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturers

1. Steel Framing and Furring: Gold Bond Building Products Div., National Gypsum Co.; Clark Steel Framing; Dietrich Industries, Inc., or equal.
2. Grid Suspension Assemblies: Chicago Metallic Corp.; USG Interiors, Inc.; National Rolling Mills Co., or equal.

2.2 STEEL FRAMING FOR PARTITIONS

- A. Studs: C-shaped, ASTM C645, with galvanized coating ASTM A525, G-90; non-load bearing rolled steel, channel shaped, punched for utility access.
1. Width: As indicated.
 2. Thickness: 18 gauge throughout, unless otherwise indicated.
 3. Tracks: Match stud grade.
 4. Spacing: 16 inches on center throughout.
- B. Deflection Tracks: Manufacturer's standard top runner designed to prevent cracking of gypsum board applied to interior partitions resulting from deflection of the structure above fabricated from steel sheet complying with ASTM A653 or ASTM A568. Thickness as indicated for studs and width to accommodate depth of studs and of the following configuration:
1. Top Runner with Slotted Flanges: 2-1/2 inch deep flanges with slots 1 inch on center.
 2. Product: Metal-Lite, Inc.; Sliptrack Systems, or equal.
- C. Furring and Bracing Members: Same material and finish as studs, thickness to suit purpose.
- D. Steel Rigid Furring Channels: ASTM C645, hat shaped, depth of 7/8-inch, and minimum thickness of base (uncoated) metal as follows:
1. Thickness: 0.0179-inch, unless otherwise indicated.
 2. Protective Coating: ASTM A653, G 40 hot-dip galvanized coating.
- E. Hat Shaped Furring Channels: Galvanize, 25-gauge roll formed for screw type application of gypsum board. Slotted RC-1 single or RC-2 double leg resilient channels where required for acoustical isolation, solid hat channels for use elsewhere. Dale; Gold Bond; or equal.
- F. Z-Furring Members: Manufacturer's standard Z-shaped furring members with slotted or nonslotted web, fabricated from steel sheet complying with ASTM A653 or ASTM A568; with a minimum base metal (uncoated) thickness of 0.0179-inch, face flange of 1-1/4 inch, wall-attachment flange of 7/8-inch, and of depth required to fit insulation thickness indicated.
- G. Trussed steel studs and runner track for plaster on wire tied metal lath. Manufacturers shall be United States Gypsum; National Gypsum; or equal.
1. Studs: Each flange consist of two 7-gauge steel wire rods, web consists of a 7-gauge steel wire rod run in a zigzag diagonal fashion between flanges so that it passes between and is welded to the double rod flanges at 6-inch on center. Weight 485 lbs per 1000 linear foot. Use 4-inch-deep studs with a corrosion resistant finish unless other depths are shown or required to match existing work. Provide

matching 24-gauge studs shoes for attaching each end of stud to runner track.

2. Runner track: Formed from corrosion resistant steel. Width and profile shall match the stud shoes.
- H. Stiffening Channels: Cold-rolled steel, 3/4-inch x 16 gauge, weighing 0.3 pounds per lineal foot, meeting ASTM material specifications for structural steel and referenced standards from the California Building Code 2007.
- I. Adjustable Wall Furring Brackets: 20-gauge galvanized steel with serrated edges.
- J. Fasteners: Galvanized, GA 203, self-drilling, self-tapping screws.
- K. Metal Backing Plates
1. Type A (Light Loads): Galvanized steel strap, 14 gauge. Up to 100 lbs/foot of backing allowed.
 2. Type B (Heavy Loads): Stud runner track, 20 gauge, welded to continuous 6 inch by 14 gauge plate as indicated. Up to 200 lbs/foot of backing allowed.
- L. Anchorage Devices: Provide drilled in anchors. Powder driven fasteners will not be approved.
- M. Wedge Anchor Bolts: Special machine bolts with built-in expanding wedge in size required but not less than 3/8-inch x 3-inch; Phillips Red Head Wedge Anchors type WS; Expansion products Wei-it standard expansion anchor bolts; or equal.
- N. One-piece deformed spring steel drive anchor 1-1/4-inch minimum diameter, 1-1/2-inch minimum embedment in concrete, 2,000-lb. holding strength; RAWL-Drives; Buildex; or equal.

2.3 LATERAL BRACING ASSEMBLY MATERIALS

- A. Compression Strut: 1-inch EMT or larger steel tubing or "C" stud selected such that I/r is 200 or less.
- B. Connector: Flatten end of EMT and provide 3/8-inch machine bolt to connect each end or provide set screws type EMT to threaded box connector with double lock nuts. Provide 11-gauge x 2 x 6-inch angle at top attached to structural deck above with two 1-3/8-inch anchor bolts.
- C. Strut Support Bracket: Custom made 11-gauge formed steel. Attach to EMT with 3/8-inch stove bolt.
- D. Turnbuckles: 1/4-inch-diameter threaded forged steel eye bolt each end, forged steel bodies, hot galvanized finish.

2.4 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

- A. General: Provide components of sizes indicated but not less than that required to comply with CBC and ASTM C754 for conditions indicated.

- B. Wire for Hangers and Ties: ASTM A641, Class 1 zinc coating, soft temper, with gauge in accordance with CBC.
- C. Angle-Type Hangers: Angles with legs not less than 7/8-inch wide, formed from 0.0635-inch thick galvanized steel sheet complying with ASTM A446, G90 Coating Designation, with bolted connections and 5/16-inch diameter bolts.
- D. Channels: Cold-rolled steel, 0.0598-inch minimum thickness of base (uncoated) metal and 7/16-inch wide flanges, and as follows:
 - 1. Carrying Channels: 1-1/2 inches deep, 1.12 pound/foot minimum, hot rolled.
 - 2. Furring Channels: 7/8-inch deep, 26 gauge, galvanized hat sections at 24 inches maximum center to center.
 - 3. Finish: ASTM A525, G60 hot-dip galvanized coating for framing for exterior soffits.
- E. Steel Studs for Furring Channels: ASTM C645, with flange edges bent back 90 degrees and doubled over to form 3/16-inch minimum lip (return), minimum thickness of base (uncoated) metal and minimum depth as follows:
 - 1. Thickness: 0.0179 inch, unless otherwise indicated.
 - 2. Depth: 1-5/8 inch, unless otherwise indicated.
 - 3. Protective Coating: ASTM A525, G40 hot-dip galvanized coating for framing for exterior soffits and ceiling suspension members in areas within 10 feet of exterior walls.

2.5 MISCELLANEOUS MATERIALS

- A. Acoustical Sealant: As specified in Section 07920.
- B. Galvanized Finish Touch-Up Coating: Liquid zinc compound that bonds electrochemically to iron, steel and aluminum, as manufactured by ZRC Chemical Products, "ZRC Cold Galvanizing Compound", or equal.

2.6 FINISHES

- A. Galvanized Surfaces: Where galvanizing is removed by welding or other assembly procedures, clean area of any foreign matter by wire brushing and metal conditioner recommended by galvanized finish touch-up manufacturer. Apply galvanized touch-up coating by brush or spray with minimum coverage of 1.4 mils, dry film.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive metal support framing systems and verify the following:
 - 1. Installation of building components located in walls is complete.
 - 2. Backing plates are properly located for support of wall hung items.

- B. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

- A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation well in advance of time needed for coordination with other construction.

3.3 COORDINATION

- A. Coordinate layout with other trades having work within, adjacent to or penetrating walls or ceilings.
- B. Coordinate with other trades for furnishing of blocking, backing, and special anchors for installation under this Section.
- C. Coordinate with trades responsible for furnishing access panels, mechanical equipment and electrical fixtures.

3.4 INSTALLING STEEL FRAMING FOR PARTITIONS

- A. Stud Partitions - Typical
- B. Accurately lay out work to provide plumb, straight-in-plane surfaces in the proper location and square with plan grid lines.
- C. Vertical surface tolerance for alignment and plumb: 1/8-inch maximum variation in 10 feet from a flat, plumb, straight surface and 1/4-inch overall in entire length or height of wall.
- D. Attach runners to concrete with 3/8-inch x 3-inch drilled wedge anchor bolts or 3/8-inch x 2-inch, spaced 16-inch on centers maximum. Use washer under head of fasteners. Power actuated fasteners NOT PERMITTED.
- E. Attach studs to adjoining masonry or concrete walls with 3/8-inch x 3-inch drilled wedge anchor bolts, spaced 32-inch on centers maximum.
- F. Space studs maximum 24-inch on centers. Studs to be continuous from floor to structural ceiling roof or floor above unless shown otherwise. Screw all studs to both sides of bottom and top runner tracks.
- G. Where studs are continuous from floor to structural members above, use gusset deflection track or the nested deflection track at top. Screw attach stud to top runner.
- H. Where ceiling abut walls provide horizontal "C" stud bridging cut in between and screwed to studs at top edges of drywall so that drywall can be screwed along top edge at 8-inch centers to bridging.
- I. At Doors and Openings
 - 1. Use double 18-gauge studs each side of openings. Run both studs to building

structure above ceiling.

2. Install a header made of 18-gauge runner track over openings. Cut flanges and bend web up 90 degrees at each end. Screw or weld to trim studs with two fasteners per side. Install jack studs over openings. Install 3/4-inch stiffening channel in stud and jack stud cutouts over opening extending through the second regular stud on each side of the opening.
 3. Install hollow metal frames by attaching 14-gauge steel floor plates welded to trim flange with two 3/8-inch x 3-inch wedge anchor bolts per jamb into concrete floor. Weld or screw trim studs to jamb anchor clips; attach header channel to head anchor clips.
 4. Install continuous horizontal 3/4-inch or 1-1/2-inch stiffener channels to fit snugly in stud knockouts at 4 feet on centers vertically and within 2 feet of top of studs. Overlap channels 8 inches minimum at end joints and wire tie in two locations with double strands of 16-gauge galvanized wire.
- J. Use 18-gauge studs or heavier for all exterior walls if required or recommended by manufacturer for partitions over 10 feet high and for all partitions having lath and plaster finish or ceramic tile finish. Use 20-gauge studs for partitions 10 feet or less in height finished with gypsum board.
- K. At partition intersections, attach studs to each other with type S-12 screws spaced 32 inches on centers maximum.
- L. Frame each side of openings for access panels with a double 20-gauge stud. Install 20-gauge header at top and bottom of opening. Attach header to side studs by cutting flanges of header and bending web 90 degrees.
- M. Install concealed-in-wall backing furnished by other trades for the support of equipment attached to walls.
- N. Provide 16-gauge steel backing plates or solid 2-inch-thick wood backing fire retardant treated per ASTM standard E 84-84 to receive all other items attached to walls unless other backing is called for. All backing plates shall be attached to a stud at each end.
- O. Backing in Stud Partitions or Furring
1. Verify that any pre-drilling of backing and attachment of spacers to prevent crushing of attached material is done prior to application of attached material.
 2. If it is determined by the ENGINEER that backing was not provided for any items as required, the CONTRACTOR shall remove the finish materials; install backing and shall patch and refinish surface to match adjacent area and surface at no additional cost to the City.
- P. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8-inch from plane of faces of adjacent framing.

3.5 INSTALLING STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

A. Suspend ceiling hangers from building structural members and as follows:

1. Hangers shall be saddle-tied around main runners to develop full strength of hangers.
2. Cross-furring shall be saddle-tied to main runners with 1 strand of No. 16 or 2 strands of No. 18 gauge tie wire.
3. Main runners shall be spliced by lapping and interlocking flanges 12 inches minimum and tying near each end with double loops of No. 16 gauge wire.
4. Cross-furring shall be spliced by lapping and interlocking the pieces 8 inches minimum and tying near each end with double loops of No. 16 gauge wire.
5. Fasten hanger wires with not less than 3 tight turns. Fasten bracing wires with 4 tight turns. Make all tight turns within a distance of 1-1/2 inches. Hanger or bracing wire anchors to the structure shall be installed in such a manner that the direction of the wire aligns as closely as possible with direction of the forces acting on the wire.
 - a. Wire turns made by machine where both strands have been deformed or bent in wrapping can waive the 1-1/2 inch requirement, but the number of turns shall be maintained, and be as tight as possible.
6. Separate all ceiling hanging and bracing wires at least 6 inches from all unbraced ducts, pipes, and conduit. It is acceptable to attach lightweight items, such as single electrical conduit not exceeding 3/4-inch nominal diameter to hanger wires using connectors acceptable to authorities having jurisdiction.
7. When drilled-in concrete anchors are used in reinforced concrete for hanger wires, 1 out of 10 shall be field tested for 200 pounds of tension. When drilled-in concrete anchors are used for bracing wires, 1 out of 2 shall be field tested for 440 pounds in tension. Shot-in anchors in concrete are not permitted.
8. Provide trapeze or other supplementary support members at obstructions to main hanger spacing.
9. Provide additional hangers, struts or braces as required at all ceiling breaks, soffits or discontinuous areas.
10. Hanger wires that are more than 1 in 6 out of plumb shall have counter-sloping wires.

B. Light Fixture Support

1. Recessed or drop-in light fixtures shall be supported directly by main runners or by supplemental framing which is supported by main runners.
2. Surface mounted fixtures shall be attached to main runner by positive clamping device made of material with a minimum of 14 gauge. Rotational spring catches do not comply.

3. Light fixtures, HVAC diffusers, speakers, etc., shall have **minimum 2 wires** at opposite ends for support if ceiling should fail during seismic fault.
- C. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring members or grid suspension members are level to within **1/8-inch** in 12 feet as measured both lengthwise on each member and transversely between **parallel** members.

3.6 WALL FURRING

- A. Provide "Z" furring system to secure insulation and gypsum board to **masonry** or concrete walls. Install in accordance with USG Gypsum Construction Handbook, current edition. Run "Z" furring channels vertically spaced as required to accommodate insulation but not over 24 inches on center: Attach "Z" furring channels to concrete or masonry walls with 1/4-inch-diameter deformed drive anchors spaced as recommended by "Z" furring channel manufacturer. Shim between channels end wall as required to achieve a **flat, straight plumb** surface.
- B. Where furring of uneven or out of plumb wall is required or where a **chase space** is required between wall and finish fur by using one of the following systems:
 1. Freestanding furring employing 1-5/8-inch studs at 16 inches **centers** for walls up to 12 feet high in steel runner channels at the bottom and top of the wall. Brace studs 10 feet and higher in the center with adjustable wall furring brackets.
 2. Hot shaped furring channels run vertically at 16-inch centers **wire tied** to horizontal 3/4-inch cold rolled stiffener channels spaced 6 inches from the **top** and bottom of the wall and at 3 feet maximum centers. Attach 3/4-inch cold rolled channels to concrete or masonry wall with adjustable wall furring brackets at each end and at 4 feet maximum centers.

3.7 LATERAL BRACING ASSEMBLIES

- A. Space lateral bracing assemblies at 12 feet on center in each direction **starting** about 6 feet from ceiling perimeter. Maximum ceiling area per bracing assembly: 144 square feet. Lateral bracing assemblies are required if any dimension of a room or space exceeds 12 feet..
- B. At each compression strut bracket install 4 diagonal, 8-gauge bracing **wires** arranged to form four right angles in plan and a 45 degree angle (not less than 30 degrees nor more than 50 degrees from the horizontal) with the plane of the ceiling. Attach bracing wires to concrete slab above steel decking with 3/8-inch x 3inch wedge anchor bolts with **eye bolt** head. Each bracing wire shall contain a turnbuckle for tensioning.
- C. Attach compression strut top connector to concrete slab above steel decking with steel angle and two 3/8-inch x 3-inch wedge anchor bolts.
- D. Attach bracing wires with triple twist tie. Wires to be straight and free of kinks. Use double nut on EMT connector or similar device for final height adjustment at compression strut. Use turnbuckle in each diagonal bracing wire for final tensioning. **Adjust** all four bracing wires in each lateral bracing assembly to have equal tension of at least **10 lbs.**

3.8 REPAIRS

- A. Replace all defective work including:

1. Bent or kinked framing members.
2. Alignment tolerances exceeding those specified.
3. Variations in true plane exceeding specified tolerances.
4. Other defects affecting the quality and appearance of the work.

END OF SECTION

SECTION 09200 - LATHING AND PLASTERING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing lathing, plastering, stucco, and all related work, complete.

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 07600 Flashing and Sheet Metal
2. Section 07920 Sealants and Caulking

1.3 CODES

- A. The 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. California Building Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. **Federal Specifications:**

FF-N-105	Nails, Brads, Staples and Spikes:	Wire, Cut and Wrought
QQ-W-461	Wire, Steel, Carbon (Round, Bare, and Coated)	
SS-C-161	Cement, Keene's	
UU-B-790	Building Paper, Vegetable Fiber, (Kraft, Waterproofed, Water Repellant and Fire Resistant)	

2. **Commercial Standards:**

ASTM C 5	Specification for Quicklime for Structural Purposes
ASTM C 28	Specification for Gypsum Plasters
ASTM C 37	Specification for Gypsum Lath

ASTM C 61	Specification for Gypsum Keene's Cement
ASTM C 150	Specification for Portland Cement
ASTM C 206	Specification for Finishing Hydrated Lime
ASTM C 841	Specification for Installation of Interior Lathing and Furring
ASTM C 842	Specification for Application of Interior Gypsum Plaster
ANSI A 42.2, 3	Portland Cement Plastering Standards

3. **Trade Standards:**

"Lathing and Plastering Reference Specifications" as compiled by the California Lathing and Plastering Contractor's Association (CLPCA).

"Handbook for Ceramic Tile Installation" (HCTI) by the Tile Council of America.

4. **Manufacturers' Standards:** In addition to the standards listed above, the lathing and plastering products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. **Samples:** Samples of integral color exterior plaster shall be submitted for color selection. When requested by the CONSTRUCTION MANAGER, a 12-inch by 12-inch sample panel of exterior cement plaster in the selected color(s) shall be submitted for approval. Samples of metal lath, metal furring devices, trim, and plastering accessories shall be submitted for approval.
2. **Manufacturer's Information:** Manufacturer's literature, specifications, installation instructions, technical data, and general recommendations for the lathing and plastering materials shall be submitted. Fastening instructions shall be submitted for securing trim items to framing.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Manufactured products shall be delivered in original, unbroken, packages, containers or bundles bearing the name of the manufacturer.
- B. **Storage:** All products shall be carefully stored as recommended in the Trade Standards in an area that is protected from deleterious elements. Storage shall be in a manner that will prevent damage to the products or marring of their finishes.

PART 2 -- PRODUCTS

2.1 PLASTER MATERIALS

- A. **General:** The materials for lath and plaster work shall conform to the applicable requirements of ASTM C 841 and ASTM C 842 and as specified herein.
1. Cement for Portland cement plaster shall be Type I Portland cement as specified in ASTM C 150.
 2. Integral colored finish coat plaster shall be factory-prepared, colored plaster, "Finish Coat Portland Cement (Stucco)," complying with ASTM C 150.
 3. Keene's cement plaster shall be a high-strength, white, gypsum plaster used with finish lime putty for extremely hard, dense surfaces conforming to ASTM C 61, and Federal Specifications SS-C-161, Type 1.
 4. Lime or hydrated lime shall conform to ASTM C 206 and quicklime shall conform to ASTM C 5. Lime putty shall weigh no less than 33 lb/cu ft and shall be made of hydrated lime or quicklime.
 5. Bonding agents, conforming to ASTM C 631, shall be non-water-deteriorating, non-oxidizing, non-crystallizing, liquid, resinous water-emulsion designed for exterior use. The bonding agent shall provide a permanent bond for gypsum, lime putty, cement, or acoustical plaster finishes to gypsum, cement plaster, concrete, masonry, wood, or steel, whether the surfaces are painted or unpainted, old or new, damp or dry. It shall be free from any tendency to harden or craze crack. It shall be non-toxic, vermin proof, and non-combustible. Bonding agents shall be certified to be non-deteriorating as shown by minimum 2 year controlled laboratory test.
 6. Gypsum plaster shall conform to ASTM C 28.
 7. Finish coat sand for exterior cement plaster finish coat shall be No. 30. Sand for interior cement plaster finish coat shall be No. 200.
- B. **Exterior Plaster:** Exterior plaster surfaces shall be a combination of Portland cement scratch and brown coats and prepared integral colored finish coat. Thickness of exterior plaster shall be not less than 7/8-inch. Exterior cement plaster over concrete block shall be not less than 1/2-inch thick and shall consist of a bonding agent applied to wall, application of a Portland cement scratch coat, and application of a prepared, integral- colored finish coat. Color to match existing.
- C. **Backing:** Plaster backing for tile work shall be Portland cement scratch coat with surface cross-scratched to provide adequate bond. All membranes, metal lathing, and accessories shall be not less than that specified within HCTI system W 231-87 and W 241-87. Welded wire fabric lath shall be used as backing behind tile work.
- D. **Interior Plaster:** Interior plaster materials shall conform to the following requirements:
1. Interior cement plaster shall be not less than 7/8-inch thick and shall be Portland cement plaster for the scratch, brown, and finish coats.
 2. Interior Keene's cement plaster shall be not less than 7/8-inch thick and shall be Keene's cement plaster over (scratch and brown) coats of gypsum plaster.

3. Interior gypsum plaster shall be 3/8-inch thick gypsum lath and 1/2-inch thick gypsum plaster finish coat.

2.2 METAL LATH AND WIRE PRODUCTS

- A. **Rib Lath:** Rib lath shall be 3.4 lb/sq yd with 3/8-inch metal rib and shall be expanded from copper-bearing-steel and coated with rust-inhibitive paint after fabrication or shall be galvanized. Rib lath shall be galvanized when used for exterior conditions and at locations with moisture, high humidity and at water holding areas.
- B. **Flat (or Self-Furring) Diamond Mesh:** Flat or self-furring diamond mesh shall be 3.4 lb/sq yd and shall be expanded from copper-bearing steel sheets either coated with rust-inhibitive paint or hot-dip galvanized after fabrication. Flat (or self-furring) diamond mesh shall be hot-dip galvanized mesh when used for exterior conditions and at locations with moisture, high humidity and at water holding structures.
- C. **Welded Wire Fabric:** Welded wire fabric, with backing, shall be fabricated from minimum 16-gauge galvanized wire, with openings not to exceed 2-inch by 2-inch, and welded at all intersections. Backing shall comply with Federal Specifications UU-B-790.
- D. **Paper Backing (Weather-Resistive Barrier):** Paper backing for use as a weather- resistive barrier with metal plaster bases shall comply with UBC Standard 17-1, Class B. It shall be either Building Paper or Vegetable Fiber which is waterproofed, water repellent, and fire resistant and of the style and grade applicable or specified for the intended use. Paper shall be securely held in place by or attached to the metal plaster base. Paper shall permit full 1/8-inch plaster embedment, for not less than 1/2 of the total length of the wire strands and 1/2 of the total weight of the metal.
- E. Where not otherwise indicated, installer shall comply with MLSFA "Technical Bulletin 101" and ASTM C 841 for selection of metal lath for each application indicated.

2.3 GYPSUM LATH

- A. Gypsum lath, either perforated or plain, shall conform to ASTM C 37.
 1. Perforated gypsum lath shall be 1/2-inch thickness, unless otherwise specified or shown.
 2. Type "X" plain gypsum lath for fire rated construction shall be 1/2-inch thick, unless otherwise specified or shown.

2.4 ACCESSORIES

- A. Metal and welded wire shapes used as base screeds, casing beads, ventilating screeds, weep screeds, control joints, etc., shall be of such size and dimension as to provide for the full required plaster thickness. Accessories shall be fabricated of minimum 24-gauge galvanized steel or minimum 19-gauge galvanized wire.
 1. Corner beads, control joints, and ventilating expansion screed with short or expanded flanges shall be fabricated from minimum 24-gauge galvanized steel.

2. Drip screed or weep screed and casing beads shall be fabricated from minimum 24-gauge galvanized steel.
3. Expansion joint trim shall be as indicated hereinafter.
4. External corner reinforcement for Portland cement plaster applications shall be fabricated either from large-opening, expanded metal or from welded, minimum 18-gauge, copper-bearing wire and shall be galvanized after fabrication.
5. Extruded aluminum vent screeds and reveal shall be as specified or shown.

2.5 SUSPENSION SYSTEM

- A. **Channels:** Channels shall be hot-rolled or cold-rolled steel, free of rust, and shall be provided with a corrosion-resistant protective coating. Channels shall be of the size set forth in the UBC for span and load imposed. Furring channels for gypsum board construction shall be as specified in Section 09250.
- B. **Tie Wire and Clips:** Tie wire and/or clips used for attaching lath to supports and for securing cross furring to primary members, shall be galvanized, soft-annealed steel wire, and the weight of galvanizing shall be not less than Class 1 as set forth in Federal Specifications QQ-W-461. Tie wire gauges shall be as set forth in the UBC.
- C. **Hangers:** Supporting hangers for main beams or runners in suspended ceilings shall be steel hanger wire of gauges set forth in the UBC and Class 1 galvanized as set forth in Federal Specification QQ-W-461.

2.6 MISCELLANEOUS MATERIALS

- A. **Nails:** Nails shall conform to Federal Specifications FF-N-105.
- B. **Staples:** Staples shall be USS 14-gauge, flattened, galvanized wire staples conforming to Federal Specifications FF-N-105.
- C. **Unspecified Materials:** Unspecified materials and fasteners shall meet or exceed the requirements of UBC and other referenced standards. In case of conflict, the most stringent requirements shall govern.

2.7 MANUFACTURERS

- A. Products shall be of the following type and manufacture, or equal:
 1. Bonding Agent: "Weldcrete" by Larson Products Corporation; "Enco Weld" by Enco Products.
 2. Expansion Joint Trim: No. J-U-4 by Superior; No. 40 by Inryco.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Unless otherwise indicated, all exterior plaster shall be Portland cement, "Exterior Plaster." Where plaster is indicated at interior conditions such as kitchens, and toilet, it shall be Keene's cement plaster. Where plaster is indicated at interior having wet, damp, or moist environments such as locker rooms, dressing areas, showers, wash areas, janitor areas, water process areas, and chemical areas, it shall be Portland cement plaster.
- B. The application and finishing of lath and plaster work shall conform to the applicable requirements of ASTM C 842 and ASTM C 841 and other referenced standards.

3.2 INSTALLATION

- A. **General:** The applied methods procedures and materials shall be appropriate for job conditions such as temperature, humidity, ventilation, and surface type and condition and shall conform to the requirements of the referenced specifications, codes, and standards.
- B. **Metal Accessories:** Metal accessories shall be set plumb, level, and true and shall be shimmed where necessary for a true, tight, and secure application. Corners shall be mitered and exposed joints shall be accurately and tightly fitted. Sections shall be installed in the maximum practical lengths and splices shall be held to a minimum. Corner beads and casing beads shall be securely fastened at spacings of not more than 12 inches.
- C. **Tile Backing:** All tiles shall be mortar set into a Portland cement plaster backing system of moisture backing system, welded wire fabric lath, and Portland cement scratch and brown coat.
- D. **Edges and Boundaries:** All plaster surfaces shall be finished to metal casings, sheet metal shapes, or wood grounds. (Wood grounds may be used only where covered by other finish work.) Where joining other materials in locations exposed to view, the edges or boundaries of all plaster surfaces shall be finished with metal casing beads.

3.3 CEILING SUSPENSION SYSTEM

- A. The ceiling suspension system shall be provided for plaster ceilings unless otherwise shown. The suspension system shall include all hangers, anchors, channels, wires, and furring to form a complete system that meets the requirements of the referenced specifications, codes, and standards.

3.4 PLASTER FINISHES

- A. **Exterior:** Exterior (Stucco) plaster finish texture shall be float finish, as indicated in the referenced standards unless otherwise indicated.
- B. **Interior:** Interior plaster shall have a putty coat finish.
- C. **Cement:** Cement plaster shall be given a fine float finish.
- D. **Keene's Cement:** Keene's cement plaster shall have a smooth, putty coat finish.

3.5 CUTTING AND PATCHING

- A. Cutting, patching, painting and repair of plaster shall be as necessary to accommodate other WORK and to restore cracks, dents and imperfections. Plaster WORK shall be repaired or

replaced as required to eliminate blisters, buckles, excessive crazing and check cracking, dry-outs, efflorescence, sweat-outs and similar defects, including areas of the WORK which do not comply with specified tolerances and where bond to the substrate has failed.

- B. Smooth-troweled finishes shall be sanded lightly to remove trowel marks and arrises.

3.6 CLEANING AND PROTECTION

- A. Temporary protection and enclosures around other WORK shall be removed when the WORK is complete. Plaster residue shall be removed promptly from door frames, windows, and other surfaces which are not to be plastered. Floors, walls and other surfaces which have been stained, marred or otherwise damaged during the plastering WORK shall be cleaned and repaired. When plastering WORK is completed, unused materials, containers and equipment shall be removed and floors cleaned of plaster debris.
- B. Installer shall advise CONTRACTOR of requirements for the protection of plaster from deterioration and damage during the remainder of the construction period.

- END OF SECTION -

SECTION 09250 - GYPSUM BOARD

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing gypsum board over wood or light gauge metal framing and furring members, and providing ceiling suspension and furring systems for gypsum board ceilings wherever wood ceiling joists are not indicated, and all appurtenant work, complete.

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 07920 Sealants and Caulking

1.3 CODES

- A. The 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. California Building Code
2. California Fire Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. **Federal Specifications:**

QQ-W-461 Wire, Steel, Carbon (Round, Bare, and Coated)

2. **Commercial Standards:**

ASTM C 36 Specification for Gypsum Wallboard

ASTM C 208 Specification for Insulating Board (Cellulosic Fiber), Structural and Decorative

ASTM C 475 Specifications for Joint Treatment Materials for Gypsum Wallboard Construction

ASTM C 514 Specification for Nails for the Application of Gypsum Wallboard

ASTM C 630	Specification for Water-Resistant Gypsum Backing Board
ASTM C 645	Non-Load (Axial) Bearing Steel Studs, Runners (Track), and rigid Furring Channels for Screw Application of Gypsum Board
ASTM C 754	Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Wallboard, Backing Board, or Water-Resistant Backing Board
ASTM D 2626	Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing

3. **Trade Standards:**

GA-203-71 (Gypsum Assn.)	Installation of Screw-Type Steel Framing Members to Receive Gypsum Board
GA-216-85 (Gypsum Assn.)	Recommended Specifications for the Application and Finishing of Gypsum Board
GA-600-78 (Gypsum Assn.)	Fire Resistance Manual

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Manufacturer's literature, installation instructions, and samples of metal trim and furring devices.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. **Delivery of Materials:** Manufactured materials shall be delivered in original unbroken packages, containers, or bundles bearing the manufacturer's name and product description and rating.
- B. **Storage:** All materials shall be carefully stored in an area which is protected from deleterious elements in a manner recommended by the material manufacturer. Storage shall be in a manner that will prevent damage to the material and its finish.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Manufacturers' Standards:** The gypsum board products shall be in accordance with the manufacturer's literature and published specifications for the products indicated.
- B. **Labelling:** Fire-rated materials shall bear testing agency labels and required fire classification numbers.

2.2 GYPSUM BOARD

- A. **General:** All gypsum board shall be fire-rated unless otherwise indicated.
- B. **Gypsum Board:** All gypsum board shall be 5/8-inch thick and provided with tapered edges unless otherwise indicated.
 - 1. Regular gypsum board shall conform to ASTM C 36, unless otherwise indicated.
 - 2. Fire-rated gypsum board shall conform to ASTM C 36, type "x", unless otherwise indicated.
 - 3. Water-resistant gypsum board shall conform to ASTM C 630, regular, type "x".
 - 4. Tile backing board shall be a Portland cement slurry, reinforced with fiber glass mesh and coated vinyl board. The board shall be not less than 1/2-inch thick and shall be designed for use behind tile.
 - 5. Sound deadening board shall conform to ASTM C 208 (wood fiber) Class A.
 - 6. Foil backed gypsum board shall conform to ASTM C 36, type "x", with laminated foil on the back surface.

2.3 TAPE AND COMPOUND

- A. Joint reinforcing tape and joint compound shall conform to ASTM C 475.

2.4 FASTENERS

- A. Nails shall conform to ASTM C 514, and shall be of the length recommended by the Gypsum Association referenced standards and the Uniform Building Code for various gypsum board thicknesses. Nails for nailing tile backing board to wood studs shall be 1- 1/4-inch galvanized roofing nails unless otherwise required by UBC, and board manufacturer.
- B. Screws shall be self-drilling, self-tapping, bugle head for use with power tools, length as recommended by Gypsum Association referenced standards and the Building Code.
 - 1. Type "S" for board to sheet metal application.
 - 2. Type "W" for board to wood application.
 - 3. Type "G" for board to board application.
 - 4. Type "S" or "S-12", 1-1/4-inch for tile backing board to metal studs application.
- C. Resilient channels shall be metal channels designed for use with sound wall construction. They shall be as recommended and approved by the gypsum board manufacturer and code.

2.5 ADHESIVES

- A. Adhesives for fastening gypsum board to gypsum board shall be in accordance with the printed recommendations of the gypsum board manufacturer.

2.6 ACCESSORIES

- A. Metal trim, corner beads, edge, casing beads, and accessories shall be ~~manufactured~~ from galvanized sheet steel unless otherwise indicated and shall be manufacturer's standard products. Special shapes shall be provided where indicated.

2.7 ACCESS PANELS

- A. Access panels shall be suitable for flush installation. Cylinder locks shall be provided where indicated.
- B. In fire-rated construction, both wall and ceiling access panels shall have a fire rating equivalent to the adjoining work.

2.8 WATERPROOF MEMBRANE

- A. Waterproof membrane shall be asphaltic saturated 43 lb (vapor-retarder) membrane conforming to ASTM D 2626 Type 1, 25 lb/100 sq ft minimum or 10-mil polyethylene film membrane.

2.9 MANUFACTURERS

- A. Products shall be of the following type and manufacture (or equal):
 - 1. Tile backing board: United States Gypsum's "Durock Board"; Laticrete International's "Latipanel."
 - 2. Gypsum board: Laticrete International; National Gypsum Co.; United States Gypsum Co.
 - 3. Access Panel: Milcor "Type DW"; Boice "Type C."

PART 3 -- EXECUTION

3.1 GENERAL

- A. Gypsum board installation and fire-rated gypsum board construction shall conform to applicable codes, reference standards, manufacturers printed recommendations, and Gypsum Association's printed recommendations.
 - 1. Gypsum board shall be applied first to ceiling and then to walls. Wall application shall be horizontal (right angles to framing), or vertical (parallel to framing), conforming to reference standards.
 - 2. All gypsum board shall be screw fastened to metal framing and furring, and/or nail or screw fastened to wood framing and furring. Fastener spacing shall be per reference standards.
 - 3. Multi-layer application shall be per reference standards indicated and manufacturer's recommendations.
 - 4. Resilient channels and multi-layer gypsum board shall be furnished, installed and constructed where sound walls are indicated.

5. Gypsum wallboard surface finish shall be three coat work.
 6. Installation of steel framing shall be in accordance with ASTM C 754 and UBC.
- B. Access panels shall be provided where indicated or where required for access to valves and equipment.
- 3.2 CEILING SYSTEM FIRE RATING
- A. Where a fire rating is indicated, the complete ceiling system shall meet the requirements for the rating indicated. The system shall conform to governing codes and shall meet UL requirements for the approved system.
- 3.3 INSTALLATION OF METAL ACCESSORIES
- A. Metal edge trim shall be applied at all discontinued edges, where abutting with another material, and where indicated. Corner beads shall be applied at all exterior corners.
- B. All metal accessories shall be set plumb, level, and true and shall be shimmed where necessary. The accessories shall be mitered at corners; exposed joints shall be accurately and tightly fitted. Sections shall be installed in lengths as long as practicable and splices shall be held to a minimum.
- C. All accessories, trim, and beads shall be securely fastened to framing members.
- 3.4 EDGE SEALING
- A. All cut, broken, or exposed edges of moisture-resistant gypsum board shall be sealed with a sealer recommended in the printed standards of the gypsum board manufacturer.
- 3.5 SURFACE FINISH
- A. All gypsum board joints shall be taped, and all joints, end trim, corner beads, fastener, and other depressions shall be treated with joint and finishing compounds applied per manufacturer's printed recommendations for three coat work.
- B. The gypsum board shall be sanded smooth, dusted, and provided with a textured smooth sealer finish coat.
- C. Gypsum board behind vinyl wall covering and wood paneling shall be left with a sanded, flush, and smooth finish surface ready for painting.
- D. Gypsum board at non-visible locations, such as within attics, shall be finished as required for fire protection.
- 3.6 RECESSED LIGHT FIXTURES
- A. Light fixtures, speakers, and other recessed items in rated ceilings shall be provided with gypsum board enclosures as required for rated ceiling system.
- 3.7 ATTIC SEPARATIONS
- A. Gypsum board attic separations, with framing if necessary, shall be provided where shown and

shall be installed and taped per UBC. Access doors shall be self-closing, and return air openings shall be equipped with fusible fire links and self-closures.

3.8 TILE BACKING

- A. **General:** All tile at toilets, locker rooms, showers, laundries, wash areas, and wet or moist areas shall be mortar set. Tile backing board shall be installed behind all tile walls which are not indicated to have mortar set tiles. Backing board shall be installed per manufacturer's published instructions.
- B. **Backing Surface Treatment:** Gypsum drywall backing surfaces shall have all nails and screws recessed. Joints shall be taped and all joints, nail, and screw depressions shall be floated.
- C. **Finish:** The finish surface shall be a sanded, dusted, and smooth finish ready for application of finish material. Joints or any other irregularities of backing surfaces shall not be visible.
- D. **Shower:** Tile backing board at showers shall be installed over a waterproof membrane.

3.9 CEILING SYSTEM

- A. The seismic restraint systems shall conform to code and shall be provided in all locations required by code.
 - 1. Ceiling systems shall be provided with diagonal bracing wires. Horizontal restraints shall be four No. 23-gauge wires secured to the main beams within 2 inches of the cross tee intersection and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the plane of the ceiling. These horizontal restraint points shall be placed not more than 12 feet on center in both directions with the first point within 4 feet from each wall. The restraint wire attachment to the supporting structure shall be adequate for the loads imposed. Side wall ties shall be provided where necessary.
 - 2. Ceiling system shall be provided with a vertical restraint system to resist seismic uplift movements. The system shall be vertical metal struts attached to the main channel, and fastened, secured and anchored to the underside of the structural system above. Restraint locations shall be not less than required by code and at horizontal restraint locations.
- B. Lighting fixtures, air diffusers, speakers and other embedments shall be coordinated to provide the ceiling design and to prevent interferences with the locations of the embedded items and the ceiling system.

- END OF SECTION -

SECTION 09300– CERAMIC TILE

PART 1- GENERAL

1.1 SUMMARY

- A. Section Includes: All ceramic and patio tile work including marble thresholds, paper backing, cementitious tile backerboard mortar setting bed, grouting, waterproof membrane, slip sheet, and expansion joint sealants.

1.2 REFERENCES

- A. “Handbook for Ceramic Tile Installation,” by the Tile Council of America (TCA).
- B. American National Standard Specifications for:
 - 1. A108.1 Glazed Wall Tile, Ceramic Mosaic Tile, Quarry Tile and Paver Tile Installed with Portland Cement Mortar
 - 2. A108.5 Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex - Portland Cement Mortar
 - 3. A108.6 Ceramic Tile Installed with Chemical-Resistant Water Cleanable Tile Sealing and Grouting Epoxy
 - 4. A108.10 Installation of Grout in Tile Work
 - 5. A108.11 Installation of Ceramic Tile or Other Hard Surfaces and Installation of Cementitious Backerboards
 - 6. A118.4 Latex - Portland Cement Mortar
 - 7. A118.6 Ceramic Tile Grouts
 - 8. A137.1 Ceramic Tile
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM C373 Water Absorption, Bulk Density, Apparent Porosity and Specific Gravity of Fired Whiteware Products
 - 2. ASTM C648 Test Method for Breaking Strength of Ceramic Tile
 - 3. ASTM C1028 Evaluating the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Pull Method

1.3 SUBMITTALS

- A. Product Data: Manufacturer's data, standard specifications, Material Safety Data Sheets, and other technical information for each product specified.
- B. Material Samples: Manufacturer's standard palette, indicating full range of tile colors, textures, and grout colors.

- C. Mock-Ups: For each type, color, and texture, minimum 2' x 2' or three full tile courses, to demonstrate proper tile pattern, trim, bond mortar and coverage; grout joint width, color, hardness and depth.
- D. Installation Instructions: Manufacturer's preparation and installation instructions.
- E. Product Certificates: Signed by manufacturer certifying that products furnished comply with requirements of this Specification.

1.4 QUALITY ASSURANCE

- A. Qualifications: Perform work under this Section by a licensed Specialty Contractor with at least 5 years of knowledge exclusively in this type of work. Employ workers who are skilled and knowledgeable in the installation of ceramic tile and familiar with the installation methods described in the TCA Handbook for Ceramic Tile Installation.
- B. Regulatory Requirements and Recommended Standards: As a minimum comply with the more restrictive of the following:
 - 1. "Handbook for Ceramic Tile Installation" Tile Council of America (TCA) 1995 Edition.
 - 2. Americans with Disabilities Act (ADA) for Accessibility.
 - 3. California Building Code Current edition.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials to the construction site packaged in sealed containers bearing the manufacturer's labels. Store all materials in a properly ventilated and watertight place, and raised above the floor or ground on pallets or wood platforms on skids. Keep dry until used.
- B. Pile sand on concrete pavement or on plywood sheets and keep covered to protect against contamination by rain, dirt, and litter.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements: Maintain temperature in areas to receive tile at not less than 50°F. The temperature of substrate shall not exceed 100°F.

1.7 MAINTENANCE

- A. Extra Materials: Provide an extra 5% of each type of tile and grout used on the project. Deliver to the jobsite in manufacturer's original, clean, marked cartons / containers.

1.8 WARRANTY

- A. Manufacturer shall provide a 5 year material warranty.
- B. Installer shall provide a 5 year labor warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers

1. Ceramic Tile: Daltile Corp.; American Olean Company, or equal.
2. Tile Setting and Grouting Materials: Laticrete International, Inc., Custom Building Products, Mapei, or equal.

2.2 MATERIALS

A. General

1. Provide ceramic tile that complies with ANSI A137.1 for types, compositions and other characteristics indicated.
2. Provide tile installation materials complying with ANSI standards referenced in setting and grouting materials articles below.

B. Glazed Ceramic Wall Tile and Trim:

1. To establish level of quality, the specification is based on the following products as manufactured by Daltile Corp. Equivalent products from other acceptable manufacturers may be approved by the Architect.
2. Field Tile 'A':
 - a. Size: 4-1/4" X 4-1/4"
 - b. Finish: Semi-gloss
 - c. Color: Atlantis (2) QH43
3. Trim:
 - a. Color & Finish: To match adjoining tile.
 - b. 2" X 6" Bullnose: #A-4200.
 - c. 3/4" X 3/4" Bullnose: #AK-106.
 - d. 2" X 2" Corner Bullnose: #A-4200
 - e. 4-1/4" X 4-1/4" Cove Base: #A-3401
 - f. 4-1/4" X 4-1/4" Corner Cove Base: #ACR-L-3401.

2.3 SETTING MATERIALS

A. Epoxy Adhesive: ANSI A118.3, thinset bond type.

B. Mortar Bed Materials

1. Portland cement: ASTM C150, type 1, gray or white.

2. Hydrated Lime: ASTM C207, Type S.
 3. Sand: ASTM C144, fine.
 4. Latex additive: As approved.
 5. Water: Clean and potable.
- C. Mortar Bond Coat Materials
1. Epoxy: ANSI A118.3, 100 percent solids
- D. Cementitious Tile Backerboard:
1. Fiber cement ceramic tile backerboard consisting of portland cement, ground silica sand, cellulose fiber or fiberglass and acrylic latex additives, moisture resistant, minimum flexural strength 2100 psi, minimum compressive strength 2500 psi, weight at least 3.5 lbs/per square foot. Surface burning per ASTM E-84: Flame Spread 0, Fuel Contribution 0, Smoke Developed 5, accepted by TCA, ICBO Evaluation Service, and CABO National Evaluation Service. Hardibacker Underlayment by James Hardie Building Products; or equal.
 2. Thickness: 7/16-inch minimum thickness
 3. Joint treatment: Fiberglass mesh tape and latex modified Portland cement mortar made by backerboard manufacturer.
- E. Cleavage Membrane: 15-pound asphalt saturated organic felt.
- F. Reinforcing Mesh: Galvanized wire fabric, 2-inch by 2-inch, No. 16 gauge wire.
- 2.4 GROUTING MATERIALS
- A. Epoxy Grout: ANSI A118.8, 100 percent solids epoxy grout.
1. Laticrete Spectralock Pro Epoxy Grout for floors and walls.
 - a. Integrally colored.
 - b. Color: To be selected by Architect from manufacturer's standard colors.
 2. Or Equal
- 2.5 WATERPROOF MEMBRANE
- A. Waterproofing membrane meeting ANSI A118.10 industry standards.
1. Membrane at Walls: 4 mil (0.1 mm) thick polyethylene film, ASTM D4397.
- 2.6 PROTECTIVE MATERIALS
- A. Heavy-duty, nonstaining construction or kraft paper with compatible adhesive tape.
- 2.7 CLEANER AND SEALER:

- A. Cleaner and sealer shall be from one manufacturer, acceptable to tile and grout manufacturers.
- B. Neutral Cleaner:
 - 1. Aqua Mix Concentrated Tile Cleaner, neutral phosphate-free cleaner.
 - 2. Custom Building Products Tile Lab Concentrated Tile/ Stone Cleaner.
 - 3. 1-lilyard Super Shine All by American Ocean Tile.
 - 4. equivalent neutral cleaner by United Ceramics.
 - 5. Or equal.
- C. Sealer: May not be required for epoxy grout. Follow manufacturer's instructions.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Site Verification of Conditions: Inspect all surfaces to which ceramic tile work is to be applied. Do not install work until unsatisfactory conditions have been corrected.
- B. Concrete surface to receive ceramic tile shall be dry, clean, and free of oily or waxy film or curing compound.

3.2 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards included under “American National Standard Specifications for the Installation of Ceramic Tile” that apply to type of setting and grouting materials and methods indicated.
- B. TCA Installation Guidelines: TCA “Handbook for Ceramic Tile Installation”; comply with TCA installation methods indicated.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.
- E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise shown.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.

- F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw cut joints after installation of tiles.
- G. Grout tile to comply with the requirements of the following installation standards:
 - 1. For ceramic tile grouts and latex-Portland cement grouts, comply with ANSI A108.10.
 - 2. Seal grout joints at time of completion.
 - a. Note: Sealing of Epoxy grout may not be required. Follow manufacturer's instructions.

3.3 INSTALLATION OF CEMENTITIOUS TILE BACKERBOARD

- A. Installation of Backerboard
 - 1. Install in strict accordance with manufacturer's printed instructions.
 - 2. Verify that supports (studs or other backing) are spaced not more than 16 inches on center. Fit all joints and cutouts closely but not forced together. Attach to wood or metal framing and with screws. NAILS NOT ACCEPTABLE. Stagger end joints. Space screws maximum of 8 inches on centers and at least 3/8-inch but not more than 5/8-inch from panel edges.
- B. Joint Treatment: Prefill joints with latex modified Portland cement mortar, embed glass mesh joint tape in uniform coating of mortar forcing the mortar through the tape, trowel the surface to completely fill the joints and fully embed the tape and then finish the surface to produce a smooth level joint.

3.4 LAYOUT AND REQUIRED TOLERANCES

- A. Layout: Lay out all tile so that no tile is less than half size in either direction. Align all joints in a grid pattern with tile joints oriented parallel to walls unless shown otherwise. Wall tile joints shall be laid out with the vertical joints plumb and the horizontal joints level. Each individual tile shall be set with equal width parallel joints all around and with its surface exactly flush with the plane of the wall or floor in which it lies. Bring surface of tile to a true plane by "beating in" with a rubber-faced block of wood and mallet.
- B. Fitting Around Adjacent Work: Fit tile closely around electrical outlets, fixtures and other penetrations so that plates, escutcheons and other covering devices overlap the edges of the tile. Cut and drill tile neatly without marring the tile. Rub all cuts smooth with a fine carborundum stone.
- C. Allowable Tolerances
 - 1. Finished tile wall shall conform to a smooth flat plane with joints of uniform width installed plumb and level and with inside and outside corners plumb and straight, to within *1/8-inch* in 8 feet and *1/16-inch* in 2 feet.
 - 2. Finish tile floor shall be sloped uniformly to drains. No portion of the tiled floor plane shall deviate more than *1/16-inch* in 2 feet from a uniform slope.

3. Tile joints shall be of uniform width and in a straight line. Maximum variation in width of joint shall be $\pm 1/32$ -inch. Joints shall not deviate from a straight line by more than $1/8$ -inch in 8 feet or $1/16$ -inch in 2 feet.

3.5 WATERPROOF MEMBRANE

- A. At toilet room, bathtub, and shower walls framed with metal studs, sheet membrane waterproofing shall be installed, whether or not indicated in the Drawings. Install membrane on the framing members behind the cementitious backer units in accordance with TCA Handbook Method W244 & B412, and per manufacturer's written instructions and ANSI A108.13 industry standards.

3.6 FLOOR TILES AT CEMENTIOUS SLABS – MORTAR BED METHOD

- A. Ceramic Mosaic Floor Tiles
 1. Bond coat and grouting for floor tile:
 - a. Epoxy bond coat and grout, in accordance with TCA Handbook Method F132, bonded.
 2. Mortar Bed Thickness: as indicated in the Drawings.

3.7 WALL TILE INSTALLATION

- A. Set tile on backerboard with a latex-modified portland cement-based bond coat in accordance with TCA Method W244 & B412, ANSI A108.5, and as follows:
 1. Provide waterproof membrane at toilet room, bathtub, and shower walls framed with metal studs.
 2. All horizontal and vertical joints and corners of the backerboard units shall have a $1/8$ -inch spacing that shall be filled solid with latex modified Portland cement mortar.
 3. Embed 2-inch-wide glass fiber mesh tape in a skim coat of mortar over the joints and corners.
 4. Float bond coat over area no greater than can be covered with tile while bond coat remains plastic. Cover evenly with no bare spots. Comb mortar with a notched trowel 10 minutes prior to applying tile. Finished mortar bond coat shall be $3/32$ to $1/8$ -inch after beating in of tile.
 5. Tile shall not be soaked. Press tile firmly into freshly notched mortar. Fit tiles so that the joint spacers on the tile edges touch each other. Bring all tiles to a true plane. Thoroughly beat in all tile while the mortar is still plastic.
 6. The beating shall fill the entire space between ribs in back of tile with mortar.
 7. Grouting of wall tile:
 - a. Epoxy grout in accordance with ANSI A108.6 and ANSI A118.3
 - b. Comply with ANSI 108.10. Force grout into joints filling all voids. Fill

grout to depth of the bottom of the cushion or radius on cushion edged tiles. Before grout sets strike or tool joints with a smooth plastic jointing tool to densify the grout and strike it off to a smooth concave surface at the proper depth.

8. Clean tile with sponges and cloth. Damp cure for 72 hours minimum.

3.8 EXPANSION JOINTS

- A. Provide expansion joints in floors where shown or required in accordance with TCA Method EJ71 1. Seal expansion joints with sealant in accordance with Section 07 92 00.

3.9 REPAIRS

- A. Replace all defective work including but not limited to:
 1. Loose tile
 2. Chipped tile
 3. Cut tile with chipped, flaked or undressed edges
 4. Split tile
 5. Cracked tile
 6. Wide joints
 7. Narrow joints
 8. Variation in true plane exceeding specified tolerances
 9. Tile out of level or alignment with adjacent tile
 10. Uneven tooling of grout joints
 11. Other defects affecting the quality, utility and appearance of the work

3.10 CLEANING AND PROTECTION

- A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove grout residue from tile as soon as possible.
 2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
 - a. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.
 3. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.
 4. Provide final protection and maintain conditions in a manner acceptable to

manufacturer and installer that ensure that tile is without damage or deterioration at time of Final Acceptance.

- a. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
5. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

- END OF SECTION -

SECTION 09500 - ACOUSTICAL CEILING SYSTEM

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all acoustical ceiling systems, including all supporting systems and appurtenant work, complete.

1.2 CODES

- A. The 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. California Building Code
 - 2. California Fire Code

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. Federal Specifications:
SS-S-118 Sound Controlling (Acoustical) Tiles and Panels
 - 2. Commercial Standards:
ASTM C 635 Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - 3. Trade Standards: "Specification for Acoustical Tile and Lay-in Panel Ceiling Suspension Systems" by the Acoustical Material Association.

1.4 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Manufacturer's catalogue containing information on all components of the ceiling system and installation instructions.
 - 2. Samples of materials proposed for use.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken, packages or containers bearing the manufacturer's label.
- B. **Storage:** All materials shall be carefully stored in an area that is protected from deleterious elements in a manner recommended by the product manufacturer. Storage shall be in a manner that will prevent damage to the material or marring of its finish.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The acoustical ceiling system products shall be in accordance with the manufacturer's published specifications and these Specifications. Products and items not specifically indicated shall be manufacturer's standard products.

2.2 GRID SYSTEM MATERIALS

- A. **Cross Tees:** Cross tees shall be properly sized, cold-rolled, electro-galvanized steel, with whitebaked enamel finish.
- B. **Wall Molding:** Wall molding shall be 1-inch by 3/4-inch matching the beams and tees in material and finish. Wall moldings with reveal shall be provided where indicated.
- C. **Hanger and Diagonal Bracing Wires:** Hanger and diagonal bracing wires shall be not lighter than 12-gauge, pre-straightened, galvanized, annealed steel wire.
- D. **Spacers:** Spacers shall be tempered spring steel and shall be fitted into wall molding to provide tension on the ceiling system.

2.3 EXPOSED GRID SYSTEMS

- A. The exposed grid system shall be a "Heavy Duty" classified system.
- B. Main beams shall be not less than 1-1/2-inch high by 1-inch wide, cold-rolled, electro-galvanized steel, with white baked enamel finish.

2.4 CONCEALED GRID SYSTEMS

- A. The concealed grid system shall be a one-direction hung, concealed, "Heavy Duty" grid system.
- B. Main beams shall be not less than 1-1/2-inch high by 7/8-inch wide by 0.016-inch thick, cold-rolled, electro-galvanized steel, with white baked enamel finish.

2.5 SEISMIC RESTRAINT SYSTEMS

- A. The ceiling support system shall be provided with horizontal and vertical seismic restraint systems conforming to code. The restraint systems shall be complete with all components necessary to meet code. The systems shall include support wires and bracing, tie wires, fasteners and anchors, brackets and supports, clips, compressive restraint members, etc. The restraint systems shall be systems approved by the local authorities.
- B. The compressive post for vertical restraint shall be a telescoping movement restraint manufactured of heavy wall galvanized tubing.

2.6 ACOUSTICAL PANEL AND TILE MATERIALS

- A. Tiles or panels shall be mineral fiber tile or panel as indicated and shall conform to Federal Specification SS-S-118.
- B. Tiles or panels shall have a flame spread rating of less than 25 when tested in accordance with UBC Standard 42-1.
- C. **Finish:** Finish shall be factory-applied white latex paint.

2.7 ACOUSTICAL PANEL AND TILE PATTERNS AND SIZES

- A. Ceiling systems shall consist of lay-in acoustical ceiling panels and suspension systems by the same manufacturer.

B. Lay-In Acoustic Panel Suspension System

1. Acoustical Ceiling Panels

- a. Panel Name: Armstrong: DUNE Second Look II #2722
- b. Panel Size: 2 foot x 4 foot.
- c. Panel Thickness: 3/4 in.
- d. Edge Detail: Angled Tegular 9/16".
- e. Light Reflectance: 0.84 minimum, complying with ASTM E 1477.
- f. CAC: Minimum 35 - 39, UL Classified, complying with ASTM E 1414.
- g. Class: Class A, in accordance with ASTM E 1264.
- h. NRC: Minimum 0.65, UL Classified, complying with ASTM C 423.
- i. Color: White.
- j. Recycled Content: Minimum 45 percent.
- k. Mold and Mildew Resistance: All panels and faces shall be treated with a biocide paint additive to inhibit mold and mildew or an anti-microbial solution.

2. Suspension System

- a. Suspension System Name: Superfine ML 9/16" Exposed Tee by Armstrong.
- b. Fire Class: Class A.
- c. Duty: Heavy Duty.
- d. Color: White.
- e. Wall Molding: Hemmed shadow molding with pre-finished exposed flanges.

2.8 ADHESIVE

- A. Tile cement or adhesive shall conform to the printed recommendations of the tile manufacturer for bonding to concrete or other indicated surface material and shall have a fire resistivity similar to ceiling material requirements.

2.9 MANUFACTURERS

- A. Products shall be of the following manufacture and type (or equal):
 - 1. Armstrong World Industries, or equivalent approved in advanced by Architect.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The acoustical ceiling system shall consist of continuous main beams and intersecting cross tees, joined together to form the patterns as indicated and acoustical ceiling panels and tiles. The system shall be complete with all necessary components, anchors, and supports.
- B. The system shall be designed so that the ceiling panels may be removed and replaced without damage, and so that main beams and cross tees can be removed or replaced without deforming the members or disturbing the balance of the grid system.
- C. Suspension systems and tile work shall be coordinated with lighting fixtures, air diffusers, speakers, smoke detectors, sprinklers, and other features so that all installations fit together without interference.

3.2 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's published directions, installation instructions, and specifications.

3.3 PROBLEM AREAS

- A. Manufacturer's published recommendations and specifications shall be followed for installation, materials, and treatment of problem areas; provided, that the manufacturer's published recommendations and specifications are not less than those required by "Specification for Acoustical Tile and Lay-In Panel Ceiling Suspension Systems" of the Acoustical Materials Association, and the Uniform Building Code.

3.4 DEFLECTIONS

- A. The ceiling system shall be engineered to carry the applied dead and live loads with a deflection of less than 1/360 of the span and shall be level to within 1/8-inch in 12 feet. The ceiling system shall conform to ASTM C 635 (Heavy Duty classification) with a minimum load carrying capacity of the main runner of 16 lb/linear foot (for a span of 4 ft 0 in.).

3.5 PATTERN AND SYMMETRY

- A. Unless otherwise indicated, the layout scheme shall be such that all ceiling tiles are symmetrical about the center of the rooms to provide the least number of cut tiles. The tiles shall be laid in a pattern with all edges in alignment and with all faces in a plane. There shall be no noticeable variations in the finished ceiling plane. Items located within the ceiling plane such as light fixtures, air diffusers, speakers, smoke detectors, and fire sprinklers shall be coordinated with other trades and shall be installed at the locations indicated. Whenever the CONTRACTOR is

not sure of an installation location he shall obtain approval, of its proposed installation, from the CONSTRUCTION MANAGER.

- B. Nondirectional tile shall be laid so no fissure pattern direction is established.
- C. Tiles shall be held down by use of hold down clips.

3.6 BEAM SPLICES AND TEE INTERSECTIONS

- A. **General:** All main beams shall be joined together by a splice clip which draws the members tightly together with bottom flanges flush. Cross tee intersections shall be joined together by interlock methods, by positioning the ends of the cross tees snugly against the main beam and in holding the cross tees in vertical alignment with bottom flanges flush. All main beam splices and cross tee intersections shall be capable of withstanding at least 100 lb tension or compression.
- B. **Termination at Walls:** The main beams and cross tees which terminate at the walls shall be attached to a perimeter wall molding, which shall be continuous along at least 2 intersecting walls, with spring steel clips. Wall molding shall be securely attached to the walls at approximately 16-inch intervals.

3.7 HANGER WIRES

- A. Hanger wires shall be spaced at maximum 48-inches on center along the main beams and at the corners of lay-in-fixtures and elsewhere as required for a fire-rated system.
- B. Hanger wires shall be secured to the supporting structure with approved fastenings. Hangers and fastenings shall be capable of carrying at least 4 times the design load but not less than 100 lbs.

3.8 MOLDINGS

- A. All outside edges such as against walls shall be provided with wall moldings. Slip-on "U" moldings shall be provided wherever tile does not abut against a wall molding or where the edge is otherwise exposed.

3.9 SEISMIC RESTRAINT SYSTEMS

- A. Seismic restraint systems shall conform to code and shall be provided at all locations required by code.
 - 1. **Horizontal Restraint:** Ceiling systems shall be provided with diagonal bracing wires. Horizontal restraints shall be effected by 4 No. 12-gauge wires secured to the main beams within 2 inches of the cross tee intersection and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the plane of the ceiling. These horizontal restraint points shall be placed 12 feet on center in both directions with the first point within 4 feet from each wall. The restraint wire attachment to the supporting structure shall be adequate for the loads imposed. Side wall ties shall be provided where necessary.
 - 2. **Vertical Restraint:** Ceiling system shall be provided with a vertical restraint system to resist seismic uplift movements. The system shall be, vertical metal strut attached to the main channel, and fastened, secured and anchored to the underside of the structural

system in a manner which meets code requirements. Restraint locations shall be not less than required by code and at horizontal restraint locations.

3.10 FIRE RATING

- A. Where a fire rating is indicated, the complete ceiling system shall meet the requirements for the indicated rating.

3.11 FINISHED CONDITION

- A. After installation, the acoustical ceiling system shall be free from any discoloration, dirt, smudges, scratches, chips, blemishes, and/or any misalignment. All damaged materials shall be replaced so that a new uniform acoustical ceiling system is provided.

3.12 EXTRA MATERIALS

- A. The CONTRACTOR shall furnish the CONSTRUCTION MANAGER with not less than two extra panels or tile for each 100 square feet of area for repair work.
- B. The extra materials shall be wrapped in plastic and paper and shall be marked to identify the product for easy identification.

3.13 ACCESS PANELS

- A. In the concealed grid system, access panels shall comprise at least 5 percent of the ceiling area, with a minimum of one per room. Access panels shall be located as indicated or where directed by the CONSTRUCTION MANAGER.

- END OF SECTION -

SECTION 09510 - NOISE CONTROL PANELS

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing wall mounted and ceiling suspended noise control panels and all related work, complete.

1.2 CODES

- A. The 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. California Building Code

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

- 1. Federal Specifications:

HH-I-558B(3)	Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type)
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- 2. Commercial Standards:

ASTM B 117	Method of Salt Spray (Fog) Testing
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ASTM C 423	Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
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ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials
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1.4 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:

- 1. Product Data: CONTRACTOR shall submit manufacturer's detailed technical product data and installation instructions for each type of noise control panel and mounting configuration, including details of core and edge construction, trim, and mounting.

- a. Copies of test results performed on similar panels from an accredited testing laboratory shall be submitted to the CONSTRUCTION MANAGER to substantiate the sound reduction capabilities of the panels.

2. Shop Drawings: Shop drawings shall be submitted indicating location and size of each noise control panel, details of mounting, requirements for finishing and other pertinent data.
3. Samples: Samples shall be submitted of the manufacturer's range of standard colors for the CONSTRUCTION MANAGER'S selection and approval.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Noise control panels shall be protected during transit, storage and handling to prevent damage, soiling and deterioration.
- B. **Delivery of Materials:** Noise control panels shall be delivered in original, unbroken packages or containers bearing the name of the manufacturer. Packages or containers shall be delivered to the site with seals unbroken.
- C. **Storage:** All components and assemblies shall be carefully stored in an area that is protected from the deleterious effects of the elements, in a manner recommended by the product manufacturer.

PART 2 - PRODUCTS

2.1 NOISE CONTROL PANELS

- A. Facings shall be 20-gauge (minimum) zinc coated G90, galvanized per ASTM A525 pre-finished steel. The face panel shall have sufficient rigidity to provide panel flatness not to exceeding deflections of L/240 as measured diagonally across the panel.
 1. Facings shall be perforated with 3/32-inch diameter holes on 5/32-inch staggered centers, ridged on 6-inch centers and flanged at sides and top for stiffness.
 2. Facing surface may be corrugated or otherwise textured to enhance noise control performance and structural rigidity.
 3. Finish shall be factory painted with modified alkyd-baked enamel. Color as selected by the CONSTRUCTION MANAGER.
- B. Noise control insulation shall be 2-inch thick fine fibered, fibrous glass having a density of not less than 1.5 lbs per cubic foot and meeting Federal Specification HH-I-558B(3), Form B, Type 1, Class 7.
 1. Where indicated, noise control insulation shall be enclosed in 2 mil plastic when panels are exposed to high humidity environments.
 2. Noise control material shall have a Class A Flame Spread rating when tested in conformance with ASTM E 84. The material shall also be classified by Underwriters Laboratories, Inc., with a flame spread index of 0 to 25 and smoke rating of 450 maximum.
- C. Framing members shall be manufactured from 18 gauge zinc coated steel. Each framing member shall be supplied with two 1/4-inch, #20, blind threaded inserts for attachment of panel to mounting bracket. Inserts shall have a tensile strength of at least 220 pounds per insert.
 1. Brackets for wall panels shall be 1 gauge Type 316 stainless steel.

2. 3/4-inch long, 1/4-inch, #20, stainless Steel bolts shall be supplied with lock washers for attachment to wall or ceiling.
- D. ACOUSTIC PERFORMANCE: The composite panel assembly when tested in accordance with ASTM C423 shall have the following minimum sound absorption coefficients:

	<u>Sound Absorption Characteristics</u>						
	<u>Octave Band</u>						
	<u>Frequencies, HZ</u>						
	<u>125</u>	<u>250</u>	<u>500</u>	<u>1K</u>	<u>2K</u>	<u>4K</u>	<u>NRC</u>
Absorption Coefficients 2"	0.21	0.73	1.05	1.01	0.97	0.97	0.95
Absorption Coefficients 4"	0.97	1.39	1.34	1.29	1.19	1.01	1.30

2.2 MANUFACTURERS

- A. Products of the type indicated shall be manufactured by one of the following (or equal):
 1. Industrial Acoustic Co. Inc. (IAC) Type N "Noise Foil".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Noise control panels shall be installed in strict compliance with manufacturer's instructions and with approved shop drawings.
- B. Noise Control Panel shall cover at least 50% walls and ceiling surface area of each generator buildings.
- C. 2-inch thick Noise Control panel, Type N "Noise Foil" by IAC or equal, shall be installed with 3-inch minimum air-gap between panels and wall surface or as per manufacturer's recommendations and approved by CONSTRUCTION MANAGER.
- D. Noise Control Panel shall be installed as per manufacturer's recommendations and approved by CONSTRUCTION MANAGER.

** END OF SECTION **

SECTION 09650 -RUBBER BASE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Topset covered rubber base for installation with surface flooring.

B. Related Requirements:

1. Section 09680 - Carpeting.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's published technical data describing materials, construction and recommended installation instructions. Submit technical data and installation instructions for each adhesive material.

B. Maintenance Instructions: Submit manufacturer's recommendations for maintenance, care and cleaning of base.

C. Samples: Submit Samples of top set base in each available color. Following color selections, submit Samples, not less than 12 inches long of each selected color and type. Submit pint cans of each type adhesive.

D. Maintenance Materials: Before Substantial Completion, deliver at least 25 lineal feet and five outside corner units of each color of rubber base installed. Deliver the materials in unopened factory containers or in sealed cartons with labels identifying the contents, matching installed materials. Include unopened cans of adhesives adequate to install the maintenance materials.

1.3 QUALITY ASSURANCE

A. Qualifications of Installer: Minimum five years of knowledge in successfully installing the same or similar flooring materials.

B. Comply with the following as a minimum requirement:

1. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM F1861: Standard Specification for Resilient Wall Base.
3. Chemically based products such as sealers, primers, fillers, adhesives, etc. must be approved by Owner's Office of Environmental Health and Safety (OEHS).
4. Each selected color and configuration shall be from same dye lot and color.

1.4 DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered to the Project site in original unopened manufacturer's packaging clearly labeled with manufacturer's name. Store materials at room

temperature, but not less than 70 degrees F, for a minimum of 48 hours before installation, unless otherwise indicated in manufacturer's printed instructions.

1.5 PROJECT CONDITIONS

- A. Ventilation and Temperature: Verify areas that are to receive rubber base are ventilated to remove fumes from installation materials, and areas are within temperature range recommended by the various material manufactures for site installation conditions.

1.6 WARRANTY

- A. Manufacturer shall provide a five year material warranty.
- B. Installer shall provide a two year fabrication and installation warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Burke/Mercer Wall Base.
- B. Roppe, Pinnacle Rubber Base.
- C. Flexco Company, Wallflower Premium Rubber Wall Base.
- D. Equal.

2.2 MATERIALS

- A. Rubber base: Conform to ASTM F 861; Group 2, solid (homogeneous); Type 1, TS, (thermoset) vulcanized rubber, Style A, 4-inch high unless otherwise indicated, integral colors as selected, non-shrinking, 1/8 inch thick, with matching molded outside corners.
- B. Base Adhesive: Water based, low odor type, as recommended by manufacturer of rubber base.
- C. Color: To be selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate the Work of this section with other sections to provide a level, smooth and clean finish surfaces to receive rubber base.

3.2 EXAMINATION

- A. Field verify dimensions and other conditions affecting the Work of this section before commencing the Work of this section.

- B. Before Work is started, examine surfaces that are to receive rubber base. Deficiencies shall be corrected before starting the Work of this section.
- 3.3 PREPARATION
- A. Do not start preparation until adjacent concrete floor slabs are at least 90 days old and finish flooring is installed.
 - B. Install rubber base when ambient temperature is 70 degrees F. or higher.
- 3.4 INSTALLATION
- A. Install top set base at hard floors, including resilient flooring, concrete, wood, carpet and other soft floors.
 - B. Securely fasten cement base to backing in long lengths in accordance with manufacturer's recommendations. Lay out lengths so that not less than 18 inches long filler pieces are provided. Assure that top and toe continuously contact the wall and floor, and that all joints are tight. Install matching factory formed external corners at all offsets. Inside corners shall be coped; wrapped corners are not acceptable.
 - C. Use of adhesive gun is prohibited. Apply adhesive directly to substrate using the appropriate notched trowel or spreader according to manufacturer's instructions. Maintain 1/8 inch gap from top of base to prevent adhesive oozing onto adjacent surfaces.
 - D. Base and outside corners shall be rolled with a seam roller before adhesive sets.
- 3.5 CLEANING
- A. Maintain surfaces of base clean as installation progresses. Clean rubber base when sufficiently seated and remove foreign substances.
 - B. Clean adjacent surfaces of adhesive or other defacement. Replace damaged and/or defective Work to the specified condition.
- 3.6 CLEAN UP
- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.
- 3.7 PROTECTION
- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 09654 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient sheet vinyl flooring with integral cove base as indicated.

B. Related Sections:

1. Section 03300 Cast-in-Place Concrete
2. Section 09300 Ceramic Tiles
3. Section 09250 Gypsum Board

1.2 DEFINITIONS

- A. Pop-up: A pop-up is defined as any surface deviation or looseness of substrate that is equal to or greater than 1/64 (0.015625) inch above the concrete floor level, regardless of the size.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's published technical data describing materials, construction and recommended installation procedures. Submit technical data and installation instructions for each adhesive material. Submit list and Product Data of recommended finish materials.
- B. Maintenance Instructions: Submit manufacturer's recommendations for maintenance, care and cleaning.
- C. Samples: Submit Samples of each type of resilient sheet flooring in each available color and pattern. Following color selections, submit 12 inch square Samples of each selected color and pattern. Submit pint cans of each type of adhesive.

1.4 QUALITY ASSURANCE

- A. Qualifications of Installer: Minimum 5 years of knowledge in successfully installing the specified products or similar flooring materials.
- B. Comply with the following as a minimum requirement:
1. All materials shall be ADA compliant.
 2. ASTM E 84: Class A Flame Spread Rating of 25 or less.
 3. Fire Test Data: ASTM E 648, NFPA 253, ASTM E 662, NFPA 258.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the Project site in original unopened manufacturer's packaging clearly labeled with manufacturer's name. Materials shall be stored at not less than 70 degrees F for not less than 48 hours before installation.

1.6 PROJECT CONDITIONS

- A. Ventilation and Temperature: Verify areas that are to receive new flooring are ventilated to remove fumes from installation materials, and areas are within temperature range recommended by the various material manufactures for Project site installation conditions.

1.7 WARRANTY

- A. Manufacturer shall provide 2 year material warranty.
- B. Installer shall provide a 2 year labor warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Armstrong Contract Interiors, Lancaster PA 17604, Azrock, Domco Inc., USA, P.O. Box 354, Florence, AL 35631, or equal.

2.2 MATERIALS

- A. Connection Corlon Inlaid Vinyl Sheet Flooring:

1. Color/Pattern: Blue Yonder - 88729
2. Size: 72" wide, 0.08" thick
3. Polyurethane coated wear surface with terrazzo like visual, 0.05" thick
4. Conform to ASTM F 1303, Type II, and Grade 1.
5. Sheet vinyl shall be Class A
6. Inorganic fibrous asbestos-free backing

- B. Crack Filler and Leveling Compound: Cementitious type, shall be Durabond's Webcrete # 95, Ardex SD-F, Armstrong S-194 or as recommended by flooring manufacturer.

- C. Concrete Primer: Non-staining type recommended by manufacturer of resilient sheet vinyl flooring.

- D. Moisture Detection Equipment: Calcium chloride testing system, consisting of pre-packaged anhydrous calcium chloride crystal test kits, and an electronic gram weight scale measurable in 1/10 grams. Equipment shall be manufactured by one of the following:

1. Sealflex Industries, Inc., 2925 College Avenue, Suite B-4, Costa Mesa, CA 92626.
 2. Vaprecision Professional Emission Testing Systems, 2941 West Mac Arthur Blvd., Suite 138, Santa Ana, CA 92704.
- E. Adhesive and Seam-Sealing Treatment for Sheet Vinyl: Adhesives shall be suitable for on-, above-, and below-grade installation.
1. Adhesive: Armstrong S-599 Premium Vinyl Back Flooring Adhesive or Armstrong S-240 High Performance Epoxy flooring adhesive or as recommended by flooring manufacture.
 2. Seam treatment shall be as recommended by flooring manufacturer and as follows:
 - a. Un-backed sheet vinyl:
 - (1) Heat weld.
 - (2) Liquid chemical sealer.
 - (3) Special seam adhesive.
 - b. Fibrous-backed sheet vinyl:
 - (1) Liquid chemical sealer.
 - (2) Special seam adhesive.
- F. Accessories: Stainless steel or extruded aluminum top trim and 3/4 inch radius plastic fillets with integral cove base.
- G. Miscellaneous Shapes: Provide miscellaneous moldings as follows and as required to complete the installation. Catalog numbers are those of Mercer. Colors shall be as selected by Architect from manufacturers standard colors.
1. Corner Guards, No. 695 Junior Corner Guard.
 2. Utility Moldings: No. 655 Utility Molding.
 3. Carpet to Tile: No. 150 Tile-Carpet Joiner.
 4. Tile Reducer: No. 633, 1/8 inch size.
- H. Underlayment: One of the following, grades stamped on panels as indicated.
1. Underlayment A-C Exterior, Sanded Face.
 2. Underlayment B-C Exterior, Sanded Face.
 3. C-C Plugged Exterior, Sanded Face.

4. Underlayment C-C. Plugged Exterior, Sanded Face.
- I. Floor Sealer: Provide one of the following:
1. Super Polymer 85, manufactured by Maintex, City of Industry, CA.
 2. Butcher's Mainstay Floor Finish, manufactured by Waxie Stationary Supply, San Diego, CA.
 3. Polymer L. A. manufactured by Alkot Industries, Tarzana, CA.
- J. Slip – resistance: Minimum coefficient of friction 0.6 per ASTM D.2047

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate with related Work to assure level, smooth, and clean finish surfaces to receive floor tile.

3.2 EXAMINATION

- A. Field verify all dimensions and other conditions affecting the Work of this section before commencing the Work of this section.
- B. Before the Work of this section is started, examine surfaces to receive resilient sheet vinyl flooring and correct deficiencies before starting the Work of this section.

3.3 PREPARATION

A. Concrete Slabs:

1. Do not start preparation until concrete floor slabs are at least 90 days old.
2. Leveling : Check subfloors for level, and make floor slabs true to level and plane within a tolerance of 1/8 inch in 10-feet. Test floor areas both ways with a 10-foot straightedge and repair high and low areas exceeding allowable tolerance. Pop ups shall be hammered out and floor filled with a cementitious leveling compound. Remove high areas by power sanding, stone rubbing or grinding, chipping off and filling with leveling compound, or equivalent method. Fill low areas with leveling compound. Repair and level the surfaces having abrupt changes in plane, such as trowel marks or ridges, whether or not within the allowable tolerance. Clean areas where repairs are performed.
3. Cleaning: After leveling, if required, clean substrates of all deleterious substances and foreign matter.
4. Cracks or Depressions: Fill voids with cementitious leveling compound of the type recommended by flooring manufacturer for the specific conditions.

5. **Moisture Testing:** Test new and old concrete slabs for adequate dryness. Testing shall conform to ASTM F 1869, and the following. Minimum testing requirements are 3 calcium chloride tests for the first 1,000 square feet of floor area, and one for each additional 1,000 square feet or fraction thereof. Unless more stringent requirements are recommended by flooring manufacturer, maximum allowable moisture release at time of flooring installation shall be 3 pounds per 24 hours per 1,000 square feet. Provide report of test as specified above. For each test, perform the following steps:
 - a. Weigh the sealed dish of crystals immediately prior to exposure. Record starting weight, date, and time.
 - b. Open kit and set crystal dish on clean concrete surface. Immediately install plastic dome over the dish. Confirm the dome is gasketed to the concrete and is airtight.
 - c. Leave test to absorb moisture for 60 to 72 hours. Maintain room temperature above 55 degrees F for duration of test.
 - d. After exposure, remove and discard housing. Replace dish lid and tape shut. Weigh the sample within one hour of removal from floor.
 - e. Compute the vapor emission in pounds, indicate location of test and vapor emission on report.
 - f. Delay application of flooring until sub-floors are sufficiently dry, or perform remedial measures as recommended by flooring materials manufacturer.
6. **Priming:** Prime concrete floor slabs installed directly on grade and other slabs if recommended by flooring manufacturer.

B. **Wood Subfloors:**

1. Install plywood underlayment on wood subfloors, except where subfloor is acceptable to flooring manufacturer. Install underlayment with smooth side up, leaving 1/16 inch at panel edges and ends. Leave a 1/8 of an inch gap between the underlayment and adjoining vertical surfaces. Edge gaps shall be filled with sealant before the finish floor is installed. Offset underlayment edges and sub floor edges 4 inches and stagger panel corners. Joints in plywood shall not be located at doorways or within 12 inches of center of doorway.
2. Install 14 gage annular nails, of length sufficient to penetrate into subflooring, to fasten underlayment. Locate nails 3/8 inch to 3/4 inch from panel edges, spaced one inch on center, staggered. Nail at 8 inches each way in the field. Nails in plywood shall not be over driven. Staples are not permitted.
3. Sweep floors. Vacuum sanding dust.

3.4 **INSTALLATION OF SHEET FLOORING**

- A. **Sheet Vinyl:** Install flooring with adhesives as recommended by flooring manufacturer. Reverse alternate sheet widths, match pattern as required and cut seams to provide tight joints and preserve flooring pattern. Seal seams as specified with no skips or gaps. Closely trim to pipes, jambs,

outlets, and like conditions. Form with integral cove base, 6 inches high unless otherwise indicated, over plastic fillets, finished at top with metal trim.

B. Sheet Vinyl with Heat-Welded Seams:

1. Install as above and in strict accordance with the latest edition of "Armstrong Guaranteed Installation System," F-5061 and the "Connection Corlon Installation & Maintenance Tip Sheet," F-7566.
2. Scribe, cut, and fit or flash cove to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets in length and sizes required. Reverse alternate sheets, where recommended by flooring manufacturer. Lay cut sheets flat and allow to acclimate to room temperature before installation.
3. Mix and install adhesives in accordance with manufacturer's instructions. Provide safety precautions during mixing and installation as recommended by adhesive manufacturer.
4. Install sheets and roll over floor surface. Adhere entire flooring using adhesives as recommended by flooring manufacturer. Work out wrinkles and air pockets. Roll material in two directions starting at center of sheet. Fit flooring neatly and tightly around penetrations. Scribe flooring to doorjamb. Terminate in center of doorways beneath closed doors.
5. Cut, rout, and heat weld all seams, with equipment and methods recommended by flooring manufacturer. Routing depth shall be no greater than 2/3 of the wear layer thickness. Insert welding rod and thermally fuse rod and adjacent material to produce a seamless homogeneous surface. Allow heat weld to cool and trim in 2 passes. Second trimming shall result in flush, smooth surface at all seams including walls and corners of integral cove areas. Inspect completed seams and reseal if necessary.
6. Extend sheets up wall to form integral coved base, 6 inch high unless otherwise indicated. Install cove fillets in corners and where walls intersect floors and other vertical surfaces to be covered. Install adhesive on vertical surfaces and hand roll flooring into place. Install metal edging strip at top of base.

C. Sheet Vinyl with Liquid Seam Sealer or Special Seam Adhesive (double-cut or recess- scribe seams with no gaps):

1. Install as above and in strict accordance with the latest edition of "Armstrong Guaranteed Installation System," F-5061 and the "Connection Corlon Installation & Maintenance Tip Sheet," F-7566.
2. Liquid Seam Sealer: Install chemical sealer inside all seams and field cuts including integral cove areas with applicator as recommended by flooring manufacturer. Protect chemically sealed seams from all traffic for a minimum of 3 hours.
2. Special Seam Adhesive: Install special seam adhesive beneath all seams and field cuts including integral cove areas. Install all adhesives as recommended by flooring manufacturer. Remove excess adhesive at seams. Protect newly sealed seams from traffic.

- D. Installation of Trim Shapes: Provide reducer strips to cover all exposed edges of resilient flooring. Provide carpet-to-tile strips at junctions with carpet.
- E. Install adhesive in a thin film evenly with a notched trowel, with type of trowel recommended by flooring manufacturer.
 - 1. Mix adhesive in accordance with manufacture's instructions.
 - 2. Install adhesive only in the area that can be covered by flooring material within the adhesive manufacturer's recommended working time.
 - 3. Remove adhesive that has dried or filmed over.
- H. Provide reducer where floor covering edges are exposed, such as at center of the door or where floor coverings terminate.

3.5 CLEANING

- A. Keep all flooring surfaces clean as installation progresses.
- B. Perform initial maintenance according to the latest edition of "Armstrong Guarenteed Installation System," F-5061 and the "Connection Corlon Installation & Maintenance Tip Sheet," F-7566.
- C. Clean flooring when sufficiently seated and remove foreign substances.
- D. Finish sheet vinyl flooring with 2 coats of floor finish installed in accordance with manufacturers instruction. Do not buff unless specifically required. Provide the manufacturers recommended drying time for each coat.
- E. Clean adjacent surfaces of adhesive or other materials. Replace all damaged or defective Work.

3.6 CLEAN UP

- A. Remove rubbish, debris and waste material and legally dispose off the Project site.

3.7 PROTECTION

- A. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings. (See Finishing the Job in "Armstrong Guaranteed Installation System," F-5061).

END OF SECTION

SECTION 09680 - CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Carpet as indicated.

1.2 SUBMITTALS

- A. Shop Drawings: Submit dimensioned layout of carpet seaming and details for binder bars.

B. Samples

1. Submit 3 labeled samples from each dye lot of carpet required for the work. Samples shall be 24x24 tile module with proper backing.
2. Trim and Accessories: Submit 12-inch long Samples of each type trim proposed for the work.
3. Samples of manufacturers' full color range for selection of colors to be used. NOTE: When color and/or pattern of product wanted is specified under Part 2 of this Section, color and/or patterns offered by manufacturers proposed will be a major consideration in determining acceptability of product submitted.

C. Product Data: Submit the following:

1. Carpet manufacturer's published technical data fully describing carpet materials, construction, and recommended installation directions.
2. Technical data and installation instructions for each adhesive and sealer material.
3. Carpet manufacturer's published instructions for maintenance, care, cleaning and repair of carpet.
4. MSDS on all manufacturer's recommended adhesives, seam and edge sealers and primers.

D. Certificate:

1. Submit a certificate from carpet manufacturer that materials supplied comply with fire hazard resistance standards specified.
2. Submit a manufacturer certification that the Installer(s) is approved by the manufacturer to install the specified product.

E. Installer's/Subcontractor's Knowledge Qualifications: Submit list of not less than 5 projects with similar scope of work, extending over period of not less than 5 years, indicating installer's knowledge record.

1.3 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. All materials shall comply with the requirements of the ADA Standards.

2. Manufacture's installation instructions.
 3. All chemically based products such as sealers, primers, fillers, adhesives, etc. must be approved by the AGENCY's Office of the Environmental Health and Safety. (OEHS)
 4. Carpet must be free of Anti-Microbial Protection (Dry Back System).
- B. Requirements of Regulatory Agencies: Carpeting shall meet requirements of federal, state and local regulatory agencies for flammability, static control, or other properties as specified, with testing documentation from the manufacturer by a third party laboratory.
 - C. Carpet Installation: Comply with CRI 104 - Standard for Installation of Textile Floor Covering Materials.
 - D. Each color of carpet shall be of the same dye lot.
 - E. Qualifications of Supervising Installer: The flooring supervisor shall have a minimum of 10 hours Cal-OSHA safety training.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Full or cut rolls of carpeting shall be cut, packaged and identified by the factory. Distributor, dealer, or vendor cutting, re-packaging, and re-labeling is not permitted.
- B. Store material at least 24 hours at room temperature prior to installation and in accordance to all manufacturer's instructions.
- C. Deliver fire-rated materials with testing agency labels and required fire classification numbers attached and legible.

1.5 JOB CONDITIONS

- A. Ventilation and Temperature: Verify areas to be carpeted are ventilated to remove fumes from installation materials, and areas are within temperature range recommended by the various material manufacturers for project site installation conditions. The temperature of a concrete slab must be stabilized above 65 degrees both 12 hours prior to and after the installation. The following environmental conditions inside the building are critical for proper installation. Temperature must be between 65 degrees F and 95 degrees F and the humidity between 10% and 65% for at least 72 hours before and 72 hours after installation. In addition, any adhesives, edge sealers and seam sealers should be stored under these conditions for a minimum of 24 hours prior to installation.
- B. Protection: Prohibit traffic on carpet for at least 12 hours after installation. Cover carpet with heavy non-staining Kraft paper in areas where the work of other trades is to be performed and/or traffic and passage areas. Protect carpet from damage or soiling. Maintain protection in place until Substantial Completion.

1.6 WARRANTY

- A. Installer shall provide a 2 year labor warranty.
- B. Manufacturer shall provide a 30 year material warranty as described below:

1. Delamination Warranty: Carpet will not delaminate for a minimum of 30 years from the date of installation.
 2. Zippering Warranty: Carpet will not zipper or develop continuous pile yarn runners in the body of the carpet for a minimum of 30 years from the date of Substantial Completion.
 3. Edge Ravel: Carpet will not have continuous pile yarn coming out at seams for a minimum of 30 years from the date of Substantial Completion.
- C. Manufacturer shall provide a 10 year material warranty for colorfastness and texture retention.
1. Texture Retention Warranty: The manufacturer warrants that the carpet will substantially maintain its physical surface texture against crushing, matting and walking out for 10 years from the date of Substantial Completion.
 2. Dimensional Stability Warranty: The manufacturer warrants that the carpet will not lose its dimensional stability (i.e., growth or shrinkage with glue-down installations) for the life of the carpet due to normal variations in atmosphere, temperature, or humidity.
 3. Colorfastness to light: Carpet will not fade for 10 years due to exposure to sunlight.
 4. Colorfastness to atmospheric contaminants: Carpet will not fade for 10 years due to atmospheric contaminants.
 5. Stain and Soil Protection: 10 year stain removal written guarantee.

1.7 MAINTENANCE

- A. Extra Materials: Provide minimum 36 inches in any one dimension of extra materials for each color, pattern, and dye lot of carpet.

PART 2 - PRODUCTS

2.1 CARPET

- A. Provide carpeting with face yarn of commercial grade, nylon with 25% post consumer recycled content, tufted) textured loop. Mohawk On The Rise Modular – Color: #7868 Moving-Up; or equal.
- B. Provide carpeting with face yarn of commercial grade 100% Antron Heat Set Continuous Filament Nylon.

1. Carpeting shall meet the following minimum requirements:

CONSTRUCTION:	Tufted
SURFACE APPEARANCE:	Textured Patterned Loop
NYLON TYPE:	Colorstrand® SD Nylon
GAUGE:	1/10 (39.37 rows per 10 cm)
PILE WEIGHT:	20.0 oz. per sq. yd. (678 g/m ²)
PILE THICKNESS:	0.139" (3.53 mm)
STITCHES PER INCH:	12.0 (47.24 per 10 cm)

DYE METHOD:	Solution Dyed
PROTECTIVE TREATMENT:	Sentry Plus
DENSITY:	5,180
WEIGHT DENSITY:	103,600
BACKING FOUNDATION:	UltraSet - Fiberglass Reinforced Thermoplastic Composite Tile
PATTERN REPEAT:	Not applicable
SIZE:	24" x 24" (.6096 m x .6096 m)
FLAMMABILITY:	ASTM E 648 Class 1 (Glue Down)
SMOKE DENSITY:	ASTM E 662 Less than 450
STATIC PROPENSITY:	AATCC-134 Under 3.5 KV
IAQ GREEN LABEL PLUS:	1098
DESCRIPTION:	Patterned Loop
CRI RATING:	Heavy Traffic
WARRANTIES:	Lifetime UltraSet Modular Warranty, Lifetime Limited Colorfastness to Light, 10 Year Limited Colorfastness to Atmospheric Contaminants, 10 Year Stain Warranty, Lifetime Static

2. Patterns and colors from the manufacturer's standard colors. The colors and patterns offered will be the major criteria used to evaluate products proposed as equivalent.
 3. Up to two different colors may be selected for this project but the carpet in any one room will be all one color.
 4. Moisture impermeable: Carpet shall be unaffected by water and moisture.
 5. Indoor Air Quality: Carpet shall meet or exceed CRI & EPA guidelines (green label certified and labeled) and may not contain any VOC's such as: 4 PCH (4 Phenylcyclohexene), PVC (Polyvinyl Chloride) or SBR latex (Styrene Butadiene Rubber).
- C. Carpet materials shall not contain quantities of toxic materials such as 4-phenylcyclohexene (4-PC), which will result in off-gassing that causes indoor air toxin levels to exceed EPA recommended guidelines after completion of construction.
- D. Carpets shall be from one dye lot, unless otherwise approved by Architect, and the OAR
- E. 5/16-inch x 1-3/8-inch, vinyl delux reducer Flexco Products; vinyl imperial reducer Mercer; or equal. Contact adhesive as recommended by the reducer strip manufacturer.
- F. Carpet Edge Strips: A-600-SH Silver Clamp Down manufactured by Universal Metals, or equal.
- G. Adhesive: Use adhesive recommended by carpet manufacturer for direct glue-down carpet installation. Where primers or sealers are furnished, verify their compatibility with adhesive. Use of adhesives containing chemicals that produce toxic off-gassing such as styrene butadiene is prohibited.
- H. Patching Compounds: Cementitious type, Ardex SD-F, Durabond's Webcrete #95, or equal, as recommended by carpet manufacturer.
- I. Primer: As recommended by the carpet manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before installation is started, examine surfaces to receive carpet. Deficiencies shall be corrected before starting work of this Section.
- B. Field verify dimensions and other conditions affecting this work before commencing carpet installation.

3.2 PREPARATION

- A. Provide concrete moisture vapor emission and pH testing to all concrete specified to be covered with carpet. Includes concrete placed below, on and above grade. For carpet replacement projects, concrete slabs not in direct contact with ground may be excluded from this requirement.
- B. Testing shall take place after allowing concrete to dry for a minimum of 90 days. Testing to be scheduled no less than 1 or more than 3 weeks prior to scheduled flooring installation.
- C. Quantification of Concrete Moisture Vapor Emission
 - 1. The test site should be maintained at the same temperature and humidity conditions as those anticipated during normal occupancy. These temperature and humidity levels should be maintained for 48 hours prior and during test period. If meeting this criteria is not possible, then minimum conditions should be 75±10°F and 50± 10% relative humidity. When a building is not under HVAC control, a recording hygrometer or data logger shall be in place recording conditions during the test period. A transcript of this information must be included with the test report.
 - 2. The number of vapor emission test sites is determined by the square footage of the facility. The minimum number of tests to be placed is equal to 3 in the first 1,000 sq. ft. and 1 per each additional 1,000 square feet.
 - 3. Test sites are to be cleaned of all adhesive residue, curing compounds, paints, sealers, floor coverings, etc. 24 hours prior to the placement of test kits.
 - 4. Weigh test dish on site prior to start of test. Scale must report weight to 0.1 grams. Record weight and start time.
 - 5. Expose Calcium Chloride and set dish on concrete surface.
 - 6. Install test containment dome and allow test to proceed for 72 hours.
 - 7. Retrieve test dish by carefully cutting through containment dome. Close and reseal test dish.
 - 8. Weigh test dish on site recording weight and stop time.
 - 9. Calculate and report results as “pounds of emission per 1,000 sq. ft. per 24 hours”.
 - 10. Moisture vapor emissions must meet manufactures recommendations prior to installation.

- D. Quantifying pH Level: At each vapor emission test site, after removal of test containment dome, perform pH test.
1. Place several drops of water onto the concrete surface to form a puddle approximately 1" in diameter.
 2. Allow the water to set for approximately 60 seconds.
 3. Dip the pH paper into the water and remove immediately, compare color to chart provided by paper supplier to determine pH reading.
 4. Acceptable range is pH 5 to pH 9. Excessive alkalinity shall be neutralized prior to installation of the carpet.
 5. Record and report results.
- E. Cleaning and Drying: Clean concrete floor slabs of all oil, grease, waxes, curing compounds, dust, dirt, debris, paint, and other deleterious substances. Provide a commercial vacuum cleaner to remove dust and dirt. Damp mop to remove dust that may remain after first vacuuming, allow surface to dry, and again vacuum; repeat procedure if necessary to eliminate all dust. Do not furnish oiled or chemical treated sawdust or any similar product for dust removal.
- F. Leveling: Verify floor slabs true to level and plane within a tolerance of 1/8 inch in 10-feet. Test floor areas both ways with a 10-foot straightedge and repair all high and low areas exceeding allowable tolerance. Pop ups shall be hammered out and floor filled with a cementitious leveling compound. Remove high areas by power sanding, stone rubbing or grinding, chipping off and filling with an approved cementitious leveling compound, or equivalent method. Fill all low areas with an approved cementitious leveling compound. Repair and level the surfaces having abrupt changes in plane, such as trowel marks or ridges, whether or not within the allowable tolerance. Again clean areas where repairs are performed. Do not sand, stone rub grind or power chip floor adhesives that contain asbestos.
- G. Wood subfloors: Clean wood subfloors of all oil, grease, waxes, dust, dirt, debris, paint, and other deleterious substances. Do not furnish oiled or chemical treated sawdust or any similar product for dust removal. Sand off projecting ridges. If recommended by carpet manufacturer, seal floors with a recommended wood sealer, compatible with adhesives to be installed.
- H. Conditioning of Materials: Carpet and adhesives shall be conditioned at the project site at not less than 65 degrees F and relative humidity between 10 percent and 65 percent for 48 hours prior to installation and in accordance to manufacturer's instructions.

3.3 CARPET INSTALLATION

- A. General: Install carpet in accordance with requirements of CRI 104, except where more stringent requirements are specified herein or recommended by carpet materials manufacturers.
- B. Installation format: Quarter-Turn
1. Start from the intersection point in the center of the floor. Install the tiles in one quadrant using the chalk lines as guidelines. Fill in the area in between the two chalk lines using the stair step method.

2. Continue to install tiles in a stair step or pyramid pattern, starting at the center point. Check to ensure tiles are properly aligned at edges during the installation.
3. Fit the tiles together by sliding them together, being careful not to trap face yarns between or under the edges of the tile. Press or roll the tiles into the adhesive. They will be removed at any time and repositioned.
4. All carpet tiles must be rolled with a 75 lb. or 100 lb. roller.
5. Use an Orcon steel wheel seam roller or similar roller to blend and enhance the seams.
 - a. The loop pile modules will have some yarn blossoming at the edges. The face yarn will require occasional trimming.

C. Site Layout

1. The starting point in a modular installation must be as near to the center of the room as possible and must be positioned to utilize the largest perimeter cut module size.
2. Snap a chalk line parallel to one major wall bisecting the starting point. It will be necessary to offset the center chalk line to assure perimeter modules will be at least half size.
3. A second chalk line must be snapped from the starting point at 90° to the first line. This can be accomplished using a 6-8-10, or larger triangle, depending on the room size.

D. Cutting Border Tiles: Cuts are made from the back. Install border tiles by placing the tile face down exactly on top of the last row of field tiles, keeping the arrows pointed in the same directions. This will be your cut tile. Using another tile, butt it against the wall allowing it to lie on top of the tile that is to be cut. Using this tile as a reference tile, score a line on the back of the tile that is to be cut. Cut the tile along the reference line being careful not to cut through the installed tile below. Install the cut tile with the cut edge along the wall. Use this same technique at doorways and other objects that must be cut around. A transition strip must be used to protect any exposed edges.

E. Pallet and Box Sequencing: It is very important to install carpet tiles in the order they were manufactured. This is easily accomplished by selecting pallets in sequential order and following the numbers located on each carton of tiles to ensure the most uniform look. Typically, an installation will begin with the lowest carton numbers and progress through the highest numbers until the project is complete.

F. Color Control: Install dye lot in the number sequence at locations indicated to prevent shading variations. Install only one dye lot for each area of building unless otherwise reviewed. If more than one dye lot is required, obtain prior review of color match between dye lots and, AGENCY's written approval.

G. Doorways: Extend carpet into doorways without piecing in and seam to the carpet on other side of door under door centerline except where metal thresholds occur; no small filler pieces of carpet will be permitted at doorways.

H. Adhesives: As recommended by the carpet manufacturer. Use of adhesives containing chemicals that produce toxic off-gassing such as styrene butadiene is prohibited.

- I. Binder Bars: Provide bars at all edges of carpet not abutting walls or other construction, securely fastened in place by using aluminum drive nails. Precisely align splices and tightly miter angles.

3.4 PROTECTION

- A. Protect the work of this Section until Substantial Completion. Prohibit traffic on carpet for at least 12 hours after installation. Cover carpet with heavy non-staining kraft paper in areas when the work of other trades is to be performed and/or traffic and passage areas. Protect carpet from damage or soiling. Maintain in place until substantial completion.

3.5 CLEANING

- A. As each carpeted area is completed, clean up all dirt and debris, remove spots and soiling with proper cleaner, trim off loose threads with sharp scissors, and vacuum entire area clean.

3.6 CLEAN-UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the project site.

3.7 INSTRUCTION

- A. Before Substantial Completion of the work, provide a 4 hour AGENCY instruction period for proper maintenance of carpeting. Instructions shall be provided by technical representative of manufacturer.

3.8 BAKE OUT

- A. After carpet installation, increase temperature of space to above 92°F and operate ventilation system on 100% outside air until all toxic off-gassing from carpet material and adhesives has been dissipated. Prior to completion of construction, submit results of air quality tests performed by an EPA approved testing laboratory demonstrating that toxin levels of building air are below EPA recommended guidelines for worn spaces occupied for 40 hours per week with building ventilating system operating at its normal intended mode of re-circulating air with minimum required fresh air makeup.

END OF SECTION

SECTION 09780– TROWELED EPOXY FLOORING

PART 1-GENERAL

1.1 SUMMARY

- A. Sections includes:
1. Moisture vapor emission testing.
 2. Surface preparation
 3. Waterproofing membrane (if required).
 4. Integral coved base
 5. Furnishing and installation of troweled epoxy flooring.

1.2 QUALITY ASSURANCE

- A. All materials used in troweled epoxy flooring system shall be manufactured by a single manufacturer to ensure compatibility and proper bonding.
- B. Applicator shall have a minimum of 3 years experience in the installation of aggregate filled epoxy flooring and be certified by the manufacturer.
- C. Owner reserves the right to core drill the finished flooring system in 3 locations to verify the thickness of the application. If the specified thickness has not been achieved, the contractor may be directed to pay for testing and reapply flooring materials until the desired thickness is obtained.

1.3 SUBMITTALS

Submit the following for Product Review:

- A. Submit manufacturer's product data, literature and brochures.
- B. Submit manufacturer's samples showing color choices and texture.
- C. Submit a statement from the manufacturer indicating the installer's certification.
- D. Prior to commencing work, installer shall prepare two 6" x 6" samples of the resinous flooring chosen for the project showing actual color, thickness and texture. These samples shall serve as a basis for comparison throughout the duration of the work.

1.4 DELIVERY, STORAGE AND HANDLING

- A. All material shall be delivered to the job site in unopened containers clearly labeled by the manufacturer and stored in a dry location at a minimum of 65 degrees Fahrenheit.

1.5 WARRANTY

- B. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of one (1) full year from date of installation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Resin systems and graded silica filler shall be supplied by Arizona Polymer Flooring, Inc., Glendale, Arizona. Aggregate fillers shall be supplied by Arizona Polymer Flooring, Inc. or other suitable sources approved by the manufacturer.
- B. Or Equal.

2.2 MATERIALS

- A. Primer, aggregate binder and top coat shall be 100% solids, thermosetting epoxy resin.
- B. Aggregate shall be graded silica, quartz or “Monterey” sand as specified by the manufacturer to meet system requirements.
- C. Two- component, aliphatic polyurethane may be used as the finish coat for selected systems as recommended by the manufacturer.
- D. Elastomeric caulking compounds shall be supplied by Vulkem, SIKA or Sonneborn.

2.3 SYSTEM DESCRIPTION

- A. Flooring system to be a minimum 1/4” thick with color and texture to match the sample chosen.
- B. Finished flooring system shall have the following performance characteristics:
 - 1. Compressive Strength (ASTM C 579): 9500 psi.
 - 2. Tensile Strength (ASTM C 307): 2500 psi.
 - 3. Flexural Strength (ASTM C 580): 4200 psi.
 - 4. Hardness, Shore D (ASTM D 2240): 85
 - 5. Impact Resistance (ASTM D 2794): passes 160 inch pounds.
 - 6. Thermal Shock Resistance (ASTM D 1044): passes.
 - 7. Tabor Abrasion (ASTM D 1044): 34 mg. loss.
 - 8. Water Absorption (ASTM D543): 0.2%
 - 9. Bond Strength (ACI 503.4-2.3.2): 350 psi, concrete failure.
 - 10. USDA Approval: Approved
- C. Chemical Resistance: (ASTM D 1308, 24 hour exposure).
 - 1. Urine no effect
 - 2. Blood no effect
 - 3. Whiskey..... no effect
 - 4. Black Ink no effect
 - 5. Brake Fluid no effect
 - 6. Gasoline no effect
 - 7. Skydrol B-4 no effect
 - 8. Hydraulic Fluid #83282 no effect
 - 9. Mineral Spirits..... no effect
 - 10. Xylene no effect

- | | | |
|-----|-----------------------------|----------------|
| 11. | MEK..... | film softened |
| 12. | 50% Sodium Hydroxide | no effect |
| 13. | 25% Hydrochloric Acid | no effect |
| 14. | 25% Sulphuric Acid | no effect |
| 15. | 25% Acetic Acid | no effect |
| 16. | 25% Nitric Acid | film blistered |

PART 3-EXECUTION

3.1 EXAMINATION

A. Verification of conditions:

1. Inspect surfaces to receive epoxy flooring.
2. Conduct relative humidity probe testing for concrete moisture according to ASTM 2170.
3. Before starting work, report in writing to the Architect any unsatisfactory condition.
4. Application of any material shall signify that surfaces have been inspected and are satisfactory.

3.2 SURFACE PREPARATION

- ##### A. Remove old coatings, substrate ridges and protrusions by grinding or sanding. Surfaces to receive flooring system shall be profiled to a minimum of 20 mils using mechanical scarification or shot blasting. The prepared surface must be inspected and approved by the manufacturer or his representative before any materials are installed.

3.3 INSTALLATION

- A. Allow sufficient time for the installation of the flooring system. At no time shall the speed of project completion be allowed to detrimentally affect the application.
- B. Provide sufficient light, power, heat and working conditions to permit proper materials of the coating. Substrate temperature shall be at a minimum of 50 degrees F during application and for 48 hours thereafter.
- C. If waterproofing is required, apply elastomeric Polyurethane 300 according to manufacturer's instructions to achieve a 40 mil membrane.
- D. Fill control joints and large holes with thickened epoxy material prior to application of flooring system according to manufacturer's instructions. Mark location of all expansion joints for sawcutting after placement of flooring system.
- E. Where troweled flooring does not abut a vertical surface and around all floor drains, cut a keyway 1/4" deep by 1" wide to receive the flooring material. Do not feather edge the materials.
- F. Prime prepared surface with Epoxy 400 immediately prior to application of troweled mortar.

- G. Mix Epoxy 400 and graded aggregate together according to manufacturer's instructions and rake or screed the material onto the surface. Finish with hand or power trowel to a minimum 1/4" thickness.
 - H. After troweled base has cured, sand or grind surface to remove trowel marks. Apply thickened Epoxy 400 at 75-100 sq. ft. per gallon. If slip-resistance is required, broadcast 24 grit bleached aluminum oxide into the wet material to achieve the desired texture. Allow to cure firm before proceeding.
 - I. Apply finish coat of Epoxy 400 at 75-100 sq. ft. per gallon.
 - J. Apply optional top coat of Polyurethane 100 or Polyurethane 501 at 300 sq. ft. per gallon.
 - K. After curing, sawcut completely through the resinous flooring at the pre-marked expansion joints. Fill the joint with elastomeric polyurethane caulking according to manufacturer's instructions.
- 3.4 FIELD QUALITY CONTROL
- A. Installer shall monitor the thickness of the system as the work progresses. Areas found to not meet the required thickness shall receive additional material until specified thickness is attained.
- 3.5 PROTECTION
- A. Installation areas must be kept free from traffic and other trades during the application procedure and cure time.

- END OF SECTION -

SECTION 09800 - PROTECTIVE COATING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes the protective coating of all indicated surfaces including surface preparation, pretreatment, coating application, touch-up, protection of surfaces not to be coated, cleanup, and all appurtenant work.
- B. Definitions
 - 1. The term "paint", "coatings", or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, except galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
 - 2. The term "DFT" shall mean minimum dry film thickness, without any negative tolerance.
- C. The following surfaces shall not be protective coated hereunder unless indicated.
 - 1. Concrete except in chemical(s) containment areas
 - 2. Stainless steel
 - 3. Machined surfaces
 - 4. Grease fittings
 - 5. Glass
 - 6. Equipment nameplates
 - 7. Platform gratings, stair treads, door thresholds, and other walk surfaces
- D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.

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 09900 - Architectural Paint Finishes

1.3 CODES

- A. The 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. California Building Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. References herein to "SSPC Specifications" or "SSPC" shall mean the published standards of the Steel Structures Painting Council, 40 24th Street, 6th Floor, Pittsburgh, PA 15222.
2. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Engineers, P.O. Box 281340, Houston, TX 77218-8340.

3. **Commercial Standards:**

ANSI A13.1	Scheme for Identification of Piping Systems
ANSI/AWWA C105	Polyethylene Encasement for Ductile Iron Piping
ANSI/AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape-Hot-Applied
ANSI/AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
ANSI/AWWA D102	Painting Steel Water-Storage Tanks

4. **Federal Specifications:**

TT-P-28	Paint, Aluminum, Heat Resisting (1200°F)
DOD-P-23236	Military Specification, Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast

1.5 SHOP DRAWINGS AND SAMPLES

- A. Submittals shall include the following information and be submitted at least 30 days prior to protective coating work.

1. **Coating Materials List:** The CONTRACTOR shall provide a coating materials list which indicates the manufacturer and the coating number, keyed to the coating systems herein, prior to or at the time of submittal of samples.
2. **Paint Manufacturer's Catalogue:** For each paint system to be used the CONTRACTOR shall submit manufacturer's catalogue containing the following data
 - a. Paint Manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.

- b. Technical and performance information that demonstrates compliance with the system performance and material requirements.
- c. Manufacturer's Instructions and recommendations on surface preparation, thinning, mixing, handling, applying and proper storage.
- d. Colors available for each product (where applicable).
- e. Compatibility of shop and field applied coatings (where applicable).
- f. Material safety data sheet for each product used.

B. Samples:

- 1. Samples of all paint, finishes, and other coating materials shall be submitted on 8.5-inch by 11-inch sheet metal. Each sample shall be completely coated over its entire surface with one protective coating material, type, and color.
- 2. Two sets of color samples to match each color selected by the CONSTRUCTION MANAGER from the Manufacturer's standard color sheets. If custom mixed colors are indicated, the color samples shall be made using color formulations prepared to match the color samples furnished by the CONSTRUCTION MANAGER. The color formula shall be shown on the back of each color sample.
- 3. Qualifications of Painting Subcontractor
 - a. Copy of a valid State of California license as required for the application of coatings.
 - b. Five references which show that the painting subcontractor has demonstrated successful knowledge with the indicated coating systems in the recent past. Provide the name, address and telephone number of the owner of each installation. The CONTRACTOR shall obtain the references from the subcontractor and submit them to the CONSTRUCTION MANAGER.

1.6 SERVICES OF MANUFACTURER

- A. For submerged and severe service coating systems, the CONTRACTOR shall require the paint manufacturer to furnish the following services:
 - 1. The manufacturer's representative shall furnish at least 6 hours of on-site instruction in the proper surface preparation, use, mixing, application and curing of the coating systems.
 - 2. The manufacturer's representative shall personally observe the start of surface preparation, mixing, and application of the coating materials.
 - 3. The manufacturer's representative shall provide technical support to resolve field problems associated with manufacturer's products furnished under this Contract or the application thereof.

4. The manufacturer shall certify that these services have been furnished, and the CONTRACTOR shall submit the certification within 7 days of completion of each paint system.

1.7 INSPECTION AND TESTING

- A. **General:** The CONTRACTOR shall give the CONSTRUCTION MANAGER a minimum of 3 days' advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days' advance notice of the start of any shop surface preparation work.
- B. All such work shall be performed only in the presence of the CONSTRUCTION MANAGER, unless the CONSTRUCTION MANAGER has granted prior approval to perform such work in its absence.
- C. Inspection by the CONSTRUCTION MANAGER, or the waiver of inspection of any particular portion of the work, shall not relieve the CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.
- D. Scaffolding shall be erected and moved to locations where requested by the CONSTRUCTION MANAGER to facilitate inspection. Additional illumination shall be furnished to cover all areas to be inspected.
- E. **Inspection Devices:** The CONTRACTOR shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gauges shall be made available for the CONSTRUCTION MANAGER'S use at all times while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the CONSTRUCTION MANAGER.
- F. **Holiday Testing:** The CONTRACTOR shall holiday test all coated ferrous surfaces inside a steel reservoir, or other surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures and surfaces coated with any of the submerged and severe service coating systems. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested. In addition to the above the CONSTRUCTION MANAGER may test any surfaces for any number of times at no additional cost to CONTRACTOR. All defects so found shall be corrected by the CONTRACTOR at no additional cost to the OWNER.
 1. **Coatings With Thickness Exceeding 20 Mils:** For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the indicated coating thickness.
 2. **Coatings With Thickness of 20 Mils or Less:** For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Razor Model M1 non-destructive type holiday detector, K-D Bird Dog, or equal shall be used. The unit shall operate at less

than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or equal, shall be added to the water prior to wetting the detector sponge.

- G. **Film Thickness Testing:** On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as Mikrotest model FM, Elcometer model 111/IEZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.
- H. **Surface Preparation:** Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standard TM-01-70 and TM-01-75.

1.8 WARRANTY INSPECTION

- A. A warranty inspection may be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. All defective work shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the one-year correction period, or may cancel the warranty inspection altogether. If a warranty inspection is not held, the CONTRACTOR shall not be relieved of its responsibilities under the Contract Documents.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer, all of which shall be plainly legible at the time of use.
- B. Paint materials shall be carefully stored in a manner that will prevent damage and in an area that is protected from deleterious elements.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Suitability:** The CONTRACTOR shall use suitable coating materials as recommended by Manufacturer for the intended service.
- B. **Compatibility:** In any coating system 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. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- C. **Colors:** All colors and shades of colors of all coats of paint shall be as indicated or selected by the CONSTRUCTION MANAGER. Each coat shall be of a slightly different shade, to

facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the CONSTRUCTION MANAGER.

D. Substitute or "Or Equal" Products:

1. The CONTRACTOR shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or-equal" material that said material meets the requirements and is equivalent or better than the listed materials in the following properties:

- a. Quality
- b. Durability
- c. Resistance to abrasion and physical damage
- d. Life expectancy
- e. Ability to recoat in future
- f. Solids content by volume
- g. Dry film thickness per coat
- h. Compatibility with other coatings
- i. Suitability for the intended service
- j. Resistance to chemical attack
- k. Temperature limitations in service and during application
- l. Type and quality of recommended undercoats and topcoats
- m. Ease of application
- n. Ease of repairing damaged areas
- o. Stability of colors

E. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the CONTRACTOR shall provide the name of least one successfully performing application of the proposed manufacturer's products in a project of comparable size and complexity constructed in the recent past.

F. The cost of all testing and analyzing proposed substitute materials that may be required by the CONSTRUCTION MANAGER shall be paid by the CONTRACTOR at no additional cost to the OWNER. If the proposed substitution requires changes in the contract work, the CONTRACTOR shall bear all such costs involved and the costs of allied trades affected by the substitution at no additional cost to the OWNER.

2.2 INDUSTRIAL COATING SYSTEMS

A. **Material Sources:** Each of the following manufacturers is capable of supplying many of the industrial coating materials indicated herein. Where manufacturers and paint numbers are listed, it is to show the type and quality of coatings that are required. Proposed substitute materials shall be considered as indicated above. All industrial coating materials shall be

materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, water, and wastewater treatment plants.

1. Ameron
 2. Carboline Coatings Company
 3. Inorganic Coatings, Inc.
 4. International (Courtaulds)
 5. Tnemec Company
- B. **System 1 - Alkyd Enamel:** High quality, gloss or semi-gloss, medium long oil alkyd finish shall have a minimum solids content of 49 percent by volume. Primer shall be as recommended by manufacturer.
1. Prime coat (DFT = 3 mils) Amercoat 5105, Tnemec 4-55, or equal.
 2. Finish coats (two or more, DFT = 3 mils), Amercoat 5401 HSA, or 5405, Tnemec 2H, or equal.
 3. Total system DFT = 6 mils.
- C. **System 2 - Not Used**
- D. **System 3 - Aluminum Silicone Resin:** Aluminum silicone resin material shall be suitable for a service temperature of up to 1,000 degrees F, and shall comply with Federal Specification TT-P-28.
1. Prime coat and finish coat (2 or more, DFT = 3 mils), Tnemec Series 39-1061, Amercoat 878, or equal.
 2. Total system DFT = 3 mils.
- E. **System 4 - Aliphatic Polyurethane:** Two component aliphatic acrylic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering and with a minimum solids content of 58 percent by volume. Primer shall be a rust inhibitive two component epoxy coating with a minimum solids content of 68 percent by volume.
1. Prime coat (DFT = 4 mils), Amercoat 385, Carboline 893, Tnemec 69, or equal.
 2. Finish coat (one or more, DFT = 3 mils), Amersfield, Carboline 134 HS, Tnemec 74, or equal.
 3. Total system DFT = 7 mils.
 4. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.
- F. **System 5 - Inorganic Zinc/Polyurethane:** The inorganic zinc primer shall be a water or solvent based, self-curing, zinc silicate 2-component inorganic coating which contains at least 85 percent of metallic zinc by weight in the dried film, and is recommended by the coating manufacturer as a primer for this system. The intermediate coat shall be a high-build two

component epoxy with a solids content of at least 70 percent by volume. Finish coats shall be a 2-component aliphatic acrylic or polyester polyurethane coating material that provides superior color and gloss retention, resistance to chemical fumes and severe weathering, and a minimum solids content of 58 percent by volume.

1. Prime coat (DFT = 2 mil), Ameron Dimetcote 21-5 or 21-9, Inorganic Coatings 531, or equal.
 2. Intermediate coat (DFT = 4 mils), Ameron 385, Inorganic Coatings P24, or equal.
 3. Finish coats (one or more, DFT = 3 mils), Ameron Amershield, Inorganic Coatings 64, or equal.
 4. Total system DFT = 10 mils.
 5. Intermediate coat shall be applied in excess of 4 mils DFT or in more than one coat as necessary to completely cover the inorganic zinc primer and prevent application bubbling of the polyurethane finish coat.
 6. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.
 7. If the inorganic zinc primer is used as a pre-construction or shop applied primer, all damaged and uncoated areas shall be spot abrasive blasted and coated after construction using the indicate material.
- G. **System 6 - Inorganic Zinc, Water Based:** Water based, self curing, ethyl silicate shall be a two component inorganic coating material that contains at least 85 percent of metallic zinc by weight in the dried film.
1. Prime coat and finish coat (One, DFT = 3 mils), Ameron Dimetcote 21-5, Inorganic Coatings 531, or equal.
 2. Total system DFT = 3 mils.
- H. **System 7 - Acrylic Latex:** Single component, water based acrylic latex with a fungicide additive shall have a minimum solids content of 35 percent by volume. Prime coat shall be as recommended by manufacturer. The coating material shall be available in the ANSI safety colors.
1. Prime coat (DFT = 2 mils), as recommended by manufacturer.
 2. Finish coats (2 or more, DFT = 6 mils), Ameron Amercoat 220, Carboline 3359, Tnemec 6, or equal.
 3. Total system DFT = 8 mils.
- I. **System 8 - Epoxy Equipment:** Two component, rust inhibitive polyamide cured epoxy coating material shall provide a recoatable finish that is available in a wide selection of colors. The coating material shall have a minimum solids content of 66 percent by volume

and be resistant to service conditions of condensing moisture, splash and spillage of lubricating oils, and frequent washdown and cleaning.

1. Prime coat DFT = 3 mils, Ameron 385, Tnemec 69, or equal.
 2. Prime coat, where shop applied. (DFT = 3 mils), universal primer, Ameron 185 HS, Tnemec 50-330 or 161, or equal.
 3. Finish coat (2 or more, DFT =6 mils), Ameron 385, Tnemec 69, or equal.
 4. Total system DFT = 6 mils.
- J. **System 9 - Inorganic Zinc/Epoxy, Equipment:** The inorganic zinc primer shall be a water or solvent based, self curing, zinc silicate, two-component inorganic coating that contains at least 85 percent of metallic zinc by weight in the dried film, and is recommended by the coating manufacture as a primer for this system. The finish coats shall be a polyamide cured epoxy material with a minimum solids content of at least 80 percent by volume, and available in a large selection of colors.
1. Prime coat DFT =3 mils Ameron Dimetcote 21-5 or 21-9, Carboline carbozinc 7 WB, or equal.
 2. Finish coats (2 or more, DFT = 9 mils) Ameron 400, Carboline 890, or equal.
 3. Total system DFT = 12 mils.
- K. **System 10 - Acrylic, Concrete:** The acrylic coating material shall be a single component, industrial grade, high molecular weight acrylic coating material shall have a minimum solids content of 35 percent by volume. The filler-sealer shall be a two component epoxy masonry sealer for wet and exterior exposure, with a solids content of at least 64 percent by volume. A 100 percent solids epoxy surface shall be used to fill holes and patch the concrete surface after abrasive blasting.
1. Prime coat (Filler-sealer), applied in two coats to the entire surface and worked into the surface with a squeegee to achieve a smooth, void-free surface, Tnemec 54-660, Ameron Nu-Klad 105A followed by Nu-Klad 114A (2 coats), or equal.
 2. Finish coats (2 or more, DFT = 6 mils), Tnemec 6, Ameron Amercoat 220, or equal.
- L. **System 11 - Aliphatic Polyurethane, Concrete:** Two component aliphatic polyester polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, and resistance to chemical fumes and severe weathering, and with a minimum solids content of 65 percent by volume. Filler-sealer compound shall be a two component epoxy material used to provide a smooth surface for the epoxy intermediate coat. The filler-sealer shall be applied to the entire concrete surface and worked into the concrete surface with a wide blade putty knife or squeegee. The intermediate coat shall be a high-build epoxy coating with a minimum solids content of 70 percent by volume.
1. Prime coat (Filler-sealer), Ameron Nu-Klad 105A followed by, Nu-Klad 114 Tnemec 54-660, or equal.

2. Intermediate coat (DFT = 4 mils), Ameron Amerlock 400, Tnemec 104 HS, or equal.
 3. Finish coats (2 or more, DFT = 3 mils), Ameron Amershield, Tnemec 74, or equal.
- M. **System 12 - Aliphatic Polyurethane, Fiber Glass:** Two-component aliphatic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, and resistance to chemical fumes and severe weathering. A primer, tie coat, or mist coat shall be used as recommended by the manufacturer.
1. Prime coat (Tie coat), Ameron Amercoat 385, Tnemec 66, or equal.
 2. Finish coats (2 or more, DFT = 3 mils), Ameron Amershield, Tnemec 74, or equal.
- 2.3 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS
- A. **Materials Sources:** The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products shall be considered as indicated above.
- B. **System 100 - Amine Cured Epoxy:** High build, amine cured, straight epoxy resin shall have a solids content of at least 80 percent by volume, and shall be suitable for long-term immersion service in potable water and wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61B Drinking Water System Components - Health Effects.
1. Prime coat and finish coats (3 or more, DFT = 16 mils), Amercoat 395, Tnemec 139, or equal.
 2. For coating of valves and non-submerged equipment, DFT = 12 mils.
- C. **System 101 - Cold-Applied Tape:** Tape coating materials and procedures shall be in accordance with ANSI/AWWA C209. Prefabricated tape shall be Type II. The system shall consist of a primer layer, inner layer tape (35 mils), and an outer layer tape (35 mils). Total system DFT = 70 mils.
- D. **System 102 - Polyamide Cured Epoxy:** High build, polyamide epoxy resin shall have a solids content of at least 56 percent by volume, and shall be suitable for long-term immersion in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61.
1. Prime coat and finish coats (3 or more, DFT = 12 mils), Tnemec 20, or equal.
- E. **System 103 - Coal Tar Epoxy:** High build, 2-component amine or polyamide cured coal tar epoxy shall have a solids content of at least 68 percent by volume, suitable for long term immersion in wastewater and for coating of buried surfaces, and conforming to DOD-P-23236, Class 2, or to SSPC Paint 16. Prime coats are for use as a shop primer only. Prime coat shall be omitted when both surface preparation and coating are to be performed in the field.

1. Finish coats (2 or more, DFT = 16 mils), Amercoat 78 HB, Tnemec 46 H-413, or equal.
2. Total system DFT = 16 mils.

F. **System 104 - Not Used**

G. **System 105 - Epoxy, Reservoirs:**

1. **Primer:** Solids content of 100 percent, NSF listed, compatible with finish coating, 3 mils.
2. **Polyamide Cured Epoxy:** High build polyamide cured epoxy coating shall have a solids content of at least 70 percent by volume and a finish coat color of white.
3. **Amine Cured Epoxy:** High build amine cured epoxy coating shall have a solids content of at least 78 percent by volume and with a finish coat color of white or ivory.
4. The epoxy coating material shall be either a polyamide-cured epoxy or an amine-cured epoxy suitable for long-term immersion service in reclaimed and potable water. The material shall be listed by NSF International as in compliance with NSF Standard 61 and shall conform with State and local health regulations and policies for service in potable water reservoirs. The CONTRACTOR shall submit a written certification that the proposed materials meet the above regulatory agency standards and policies. The material shall be applied with a primer if recommended by the coating manufacturer.
5. **Part A:** Products shall be as listed, or equal:

a.	Pre-coating, prior to erection. See Note (1) under Paragraph f.	(DFT = 3 mils)	Ameron Dimetecote 21-5, International Interline 982
b.	Finish coating, prior to erection. Top of roof rafters, girders, and other areas not accessible after erection.	(DFT = 9 mils)	Ameron Amercoat 395, International Interline 925
c.	Touch up, following erection. See Note (2) under Paragraph f.	(DFT = 3 mils)	
d.	Difficult-to-coat areas, following erection. See Note (3) under Paragraph f.	(DFT = 9 mils)	Ameron Amercoat 395, International Interline 925
e.	Finish Coats (2 or more)	(DFT = 9 mils)	Ameron 395, International Interline 925
f.	Notes:		
	(1) All lap roof plate edges, both sides, are to be pre-coated. If necessary, zinc primer exposed on exterior of roof may be removed prior to welding.		

	Pre-coating shall extend at least 6 inches from plate edges.
	(2) Touch-up coating shall be done for areas damaged during erection, or areas not pre-coated. The CONTRACTOR shall spot sandblast to SSPC-SP-5 - white metal blast cleaning, before application of coating. Material used for touch-up shall be the specified material, or a compatible primer recommended by the manufacturer.
	(3) All edges, nuts, bolts, lap joints, weld seams and the roof rim angle shall receive one brush-applied coat prior to the application of the first complete spray coat.

6. **Part B:** Products shall be as listed, or equal:

a.	Difficult-to-coat areas. See Note (1) under Paragraph d.		Ameron Amercoat 395, International Interline 925
b.	Finish coats (2 or more). Finish coats to be applied at 4-6 mils DFT per coat. See Note (1) under Paragraph d.	(DFT = 12 mils)	Ameron Amercoat 395, International Interline 925
c.	Total system DFT = 12 mils		
d.	Notes:		
	(1) All edges, nuts, bolts, lap joints, and weld seams shall receive one brush-applied coat prior to the application of the first complete spray coat.		

7. **Curing Period:** Prior to immersion, the completed system shall be subjected to at least 240 hours of curing time with the metal temperature at a minimum of 70 degrees F, or 480 hours at a minimum of 60 degrees F, both conditions at a maximum relative humidity of 50 percent and under the forced ventilation conditions required by the paragraph entitled "Curing of Coatings, herein. More curing time or a higher temperature shall be provided if recommended by the epoxy coating manufacturer. If the environmental conditions do not provide the necessary minimum temperature, use heated air to provide the necessary heat for curing. Other combinations of curing time and temperature may be used if the coating manufacturer presents satisfactory documentation and test results to substantiate that the degree of curing is equal or greater than curing for 240 hours at 70 degrees F.

8. **Volatile Organic Compound Testing:** The completed interior reservoir coating system shall be tested for volatile organic compounds as specified herein.

H. **System 106 - Fusion Bonded Epoxy:** The 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.

1. Coating DFT = 16 mils, Scotchkote 134 (electrostatic) or 206N (fluidized bed), or equal, applied in one coat.
2. For coating of valves, DFT = 12 mils.
3. 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 312 or as recommended by the powder epoxy manufacturer.

I. System 107 - Chemical Resistant Sheet Lining:

1. **Materials:** The CONTRACTOR shall use natural rubber, chlorobutyl rubber, ethylene propylene diene monomer (EPDM) rubber, chloroprene polymer (neoprene) rubber, or chlorosulfonated polyethylene (Hypalon) rubber sheet lining materials as indicated herein. The shop drawing submittal shall contain technical information that confirms the suitability of the lining material system for long-term contact with each chemical to be stored. The service temperatures are expected to be up to 150 degrees F.
2. Neoprene sheet lining material shall be synthetic rubber formulated for steam curing at atmospheric pressure. The minimum lining thickness shall be 3/16 inch. The lining material shall be Polymeric Protective Linings BFG 2011 (59688), or equal.
3. Chlorobutyl sheet lining material shall be synthetic rubber formulated for steam curing at atmospheric pressure. The minimum lining thickness shall be 3/16-inch. The lining material shall be Polymeric BFG 1051 (60924), or equal.
4. Natural rubber (soft) sheet lining material shall be soft natural rubber formulated for steam curing at atmospheric pressure. The minimum lining thickness shall be 3/16 inch. The lining material shall be Polymeric BFG 2004 (83160), or equal.
5. Material rubber (hard) sheet lining material shall be a hard, natural rubber resistant to oxidizing agents and formulated for autoclave curing. The minimum lining thickness shall be 3/16 inch. The lining material shall be Polymeric BFG 1006 (8631), or equal.
6. EPDM sheet lining material shall be synthetic rubber suitable for use as a lining for 50 percent sulfuric acid solution and formulated for autoclave or steam curing under pressure. The lining material shall be Polymeric BFG 1039 (EP 156), or equal.
7. Hypalon sheet lining material shall be synthetic rubber suitable for use as a lining for 50 percent sulfuric acid solution. The lining material shall be Polymeric BFG 2045 (8706), or equal.
8. Primers, adhesives, activators, accelerators and other necessary materials shall be as specified by the sheet material manufacturer.
9. **Metal Surface Preparation:** Prior to abrasive blast cleaning the base metal shall be prepared as specified by the sheet lining material manufacturer's installation instructions. If the instructions differ from these specifications the higher degree of cleaning and surface preparation shall be provided. Abrasive blast cleaning shall be done in accordance with this Section.

10. Installation of lining materials shall be in accordance with the material manufacturer's written installation instructions. All interior surfaces shall be lined, including all piping, vents, fittings, flange faces, manhole covers and blind flanges.
 11. The lining system shall be holiday tested in accordance with this Section before and after curing.
 12. The lining system shall be cured by steam using the time and temperature as specified by the material manufacturer.
- J. **System 108 - Epoxy, Concrete:** The coating material shall be an amino cured epoxy material suitable for long-term immersion in water and wastewater and for service where subjected to occasional splash and spillage of water and wastewater treatment chemicals. The finish coating material shall have a minimum solids content of 69 percent by volume. If used for potable water service the finish coating material shall be listed by the NSF International as in compliance with NSF Standard 61, and shall conform with state and local health regulations and policies for service in potable water. The filler-sealer shall be a 100 percent solids amine-cured epoxy material with silica and inert fillers.
1. **Filler-sealer:** Plastic 9029 (applied by squeegee); Tnemec 69-1211 (6-8 mils) followed by Tnemec 63-1500; Ameron Nu-Klad 105A followed by Nu-Klad 114A (two coats) or equal.
 2. Finish coats (two or more, DFT = 12 mils); Plasite 9133; Tnemec 69; Ameron Amercoat 395, or equal. On walking surfaces use a non-skid additive such as Ameron 886 in the final coat.
- K. **System 109 - Not Used**
- L. **System 110 - Not Used**
- M. **System 111 - Vinyl Ester:** Vinyl ester resin coating material with an inert flake pigment suitable for immersion service in 30 percent hydrochloric acid and 30 percent sulfuric acid solutions.
1. Two or more coats (DFT = 40 mils), Plasite 4100, or equal. Use a prime coat as recommended by the material manufacturer.
- N. **System 112 - Vinyl Ester, Concrete:** Vinyl ester resin coating material with an inert flake pigment suitable for immersion service in hydrochloric acid and sulfuric acid solutions. The filler-sealer shall be a 100 percent solids amine-cured epoxy or vinyl ester material with silica and inert fillers. The filler-sealer is applied to the entire concrete surface. A 100 percent solids epoxy or vinyl ester surfacer shall be used to fill holes and patch the concrete surface after abrasive blasting.
1. Prime coat (filler-sealer), applied in two coats using a squeegee to achieve a smooth void-free surface, Plasite 9028 MI, or equal.
 2. Finish coats (two or more, DFT = 40 mils), Plasite 4100, or equal.

2.4 SPECIAL COATING SYSTEMS

- A. **System 200 - PVC Tape:** Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils.
- B. **System 201 - Rich Portland Cement Mortar:** Rich Portland cement mortar coating shall have a minimum thickness of 1/8-inch, followed by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped and sealed with tape.
- C. **System 203 - Epoxy Surfacing:** Two-component epoxy floor surfacing shall be formulated to resist many acids, alkalies, and solvents. Material shall be resistant to liquid alum, sodium hydroxide, and 50 percent sulfuric acid. Products shall be as follows, or equal:
1. Prime coat Nu-Klad 105; finish coat Nu-Klad 110 (1/4-inch thick), or equal.
- D. **System 204 - Water-Retardant:** Two coats (or single coat if manufacturer recommends in writing) of a clear, non-staining, silane-modified-siloxane masonry water-retardant material. The water-retardant system after application shall be provided with not less than a five-year warranty on the performance of the product.
1. TAMMS Barricade Series; Rainguard "Blok-Lok"; or equal.
- Surfaces shall be cleaned with a chemical cleaner approved by the manufacturer and power wash. Surfaces shall be clean and dry before application of the material. Method and rate of application shall be in accordance with manufacturer's published instructions. A manufacturer's representative shall be present during applications if necessary for warranty.
- E. **System 205 - Polyethylene Encasement:** Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.
- F. **System 206 - Cement Mortar Coating:** A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than one part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane-Forming Compounds for Curing Concrete" ASTM C 309-81, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped by at least 6 inches.
- G. **System 207 - Not Used**
- H. **System 208 - Aluminum Metal Isolation:** Two coats of a high build polyamide epoxy paint, such as Tnemec 66, or equal (8 mils). Total thickness of system DFT = 8.0 mils.
- I. **System 209 - Alkyd-Wood:** Industrial quality, gloss or semi-gloss, medium long oil alkyd coating material with a minimum solids content of 49 percent by volume. Primer shall be an alkyd primer as recommended by the manufacturer.
1. Prime coat DFT = 3 mils
 2. Finish coats (two or more, DFT = 3 mils), Amercoat 5401, Tnemec 2H, or equal.

3. Total system DFT = 6 mils.
- J. **System 210 - Acrylic-Wood:** Single component, water-based acrylic latex coating material with a fungicide additive and a minimum solids content of 35 percent by volume. Primer shall be an alkyd primer as recommended by the manufacturer.
1. Prime coat DFT = 2 mils.
 2. Finish coats (two or more, DFT = 6 mils), Amerguard 220, Carboline 3300, Tnemec 6, or equal.
 3. Total system DFT = 8 mils.
- K. **System 211 - Acrylic Drywall:** Single component, water-based acrylic latex coating material with a fungicide additive and a minimum solids content of 35 percent by volume. Primer shall be a PVA sealer as recommended by the manufacturer.
1. Prime coat DFT = 1.5 mils.
 2. Finish coats (two or more, DFT = 6 mils), Amerguard 220, Carboline 3300, Tnemec 6, or equal.
 3. Total system DFT = 7.5 mils.

PART 3 – EXECUTION

3.1 WORKMANSHIP

- A. Skilled craftsmen and knowledgeable supervision shall be used on all WORK.
- B. Coating shall be done in a workmanlike manner so as to produce an **even** film of uniform thickness. Edges, corners, crevices, and joints shall receive special **attention** to insure thorough cleaning and an adequate thickness of coating material. The **finished** surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given to insure that edges, **corners**, crevices, welds, and similar areas receive a film thickness equivalent to **adjacent** areas, and installations shall be protected by the use of drop cloths or other precautionary measures.
- C. All damage to surface resulting from the WORK shall be cleaned, repaired, and refinished to original condition.

3.2 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. **Manufacturer's Recommendations:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.
- B. All protective coating materials shall be used within the manufacturer's **recommended** shelf life.
- C. **Storage and Mixing:** Coating materials shall be stored under the **conditions** recommended by the Material Safety Data Sheets, and shall be thoroughly stirred, strained, and kept at a

uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.3 PREPARATION FOR COATING

- A. **General:** All surfaces to receive protective coatings shall be cleaned as indicated prior to application of coatings. The CONTRACTOR shall examine all surfaces to be coated, and shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application. Surfaces to be coated shall be dry and free of visible dust.
- B. **Protection of Surfaces Not to be Coated:** Surfaces which are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.
- C. All hardware, lighting fixtures, switchplates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.
- D. Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.
- E. **Protection of Painted Surfaces:** Cleaning and coating shall be scheduled so that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

3.4 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:
 - 1. **Solvent Cleaning (SSPC-SP1):** Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
 - 2. **Hand Tool Cleaning (SSPC-SP2):** Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
 - 3. **Power Tool Cleaning (SSPC-SP3):** Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
 - 4. **White Metal Blast Cleaning (SSPC-SP5):** Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.

5. **Commercial Blast Cleaning (SSPC-SP6):** Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
6. **Brush-Off Blast Cleaning (SSPC-SP7):** Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust and paint which cannot be removed by a dull putty knife may remain.
7. **Near-White Blast Cleaning (SSPC-SP10):** Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

3.5 METAL SURFACE PREPARATION (UNGALVANIZED)

- A. The minimum abrasive blasting surface preparation shall be as specified in the coating system schedules included at the end of this Section. Where there is a conflict between these specifications and the coating manufacturer's printed recommendations for the intended service, the more stringent degree of cleaning shall apply.
- B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this Section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers, NACE Standard TM-01-70 - Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive and TM-01-75 - Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grits...
- C. Oil, grease, welding fluxes and other surface contaminants shall be removed by solvent cleaning per SSPC-SP1 prior to blast cleaning.
- D. All sharp edges shall be rounded or chamfered and all burrs, and surface defects and weld splatter shall be ground smooth prior to blast cleaning.
- E. The type and size of abrasive shall be selected to produce a surface profile that meets the manufacturer's recommendation for the specific coating and service conditions. Abrasive shall not be used unless approved by the CONSTRUCTION MANAGER.
 1. Submerged and Severe Service
 - a. Automated blasting systems shall not be used for surfaces that will be in submerged service but are acceptable for severe service.
 - b. Abrasives for submerged and severe service coatings shall be clean, hard, sharp cutting crushed; no metallic abrasives shall be used.
 2. Other Services
 - a. Either automated or manual methods of blasting may be used.
 - b. Abrasives shall be clean, oil-free metallic abrasives, composed of at least 50 percent grit.

- F. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.
- G. Compressed air for air blast cleaning shall be supplied at adequate pressure from well maintained compressors equipped with oil/moisture separators which remove at least 95 percent of the contaminants.
- H. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming or another approved method prior to painting.
- I. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.
- J. Damaged or defective coating shall be removed by the specified blast cleaning to meet the clean surface requirements before recoating.
- K. If the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC-SP2, or SSPC-SP3 may be used.
- L. Shop applied coatings of unknown composition shall be completely removed before the specified coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC-SP1 before the abrasive blast cleaning work has been started.
- M. Shop primed equipment shall be solvent cleaned in the field before finish coats are applied.

3.6 SURFACE PREPARATION FOR GALVANIZED FERROUS METAL

- A. Galvanized ferrous metal shall be alkaline cleaned per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used, followed by brush-off blast cleaning per SSPC-SP7.
- B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

3.7 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL RESERVOIR INTERIORS

- A. **General:** All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.
- B. **Abrasive Blast Cleaning:** The CONTRACTOR shall provide the degree of cleaning specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not specified in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC-SP6, Commercial Blast Cleaning. Areas of tightly adhering coatings shall be cleaned to SSPC-SP7, Brush-off Blast Cleaning, with the remaining thickness of existing coating not to exceed 3 mils.

- C. **Incompatible Coatings:** If coatings to be applied are not compatible with existing coatings the CONTRACTOR shall apply intermediate coatings per the paint manufacturer's recommendation for the specified coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.
- D. **Unknown Coatings:** Coatings of unknown composition shall be completely removed prior to application of new coatings.
- E. **Water Abrasive or Wet Abrasive Blast Cleaning:** Where indicated or where job site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged and severe service coating systems unless indicated.

3.8 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

- A. Surface preparation shall not begin until at least 30 days after the concrete or masonry has been placed.
- B. All oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC-SP1 before abrasive blast cleaning.
- C. Concrete, concrete block masonry surfaces and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, deteriorated concrete, and to roughen the surface equivalent to the surface of the No. 80 grit flint sandpaper.
- D. If acid etching is required by the coating application instructions, the treatment shall be made after abrasive blasting. After etching, rinse surfaces with water and test the pH. The pH shall be between neutral and 8.
- E. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.
- F. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as Delmhorst Model DB, or equal.

3.9 PLASTIC, FIBER GLASS, AND NONFERROUS METALS SURFACE PREPARATION

- A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.
- B. Non-ferrous metal surfaces shall be solvent-cleaned SSPC-SP1 followed by sanding or brush-off blast cleaning SSPC-SP7.
- C. All surfaces shall be clean and dry prior to coating application.

3.10 ARCHITECTURAL CONCRETE BLOCK MASONRY SURFACE PREPARATION

- A. The mortar surfaces shall be cured at least 14 days before surface preparation work is started.
- B. Dust, dirt, grease, and other foreign matter shall be removed prior to abrasive blasting.
- C. The masonry surfaces shall be prepared in accordance with the material manufacturer's printed instructions.

3.11 SHOP COATING REQUIREMENTS

- A. Unless indicated otherwise, items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field after installation with the indicated or approved color. The methods, materials, application equipment and all other details of shop painting shall comply with this section. If the shop primer requires topcoating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.
- B. All items of equipment, or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.
- C. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the specified quality in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the shop drawings for the equipment.
- D. For certain small pieces of equipment the manufacturer may have a standard coating system which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- E. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before topcoated, or less time if recommended by the coating manufacturer.
- F. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.
- G. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment shop drawings.

3.12 APPLICATION OF COATINGS

- A. The application of protective coatings to steel substrates shall be in accordance with "Paint Application Specification No. 1, (SSPC-PA1)," Steel Structures Painting Council.
- B. Cleaned surfaces and all coats shall be inspected prior to each succeeding coat. The CONTRACTOR shall schedule such inspection with the CONSTRUCTION MANAGER in advance.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe painting for these areas.
- F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- G. Finish coats, including touch-up and damage repair coats shall be applied in a manner which will present a uniform texture and color matched appearance.
- H. Coatings shall not be applied under the following conditions:
 - 1. Temperature exceeding the manufacturer's recommended maximum and minimum allowable.
 - 2. Dust or smoke laden atmosphere.
 - 3. Damp or humid weather.
 - 4. When the substrate or air temperature is less than 5 degrees F above the dewpoint.
 - 5. When air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dewpoint within 8 hours after application of coating.
 - 6. When wind conditions are not calm.
- I. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychometric tables.
- J. Steel piping shall be abrasive blast cleaned and primed before installation.
- K. The finish coat on all work shall be applied after all concrete, masonry, and equipment installation is complete and the work areas are clean and dust free.

3.13 CURING OF COATINGS

- A. The CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the stringent, prior to placing the completed coating system into service.
 - B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.
 - C. **Forced Air Ventilation of Steel Reservoirs and Enclosed Hydraulic Structures:** Forced air ventilation is required for the application and curing of coatings on the interior surfaces of enclosed hydraulic structures. During application and curing periods continuously exhaust air from the lowest level of the structure using portable ducting. After all interior coating operations have been completed provide a final curing period for a minimum of 10 days, during which the forced ventilation system shall operate continuously.
- 3.14 TESTING FOR VOLATILE ORGANIC COMPOUNDS IN POTABLE WATER RESERVOIRS
- A. **General:** The CONTRACTOR shall provide the following services to ensure that the interior reservoir coatings or linings do not convey volatile organic compounds to the potable water.
 - B. **Selection of Coating or Lining Material:** The CONTRACTOR shall provide a coating or lining system that has a successful record in meeting the national, regional, and local regulations and policies pertaining to leaching of volatile organic compounds into potable water.
 - C. Before the coating or lining materials are used, the CONTRACTOR shall by letter notify the regulatory agency having jurisdiction. The letter shall describe the proposed materials, including brand names, catalog numbers, catalog technical data, application and curing instructions, and material safety data sheets.
 - D. The CONTRACTOR shall provide curing time, temperature and ventilations as required by the manufacturer or this Section, whichever is the more stringent requirement. In some cases, the CONTRACTOR may find it necessary to extend the curing time or ventilation time beyond the requirements in order to comply with the regulatory agency requirements or to reduce the leached organic compounds to the required levels. All costs in connection with any extended curing times required for curing shall be at no additional cost to the OWNER.
 - E. Following the curing or ventilation period, the CONTRACTOR shall clean, disinfect and fill the reservoir as specified.
 - F. A 7-day soaking period shall follow initial filling to determine the presence of any leached organics. Before the tank is placed into service, samples of the water in the tank will be taken by the CONSTRUCTION MANAGER and analyzed by a laboratory approved by the State of California or the EPA. Analyses will be for volatile organic compounds by EPA Method 524.1 - Volatile Organic Compounds in Water by Purge and Trap Gas Chromatography/Mass Spectrometry or 524-2 or equivalent (this test includes TCE, PCE, xylenes, toluene, ketones, carbon tetrachloride, and similar compounds).
 - G. If the test results are above either (1) 0.005 mg/l for TCE, 0.004 mg/l for PCE, 0.62 mg/l for xylenes, 0.10 mg/l for toluene, 0.75 mg/l for methyl-ethyl ketone (to be used as representative for all ketone compounds), 0.005 mg/l for carbon tetrachloride, or (2) the regulatory agency's

recommended Action Level Limits, whichever is less, the CONTRACTOR shall drain the water from the tank and flush, refill, and retest at no additional cost to the OWNER. The CONTRACTOR shall provide as many curing, soaking, and flushing cycles as necessary to reduce the leached volatile organic compounds to levels below the requirements.

3.15 IDENTIFICATION OF PIPING

- A. Identification of piping shall be in accordance with Section 15030, "Piping Identification Systems."
- B. Every valve or connection, where it may be possible for a worker to be exposed to a hazardous substance, shall be labeled per General Industry Safety Orders, Article 112 and 5194.
- C. All unburied pipe in structures and in chemical pipe trenches shall be color-code painted. Colors shall be as selected by the CONSTRUCTION MANAGER, or as indicated.

3.16 COATING SYSTEM SCHEDULES - FERROUS METALS

A. **Coating System Schedule, Ferrous Metal - Not Galvanized:**

	<u>Item</u>	<u>Surface Prep.</u>	<u>System No.</u>
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC-SP6	(1) alkyd enamel
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC-SP6	(4) aliphatic polyurethane
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Near white metal blast cleaning SSPC-SP10	(5) inorganic zinc/polyurethane
FM-2	(NOT USED)		
FM-3	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in potable water or utility water, including all surfaces lower than 2 feet above high water level and all surfaces inside enclosed hydraulic structures and vents	White metal blast cleaning SSPC-SP5	(100) amine-cured epoxy

	<u>Item</u>	<u>Surface Prep.</u>	<u>System No.</u>
	(excluding shop-coated valves, couplings, pumps).		
FM-4	Surfaces exposed to high temperature (between 150 and 600 degrees F).	White metal blast cleaning SSPC-SP5	(100) amine-cured epoxy
FM-5	Surfaces exposed to high temperature (between 600 and 1000 degrees F).	Near white metal blast cleaning SSPC-SP10	(3) aluminum silicone resin
FM-6	Buried small steel pipe.	Removal of dirt, grease, oil	(200) PVC tape
FM-7	Where indicated, ferrous surfaces in water passages of all valves 4-inch size and larger, exterior surfaces of submerged valves.	White metal blast cleaning SSPC-SP5	(100) amine-cured epoxy
FM-8	Where indicated, ferrous surfaces in water passages and submerged surfaces of all pumps which have discharge size of 4 inches or larger.	White metal blast cleaning	(100) amine-cured epoxy
FM-9	Ferrous surfaces of sleeve-couplings.	Solvent cleaning SSPC-SP1, followed by near-white metal blast cleaning SSPC-SP5	(106) fusion-bonded epoxy
FM-10	All ferrous surfaces of sluice gates, flap gates, and shear gate, including wall thimbles.	White metal blast cleaning SSPC-SP5	(100) amine-cured epoxy
FM-11	Buried surfaces that are not indicated to be coated elsewhere.	White metal blast cleaning SSPC-SP5	(100) amine-cured epoxy
FM-12	(NOT USED)		
FM-13	(NOT USED)		
FM-14	Structural steel,	Per FM-1	Per FM-1

	<u>Item</u>	<u>Surface Prep.</u>	<u>System No.</u>
	miscellaneous metalwork, and supports for prefabricated metal buildings		
FM-15	Structural steel, miscellaneous metalwork, and supports for roof and fascia support systems for buildings	Per FM-1	Per FM-1
FM-16	Surfaces of indoor equipment, not submerged.	Commercial blast cleaning SSPC-SP6	(8) epoxy, equipment
FM-17	Existing equipment.	Minimum preparation shall be the manufacturer's requirements for service preparation or per SSPC-SP2, hand tool cleaning removal of loose rust, mill scale, and loose paint, by hand chipping, scraping, sanding and wire brushing; not all mill scale, rust and paint may not be removed by this process, but loose mill scale, loose rust, loose paint and other detrimental foreign matter present shall be removed.	Prime and Recoat per FM-1 requirements
FM-18	Buried pipe couplings, valves, fittings, and flanged joints (where piping is plastic).	Removal of dirt, grease, oil	(201) rich Portland cement mortar
FM-19	Buried pipe couplings, valves, and flanged joints (where piping is ductile or cast iron, not tape-coated), including epoxy-coated surfaces.	As specified by reference specification	As specified by reference specification
FM-20	Buried pipe couplings, valves, and flanged joints (where pipe is mortar-coated steel or reinforced concrete), including	Removal of dirt, grease, oil	(206) cement-mortar coating

<u>Item</u>	<u>Surface Prep.</u>	<u>System No.</u>
epoxy-coated surfaces.		

- B. **Coating System Schedule, Ferrous Metal - Galvanized:** Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer. All galvanized surfaces except for the following items shall be coated unless coating is required by other Sections: (1) Floor gratings and frames, (2) Handrails, (3) Stair treads, (4) Chain link fencing and appurtenances.

<u>Item</u>	<u>Surface Prep.</u>	<u>System No.</u>
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC-SP1 (1) alkyd enamel
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC-SP1 (4) aliphatic polyurethane
FMG-2	(NOT USED)	
FMG-3	Buried small steel pipe.	Removal of dirt, grease, oil (200) PVC tape
FMG-4	Buried miscellaneous surfaces, couplings, valves, and flanged joints.	Removal of dirt, grease, oil (201) rich Portland cement mortar
FMG-5	Indoor sheet metal flashings, exposed ducts.	Solvent cleaning SSPC-SP1 (1) alkyd enamel
FMG-6	Surfaces buried or submerged in water or wastewater, including all surfaces lower than two feet above high water level and all surfaces inside enclosed hydraulic structures and vents.	Solvent cleaning SSPC-SP1 followed by brush-off grade blast cleaning SSPC-SP7 (100) amine-cured epoxy

- C. **Coating System Schedule, Steel Water Reservoir Interior:** (NOT USED)

- D. **Coating System Schedule, Steel Digester Floating Covers and Digester Gasholders:** (NOT USED)

- E. **Coating System Schedule, Interior Surfaces of Welded Steel Tanks:** As specified by reference specification.

3.17 COATING SYSTEM SCHEDULE, NON-FERROUS METAL, PLASTIC, FIBER GLASS

- A. Where isolated non-ferrous parts are associated with equipment or piping, the CONTRACTOR shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames or hatches. Only primers recommended by the coating manufacturer shall be used.

	<u>Item</u>	<u>Surface Prep.</u>	<u>System No.</u>
NFM-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC-SP1	(1) alkyd enamel
NFM-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC-SP1	(4) aliphatic polyurethane
NFM-2	(NOT USED)		
NFM-3	Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC-SP1	(208) aluminum metal isolation
NFM-4	Polyvinyl chloride plastic piping, indoors and outdoors, or in structures, not submerged.	Solvent cleaned SSPC-SP1	(7) acrylic latex
NFM-5	Fiber glass surfaces.	Per Paragraph 3.9	(12) aliphatic polyurethane-fiber glass
NFM-6	Buried non-ferrous metal pipe.	Removal of dirt, grease, oil	(200) PVC tape

3.18 COATING SYSTEM SCHEDULE-CONCRETE

	<u>Item</u>	<u>Surface Prep.</u>	<u>System No.</u>
C-1	Exposed indoors and outdoors, as shown.	Per Paragraph 3.8	(10) acrylic, concrete
C-1	All surfaces indoors and outdoors, as indicated.	Per paragraph 3.8	(11) aliphatic polyurethane,

	<u>Item</u>	<u>Surface Prep.</u>	<u>System No.</u>
			concrete
C-2	Submerged in water or wastewater including surfaces up to 2 feet above high water line and down to 2 feet below low water line and all surfaces in an enclosed structure, as shown.	Per Paragraph 3.8	(108) epoxy, concrete
C-2	Submerged in wastewater including surfaces up to 2 feet above high water line and down to 2 feet below low water line and all surfaces in an enclosed structure, as shown.	Per Paragraph 3.8	(112) vinyl ester, concrete
C-3	Floor slab, exposure to chemicals, as shown.	Per Paragraph 3.8	(203) epoxy surfacing
C-4	Wall, floors, exposure to chemical splash, washdown, as indicated.	Per paragraph 3.8	(11) aliphatic polyurethane concrete
C-5	Interior surfaces of sewer manholes, including bottom, and metal appurtenances, for manholes indicated.	Per Paragraph 3.8	(12) vinyl ester, concrete

3.19 COATING SYSTEM SCHEDULE-CONCRETE BLOCK MASONRY (NOT USED)

** END OF SECTION **

SECTION 09900 - ARCHITECTURAL PAINT FINISHES

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes preparation of surfaces and painting of surfaces not intended to receive other protective coatings.
- B. Following are some of the types of surfaces which are not included in the WORK of this Section:
 - 1. Factory-finished surfaces.
 - 2. Surfaces whose coatings are for the specific purpose of protection from abrasion, wear and tear, or from corrosion, oxidation, decomposition, or other effects of exposure.
 - 3. Stainless steel, aluminum brass, bronze, and plated finished metals (not zinc or cadmium).
 - 4. Finish hardware except prime-coated items, and fusible links, UL labels, nameplates, numbers, and identifying data.

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 09800 - Protective Coating

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).

1.4 CODES

- A. The WORK of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:
 - 1. California Building Code

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Manufacturer's product data describing paint materials as to composition and manufacturer's recommended usage, preparation and application.

2. List of proposed paint materials with each material identified, manufacturer's name, product name, and number. The list shall include primers, thinners, and coloring agents. The list shall be submitted within 60 days after Notice to Proceed.
3. Color samples and stain samples. Stain samples shall be provided on the same material as the stain will be applied in the final installation. Samples of all paint, finishes, and other coating materials shall be submitted on 8.5-inch by 11-inch sheet metal. Each sample shall be completely coated over its entire surface with one protective coating material, type, and color.
4. Identification, including finish and color, of surfaces to receive paint materials.

1.6 FIELD TESTING

- A. Thickness of the paint film shall be tested by the CONSTRUCTION MANAGER in compliance with Section 09800. CONTRACTOR shall furnish the required gages for performing these tests.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The paint materials shall be delivered to the job site in the manufacturer's unopened containers.
- B. Paint materials shall be covered, and precautions shall be taken for the prevention of fire. Paint thinner shall not be stored in a room scheduled to receive resilient flooring.

1.8 QUALIFICATIONS

- A. Paint materials shall be the products of reputable manufacturers, specializing in such products, who have demonstrated successful knowledge with the indicated coating systems in the recent past.

1.9 WARRANTY INSPECTION

- A. A warranty inspection shall be conducted during the eleventh month following completion of painting WORK. The CONTRACTOR and Installer shall attend this inspection. The OWNER may, at his sole option, by written notice to the CONTRACTOR, reschedule the warranty inspection within the contract guarantee period, or may cancel the warranty inspection altogether.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **General:** Only paint materials certified as complying with the indicated requirements shall be provided.
- B. **Products:** Paint materials shall be new and of current manufacture.

2.2 ALTERNATIVE MATERIALS

- A. Where alternative painting systems are indicated, selection from among the alternatives is the CONTRACTOR's option.
- B. Coatings applied under a single paint system shall be the products of a single manufacturer.

2.3 FACTORY MIXING

- A. Paint shall be factory-mixed to the specified color, gloss, and consistency indicated.

2.4 PRIMERS AND FINISH PAINTS

- A. **Primers:** Primers, represented by the symbol below for the associated generic group, shall be the product, known by the tradename, of one of the listed manufacturers (or equal):

<u>Symbol</u>	<u>Generic Group</u>	<u>Manufacturer/Trade Name</u>
P1	Masonry Prime Coat (waterproofing)	Chemstop Heavy Duty Masonry Waterproofing Rainguard Heavy Duty Waterproofing Thompson Heavy Duty Water Seal
P2	Pigmented Wall Primer and Sealer	Pittsburgh Speedhide Primer Sealer SW Wall Primer and Sealer B49W1 Sinclair Pigmented Sealer
P3	Pigmented Vinyl Primer	Pittsburgh Speedhide Vinyl Primer, Pigmented SW Promar Latex Pigmented Wall Primer B28W1 Sinclair Pigmented PVA Sealer
P4	Exterior Wood Primer	Pittsburgh Exterior Wood Primer B46W31 Sinclair Exterior Wood Primer
P5	Enamel Undercoater	Pittsburgh Speedhide Enamel Undercoater SW Enamel Undercoater B49W2 Sinclair Sinco Prime Undercoater
P6	Clear Primer-Sealer	Pittsburgh REZ Clear Primer-Sealer Sinclair Clear Primer-Sealer
P7	Wood Waterproofing	Chemstop Wood Waterproofing Houston Chemical Co., No. 3 Waterproofing
P8	Semi-Transparent Stain	Pittsburgh REZ Semi-Transparent Stain SW Exterior Semi-Transparent Stain A14 Sinclair Stainteke Semi-Transparent Stain

- B. **Finish Paints:** Finish paints, represented by the symbol below for the associated generic group, shall be the product, known by the tradename, of one of the listed manufacturers (or

equal):

<u>Symbol</u>	<u>Generic Group</u>	<u>Manufacturer/Trade Name</u>
F1	Latex Flat Wall Paint	Pittsburgh Speedhide Latex Flat Wall SW Promar Latex Flat Wall B30 Series Sinclair Sinwall Vinyl Latex
F2	Semi-Gloss Alkyd Enamel	Pittsburgh Speedhide Semi-Gloss Enamel SW Promar Alkyd Semi-Gross Enamel B34 Series Sinclair Sinco Satin Enamel
F3	Exterior Latex Finish	Pittsburgh Speedhide Semi-Gloss Enamel SW Promar Exterior Latex B36 Series Sinclair Plast-O-Life
F4	Gloss Alkyd Enamel	Pittsburgh Speedhide Exterior Wood Finish SW Promar Gloss Alkyd Enamel Sinclair Avalon Gloss
F5	Wood Stain	Pittsburgh REZ Wood Tones SW Marc-Not Gloss Varnish A66V5 Sinclair Colormatic Wood Stain
F6	Varnish	Pittsburgh Satin Wood REZ SW Mar-Not Satin Varnish A66F2 Sinclair Velvet Varnish

2.5 SCHEDULE OF PRIMERS AND FINISHES

- A. **Primers and Finishes:** Primers and finishes shall be applied, as indicated, for exterior and interior WORK in compliance with SSPWC Sub-section 310-5 and this Section.
- B. **Colors:** Colors shall comply with the color selection and the Contract Documents.

<u>Item</u>	<u>Coat</u>	<u>1st Coat</u>	<u>2nd Coat</u>	<u>3rd Coat</u>	<u>4th</u>
1. <u>Exteriors</u>					
Exterior Concrete Block Masonry, Waterproofing	P1	P1	--	--	
Exterior Wood, Flat	P4	F3	F3	--	
Exterior Wood, Stain	P8	P8	--	--	
Exterior Wood, Sealer	P7	--	--	--	

2. Interiors

Interior Wall Surfaces, Vinyl Wall Covering	Sealed or Sized	--	--	--
Interior Plaster, Flat	P2	F1	F1	--
Interior Dry Wall, Flat	P3	F1	F1	--
Interior Plaster, Semi-Gloss	P2	F2	F2	--
Interior Drywall, Semi-Gloss	P3	F2	F2	--
Interior Wood, Semi-Gloss	P5	F2	F2	--
Interior Wood, Stain/Varnish	P6	F5	F6	F6
Interior Wood, Stain	P8	P8	--	--

2.6 EXTRA PAINT MATERIALS

- A. The CONTRACTOR shall furnish 2 extra gallon of each paint material and color used.

PART 3 -- EXECUTION

3.1 GENERAL REQUIREMENTS

- A. **Atmospheric Conditions:** Painting shall comply with SSPWC Sub-section 310-1.1 except that painting shall not be applied under the following conditions: (1) when the surrounding air temperature or the temperature of the surface to be coated is below 40 degrees F; (2) to wet or damp surfaces or in rain, fog or mist; (3) when the temperature is less than 5 degrees F above the dewpoint temperatures; (4) when it is expected the air temperature will drop below 40 degrees F, or less than 5 degrees F above the dewpoint within 8 hours after application of coating; or (5) in extreme heat or in dust- or smoke-laden air. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau psychrometric tables.
- B. **Workmanship:** Except as otherwise indicated, paint materials shall be applied by brush or roller and in accordance with the manufacturer's instructions. Each coat shall be applied at proper consistency, and shall be free of brush or roller marks, sags, runs or other evidence of poor workmanship. The splattering of paint on glass, hardware, tile, trim, and other surfaces is not permitted. Masking tape shall be applied. Surfaces shall be sanded between enamel coats.
- C. **Coverage Rates:** In no case shall paint application exceed the paint manufacturer's published coverage rate based upon unthinned material. In the event that paint has been extended beyond the recommended coverage, or the "hide" produced is inadequate, additional coats shall be applied. The manufacturer's recommended amount of thinner shall not be exceeded. Finish paint material shall be applied directly from manufacturer's container.
- D. **Protection:** Floors, fixtures, equipment, and similar surfaces shall be protected with impervious protective covers and drop cloths.
- E. **Removal of Finish Hardware:** Finish hardware shall be removed prior to painting and re-installed.

- F. **Contrasting Colors:** Where painting is to be executed in contrasting colors, edges shall be cut to meet true lines. Holidays and restrikes in painted surfaces shall be sufficient cause for recoating the entire surface involved.
- G. **Barricades:** Barricades and wet paint signs shall be maintained for duration of painting.
- H. **Scaffolds:** Scaffolds, staging, and planking shall be used wherever required for proper painting.

3.2 SURFACE PREPARATION

- A. **Woodwork:** The preparation of woodwork surfaces for which painting is indicated shall comply with SSPWC Sub-section 310-4 and the following:
 - 1. Painted Surfaces shall be sanded smooth and dusted clean. Nail holes, cracks, or other defects shall be carefully filled after prime coat using fill material which matches the color of the paint. Knots and sappy areas shall be covered with shellac or accepted knot sealer.
 - 2. Fill WORK shall be knifed (thumb filling is not allowed). On painted and enameled WORK, exposed end grain shall be putty-glazed smooth and flush, and shall be allowed to dry before the next coat.
- B. **Ferrous and Galvanized Metal:** Ferrous metal surfaces shall be prepared in compliance with SSPWC Sub-sections 310-2 and 310-3. Surfaces shall be cleaned of rust, scale, grease, oil, and other deleterious matter by wire brushing, scraping, washing with solvent, sandblasting, and other means necessary to prepare surfaces properly for painting. Shop painted ferrous metal surfaces that show rusting when initially installed shall be touched up with a rust inhibitor complying with the requirements of MIL-M-10578B for Phosphoric Acid Rust Inhibitor. Rust inhibitor shall be applied only after wire brushing to a sound surface, and the surface shall be prime coated. Galvanized metals shall be cleaned with suitable organic solvent. Empty containers and paint-soiled or oily rags shall be removed from the site at the end of each day's work.
- C. **Masonry and Concrete:** Masonry and concrete shall be dry and free of dust, dirt, grease, oil, and other foreign matter such as loose or granular material. Holes, cracks, joints and other surface defects shall be repaired and filled out flush and smooth with appropriate products, except where a priming coat is recommended by the manufacturer of the paint. Glaze and loose particles shall be removed by wire brushing. No evidence of curing compounds, release agents and the like will be acceptable.

3.3 APPLICATION

- A. Paint shall be applied in accordance with manufacturer's printed instructions.
- B. Spray painting, where allowed, shall be conducted under controlled conditions, and the CONTRACTOR shall be responsible for damage to adjacent work or adjoining property resulting from spray painting.
- C. Drying times shall not be less than those in manufacturer's printed instructions.
- D. Surfaces found to contain runs, overspray, roughness, or other signs of improper application shall be recoated.

- E. Exposed surfaces behind permanent cabinets, cases, counters, and similar WORK shall be painted prior to installation.
- F. Woodwork shall be sanded smooth and knots and pitch streaks shall be painted with a thick coat of orange shellac or a resin sealer, except for stained wood. Nail holes and minor imperfections shall be filled between first and second coat; color of fill material shall match stain in the case of stained work.
- G. Back surfaces of wood trim and finish that will be concealed after installation, including exposed grounds, and paneling shall be painted prior to installation; the primer indicated for exposed surfaces shall be applied. WORK to receive a natural finish shall be backpainted with one coat of spar varnish. Backpainting shall be omitted on factory finished casework and cabinets.
- H. The number of coats indicated to be applied are minimums. Paint finishes shall be even, of uniform color, and shall be free from cloudy or mottled appearance in surfaces and evident thinness of coatings. Each coat shall be tinted a sufficiently different shade of finish color to permit identification, in accordance with accepted samples.

3.4 REQUIREMENTS OF PAINTING AND FINISHING WORK

- A. **Exterior:** Exposed exterior surfaces of the building shall be painted and finished in accordance with the indicated requirements AND MATCH EXISTING. Exposed surfaces of metal, sheet metal, mechanical equipment, and other, as required, shall be painted with the indicated primers and finish of paint.
- B. **Interior:** Exposed interior surfaces of the building shall be painted and finished in accordance with the indicated requirements and as follows:
 - 1. Exposed surfaces of gypsum wallboard, plaster, and doors and frames, shall be primed and painted as indicated.
 - 2. Metal surfaces in partitions and ceilings such as registers, grilles, and similar items shall be painted to match finish of room or area except as otherwise indicated.
 - 3. Painted doors opening into rooms or spaces with different finishes or colors shall be edge-finished as directed. Closet and storage room doors shall be finished on both sides to match the room into which they open.
- C. **Mechanical and Electrical Work:** Mechanical and electrical products requiring painting shall conform to the requirements of Section 09800 except for the following:
 - 1. Areas behind grilles, baffles, ventilators, and louvers: exposed surfaces, not factory finished, visible from inside and outside of the building shall be painted with appropriate primers and one coat of black semi-gloss (low sheen) enamel paint far enough to conceal such areas and spaces when looking towards them from the floor and ground levels.
 - 2. Pipe Identification: Piping shall be identified according to the requirements of Section 15030.

3.5 INSPECTION AND CLEANING

- A. **General:** The WORK of this Section includes inspection of finishes after painting WORK has been completed. Splatterings of paint materials on adjoining WORK including plumbing fixtures,

trim, tile, and finish metal surfaces is not allowed. Abraded, stained, or otherwise disfigured painting WORK shall be touched-up.

- B. Upon completion of the work, staging, scaffolding and containers shall be removed from the site. Coating spots and oil or stain upon adjacent surfaces shall be removed and the job site cleaned. Damage to adjacent surfaces or facilities resulting from the WORK performed under this Section shall be cleaned, repaired or refinished.

** END OF SECTION **

SECTION 09970 - CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Concrete densifier and sealer.

1.2 RELATED SECTIONS

- A. Section 03331 - Cast-in-Place Architectural Concrete
- B. Section 03350 - Concrete Finishing

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, including surface preparation and application instructions.
- B. Manufacturer's Certification: Submit manufacturer's ISO 9001/9002 certification.
- C. Mock Up:
 - 1. For each type of sealer specified, prepare a mock up on the actual surface scheduled to receive the sealer, in the type, color, sheen, and number of coats specified, for the Architect and/or Owner's approval prior to starting application of the sealer.
 - 2. Size: minimum 36" x 36"
 - 3. Location: Select an area for the mock up that will be least visible upon final completion of the Work. The Architect and/or Owner shall approve the location prior to preparing the mock up.
 - 3. The approved mock up shall be the basis for acceptance of the final work.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: ISO 9001/9002 registered or provide proof of documented quality assurance system. Quality assurance system shall be registered by independent registrar accredited by ANSI Registrar Accreditation Board (ANSI-RAB) or by another internationally recognized body.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in clean, dry area in accordance with manufacturer's instructions. Keep containers sealed until ready for use. Keep from freezing.
- C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply sealer when concrete or air temperatures are below 40 degrees F (4 degrees C) or above 135 degrees F (57 degrees C).

1.7 MAINTENANCE

- A. Provide at least one gallon of each type, color and sheen of sealer installed. Label containers with color designation indicated on Drawings.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The Euclid Chemical Company
 - 1. Product Name: “Euco Diamond Hard”
- B. Sonneborn:
 - 1. Product: “Kure-N-Harden”
- C. Or Equal

2.2 MATERIALS

- A. Concrete Sealer:
 - 1. Liquid densifier and sealer.
 - 2. Type: Clear, water-based, blend of silicate polymers.
 - 3. Compliance:
 - a. Meets maximum VOC content of 400 g/L in accordance with EPA 40 CFR Part 59, Table 1, Subpart D for concrete protective coatings.
 - b. Meets California and New Jersey air quality standards.
 - 4. VOC Content: 0 g/L.
 - 5. USDA approved.
 - 6. Ultraviolet resistant.
 - 7. Blush resistant.
 - 8. Non-yellowing.
 - 9. No odor.
 - 10. Penetrating.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine concrete surfaces to receive sealer. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions are corrected.

3.2 SURFACE PREPARATION

- A. Prepare concrete surfaces in accordance with manufacturer’s instructions.
- B. New Concrete: Cure concrete in accordance with manufacturer’s instructions and as specified in Section 03300.
- C. Existing Cured Concrete: Ensure surfaces are clean, dry, and free of coatings and contaminants.

3.3 APPLICATION

- A. Apply sealer to concrete surfaces in accordance with manufacturer's instructions.
- B. Do not leave excess sealer residue on treated concrete surfaces. Remove excess hardened sealer.
- C. Do not use as a curing compound.
- D. Do not dilute sealer.

3.4 PROTECTION

- A. Protect horizontal surfaces from traffic until sealer has cured.

END OF SECTION

SECTION 10140 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Interior and exterior accessibility and identification signs.
2. Exterior building signs.

B. References

1. National Fire Protection Association (NFPA) No. 704 **Standard** System for the Identification of the Hazards of Materials for Emergency Response.
2. California Building Code, Current Edition.
3. Chapter 3, Title 19, CCR
4. ASTM D4802-02 Standard Specification for Poly (Methyl Methacrylate) Acrylic Plastic Sheet.
5. ASTM B209-04 Standard Specification for Aluminum **and** Aluminum-Alloy Sheet and Plate
6. ASTM B221-04a Standard Specification for Aluminum **and** Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
7. Uniform Sign Code Book

1.2 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating sign style, lettering, overall dimensions and quantities. Submit floor plans showing locations for each sign.
- B. Material Samples: Submit three samples illustrating full size sample sign, of type, style and color specified.
- C. Manufacturer's installation instructions.

1.3 REGULATORY REQUIREMENTS

- A. Conform to accessibility provisions for CBC Chapters 10 and 11B.
- B. Tactile Signage Requirements
1. Letters and numbers shall have width-to-height ratio of between 3 to 5 and 1 to 1 and stroke width-to-height of between 1 to 5 and 1 to 10.
 2. Characters and symbols shall contrast in color or image with either light letters on dark background or dark letters on light background.

3. Letters and numbers on permanent room identification signs shall be raised minimum 1/32 inch, and shall be sans serif uppercase.
4. Upper case letters shall be accompanied by Contracted Grade 2 Braille tactile identification. Dots shall be 1/10 inch (2.54 mm) on centers in each cell with 2/10 (5.08 mm) space between cells. Dots shall be raised a minimum of 1/40 inch (0.635 mm) above background.
5. Minimum height for raised characters or symbols: 5/8 inch. Maximum Height: 2 inches. Tactile Symbols: ¼ inch minimum stroke width.
6. Pictograms: Shall be accompanied by equivalent verbal description directly below.
7. Room Identification signs shall be located on wall adjacent to latch side of door or nearest adjacent wall, minimum 4 inches and maximum 12 inches from edge of door, 48" minimum to baseline of lowest tactile character and 60" maximum to baseline of highest line of raised character to finished floor. Mounting location shall be determined so that person may approach within 3 inches of signage without encountering protruding objects or standing within door swing.
8. Finish and Contrast: Characters, symbols and their background shall have a non-glare finish. Characters and symbols shall contrast with their background, either light characters on a dark background or dark characters on a light background.
9. International Symbol of Accessibility: Conform to requirements for colors and contrasts, CBC Chapter 11B.

C. Pre-Installation Conference

1. Notify CITY's CONSTRUCTION MANAGER when signs are ready for installation. Arrange for conference at site. Do not proceed with installation until CITY'S CONSTRUCTION MANAGER's approval of specific locations and methods of attachment has been obtained.
2. Provide signs from one manufacturer, unless otherwise approved.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site and protect from damage. Store until immediately prior to Notice of Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products of following manufacturers form basis for design and quality intended.
 1. H. Toji and Company, Gardena, CA.
 2. Karman Ltd., Architectural Signs, Canoga Park, CA.
 3. Vomar Products Inc., Canoga Park

4. ASI Sign Systems, Inc., Dallas, TX.
5. Mohawk Sign Systems, Inc., Schenectady, NY.
6. Pacific Bronze Co., Rio Vista, CA
7. Or Equal

2.2 EXTERIOR SIGN MATERIALS

- A. Sign: 0.080 inch aluminum with rounded corners; white on dark blue background; non-glare, high contrast signs. Sign shall be mounted on post or wall with lower edge between 48 inches and 60 inches above ground surface.
- B. Post: 2 by 2 inch galvanized steel tubing, weighing minimum of 4.31 pounds per foot and conforming to ASTM A500, Grade B, 3/16 inch thick wall thickness.

2.3 ROOM IDENTIFICATION SIGNAGE

- A. Colors: Sign colors as selected by CITY'S CONSTRUCTION MANAGER.
- B. Lettering Type Style (uppercase letters only): Type face shall be Helvetica Regular.
- C. Polished edges, all signs.
- D. Fabricate sign so that raised letter cannot be peeled off.
- E. Provide room identification signs to each room and space. Install on wall adjacent to door, on latch side, 48" minimum to baseline of lowest tactile character and 60" maximum to baseline of highest line of raised character to finished floor, 4 inches minimum and 12 inches maximum from edge of door or nearest adjacent wall.
- F. Rooms or areas with more than one access shall have identification signage located at main entry. All other entrances to room shall be identified with room number signs.
- G. Material: Laminated acrylic plastic 1/4 inch thick, polished edges, colors as selected by Architect.
 1. Room Identification Sign: 7 inches by 9 inches with 4 inches by 4 inches window for name and title removable insert. Locate room name immediately below window, 1 inch high, minimum 1/32 inch thick raised, accompanied by Braille indicator immediately below, on same sign.
 2. Room Number Sign: 9 inches wide by 4 inches high; room number, 1 inch high, minimum 1/32 inch thick raised, accompanied by Braille indicator immediately below, on same sign.
- H. Lettering style shall be Helvetica Regular.

2.4 ACCESSIBILITY ENTRANCE SIGNS AND PATH OF TRAVEL DIRECTIONAL SIGNS

- A. Entrance Sign: Provide at each building entrance an International Symbol of Accessibility sign, additionally and with additional directional signs. Signs shall be visible to persons along approaching pedestrian ways.

- B. Directional Signs: Provide wherever accessible route deviates from general circulation path with arrow indicators and International Symbol of Accessibility.
- C. Signs shall be mounted on post or wall with lower edge between 48 inches and 60 inches above ground surface.
- D. No Smoking Sign: Provide at each building entrance reverse cut white vinyl sign with 4-1/2 inches high no smoking symbol, mounted on glass entry doors.. Under No Smoking symbol, words "No Smoking", minimum ½ inch high, San Serif upper and lower case characters.

2.5 PARKING SIGNS

- A. Tow-Away Sign: Size shown on drawings with rounded corners. White reflective graphics on dark blue reflective background, with lettering not less than 1 inch high.
- B. Accessible Parking Sign: Size shown on drawings with rounded corners. White reflective graphics on dark blue reflective background, with 8 inches high International Symbol of Accessibility. Van accessible spaces shall include words "Van Accessible" below pictogram on same sign, or a separate sign with words shall be installed below ISA sign.
- C. Signs shall be mounted on posts at head of each accessible parking with lower edge 80 inches above ground surface, or mounted on walls at a minimum height of 36 inches from ground surface.
- D. Headroom Signs: On parking structures provide signs indicating headroom clearance height at entries and at any point of a vehicular path where entry clearance height is reduced.

2.6 OCCUPANT LOAD SIGNS

- A. Provide maximum occupancy load signs. Post in a conspicuous place near main exits or exit-access doorway of following areas:
 - 1. Assembly rooms.
 - 2. Rooms over occupant load of 50.
 - 3. Conference rooms.
 - 4. Mezzanines.
 - 5. Dining Rooms.
 - 6. As otherwise indicated in the Drawings.
- B. Material: Laminated plastic, ¼ inch thick, colors as selected by Architect.
 - 1. Upper layer: Non-glare clear acrylic 1/8 inch thick.
 - 2. Lower layer: Opaque acrylic, 1/8 inch thick.
 - 3. Polished edges.
- C. 4 inches high, minimum 8 inches long, sub-surface application, 7/8 inch high letters, 1 inch high numerals.

- D. Sign to read: "MAXIMUM OCCUPANCY LOAD XXX", or as otherwise indicated in the Drawings. Obtain occupant load from Architect. Match room name sign lettering style.

2.7 STAIRWAY IDENTIFICATION AND EXIT SIGNS

- A. Stairway identification/emergency procedure signs shall be located at each floor level in enclosed stairways, identifying stairway, roof access if any, floor level and upper and lower terminus of stairway.
- B. Mount signs at height shown on drawings immediately adjacent to door on strike side.
- C. Sign size minimum 12 by 12 inches. Copy, in order of:
1. Stairway location 1 inch block lettering with $\frac{1}{4}$ inch strokes.
 2. Upper terminus, such as "Roof Access" or "No Roof Access", in 1 inch block lettering with $\frac{1}{4}$ inch strokes.
 3. Floor level number and "EXIT STAIR" in 5 inch letter or number with $\frac{3}{4}$ inch strokes.
 - a. Mezzanine levels shall be identified by letter "M" preceding floor number.
 - b. Basement levels shall be identified by letter "B" preceding floor number.
 4. Lower terminus and upper terminus, such as "1 through G", in 1 inch block lettering with $\frac{1}{4}$ inch strokes.
 5. Letters shall be accompanied by Contracted Grade 2 Braille tactile identification. Dots shall be $\frac{1}{10}$ inch on centers in each cell with $\frac{2}{10}$ inch space between cells. Dots shall be raised a minimum of $\frac{1}{40}$ inch above background.
- D. Exit signs: Provide following signs:
1. "EXIT", on unlocked exit doors without an alarm, leading to exterior of building.
 2. "STAIR", on ground floor level of stairway doors and on enclosed stairway doors on any floor which does not lead to an exit.
 3. "EXIT ALARM WILL SOUND", on exit doors with an alarm.
 4. "EXIT ONLY" or "EXIT STAIR ONLY", on exit doors and stair exit doors which lock from outside and does not allow a return.
 5. Each grade-level exterior exit where an illuminated exist sign is required according to CBC 10 shall be identified by a tactile exit sign with the word, "EXIT."

6. Each exit door where an illuminated exist sign is required according to CBC 10 that leads directly to a grade-level exterior exit by means of a stairway or ramp shall be identified by a tactile exit sign with the following words as appropriate:
 - a. "EXIT STAIR DOWN"
 - b. "EXIT RAMP DOWN"
 - c. "EXIT STAIR UP"
 - d. "EXIT RAMP UP"
7. Each exit door where an illuminated exist sign is required according to CBC 10 that leads directly to a grade-level exterior exit by means of an exit enclosure that does not utilize a stair or ramp, or an exit passageway shall be identified by a tactile exit sign with the words, "EXIT ROUTE."
8. Each exit access door from an interior room or area where an illuminated exist sign is required according to CBC 10 shall be identified by a tactile exit sign with the words, "EXIT ROUTE."
9. Each exit door through a horizontal exit where an illuminated exist sign is required according to CBC 10 shall be identified by a tactile exit sign with the words, "TO EXIT."
10. For the purposes of this Section "tactile exit signs" shall comply with the requirements of CBC Chapter 11B.
11. Letter size 5 inches with $\frac{3}{4}$ inch strokes. Letters shall be accompanied by Contracted Grade 2 Braille tactile identification. Dots shall be $\frac{1}{10}$ inch on centers in each cell with $\frac{2}{10}$ inch space between cells. Dots shall be raised a minimum of $\frac{1}{40}$ inch above background.

2.8 EMERGENCY GAS-SHUT OFF SIGN

- A. Refer to Mechanical drawings for locations.
- B. Sign: 6" x 6" x $\frac{1}{4}$ " thick, text to include: "Emergency gas-shut off valve."

2.9 TACTILE EXIT SIGNS

- A. Conform to CBC Chapter 11B
- B. Install sign at each exit door or exit access door where an illuminated exist sign is required according to CBC 10, with words:
 1. "EXIT" at each grade level exterior door.
 2. "EXIT STAIR UP" or "EXIT STAIR DOWN".
 3. "EXIT RAMP UP" or "EXIT RAMP DOWN".
 4. "EXIT ROUTE"

2.10 FIRE SPRINKLER RISER ROOM SIGN

- A. Locate one sign at each fire sprinkler riser room door as indicated in drawings.
- B. Text: Sign to read "Fire Sprinkler Riser Room", white color letters, 1 inch high on red background.

2.11 LOCKER "ISA" SIGN

- A. "ISA" sign shall be located on face of ADA locker door indicated in drawings.
- B. Sign: 6" x 6" x 1/4" thick

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Beginning of installation means installer accepts existing surfaces.

3.2 METHODS OF INSTALLATION

- A. Interior Identification Signs and Interior Directional Signs:
 - 1. Fasten to wall with 4 tamper-proof round-head screws, one at each corner of sign. Furnish plastic anchors.
 - 2. When concealed installation is specified, install backplate to wall as above. Fasten sign to backplate with very high-bond double-faced tape.
 - 3. For installation on glass, fasten sign to glass with very high bond double faced tape. On opposite side of glass, anchor matching backplate to glass with very high-bond double-faced tape.
- B. Geometric Signs: Geometric toilet room signs shall be fastened to doors with 3 tamper-proof oval-head counter-sunk screws.
- C. Exterior Post Mounted Directional Signs: Install by post mount. Size of required footing shall be as indicated.
- D. Exterior Wall Mounted Identification Signs and Directional Signs:
 - 1. Aluminum signs: Fasten to wall with 4 tamper-proof round-head screws, one at each corner of sign. Furnish plastic anchors.
 - 2. Acrylic signs: Install backplate to wall as above. Fasten sign to backplate with very high-bond double-faced tape and silicone.

3.3 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off project site.

3.4 PROTECTION

- A. Protect work of this Section until Substantial Completion.

END OF SECTION

SECTION 10211 – TOILET COMPARTMENTS

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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid-color reinforced composite toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Sections:
 - 1. Division 10 Section "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show overhead support or bracing locations.
- C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for units, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
 - 2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the Americans with Disabilities Act (ADA) for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).
- C. Brass Castings: ASTM B 584.
- D. Brass Extrusions: ASTM B 455.
- E. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- F. Stainless-Steel Castings: ASTM A 743/A 743M.
- G. Adhesives: Manufacturer's standard product that complies 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."

2.2 SOLID-COLOR REINFORCED COMPOSITE UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide:
 - 1. Bobrick Washroom Equipment, Sierra Series
 - 2. Or approved equal.

- B. Toilet-Enclosure Style: Floor mounted and Overhead Braced
- C. Urinal-Screen Style: Wall Hung with Floor Mounted Support Pilaster
- D. Door, Panel, Screen, and Pilaster Construction: Solid, solid-color reinforced composite panel material, not less than 3/4 inch thick, seamless, with eased edges and with homogenous color and pattern throughout thickness of material.
 - 1. Color and Pattern: Forest Green SC04
- E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
- F. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters; with shoe and sleeve (cap) matching that on the pilaster.
- G. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
 - a. 18 gauge at toilet compartments, 11 gauge at urinal screens.
 - b. Provide through-bolted, stainless steel, pin-in-head Torx sex bolt fasteners. Through-bolted fasteners shall withstand direct pull force exceeding 1,500 lbs. per fastener.

2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - 1. Material: Stainless steel.
 - 2. Hinges: Manufacturer's standard continuous, 16 gauge, cam type that swings to a closed or partially open position.
 - a. Attach to door and stile with theft-resistant, pin-in-head Torx stainless steel machine screws into factory installed, threaded brass inserts. Threaded brass inserts shall withstand a direct pull force exceeding 1,500 lbs per insert.
 - 3. Latch and Keeper: Manufacturer's standard surface-mounted sliding latch unit requiring less than 5-lb of force to operate.
 - a. Attach latch track to door with machine screws into factory installed threaded brass inserts. Threaded brass inserts shall be factory installed for door hinge and latch connections and shall withstand a direct pull exceeding 1,500 lbs. per insert.
 - b. Secure latch keeper to stile with through-bolted, stainless steel, pin-in-head Torx sex bolt fasteners. Fasteners shall withstand direct pull force exceeding 1,500 lbs. per fastener.
 - 4. Coat Hook: Secured to door by through-bolted, theft-resistant, pin-in-head Torx stainless steel screws. Through-bolted fasteners shall withstand a direct pull force exceeding 1,500 lbs. per fastener.
 - 5. Door Bumpers: Two 11-gauge (3mm) stainless steel door stop plates with attached rubber bumpers at each door.
 - 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Install below latch.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

- C. Anchorages and Fasteners: Unless otherwise noted, provide manufacturer's **standard** exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match **the items** they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-**bolt** applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other **rust-resistant**, protective-coated steel.

2.4 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes **at pilasters** to conceal supports and leveling mechanism.
- B. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant **anchoring** assemblies with leveling adjustment at tops and bottoms of posts. Provide shoes and **sleeves (caps)** at posts to conceal anchorage.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- **(610-mm-)** wide, in-swinging doors for standard toilet compartments and 36-inch- **(914-mm-)** wide doors with a minimum 32-inch- **(813-mm-)** wide, clear opening for compartments **designated** as accessible.

PART 3-EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. **Install units** rigid, straight, level, and plumb. Secure units in position with manufacturer's **recommended** anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and **tighten**. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural **floor** unless otherwise indicated in manufacturer's written instructions. Secure **continuous head rail** to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors **with tops of panels**, and adjust so tops of doors are parallel with overhead brace when doors are **in closed** position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. **Set units** level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware **manufacturer's** written instructions for proper operation. Set hinges on in-swinging doors **to hold** doors open approximately 30 degrees from closed position when unlatched. Set hinges **on** out-swinging doors to return doors to fully closed position.

- END OF SECTION -

SECTION 10260 - STAINLESS STEEL CORNER GUARDS

PART 1 – GENERAL

1.1 SUMMARY

- A. Corner guard system for wall protection:

1.2 SECTION INCLUDE

- B. Stainless Steel Corner Guard Systems

1.3 SUBMITTALS

- A. Product data for each type of corner guard specified.
- B. Detail drawings indicating mounting details with the appropriate fasteners for specific project substrates.
- C. Samples for verification purposes of corner guard, 6" (152mm) long, in full size profiles of each type and color indicated.
- D. Cleaning and maintenance instructions for door and wall protection systems.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened factory packaging to the jobsite and store in original packaging in a climate controlled location away from direct sunlight.

1.5 PROJECT CONDITIONS

- A. Products must be installed in an interior climate controlled environment.

1.6 WARRANTY

- A. Standard limited lifetime warranty against material and manufacturing defects.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Acceptable Manufacturers:
 - 1. InPro Corporation Door and Wall Protection Systems
 - 2. Or Equal
- B. Provide all corner guards and wall protection from a single source.

2.2 MANUFACTURED UNITS

- A. Corner Guards

1. 3½"(89mm) x 3½"(89mm) x 48" (1.21m), ¼" radius, Screw-on, 304 Stainless Steel, 16 gauge

2.3 MATERIALS

- A. Stainless Steel: Corner Guards shall be manufactured from Type 304, 16 gauge.

2.4 COMPONENTS

- A. Attachment

1. Fasteners: Pre-drilled beveled holes and Phillips head screws.

2.5 FINISHES

- A. Stainless steel: No. 4 satin finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions in which the corner guard systems will be installed.
 1. Complete all finishing operations, including painting, before beginning installation of corner guards.
- B. Wall surface shall be dry and free from dirt, grease and loose paint.

3.2 PREPARATION

- A. General: Prior to installation, clean substrate to remove dust, debris and loose particles.

3.3 INSTALLATION

- A. Install corner guards at **ALL** outside gypsum board corners in accordance with the Drawings.
- B. General: Locate the corner guard as indicated on the approved detail drawing for the appropriate substrate and in compliance with the manufacturer's installation instructions. Install corner guard level and plumb at the height indicated on the drawings.
- C. Installation of Stainless Steel Corner Guards:
 1. Surface must be dry, clean and properly sealed.
 2. Screw on: Position the corner guard on the wall and attach it using the supplied screws.
 3. Remove the protective plastic covering from the exposed surface of the corner guard.

3.4 CLEANING

- A. At completion of the installation, clean surfaces in accordance with the manufacturer's clean up and maintenance instructions.

END OF SECTION

SECTION 10280 – TOILET ACCESSORIES

PART 1-GENERAL

1.1 SUMMARY

- A. Section Includes: Toilet accessories as indicated.
- B. Related Sections
 - 1. Section 05120, Structural Steel
 - 2. Section 05400, Cold Formed (Light) Metal Framing
 - 3. Section 09100, Metal Support Assemblies

1.2 SYSTEM DESCRIPTION

- A. Regulatory Requirements: Comply with CBC requirements and ADA requirements for accessibility.

1.3 SUBMITTALS

- A. Shop Drawings: Submit a schedule of accessories and shop drawings indicating installation methods and fasteners.

1.4 QUALITY ASSURANCE

- A. Coordinate related work as required to ensure proper and adequate provision in framing of backing and wall finish for installation of accessories.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect accessories from damage.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Bradley Corporation
- B. Bobrick Washroom Equipment
- C. American Dispenser Company
- D. Or equal.

2.1 GENERAL

- A. Accessories shall be provided with necessary anchoring devices and fasteners appropriate for surfaces on which items are to be fastened.

2.2 MATERIALS

- A. Liquid Soap Dispenser: See Drawings
- B. Toilet Paper Boxes: See Drawings
- C. Paper Towel Boxes: See Drawings
- D. Toilet Seat Cover Dispensers: See Drawings
- E. Sanitary Napkin Vendors and Disposals: See Drawings
- F. Mirrors: See Drawings
- G. Mirror with Shelf: See Drawings
- H. Coat Hook: See Drawings.
- I. Grab Bars: See Drawings
 - 1. Stainless steel, 1-1/2-inch-outside diameter, 18-gauge wall, type 304 satin finish. Concealed mounting and stainless steel flange.
 - a. Concealed Mounting on Walls: Provide 12-gauge anchor plate of required length and fasteners for thickness of wall finish.
 - 2. Grab bars over 36 inches in length shall be furnished with stainless steel support at mid-point. Exposed stainless steel to be 180 grit satin finish.
- J. Shower Seat: See Drawings
- K. Safety Belts: See Drawings
- L. Waste Receptacle: See Drawings
- M. Mop Rack: See Drawings

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Check openings in substrates to receive accessories. Verify openings are correctly located and sized to receive accessories, and that locations will comply with disability access requirements. Confirm that blocking, backing or support is properly located and adequate for the accessory installation.
- B. Verify spacing of plumbing fixtures and toilet partitions. Confirm spacing and locations are compatible with proposed accessory locations and will allow compliance with disability access requirements.

3.2 INSTALLATION

- A. Install toilet accessories in accordance with manufacturer's written recommendations and accessibility requirements. Fasten components firmly in place.

- B. Drill holes to correct size and application that is concealed by item with ¼ inch tolerance.
- C. Install recessed accessories into wall openings with sheet metal screws into metal frames.
- D. Install surface-mounted accessories to backing plates with machine screws, plumb, and aligned.
- E. Grab Bars
 - 1. Fasten to toilet partition with 3-inch diameter stainless steel back plates with studs, couplings, and stainless steel machine screws.
 - 2. At wood stud walls, fasten wood blocking with threaded stainless steel wood screws of sufficient length to penetrate blocking 1-1/4 inches minimum.

- END OF SECTION -

SECTION 10281- ELECTRIC HAND DRYER

PART 1- GENERAL

1.1 SECTION INCLUDES

- A. Warm air, high speed, energy efficient self-contained electric hand dryers.

1.2 REFERENCES

- A. ICC/ANSI A117.1 - American National Standard for Accessible and Useable Buildings and Facilities; 1998.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Operating instructions and performance.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- B. Shop Drawings showing dimensions, method of attachment, and required supports.
- C. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
- D. Dryer to be MADE IN USA Certified. Verify Certification # MAOAA.0027
- E. Electrical wiring diagrams for connection of hand dryers. G. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing electric hand dryers with 20 years minimum knowledge.
- B. Equipment certified by Underwriters Laboratory, Inc., with UL labels.
- C. Comply with ICC/ANSI A117.1.

1.5 WARRANTY

- A. Provide manufacturer's standard limited warranty for period specified.

PART 2- PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Excel Dryer Inc., which is located at: 357 Chestnut St. P. O. Box 365; East Longmeadow, MA 01028; Tel: 413-525-4531; Email: request info

(sales@exceldryer.com); Web: www.exceldryer.com

B. Or Equal.

2.2 ELECTRIC HAND DRYERS

A. Accessories shall be provided with necessary anchoring devices and fasteners appropriate for surfaces on which items are to be fastened.

2.3 MATERIALS

A. Hand Dryer: rapid drying, energy efficient electric hand dryer; XLERATOR-ECO; recess mounted; entire dryer internally grounded.

1. Model #: XL-SB-ECO,
2. Finish: brushed stainless steel.
3. Provide optional ADA recess kit.
4. Warranty Period: 5 years; limited warranty.
5. MADE IN USA Certified. Verify Certification # MAOAA.0027
6. Controls: Completely sealed control assembly and optics for protection against moisture, lint/dust and vandalism. Automatic, activated by infrared optical sensor. Operates while hands are under blower. Shut-off within 2 seconds when hands removed or in 35 seconds if hands not removed.
7. Cover: One piece, vandal resistant, reinforced white thermoplastic (Bulk Molding Compound).
8. Image: Custom digital image as selected by Architect. Not Applicable.
9. Air Intake: Small circular Inlet openings on bottom of cover.
10. Air Outlet: Delivers focused air stream of 18,000 LFM at nozzle and 16,000 LFM at average hand position of 4 inches (102 mm) below air outlet.
11. Noise Reduction Nozzle: 1.1 noise reduction nozzle. Reduces air deflection noise and decibel level by 9db.
12. Wall Plate: Injection molded, rib reinforced plate with metal L brackets to attach cover, with ten 5/16 inch (8 mm) diameter holes for surface mounting to wall and three 7/8 inch (22 mm) diameter holes for electrical wiring; bottom hole suitable for surface conduit.
13. Recess Kit: ADA compliant recess kit is fabricated of 22 GA 18-8 type 304 stainless steel with #4 satin finish with 16 GA 18-8 type 304 stainless steel dryer mounting plate. All welded construction. 16-3/8 inches (416 mm) wide by 26 inches (660 mm) high by 3-3/8 inches (86 mm) deep.
14. Nominal Size: 11-3/4 inches (298 mm) wide by 12-11/16 inches (322 mm) high by 6-11/16 inches (170 mm) deep.

15. Weight
 - a. 15 pounds (6.8 kg) stainless cover.
16. Power Source: See electrical drawings
17. Combination Motor and Blower: Series commutated, through-flow discharge, vacuum type; 5/8 HP, 20,000 RPM. Air flow rate: 19,000 linear feet per minute (97 meters per second) at air outlet, 16,000 linear feet per minute (81 meters per second) at average hand position of 4 inches (102 mm) below air outlet.
18. XLERATOR ECO: No heating element installed. (500W Unit)
19. All metal parts coated according to Underwriters Laboratories, Inc. requirements.
20. Mount dryers at heights indicated on Drawings.

PART 3—EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding. **INSTALLATION**

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Coordinate requirements for blocking to ensure adequate means for support and installation of hand dryers.
- D. Coordinate requirements for power supply, conduit, disconnect switches and wiring.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
 1. Accessible layout for persons with physical disabilities must ensure a minimum clear floor space of 30 inches by 48 inches (762 mm by 1219 mm) in front of or parallel to hand dryers. A portion of the hand dryer may project into this clear space if there is a 29 inches (737 mm) minimum knee and toe space beneath the hand dryer; recommended to install at least one hand dryer for persons with physical disabilities in multiple hand dryer installations.
- B. Install dryers at specified heights.
- C. Install dryers securely to supporting substrate so that fixtures are level and aligned with each other. Use type and length of fastener as recommended by manufacturer for type of substrate.

3.4 PROTECTION

- A. Inspect installation to verify secure and proper mounting. Test each dryer to verify operation, control functions, and performance. Correct deficiencies.
- B. Protect installed driers until completion of project.
- C. Replace damaged products before Substantial Completion.

- END OF SECTION -

SECTION 10500 – LOCKERS

PART 1-GENERAL

1.1 DESCRIPTION

- A. Provide metal lockers and benches.

1.2 RELATED SECTIONS

- A. Section 10140 - Signage

1.3 QUALITY ASSURANCE

- A. Lockers shall be the product of a manufacturer regularly engaged in the production of metal lockers.

1.4 SUBMITTALS

Submit the following for Product Review:

- A. Submit data fully describing every product or item proposed for use for product review.
- B. Submit manufacturer's standard colors.
- C. Provide directory listing locker numbers and combinations for each door lock.

PART 2 – PRODUCTS

2.1 LOCKERS

- A. Manufacturers: Republic Steel "Standard" lockers, Lyon "Standard" lockers, or equal.
- B. Size: 9 inches wide by 18 inches deep by 30 inches high, double tier.
- C. Material: Cold-rolled sheet steel, phosphatized and primed to inhibit corrosion.
- D. Doors: 16 gauge with flanged edges. Provide ventilating louvers top and bottom.
- E. Hinges: Five knuckle, 2 inches long, welded to frame and bolted to door. Provide 3 hinges per door.
- F. Door Frames: 16 gauge formed to a channel shaped with continuous door strikes and rubber silencers.
- G. Top: Provide 18 gauge sloped top.
WPC1O2B 10500 - 1 894615
- H. Base: Lockers set on concrete curbs provide in another section.
- I. Interior Equipment: 24 gauge top shelf and three garment hooks.

- J. Locking Devices: Each locker shall have a lift type handle with locking device engaging the door frame at three points. Door shall be automatically self-latching. Provide built-in combination lock. Accessible lockers shall have ADA-compliant door handle which is operable with one hand and does not require tight grasping, pinching or twisting of the wrist. Operating force shall be 5 pounds maximum.
- K. Trim: Provide all necessary trim, clips, splice plates, filler panels and wall scribes, hardware and fasteners as required for a complete installation.
- L. Name Plates: Each locker shall be furnished with a number plate riveted to the door. Locker shall be arranged so that locker numbers are in consecutive order.
- M. Finish: Factory applied baked enamel, interior and exterior, color to be Forest Green 66 per manufacturers color line.
- N. Provided ADA-compliant accessible lockers in quantity required by CBC chapter 11B.
- O. ISA Door Sign: Doors of accessible lockers shall be identified with the International Symbol of Accessibility per Section 10140 Signage.

2.2 BENCHES

- A. Materials: Provide clear lacquered hardwood seat and 10 gauge tubular steel pedestal legs with baked enamel finish matching finish of lockers.
- B. Seat Dimensions: 20-inch wide by 2-inch thick by length as shown on plans. Height of pedestal legs: 16 inches.
- C. To be ADA compliant per California Building code.

Furnish with four equally spaced holes in each pedestal base for 3/8-inch diameter expansion anchors.

PART 3-EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written installation instructions.
- B. Lockers: Fasten to floor and walls as shown on the Drawings and as required to resist a force of 500 pounds acting in any direction. Install fillers, trim and bases filling all gaps and voids.
- C. Benches: Fasten to floor with 3/8-inch round stainless steel expansion anchor bolts.

- END OF SECTION -

SECTION 10520 - FIRE EXTINGUISHERS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing fire protection equipment, cabinets, and appurtenant work, complete.

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.

1.3 CODES

- A. The 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. California Building Code
 - 2. California Fire Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. **Trade Standards:**
 - a. National Fire Protection Association, Standard No. 10, "Portable Fire Extinguishers"
 - b. Underwriter's Laboratory, Fire Protection Equipment List

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in addition to General Requirements:
 - 1. Manufacturer's catalogue containing technical data, installation instructions, and details.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Fire extinguishers and appurtenant materials shall be delivered in original unbroken packages or containers, bearing the manufacturer's label with manufacturer's name, product description, and rating.
- B. **Storage:** All materials shall be carefully stored in an area which is protected from deleterious elements as recommended by the material manufacturer. Storage shall be in a manner that will prevent damage to the material and its finish.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All fire protection equipment shall be from the same manufacturer and shall meet the requirements of NFPA Standard No. 10, "Portable Fire Extinguishers"

2.2 FIRE EXTINGUISHERS

- A. Type A extinguisher shall be 20 lb minimum capacity, dry chemical type with minimum UL rating of 10-A:60-B:C, in enameled steel container, for Class A, Class B, and Class C fires.
- B. Type B extinguisher shall be 10 lb minimum capacity, dry chemical type with minimum UL rating of 4-A:60-B:C, in enameled steel container, for Class A, Class B, and Class C fires.
- C. Type C extinguisher shall be 14 lb minimum capacity, CleanGuard 14 Model CA-1481 with minimum UL rating of 2-A:10-B:C, in enameled seamless steel container, for Class A, Class B, and Class C fires.

2.3 CABINETS

- A. Fire extinguisher cabinet shall be mounted steel cabinet with Kynar-coated aluminum door and door frame, and projecting, convex, butyrate plastic, canopy type viewing door panel. The size shall be as necessary to hold fire extinguisher at cabinet location.

2.4 BRACKETS AND OTHER MATERIALS

- A. Mounting brackets shall be specially designed for extinguishers or cabinets, and shall be made of 316 stainless steel.
- B. All other materials, not specifically described, but required for a complete and proper installation of fire fighting devices shall be as selected by the CONTRACTOR.

2.5 MANUFACTURERS

- A. Fire protection equipment shall be manufactured by one of the following (or equal):
 - 1. General Fire Extinguisher Corp.
 - 2. J.L. Industries
 - 3. Potter-Roemer
 - 4. Standard Fire Equipment (Division of Zurn Co.)
 - 5. Walter Kidde and Co.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **Brackets:** All fire extinguishers shall be provided with and installed on brackets or brackets within cabinets. The CONTRACTOR shall block and reinforce the wall area as necessary to support the fire extinguishers.
- B. **Locations:** Fire protection equipment locations shall be verified with the CONSTRUCTION MANAGER and Fire Marshal before installation and shall be installed, where directed, per NFPA Standard No. 10, "Portable Fire Extinguishers."

** END OF SECTION **

SECTION 10670 - STORAGE SHELVING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing metal storage shelving, and all appurtenant work.

1.2 CODES

- A. The 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. California Building Code

1.3 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in addition to General Requirements:

- 1. Shop drawings of storage shelving.
- 2. Manufacturer's product data containing technical data, installation instructions, and colors available for each type of shelving, storage bins, and revolving bins.
- 3. Samples of all the materials and manufacturer's standard colors proposed for use on the WORK. The samples shall be clearly marked to show the manufacturer's name and product identification.
- 4. Seismic calculations of seismic forces for fully loaded shelving and anchors indicating compliance with CBC. Unless otherwise indicated, seismic design importance factor shall be 1.5.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Metal shelving size shall be as shown on the Drawings.
- B. Each unit shall be provided as a complete unit with open uprights and open back.
- C. Color of shelving units shall be as selected by the OWNER. Any special color, if selected, shall be provided at no additional cost to the Owner.

2.2 METAL SHELVING

- A. Metal shelving shall be as follows:
 - 1. Materials: Sheet metal shall be cold-rolled sheet metal of minimum 14 gauges or as indicated by the

manufacturer and approved by the CONSTRUCTION MANAGER. Rolled steel tees and shapes shall be provided where necessary.

2. Uprights: Open uprights shall consist of two 1-1/2-inch by 1-1/2-inch by 1/8-inch rolled tees and 1 cross brace of two 1-inch by 12-gauge bands. All uprights shall be punched for self-adjustment at not more than 2 inches on center.
3. Shelving: Shelving shall be heavy duty reinforced shelving of 14-gauge sheet with front, rear and end flanged down and up to form safe edges. Shelves shall be reinforced at front and rear flange with minimum 1-inch by 12-gauge band. All corners shall be lapped and spot welded. Shelving shall be punched at 3-inch centers for divider adjustment. Shelving shall be provided with and assembled to uprights with quick adjustment clips and fasteners. Each shelf shall be provided with a continuous label holder.
4. Base: Base shall be 3 or 4 inches high and constructed of not less than 20-gauge steel sheet. Base shall be channel formed with ends constructed to engage uprights and to lock in place with necessary anchor fasteners to concrete floor slab.
5. Finish: All parts shall be shop PVC powder coated. Powder coat color will be decided by the OWNER.

2.3 MANUFACTURERS

A. Metal storage shelving shall be a product of the following manufacturer (or equal):

1. Lyon Metal Products, Inc.
2. Penco Products
3. RTI Shelving Systems

PART 3 -- EXECUTION

3.1 FABRICATION

A. WORK shall be fabricated in a shop to the greatest extent possible, before the application of finishes. Sharp and rough edges and corners and welds shall be ground smooth. Components, joints and connections shall be designed to withstand the most severe possible loading conditions, with a normal safety factor.

3.2 INSTALLATION

A. The shelving units shall be installed in groups as indicated. They shall be fastened to sides of each other and to the rear where back to back. The CONTRACTOR shall secure the units to the floor with galvanized steel angles and stainless steel adhesive anchor bolts. Units shall be provided with all necessary seismic bracing required by the California Building Code.

**** END OF SECTION ****

SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing general requirements for the WORK of applicable Sections of these Specifications. Unless there are more restrictive requirements in the individual Sections, the provisions of this Section shall apply.
- B. The WORK of this Section applies to the WORK of the following Sections:
 - 1 Equipment in Divisions 11, 13, 15 and 16.

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 01640 Seismic Design of Equipment and Equipment Anchorage
 - 2 Section 05120 Structural Steel
 - 3 Section 05500 Miscellaneous Metalwork
 - 4 Section 09800 Protective Coating
 - 5 Section 11002 Equipment Supports, Grouting and Installation
 - 6 Section 11005 Machine Alignment
 - 7 Section 11020 Vibration and Critical Speed Limitations
 - 8 Section 13300 Instrumentation and Control
 - 9 Section 13350 Commissioning
 - 10 Section 15000 Piping Components
 - 11 Section 15020 Pipe Supports
 - 12 Section 16030 Electrical Tests
 - 13 Section 16050 Basic Electrical Materials and Methods

1.3 CODES

- A. The 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 Mechanical Code (UMC)
 - 2. Uniform Plumbing Code (UPC)
 - 3. Uniform Fire Code (UFC)
 - 4. National Electrical Code (NEC)
 - 5. Uniform Building Code (UBC)

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the applicable standards of the following organizations apply to the WORK of this Section:

1. American Society for Testing and Materials (ASTM)
2. American Public Health Association (APHA)
3. American National Standards Institute (ANSI)
4. American Society of Mechanical Engineers (ASME)
5. American Water Works Association (AWWA)
6. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
7. American Welding Society (AWS)
8. National Fire Protection Association (NFPA)
9. National Electrical Manufacturers Association (NEMA)
10. Antifriction Bearing Manufacturers Association (ABMA)
11. American Gear Manufacturers Association (AGMA)

B. The current editions of the following apply to the WORK of this Section:

ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys
ANSI B46.1	Surface Texture
ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inch)
ANSI/ASME B31.1	Power Piping
ANSI/AWWA D100	Welded Steel Tanks for Water Storage
AWWA C206	Field Welding of Steel Water Pipe
ASTM A 48	Specification for Gray Iron Castings
ANSI A 58.1	Minimum Design Loads for Buildings and Other Structures
ASTM A 108	Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
ANSI/NFPA 70	National Electrical Code
MIL STD 167-2	Mechanical Vibrations of Shipboard Equipment (Reciprocating Machinery and Propulsion System and Shafting)

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Manufacturer's product data including catalogue cuts.
2. Equipment name, identification number and specification numbers.
3. Shop drawings showing details, dimensions, anchorage details, and installation of equipment with all special fittings, appurtenances and required clearances.
4. Shipping weights.
5. Calculations of equipment anchorage forces and anchorage details.

6. Certification that the single manufacturer accepts the indicated unit responsibilities.
7. Parts list with materials of construction by ASTM reference and grade.
8. List of at least 5 installations and telephone numbers, where identical equipment has been used.
9. Documentation of knowledge of specialist who will perform torsional and vibration analysis.
10. Torsional and lateral vibration analysis reports.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. Manufacturer's catalog including installation instructions.
2. Manufacturer's operating and maintenance procedures including lubricating instructions.
3. Manufacturer's certification that products comply with the indicated requirements.
4. Bearing L-10 life calculations.
5. Certification that products have been factory-tested and found to conform with the contract requirements.
6. Certification that the WORK has been field-tested and the WORK complies with the indicated requirements.
7. Equipment tolerances
8. Electrical data including control and wiring diagrams.
9. Address and telephone number of local service representative.

1.7 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** An authorized service representative of the manufacturer shall visit the site and witness the following:

1. Installation of the equipment.
2. Inspection, checking, and adjusting the equipment.
3. Startup and field-testing for proper operation.
4. Performing field adjustments to ensure that the equipment installation and operation comply with the Specifications.

B. Instruction of OWNER'S Personnel:

1. An authorized service representative of the manufacturer shall **instruct** the OWNER'S personnel in the operation and maintenance of the equipment, **including** step-by-step troubleshooting with necessary test equipment. Training shall be **specific** to the models of equipment provided.
2. The representative shall have at least one year of qualified **knowledge** in training covering the relevant subjects described in paragraph 11000-1.7B.1. A resume for the representative shall be submitted to the CONSTRUCTION MANAGER.
3. Training shall be scheduled a minimum of 3 weeks in advance of **the first session**.
4. Proposed training material and a detailed outline of each lesson **shall be developed** and submitted to the CONSTRUCTION MANAGER for review. **Comments** from the CONSTRUCTION MANAGER shall be incorporated into the material.
5. Training materials shall remain with the trainees.
6. The OWNER may videotape the training sessions for later use **with** the OWNER'S personnel.

- C. **Local Service:** The manufacturer shall have a local service agency (**within** 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.

1.8 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 two OWNER-designated **inspectors** for the number of days indicated to complete such inspections or observations, 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. **Product Testing:** Products shall be tested at the factory for compliance **with** the indicated requirements. The CONTRACTOR shall provide the CONSTRUCTION MANAGER a written notification of testing dates at least 2 weeks in advance of **testing**, unless more advance notice is specified elsewhere.
- C. **Balancing:** Rotating elements of equipment, except small, **commercially** packaged equipment, shall be statically and dynamically balanced at the factory **prior to** final assembly. The CONTRACTOR shall furnish certified copies of all test results.

1.9 FIELD TESTING

- A. **Testing:** Products shall be field-tested for compliance with the indicated **requirements**.
- B. **Witnesses:** The OWNER and the CONSTRUCTION MANAGER (**at the option of either**) reserves the right to witness field tests.

1.10 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer. Materials delivered onsite without an approved submittal for verification shall be rejected and payment withheld.
- B. **Storage:** Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.
- C. **Protection of Equipment:** Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weather tight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings. Gears and bearings to be stored for extended periods shall be containerized suitable for export shipment.
- D. **Investigation of Failed Products:** Prior to disposal of failed products, the CONTRACTOR shall investigate the causes of failure and submit a report to the CONSTRUCTION MANAGER, who will subsequently direct the CONTRACTOR for disposal.

1.11 UNIT RESPONSIBILITY

- A. Equipment systems made up of two or more components shall be provided as a unit by the manufacturer of the driven equipment. The manufacturer of the driven equipment shall assume the unit responsibility. Unless otherwise indicated, the CONTRACTOR shall cause each system component to be furnished by the manufacturer with unit responsibility. The extent of the manufacturer's responsibilities shall include engineering the specified equipment, preparation of all submittal materials, coordinating manufacture and procurement, compatibility and shipment of all specified components, design of all equipment supports, providing installation and testing specialists to assist the CONTRACTOR in completing the installation and commissioning the equipment, furnishing factory certified specialists to train the OWNER's staff, and the production and submission of specified operation and maintenance manuals. The CONTRACTOR is responsible to the OWNER for performance of all systems as indicated. The CONTRACTOR shall ensure the submittal of a Certificate of Unit Responsibility signed by the manufacturer with unit responsibility.

1.12 TORSIONAL AND VIBRATION ANALYSIS

- A. **Torsional Analysis:** The drive train shall be free from torsional criticals which produce combined (steady plus transient 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 20 percent below to 30 percent above the operating speeds required by the specified operating conditions, or during startup, shutdown or drive control transients. In accordance with MIL STD 167-2, under no circumstances shall combined torsional steady state and transient vibratory stresses exceed 4 percent of the material's ultimate tensile strength, nor more than 50 percent of the material's fatigue limit, whichever is less. Stress concentration factors to be used in the equation:

$$S = Scf \times \frac{(G \times D \times \Delta \Theta)}{2L}$$

where:

- S = stress, psi
- Scf = stress concentration factor, dimensionless
- D = minimum shaft diameter, inches, at point of concentration
- $\Delta \Theta$ = twist in shaft between adjacent masses, radians
- L = effective length between masses, inches
- G = shear modulus of material, lb/in²

The Scf, to be applied at all the roots of all keyways and changes in shaft diameter shall be as follows:

Scf	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 Scf between data points in the table above shall be based upon a straight line interpolation.

One analysis is required for each piece of unique equipment and for each set of identical equipment assigned to the same application. This general requirement is applicable under the individual equipment specifications or the equipment type general specifications where more detailed torsional, vibration, critical speed, and/or shaft deflection analyses may be required.

The CONTRACTOR shall submit to the CONSTRUCTION MANAGER a torsional and lateral vibration analysis of the following equipment. The analysis shall be performed by a specialist (or for completely assembled and delivered equipment, may be performed by the manufacturer's standard protocols) who has performed, in the recent past, a torsional and lateral vibration analysis on at least one project of comparable size and complexity. The specialist shall be approved by the CONSTRUCTION MANAGER.

1. All engine drives.
2. All blowers and compressors with drives of 100 horsepower and over.
3. All vertical pumps with universal joints and extended shafts.
4. All equipment with variable speed drives, 25 horsepower and over.
5. All other equipment where indicated.

During construction and testing of all engine driven equipment and all gear driven equipment, the torsional analysis specialist shall visit the site and conduct a field torsio-graph test on one randomly selected unit in each set of these equipment to verify the desktop torsional analysis. The test shall be conducted on selected accessible portions of the rotating equipment when operating throughout the full range of specified operating conditions.

- B. **Field Vibration Analysis:** During construction and testing of all engine driven equipment and all 100 horsepower and larger motor driven equipment operating at less than 1,200 rpm, the above mentioned torsional analysis specialist shall make at least two site visits to analyze and measure the amount of equipment vibration and make a written recommendation for keeping the vibration at a safe limit. The vibration analysis is required for each piece of rotating equipment.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **General:** Only products meeting the indicated requirements shall be provided.
- B. **Manufacturers:** Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.
- C. **Products:** Materials shall be suitable for the intended purpose and free of defects and shall be recommended by the manufacturer for the application indicated.
- D. **No Endorsement:** The listing of a manufacturer shall not be construed as an endorsement of a particular manufacturer's product, nor shall it be construed that a named manufacturer's standard product will comply with the indicated requirements. No preference is implied by the order of listing of named manufacturers, and the listings are not intended to be comprehensive. The manufacturer listings are only an indication that the OWNER and DESIGN CONSULTANT believe that the named manufacturers are capable of producing equipment and products which will satisfy the indicated requirements.

2.2 GENERAL REQUIREMENTS

- A. **Noise Level:** When in operation, no piece of equipment shall exceed the OSHA noise level requirements for a one hour exposure.
- B. **Personal Hearing Protection:** The WORK includes multiple sets of three pairs of high attenuation hearing protectors complying with the requirements of ANSI S12.6 and producing a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. One set of hearing protectors shall be stored in a weatherproof, labeled, steel cabinet which shall be mounted in a location near each noise producing equipment installation.
- C. **Service Factors:** Service factors shall be applied in the selection and design of mechanical power transmission components where so indicated in individual Sections. When not indicated there, minimum service factors shall be 1.25.

- D. **Welding:** Except as otherwise indicated, welding shall comply with ANSI/AWWA D100 and AWWA C206 and the following:
1. Composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds and shall prevent entrance of air or moisture.
 2. Welding shall be by the metal-arc method or gas-shielded arc method described in the American Welding Society's "Welding Handbook" as supplemented by other AWS standards. Qualification of welders shall comply with AWS Standards.
 3. In assembly and during welding, the component parts shall be clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. Sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.
- E. **Identification of Equipment Items:** Each item of equipment shall have an indelible, legible identifying mark corresponding to the equipment number indicated.
- F. **Vibration Level:** Except as otherwise indicated, equipment subject to vibration shall be provided with restrained spring-type vibration isolators or pads complying with the manufacturer's written recommendations.
- G. **Shop Fabrication:** Shop fabrication shall be performed in accordance with the shop drawings.
- H. **Tolerances:** The variation in length of members without machine finished ends and which are to be framed shall not exceed 1/16-inch for members 30 feet or less and shall not exceed 1/8-inch for members over 30 feet.
- I. **Machine Finish:** The type of finish shall be the most suitable for the application in micro-inches complying with ANSI B46.1. The following finishes shall be used:
1. Surface roughness of surfaces in sliding contact shall not exceed 63 micro-inches.
 2. Surface roughness shall not exceed 250 micro-inches except where a tight joint is indicated.
 3. Surface roughness for other mechanical parts shall not exceed 500 micro-inches.
 4. Surface roughness of contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall not exceed 32 micro-inches.
- J. **Seismic Design:** The seismic design of equipment shall be based on the horizontal peak ground acceleration indicated in the Geotechnical Report or in accordance with California Building Code 2010 (CBC), whichever is greater. Unless otherwise indicated, Occupancy Category shall be III, and seismic design importance factors shall be $I = 1.25$, $I_p = 1.5$ in

accordance with Table 11.5-1 per ASCE7-05. Determination of seismic forces and load combinations shall follow procedures in the ASCE7-05, Chapter 13.

2.3 EQUIPMENT SUPPORTS AND FOUNDATIONS

- A. **Equipment Supports:** Equipment supports, anchors, and restrainers shall be designed for static, dynamic, wind, and seismic loads per Section 01640.
- B. **Equipment Foundations:** Unless otherwise indicated, equipment foundations shall conform to the requirements of Section 11002.

2.4 PIPE HANGERS, SUPPORTS, AND GUIDES

- A. Pipe connections to equipment shall be supported, anchored, and guided to minimize stresses and loads on equipment flanges and equipment. Supports and hangers shall comply with the requirements of Section 15020.

2.5 FLANGES AND PIPE THREADS

- A. Flanges on equipment shall comply with ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise indicated. Threaded flanges and fittings shall have standard taper pipe threads complying with ANSI/ASME B1.20.1.

2.6 COUPLINGS

- A. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to minimize shock loads. Where required for vertical shafts, 3-piece spacer couplings or universal type couplings for extended shafts shall be installed.
- B. The equipment manufacturer shall recommend the size and type of coupling required for each specific application.
- C. Taper-lock bushings may be used where indicated.
- D. Where universal type couplings are indicated, they shall be of the needle bearing type construction, equipped with commercial type grease fittings. Bearings shall be sized in accordance with ABMA 11, using a 1.25 service factor, for the same L-10 life expectancy as the driven equipment, but not less than 50,000 hours.

2.7 SHAFTING

- A. **General:** All shafting shall be continuous between bearings and shall be sized properly to transmit the power required. Keyways shall be provided in accordance with standard practice.
- B. **Materials:** Shafting materials shall be selected for the type of service and torque transmitted and the effect of corrosive gases, moisture, and fluids shall be considered. Unless otherwise specified, materials shall conform to the following:
 - 1. Low carbon cold-rolled steel shafting: ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting: ASTM A 108, Grade 1045.
 3. Corrosion-resistant shafting: stainless steel or Monel, whichever is most suitable for the intended service.
 4. **Extended shafting:** carbon fiber/resin composite.
- C. **Differential Settlement:** Where differential settlement between the driver and the driven equipment is indicated, an extension shaft with 2 sets of universal type couplings shall be provided.

2.8 BEARINGS

- A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (ABMA).
- B. Bearing selection shall include the following criteria: fitting practice, mounting, lubrication, sealing, static rating, and housing strength.
- C. Re-lubricatable type bearings shall be equipped with an Alemite type hydraulic grease fitting in an accessible location.
- D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's best recommended grease to insure maximum bearing life and best performance.
- E. Except where otherwise indicated, bearings for process equipment shall be selected for a minimum L-10 life expectancy of 50,000 hours for intermittent service and 100,000 hours for continuous service, in accordance with ABMA 9 or 11. Anti-friction bearings for pumps with discharge nozzle sizes 14 inches in diameter or greater, or pumps with a shaft diameter greater than 4 inches, shall be selected for an L-10 life expectancy 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, right-angle gears, and flywheel bearings shall be selected using the same criteria as specified for the driven equipment, but not less than 50,000 hours. This requirement supersedes any specified bearing life in the detailed specification sections. 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 included in the Owner's Manual.
- F. Bearing housings shall be of cast iron or steel and the bearing mounting arrangement shall be in accordance with the published standards of the manufacturer. Split-type housings may be used.
- G. Unless otherwise indicated, sleeve-type bearings shall have a Babbitt or bronze liner.

2.9 GEARS AND GEAR DRIVES

- A. Except as otherwise indicated, gears shall be of the helical or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a minimum service factor of 1.7, a minimum L-10 bearing life of 60,000 hours at the worst combination of specified operating

conditions, in accordance with ABMA 9 or 11, and a minimum efficiency of 94 percent. Worm gears shall not be used.

- B. Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided and installed for easy reading.
- C. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.
- D. Material selections shall comply with AGMA values and the manufacturer's recommendations. Input and output shafts shall be properly designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.
- E. Oil level and drain location shall be readily accessible. Oil coolers or heat exchangers with all required appurtenances shall be included where indicated.
- F. Where gear drive input or output shafts connect to couplings or sprockets, the gear drive manufacturer shall supply matching key.

2.10 DRIVE CHAINS (NOT USED)

2.11 SPROCKETS (NOT USED)

2.12 V-BELT DRIVES

- A. V-belts and sheaves shall be of the best commercial grade and shall conform to ANSI, MPTA, and RMA Standards.
- B. Sheaves shall be machined from gray cast iron.
- C. Sheaves shall be statically balanced. In applications where excessive vibration is expected, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm shall be of materials and construction recommended by the manufacturer.
- D. Sheaves shall be provided complete with taper-lock or QD bushings as required.
- E. Finish bored sheaves shall be provided complete with keyseat and set screws.
- F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.13 DRIVE GUARDS

- A. Power transmission, prime movers, machines, shaft extensions, and moving machine parts shall be guarded. Unless otherwise indicated for corrosive environment, the guards shall be constructed of minimum 10 gauge expanded, flattened steel with smooth edges and corners, galvanized after fabrication and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.14 FLEXIBLE CONNECTORS AND DUAL PIPE COUPLINGS

- A. Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment in accordance with the requirements of the ANSI B31.1.
- B. Dual pipe couplings, separated by an 18-inch pipe spool unless otherwise indicated, shall be installed on the suction and discharge of all pumps - inboard of the isolation valves. Dual pipe couplings, separated by not less than two pipe diameters nor more than 5 feet, shall be installed on all piping where it exits a structure. Couplings shall be restrained where required. Dual flexible pipe joints may be used where indicated in buried pipe applications in lieu of dual pipe couplings. Flexible connectors are not permitted where dual pipe couplings are specified.

2.15 INSULATING CONNECTIONS

- A. Insulating bushings, unions, couplings, and flanges, shall comply with the requirements of Section 15000.

2.16 GASKETS AND PACKINGS

- A. Gaskets shall comply with the requirements of Section 15000.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane "Everseal," or equal.
- C. Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer.

2.17 TOOLS AND SPARE PARTS

- A. **Tools:** The WORK includes one complete set of special tools recommended by the manufacturer for maintenance and repair of each separate type of equipment; tools shall be stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.
- B. **Spare Parts:** All equipment shall be furnished with the manufacturers' recommended spare parts, as indicated in the individual equipment Sections.

Spare parts shall be tagged by project equipment number and identified as to 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 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.

2.18 NAMEPLATES

- A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations with stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.19 OVERLOAD PROTECTION

- A. **General:** Where indicated, mechanical or electronic overload protection devices shall be installed on equipment.
- B. **Mechanical System:** The overload protection shall be a mechanical device designed to provide reliable protection in the event of excessive overload. It shall be a ball detent type designed for long term repeatability and life. It shall be infinitely adjustable by a single adjusting nut which shall be tamper proof, and incorporate a torque monitoring and control system. It shall activate an alarm set for 85 percent, and a motor cutout switch set for 100 percent of maximum continuous running torque. A visual torque indicator shall be provided and oriented so that it may be read from the walkway. The dial shall be calibrated from 0 to 100 percent of maximum continuous running torque. The design of the torque limiter should initiate the mechanical disengagement of the drive upon overload. Each unit shall be suitable for outdoor and corrosive environments with a protective finish, corrosion inhibiting lubricants and a stainless steel cover.
- C. **Electronic System:** Overload protection may be an Electronic Torque Monitoring Control System capable of displaying torque, rpm's, one level of overload, and two levels of overload of the drive system. It shall incorporate a time-delay for startup and a voltage monitoring and compensation circuit for up to +/-15 percent variation.

The overload device shall have an enclosure suitable for outdoor installation at temperatures of 0-70 degrees C, and relative humidity up to 95 percent. A visual torque dial shall be provided and oriented so that it can be easily read from the walkway.

The torque monitoring system shall be calibrated to include: alarm and shut down the system in the event the torque drops to 50 percent of normal running; alarm at 85 percent of maximum continuous running torque and shut down the motor at maximum continuous running torque of the equipment. The system shall be calibrated at the factory of the equipment manufacturer and it shall be capable of monitoring twice the maximum continuous running torque of the equipment.

- D. **Definition:** For the purpose of these Specifications, "maximum continuous running torque" shall be defined as the lesser of: the motor continuous running torque rating, the gear drive continuous running torque rating, or the driven mechanism continuous running torque rating, not exceeding a service factor of 1.0.
- E. **Manufacturers:** Overload protection devices shall be manufactured by the following (or equal):
 - 1. American Autogard Corporation
 - 2. Ferguson Machine Company

2.20 ANCHOR BOLTS, NUTS AND WASHERS

- A. Unless otherwise indicated, anchor bolts, nuts and washers for anchoring equipment to foundations and connecting bolts for equipment assemblies supported by other assemblies shall conform to the requirements of Section 05500. Unless otherwise specified, the CONTRACTOR shall provide Type 316 stainless steel anchor bolts and washers, and Type 416 stainless steel or other corrosion resistant, non-galling alloy nuts. In ferrous chloride and ferric chloride containment areas, unless otherwise specified, provide Hastelloy C or Alloy 276 anchor bolts, nuts, washers and connecting bolts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. **General:** Products and equipment shall be installed in accordance with the manufacturer's written installation instructions, the requirements of this Section, the requirements of the individual equipment specifications, and as indicated.
- B. **Alignment:** 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 work. Alignment techniques shall conform to the requirements of Section 11005.
- C. **Lubricants:** The CONTRACTOR shall provide for each item of mechanical equipment a supply of the lubricant required for the 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.

3.2 COUPLINGS

- A. Couplings shall be installed in accordance with the manufacturer's installation instructions.

3.3 INSULATING CONNECTIONS

- A. Insulating connections shall be installed in accordance with the manufacturer's instructions.

3.4 PIPE HANGERS, SUPPORTS, AND GUIDES

- A. Hangers, supports, and guides shall be installed in compliance with ANSI/ASME B31.1 and with Section 15020.

3.5 BOLTS AND MISCELLANEOUS METALS

- A. Bolts, including anchor bolts, and miscellaneous metals shall comply with paragraph 11000-2.20 and Section 05500. Installation of equipment anchor bolts shall comply with Section 11002.

3.6 PACKAGED EQUIPMENT

- A. When any system is provided as pre-packaged equipment, coordination shall include space and structural requirements, clearances, utility connections, signals, outputs and features required by the manufacturer including safety interlocks.

3.7 PROTECTIVE COATING

- A. Equipment shall be painted and coated in accordance with Section 09800. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

** END OF SECTION **

SECTION 11002 - EQUIPMENT SUPPORTS, GROUTING AND INSTALLATION

PART 1--GENERAL

1.1 WORK OF THIS SECTION

- A. This Section specifies minimum requirements for equipment supports, including concrete housekeeping pads, equipment bases, supports, anchorage, and accessories with weights greater than 200 pounds. If conflict exists between this Section and requirements of individual equipment manufacturers, the more restrictive requirements shall prevail.
- B. The CONTRACTOR shall provide all supports, anchorage, and mounting of all equipment, unless otherwise specified in accordance with the manufacturers recommendations, and requirements of industry standards. Each piece of equipment shall be anchored to resist the greater of the maximum lateral and vertical forces required by the local governing code or by the manufacturer of the equipment, whichever is greater. This force shall be considered acting at the center of gravity of the piece under consideration. No equipment shall be anchored to vertical structural elements without written approval of the CONSTRUCTION MANAGER. The CONTRACTOR shall provide all elements required to resist the calculated forces described herein or required by the equipment manufacturer. The CONTRACTOR shall provide certification that for equipment, 20 horsepower and larger, anchor bolt calculations showing adequacy of bolt sizing and anchor embedment have been performed and signed by a registered structural or civil engineer.

1.2 SPECIFICATIONS AND STANDARDS

- A. 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.
- 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, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/HI 1.3.4	Centrifugal pumps, Horizontal Baseplate Design
ANSI/HI 1.4	Centrifugal Pumps B Installation, Operation and Maintenance
ANSI/HI 2.4	Vertical Pumps : Installation, Operation and Maintenance

Reference	Title
API 610, 1995	Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Services
API RECOMMENDED PRACTICE 686	Recommended Practices for Machinery Installation and Installation Design
ASTM C531	Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, and Monolithic Surfacing.
ASTM C579	Compressive Strength of (Method/B) Chemical Resistant Mortars and Monolithic Surfacing.
ASTM C638	Tensile Properties of Plastics.
ASTM C882	Bond Strength of Epoxy-Resin Systems Used with Concrete
ASTM C884	Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay
ASTM C1181	Creep of Concrete in Compression
ASTM D2471	Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins
SSPC	Society for Protective Coatings Specifications, Vol. 2

1.3 SHOP DRAWINGS AND SAMPLES

A. The following information shall be submitted:

1. Shop drawings for all equipment bases and anchorage details.
2. Certification of anchor bolt calculations specified in paragraph 11002-1.1 B.
3. Machine and equipment base installation schedule with manufacturers' anchor bolt torque requirements, as specified in paragraph 11002-2.1.
4. Results of grout strength tests, as specified in paragraph 11002-3.2 E.

PART 2--PRODUCTS

2.1 GENERAL

A. 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 concrete housekeeping pads. All equipment shall be mounted on concrete housekeeping pads. Under no circumstances shall equipment supports be grouted directly to concrete slabs or floors. Bases for equipment shall be hot-dip galvanized after fabrication unless otherwise specified.

Mounting pads for equipment shall have the zinc layer removed and shall be finished flat and parallel after galvanizing. Sole plates and leveling plates shall not be galvanized. Machined surfaces shall be protected with two layers of duct tape after machining and before shipment from the factory.

- B. Prior to initiating any installation efforts, the CONTRACTOR shall produce a machine base schedule containing the expected dates for setting anchor bolts, casting housekeeping pads, preparation of housekeeping pads for grouting, grouting, and final anchor bolt clamping for each item of equipment. The schedule shall list the equipment, by equipment number, and shall be accompanied by written verification of anchor bolt clamping torque from the equipment manufacturer.
- C. Installation practices shall follow the guidance presented in Chapters 4 and 5 of API Recommended Practice 686, unless superseded by more restrictive requirements of these specifications or manufacturer requirements.

2.2 CONCRETE HOUSEKEEPING PADS

- A. Concrete housekeeping pads for equipment and floor penetrations shall be at least 2 inches larger in plan than the steel or cast base and not less than 6 inches above the finished floor elevation, and shall be shaped to drain liquids away from the base. Housekeeping pad details shall follow the requirements set forth on MWWD Standard Detail M-114A unless superseded by more restrictive requirements of these specifications or the requirements of the equipment manufacturer. All conduits, piping connections, drains, etc., serving the equipment, shall be enclosed by the concrete pad. Unless otherwise specified, no conduits, piping connections, drains, etc., will be accepted which rise directly from the floor.

2.3 EQUIPMENT BASES

A. General

1. Unless otherwise specified, mounting bases for equipment 20 horsepower and larger shall be a minimum of 1 inch thick. All bases shall have edges bearing on the grout surface rounded to a radius of not less than 2 inches to avoid producing stress risers on the grouted foundation. Grout pouring holes shall be provided in all bases and all bases shall have grout release holes. Except where vibration isolation systems are specified, all bases shall be grouted as specified in this Section. Internal stiffeners shall be provided and shall be designed to allow free flow of grout from one section of the base to another. The minimum acceptable opening in cross-bracing and stiffeners shall be 2 inches high by 6 inches in length. All welds shall be continuous and free from skips, blow holes, laps and pockets.
2. Equipment bases for horizontal pumps shall conform to the requirements of this Section, ANSI/HI 1.3.4, API 610 (paragraph 3.3), and shall provide common support for the pump and motor (and flywheel, if one is specified). In the event of conflict, the requirements of this Section shall govern. Eight positioning jackscrews shall be provided for all drivers and flywheels (if specified) for all horizontal pump baseplates. All bases for horizontal pumps shall be equipped with jackscrews for positioning and leveling the base prior to grouting.

3. Mounting holes for anchor bolts in the bases shall be drilled and not burned out and they shall not be open slots. All mounting studs shall be Type 316 stainless steel. Anchor bolts shall be as specified under paragraph 11002-2.6. A non-seize or non-galling compound shall be used on all threads.
4. Mounting pads for equipment shall be machined after all welding and stress relieving and shall be coplanar to 0.002 inch in all directions. Mounting pads shall extend not less than 1 inch on all sides beyond the position for the equipment.
5. Equipment bases - for vertical volute-type pumps weighing more than 2000 pounds - shall be soleplates or leveling boxes under individual feet or support brackets integral with the volute casting. Direct mounting of the volute on housekeeping pads will not be permitted. Sole plates, mounting blocks and baseplates weighing more than 1000 pounds shall be leveled with jackscrews incorporated into the fabrication. Jackscrews shall be located in thickened pads or otherwise in sufficient metal to provide ease in adjusting level.
6. Sole plates, mounting blocks and baseplates weighing more than 1000 pounds shall be leveled with jackscrews incorporated into the fabrication. Jackscrews shall be located in thickened pads or otherwise in sufficient metal to provide ease in adjusting level.
7. The seismic design of equipment bases shall conform to the requirements of paragraph 11000-2.2J.

B. Type I Bases:

1. Type I bases shall be structural steel bases with thickened steel pads for doweling. The bases shall be rectangular in shape for equipment other than centrifugal refrigeration machines and pump bases, which may be "T" or "L" shaped to accommodate the equipment drive and accessories. Pump bases for split case pumps shall include supports for suction and discharge base ells, 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 base. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Terminations requiring connections to the base shall be nuts welded to the bottom side of the base and plugged with cork, plastic plugs or grease, or acorn nuts. Grout holes shall be provided for the bases of all equipment where vibration isolation is not specified.

C. Type II/III Bases: (NOT USED)

D. Type IV Bases :

1. Type IV bases shall be cast iron. Cast iron bases located within buildings do not require galvanizing but shall be sealed in accordance with the requirements for bleeding surfaces specified in Section 09800 prior to grouting. Terminations requiring connections to the base shall be nuts welded to the bottom side of the base and plugged with cork, plastic plugs or grease, or acorn nuts. In no case shall the fastener terminate only into the metal base.

E. Sole Plates:

1. Where sole plates are provided, the underside shall be scribed with the words "THIS SIDE DOWN" using welding rod material prior to milling the equipment mating surface flat to a tolerance of not less than 0.002/foot in all directions. Sole plates shall be designed to be installed in the housekeeping curbs shown.

2.4 GROUT FOR EQUIPMENT BASES

A. Epoxy Grout:

1. Unless otherwise specified, grout for equipment bases shall be non-shrinking epoxy grout conforming to the following requirements:

Test	Result
ASTM C531	Shrinkage shall be less than 0.080% and thermal expansion less than 17×10^{-6} in/in/°F
ASTM C579	Strength shall be a minimum of 12,000 psi in 7 days when tested by method B, modified.
ASTM C882	Bond strength to Portland concrete shall be greater than 2000 PSI
ASTM C884	Epoxy grout shall pass the thermal compatibility test when overlaid on Portland cement concrete
ASTM D638	Tensile strength shall not be less than 1700 psi. Modulus of elasticity shall not be less than 1.8×10^6 psi
ASTM C1181	Creep of the epoxy grout shall be less than 0.005 in/in with the test at 70°F and 140°F with a load of 400 psi
ASTM D2471	Peak exothermic temperature shall not exceed 110°F when a specimen 6 inch diameter x 12 inches high is used. Gel time shall be a least 150 minutes

2. The vehicle shall be a two-component (liquid and hardener) system designed to yield the above characteristics when combined with the manufacturer's recommended aggregate system. The grout shall be suitable for supporting precision machinery subject to high impact and shock loading in industrial environments while exposed to elevated temperature as high as 150 degrees F, with a load of 1200 psi. Aggregate for equipment base grout shall be as furnished by the manufacturer of the epoxy grout mix.

B. Cementitious Grout

1. Cementitious grout for use with equipment supports for equipment rated 5 horsepower and smaller or weighing less than 1000 pounds, whichever is less, shall be non-shrink grout as specified in Section 03315. Procedures for leveling and clamping equipment shall be as specified in this Section.

2.5 EPOXY PRIMER

- A. The 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 ANCHOR BOLTS

- A. Anchor bolts shall be as specified in paragraph 11000-2.20, set in PVC sleeves. Sleeves shall allow a free length projection of not less than fifteen bolt diameters above the concrete required to develop the strength of the bolt. Projection above the nut on the baseplate or soleplate shall be no more than 3/4 inch. Anchor bolts shall be located not less than 6 anchor bolt diameters from the foundation edge in all directions.

PART 3--EXECUTION

3.1 GENERAL

- A. Pumps shall be installed in accordance with this Section and ANSI/HI 1.4 and ANSI/HI 2.4. Grouting of equipment bases 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 shall be grouted with the equipment removed.
- B. Equipment that is not mounted on vibration isolators shall be anchored directly to the supporting floor system. In addition to the anchorage, all such equipment shall be internally designed so that all static and moving parts are anchored to the supporting framework to resist all imposed forces. All forces shall be transmitted to the base in order to be anchored as required.
- C. 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. Where the equipment manufacturer requires a rigid connection between the machine and connecting piping systems (generally, this will be higher discharge head pumps), the flexible coupling shown may be deleted and the CONTRACTOR shall install the equipment in the following manner:
 - 1. The equipment housekeeping pad shall be prepared as specified under paragraph 11002-3.2 B.
 - 2. The baseplate, soleplate or leveling blocks supporting the equipment shall be installed, leveled, and grouted in place as specified.
 - 3. The equipment shall be installed, aligned and doweled in place as specified.
 - 4. The piping shall be installed and aligned to the equipment connections and the field piping connections without welding on 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.
 6. The final sections of pipe 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.
- D. Conduit and piping for future equipment shall be capped flush with the floor or concrete pad in such a manner to allow future connection.
- E. The CONTRACTOR shall coordinate location of electrical conduit and piping penetrations within the concrete pad and equipment base. All penetrations shall stub-up on the same side of the equipment as required for connection to the equipment. Equipment drains shall be located as required for drainage from equipment.
- F. Prior to commencing equipment installation work, the CONTRACTOR shall cause the manufacturer of the epoxy grout to be used for equipment installation to conduct a training school for the workmen to be using the product. 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.

3.2 INSTALLATION

A. Anchor Bolts:

1. Prior to concrete placement, anchor bolts shall be accurately set according to the manufacturer's foundation drawings and firmly secured to prevent shifting during concrete placement. Drilled in anchor bolts will not be accepted. The bolts shall be embedded in the structural concrete to develop the full strength of the bolt. Concrete in housekeeping pads cannot be used for this purpose. All anchor bolts shall be dimensionally checked against the foundation drawings for proper length, diameter, thread length, thread projection, etc., by a representative of the equipment manufacturer prior to placing concrete. Prior to placing concrete for the housekeeping pad, plastic sleeves shall be placed around each bolt to provide for minor adjustment of bolt position prior to grouting. Sleeves shall be filled with a pliable, nonbonding material such as silicon rubber or wax to prevent contact between the concrete or grout and the anchor bolt. Bolt threads and projections in the sleeves (refer to paragraph 11002-2.6) above the structural slab shall be protected in the sleeve by heavily greasing or waxing the threads and shank with paste wax and wrapping with plastic sheeting. The protective wrapping shall be firmly secured with tie wires. The protective wrapping shall be removed prior to placing the grout.
2. The equipment manufacturer shall recommend the size of the anchor bolts for the equipment and shall also furnish the recommended tightening torque for the nuts; however, the minimum size bolt shall be 3/4 inch for equipment rated 20 to 100 horsepower, 1 inch for equipment rated over 100 to 300 horsepower and 1-1/4 inches for 300 to 500 horsepower. Anchor bolts for equipment rated over 500 horsepower shall be as recommended by the manufacturer of the equipment and as approved by the CONSTRUCTION MANAGER.

B. Concrete Housekeeping Pad Preparation:

1. After the concrete is fully cured (sample cylinders, as specified in Section 03300, shall be taken and tested for all housekeeping pads supporting equipment weighing more than 1000 pounds), the housekeeping pad shall be chipped approximately 3/4 inch to 1 inch to remove all laitance and defective or weak concrete. A light duty, hand held pneumatic chipper with a chisel type tool shall be used for chipping the foundation. Abrasive blast, bush-hammer, jack hammers with sharp chisels or needle gun preparation of concrete surfaces to be grouted are not acceptable. The amount of concrete removed shall be such that the final baseplate or soleplate elevation results in not less than 3 inches of grout between the surface of the housekeeping pad and lower baseplate flange or the underside of the soleplate.
2. All edges shall be chamfered 2 to 4 inches at a 45-degree angle. All dust, dirt, chips, oil, water, and any other contaminants shall be removed and the foundation shall be covered with protective plastic sheeting. The grout contact surface on the housekeeping pad shall be coated with one coat (not more than 5 mils) of catalyzed epoxy resin.

C. Equipment Bases and Soleplates:

1. All surfaces of equipment bases and soleplates to be in contact with epoxy grout shall be cleaned to SP-6 and shall be primed with epoxy primer within 8 hours of cleaning.

D. Leveling and Shimming:

1. All machinery shall be mounted and leveled by millwrights. All equipment bases and equipment shall be leveled against steel surfaces. Use of other materials for leveling purposes is strictly and specifically prohibited. Unless otherwise specified, baseplates, mounting blocks and soleplates weighing less than 1000 pounds shall be leveled on stainless steel blocks 4 inches square and 1-1/2 inches thick with a hole drilled in the center for the anchor bolt, placed under the base at every anchor bolt. Leveling shall be by use of mounting blocks machined flat on all horizontal surfaces and measuring not less than 4 inches wide horizontally and shims that shall extend not less than three inches beyond the base of the equipment. Mounting blocks shall be coated with a light oil just prior to beginning the leveling and grouting work. Using precut stainless steel shims coated with a light oil between the base and the steel blocks at the anchor bolts, the CONTRACTOR shall level the equipment baseplates, soleplates or mounting blocks against the anchor bolt nuts (finger tight only) to a maximum tolerance of 0.0005 in./ft or as otherwise required by the equipment manufacturer, if more stringent. Mounting surfaces for equipment shall be coplanar within 0.002 inch in any direction. The shims shall be placed so the tabs on the shims are easily accessible. A minimum of four shims per anchor bolt shall be used. The total shim thickness at each anchor bolt shall be at least 0.015 inch. Leveling shall be against anchor bolts prior to final grouting.
2. The CONTRACTOR shall level the equipment against the anchor bolt nuts to a maximum tolerance of 0.002 in./ft or as otherwise required by the equipment manufacturer, if more stringent. Leveling equipment shall be precision surveying equipment. Machinists' spirit levels will not be permitted for leveling purposes for any base plate or equipment foundation with a plan dimension greater than 4 feet.

3. Leveling nuts may be used for mounting equipment weighing less than 500 pounds. The CONTRACTOR shall level the equipment against the anchor bolt nuts to a maximum tolerance of 0.0005 in./ft or as otherwise required by the equipment manufacturer, if more stringent. Anchor bolt nuts shall be only finger tight during the leveling process. Wedges will not be allowed and under no circumstances shall shims be used as permanent support under baseplates, soleplates or leveling plates.

E. Grouting:

1. Grout forms shall be built of minimum of 3/4-inch thick waterproof plywood and shall be securely braced (minimum brace size shall be 2 inches x 4 inches). Forms shall provide a minimum of 2-inch hydrostatic head above the final elevation of the grout to assist in flow during installation.
2. Forms must 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, 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. All outside vertical and horizontal edges of the grout shall have 45-degree chamfers. Blockouts shall be provided at all shimming and leveling nut positions to allow removal of shimming equipment after the grout has cured. Jackscrews shall be coated with a light oil or other acceptable bond-breaking compound.
3. The 45-degree 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 baseplates with solid sides and soleplates, shall be 1.0 inch above the bottom of the baseplate or the underside of the soleplate. The grout's final elevation shall not be so high as to bond the anchor bolt nut and washer.
4. The epoxy resin and hardener shall be mixed in accordance with the grout manufacturer's recommendations. Aggregate shall be slowly added to the mixer one bag at a time. The grout should be mixed only long enough to wet out all the aggregate. 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. The 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. 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 or soleplate 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 (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.

5. A grout sample shall be taken for each piece of equipment to be grouted. The sample shall be placed in a cylinder of sufficient size to yield three 2-inch x 2-inch x 2-inch test samples. The samples shall be tagged with the equipment number and ambient temperature at the time of placement. The samples shall be tested in accordance with the manufacturer's recommendations. 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 an independent testing laboratory. 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.

F. Completion:

1. Upon acceptance by the CONSTRUCTION MANAGER and the equipment manufacturer's representative after the grout has reached sufficient strength, the shims shall be removed, and leveling nuts or jack screws backed off to allow the grout to fully support the equipment base, leveling block or soleplate. Removal of extended shimming material (direct mounted baseplates weighing 1000 pounds or less) shall be by sledge hammer, taking care not to damage the grout. Once shims have been removed, or jackscrews backed off, the anchor bolts shall be torqued, using calibrated indicating torque wrenches, to develop the full clamping force required by the equipment manufacturer. Anchor bolts shall be torqued in increments of not more than 25 percent of final value in an alternating pattern to avoid stress concentration on the grout surface. Pockets for access to shims, or leveling nuts shall be filled with grout mix and pointed after the anchor bolts have been torqued to final values.

****END OF SECTION****

SECTION 11005 - MACHINE ALIGNMENT

PART 1--GENERAL

1.1 WORK OF THIS SECTION

- A. This Section specifies requirements for alignment of all new and modified mechanical equipment (such as the four engine generators) to be furnished or modified under this contract. Equipment with drivers 5 horsepower and less 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:** 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:** Unless otherwise specified by more stringent manufacturer's requirements, all mechanical equipment affected by this specification shall be aligned to the following criteria:

Speed, rpm, maximum	Couplings		Spacer Shafts offset, mils/ inch of shaft length
	Offset (mils)	Angularity (mils/inch)	
600 and less	5.0	1.0	1.8
900	6.0	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 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 shall be compatible with 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 computer shall be powered by rechargeable NiCad batteries and shall be capable of storing up to 1000 machine measurement sets, complete with labels, graphics and comments. The link between field measurement instruments and the computer shall be through infrared transmission. Cable link-dependent equipment will not be acceptable. External interface between the field computer and other processors shall be by RS-232C serial cable ports.

2. The laser emitter shall be Class 2 type, FDA 21 CFR 1000 and 1040 compliant, powered by lithium ion batteries. The laser shall operate on a 670 nm wavelength and shall have a beam, divergence of less than 0.3 microradians at a power of not more than 1 microwatt. The laser receiver shall have 5 axis capability with a resolution of 0.04 mil offset and 10 micro radians angularity.

1.3 SPECIFICATIONS AND STANDARDS

- A. This Section contains references to the following documents. They are a part of this Section and any referencing section as specified and modified. In the event of conflict between the requirements of this Section or any referencing section and those of the listed documents, the requirements of this Section or the referencing 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, second edition, John Piotrowski, Marcel Decker Inc.

PART 2--PRODUCTS

2.1 EQUIPMENT

- A. Laser alignment equipment shall be Rotalign® Pro as manufactured by Ludeca, Inc., of Miami, Florida, or equal.

2.2 PRODUCTS 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. (NOT USED).
 2. All alignment records, in both hard copy and electronic format. The hard copy shall be signed and dated by the technician performing the alignment work and shall be witnessed by the CONSTRUCTION MANAGER.

PART 3--EXECUTION

3.1 CONSTRUCTION

- A. After machine base grouting as specified under Section 11002, all machines mounted on baseplates or sole plates specified above shall be aligned as specified under this Section. 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. All machines shall be 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 and repeat the alignment process. All machine alignment parameters shall be rechecked after the equipment has been brought to operating temperature by operation at specified conditions. Where required by other sections in these Contract Documents, factory authorized installation technicians representing the equipment manufacturer shall witness final alignment work. All alignment work shall be independently checked using the shaft and coupling spool method described in Shaft Alignment Handbook. After completion of all alignment work and acceptance in writing by factory installation technicians, all machines shall be doweled in place using tapered stainless steel dowels. 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 of the alignment equipment. The use of laborers, carpenters or apprentices for this work shall not be acceptable. All final results of the alignment work shall be subject to inspection and verification by the CONSTRUCTION MANAGER.

END OF SECTION

SECTION 11020 - VIBRATION AND CRITICAL SPEED LIMITATIONS

PART 1--GENERAL

1.1 WORK OF THIS SECTION

- A. This Section specifies vibration and critical speed limitations for all new and modified rotating mechanical equipment such as four engine generators. Factory and/or field testing and vibration measurements shall be taken when specified in the individual equipment specification sections.

1.2 VIBRATION LIMITATIONS

- A. **General:** Vibration frequencies shall span the range from 5.0 to 5000 Hz. Where specified, measurements shall be obtained while the installed equipment is operating within the specified speed range.
- B. **Centrifugal:**
1. **Machines with Sleeve Bearings:** Unless otherwise specified, centrifugal machines with sleeve bearing shafts shall not exhibit unfiltered RMS readings for vibration displacement in excess of the following:

Shaft speed range, rpm	Displacement, peak to peak, mils
Up to 900	3.5
901-1800	3.0
1801-3000	2.5
3001-4500	2.0
Above 4500	1.6

2. Displacement measurements shall be taken radially on the shaft at two points at each bearing, except for well pumps which shall be measured at top of motor. Measuring points shall be 90 degrees apart.
 3. **Machines with Antifriction Bearings:** Unless otherwise specified, centrifugal machines with antifriction bearing shafts shall not exhibit unfiltered RMS readings for vibration velocity in excess of 0.12 inch per second. Velocity measurements shall be taken on one point of each bearing housing.
- C. **Positive Displacement Machines:** Unless otherwise specified, positive displacement machines of the rotary, reciprocating and controlled volume types shall operate without any lateral or torsional vibration characteristics that may accelerate wear of the equipment. The CONTRACTOR shall provide manufacturer's certification that the manufacturer has

inspected the machine under operating conditions and found it to comply with the requirements of this paragraph.

1.3 CRITICAL SPEED REQUIREMENTS

- A. Unless otherwise specified, rotating mechanical equipment shall not exhibit critical speeds within the specified range of operating speeds. Critical speeds for equipment with rigid rotor systems shall be at least 20 percent greater than maximum operating speed. Critical speeds for equipment with flexible shaft-rotor systems shall be at least 15 percent below minimum operating speed and 20 percent above maximum operating speed.

1.4 SHOP DRAWINGS AND SAMPLES

- A. The following information shall be submitted:
 - 1. Manufacturer's certified data showing location of critical speeds in relation to operating speeds.

PART 2--PRODUCTS (NOT USED)

PART 3--EXECUTION (NOT USED)

****END OF SECTION****

SECTION 11175 - PUMPS, GENERAL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing general requirements for **pumps** and pumping appurtenances both new and modified, and providing special tools and **spare parts**.
- B. The WORK also includes coordination of design, assembly, testing and **installation**.

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 11000 Equipment, General Provisions
 - 2. Section 11002 Equipment Supports, Grouting and Installation
 - 3. Section 11005 Machine Alignment
 - 4. Section 11020 Vibration and Critical Speed Limitations

1.3 SPECIFICATIONS AND STANDARDS

- A. Specifications and standards shall comply with Section 11000 and **shall** include the following:

AISC	American Institute of Steel Construction, Manual of Steel Construction, Allowable Stress Design - 9th Edition
AISI 1045	Steel
ANSI/ASME B73.1	Specifications for Horizontal End Suction Centrifugal Pumps for Chemical Process
ANSI/ASME B73.2	Specifications for Vertical In-Line Centrifugal Pumps for Chemical Process
ANSI/AWWA E101	Deep Well Vertical Turbine Pumps - Line Shaft and Submersible Types
ANSI/HI 1.1-1.6	Centrifugal Pumps
ANSI/HI 2.1-2.6	Vertical Pumps
ANSI/HI 3.1-3.6	Rotary Pumps
ANSI/HI 6.1-6.6	Reciprocating Pumps
ANSI/HI 7.1-7.5	Controlled Volume Pumps

ANSI/HI 9.1-9.5	Pumps - General Guidelines
ANSI/HI 9.3.3	Pumps - Polymer Material Selection
ANSI/HI 9.6.1	Centrifugal and Vertical Pumps for NPSH Margin
ANSI/HI 9.6.3	Centrifugal/Vertical Pumps Allowable Operating Region
ANSI/HI 9.6.4	Centrifugal and Vertical Pumps. Vibration Measurements and Allowable Values.
ANSI/HI 9.8	Pump Intake Design Standard
ANSI/IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
ANSI/IEEE 115	Test Procedure for Synchronous Machines
API 610, 1995	Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Services
ASME Code	ASME Boiler and Pressure Vessel Code
ASTM A 53	Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
ASTM A128	Steel Castings, Austenitic Manganese
ASTM A 216	Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service
ASTM A217	Steel Castings, Austenitic and Martensitic Stainless and Alloy
ASTM A 276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A 278	Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650° F (345° C)
ASTM A 283	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 322	Specification for Steel Bars, Alloy, Standard Grades
ASTM A 395	Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A 470	Specification for Vacuum-Treated Carbon and Alloy Forgings for Turbine Rotors and Shafts
ASTM A 536	Specification for Ductile Iron Castings

ASTM A 571	Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low Temperature Service
ASTM A 576	Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A 743	Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, and Nickel-Base Corrosion-Resistant for General Application
ASTM A 744	Castings, Iron Chromium-Nickel, Corrosion Resistant, for Severe Service
ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings
ASTM B 148	Aluminum Bronze Sand Castings
ASTM B 505	Copper-Base Alloy Continuous Castings
ASTM B 584	Copper Alloy Sand Castings for General Applications
ASTM E 448	Recommended Practices for Scleroscope Hardness Testing of Metallic Materials
AWS-B3.0	Welding Procedures and Performance Qualifications
AWS-D1.1	Structural Welding Code--Steel
Hydraulic Institute	(See applicable ANSI/HI Standard) Standards
ISO 9001	Quality Systems
ISO 10816	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 III, 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.
NEMA MG1	Motors and Generators
UL 674	Motors and Generators, Electric, for Use in Hazardous Locations, Class 1, Groups C and D, Class II, Groups E, F and G

1.4 SHOP DRAWINGS AND SAMPLES

- A. In addition to the requirements of Section 11000 and the material listed in the detailed specification, the following shall be submitted:

1. At least one successfully operating installation of comparable size and complexity (including no cavitation, damaging vibration or shaft damage within the first three years of operation) designed and installed in the recent past by the proposed pump manufacturer, with address and telephone numbers.
2. A Certificate of Unit Responsibility Assignment signed by officers of both the CONTRACTOR and the pump manufacturer corporations, attesting to the assignment of responsibility in accordance with these Contract Documents. ***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 motor, 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 11175-2.1A.
6. Predicted pump performance curves for each condition point specified showing head, power, efficiency, and NPSH required on the ordinate plotted against capacity (in gpm) on the abscissa. Pump inlet, bowl, column and discharge head losses for column pumps shall be shown as separate curves where appropriate. Curves for variable speed pumps shall be provided at 100-rpm intervals between the minimum and maximum speeds required to achieve the specified operating conditions. Manufacturer's recommended operating range for stable operation and prevention of surge, cavitation and vibration. Under no circumstances shall the manufacturer's recommended operating range be less than that required to meet the pump operating conditions specified.
7. NPSHR margin calculations performed in accordance with paragraph 11175-1.9G.2 or 3 as applicable and including the information required under paragraph 11175-1.9G.1.

8. Motor submittal information as specified in the Contract Documents. In addition, this information shall include certified calculations for motor rotor and frame reed frequencies, as specified under paragraph 11175-1.9H.
9. Complete description and sketch of proposed test setup for factory test if a factory test is required by the terms of these specifications, at least 10 weeks in advance of the proposed test date. Submittal material shall include sample calculations and proposed test log format. Submittal shall be in accordance with paragraph 11175-1.7C.6.
10. Information required under Section 11020.
11. Drawings showing general dimensions and confirming the size of pumps, motors, drives, flywheels (if required), and specified appurtenances; piping connections; construction details of equipment; wiring diagrams; and weight of equipment.
12. Variable-speed drive information as required under Division 16 if the equipment specified includes variable speed capability.
13. Drive unit support calculations and data if the drive is separately supported and if the analysis under the requirements of paragraph 11175-1.10 is required by the terms of these specifications.
14. Qualifications of the design professional performing the mass elastic design analyses specified under paragraph 11175-1.10 if the subject analysis is required by the terms of these specifications.
15. Critical speed calculations and mass elastic systems analyses for pumps as specified in paragraphs 11175-1.9C or 11175-1.10, if the subject analyses are required by the terms of these specifications.
16. Manufacturer's design and calculations for intermediate shafting, if intermediate shafting is required. Show shaft lengths, location of bearing supports, and shaft critical speed.
17. Shaft deflection calculations to demonstrate compliance with paragraph 11175-1.10 if shaft deflection calculations are required by the terms of these specifications.
18. Calculations justifying the dimensions of flywheels, if flywheels are required.
19. Details of the pump and drive unit foundation, including type, size, number, and arrangement of anchor bolts, dimensional drawings of the sole and base-plates, and all other information required under Section 11002.
20. If factory tests are required by the terms of these specifications, certification of satisfactory testing of each unit as specified. The certified material shall include copies of test logs and resulting performance curves at least four weeks prior to shipping the units from the factory. Manufacturer's reports on hydrostatic tests, including calibration test results on all instruments used to conduct the factory hydrostatic and performance tests.

21. Results of motor rotor, frame and assembly bump tests, certified as specified under paragraph 11175-1.9H, along with the design professional's supplementary report as specified under paragraph 11175-1.10B.
22. Vibration measurement results as specified in paragraph 11175-3.5.

1.5 OWNER'S MANUAL

- A. In addition to the requirements of Section 11000, the following shall be included in the OWNER'S MANUAL submittal:
 1. Manufacturer's written guarantee that pumping equipment operates with efficiencies, heads and flow ranges indicated and meets vibration and critical speed limitations indicated.
 2. Drive unit support calculations and data if the drive is separately supported and if the analysis under the requirements of paragraph 11175-1.10 is required by the terms of these specifications.
 3. Critical speed calculations and mass elastic systems analyses for pumps as specified in paragraphs 11175-1.9C or 11175-1.10, if the subject analyses are required by the terms of these specifications.
 4. Shaft deflection calculations to demonstrate compliance with paragraph 11175-1.10 if shaft deflection calculations are required by the terms of these specifications.
 5. Calculations justifying the dimensions of flywheels, if flywheels are required.
 6. Performance guarantee as specified in paragraph 11175-1.7C if a Performance Guarantee has been specified.
 7. Balance logs for pumps with nozzles sizes 6 inches in diameter and greater, certified, signed and notarized in accordance with paragraph 11175-2.7.
 8. Certified copies of factory test logs and resulting performance curves. Manufacturer's reports on hydrostatic tests, including calibration test results on all instruments used to conduct the factory hydrostatic and performance tests.
 9. Vibration measurement results as specified in paragraph 11175-3.5.

1.6 SERVICES OF MANUFACTURER

- A. Services of manufacturer shall be provided in accordance with Section 11000, this Section, and the detailed pump specifications.

1.7 FACTORY 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 two OWNER-designated inspectors for the number of days indicated to complete such inspections or observations, 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. **Performance Curves:** Centrifugal pumps shall have a continuously rising curve toward the shut-off head and in no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or engine. The allowable operating region for all centrifugal and axial flow pumps shall comply with the requirements of paragraph 11175-1.9.
- C. **Performance Confirmation:** Pumps, drives, and motors shall be factory-tested to confirm specified requirements in accordance with the applicable ANSI/HI Pump Standards Test Code for Centrifugal, Vertical, Rotary, and Reciprocating Pumps, and test data shall be recorded. Tests shall be performed on all pumps and motors of sizes 25 horsepower and larger. Prototype model tests will not be acceptable.
 - 1. Test data shall include the following:
 - a. Hydrostatic test results
 - b. Hydraulic test results with, unless otherwise specified, a minimum of 10 readings between shutoff head and 25 percent above design capacity.
 - c. Certified pump curves showing head/flow, horsepower, efficiency and NPSHR curves.
 - d. Certification that the pump horsepower demand will not exceed the rated motor horsepower beyond a 1.0 service rating at any point on the curve.
 - e. Motor test results
 - f. NPSH margin test results, if NPSH margin tests are required
 - 2. **Factory Tests of Motors:** All pump motors of sizes 25 horsepower and larger, shall be assembled, tested, and certified at the factory and the working clearances checked to insure that all parts are properly fitted. The tests shall comply with ANSI/IEEE 112 and ANSI/IEEE 115 standards, including heat, running and efficiency tests.
 - 3. **Hydrostatic Tests:** All pressure sustaining parts shall be subjected to factory hydrostatic tests. Hydrostatic tests for centrifugal and axial flow pumps shall conform to the requirements of API 610.
 - 4. **Performance Guarantee:** Unless specified otherwise, pump performance, including NPSHR for centrifugal and axial flow pumps, shall be guaranteed by the pump manufacturer to the most restrictive tolerances set forth in the applicable ANSI/HI Standard. 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, 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 rating.

5. **Factory Witnessed Tests:** Unless otherwise specified, pumps, variable speed drives (if any), and motors, for pumping units 150 horsepower and larger, shall be factory tested as complete, assembled units and witnessed by a representative of the CONSTRUCTION MANAGER and of the OWNER.
6. The CONTRACTOR shall submit a sketch of the proposed witnessed test setup, along with a description of the proposed testing procedure to the CONSTRUCTION MANAGER for acceptance at least 10 weeks in advance of the proposed test date. No tests shall be performed until the test procedure meets with the CONSTRUCTION MANAGER'S approval. In addition, the CONTRACTOR shall furnish the CONSTRUCTION MANAGER with at least 4 weeks advance written notice of the date and location of the witnessed performance tests.
7. **Witnessed Tests:** Witnessed pump performance tests shall be in accordance with the applicable ANSI/HI test standard. NPSHR tests shall also be performed for centrifugal and axial flow pumps to confirm the data used to establish NPSHA margin as specified in paragraph 11175-1.9G. NPSHR tests for column type (axial flow and vertical turbine) pumps shall be performed using the method described for Figure 2.6.3 or Figure 2.6.4 in ANSI/HI 2.6. All NPSHR tests shall extend from 10 percent to 120 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. Not less than ten data points shall be developed during the test. Failure to achieve guaranteed performance (capacity and head, efficiency or NPSHR) shall be cause for rejection. Tolerances shall be the most restrictive set forth in the applicable standard. 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 rating.
8. **Non-Witnessed Tests:** Where non-witnessed tests are permitted, centrifugal and axial flow pumps shall be tested in accordance with ANSI/HI 1.6 or 2.6, as applicable. Not less than ten data points shall be developed during the test. NPSHR tests shall also be performed to confirm the data used to establish NPSHA margin as specified in paragraph 11175-1.9G. NPSHR tests for column type (axial flow and vertical turbine) pumps shall be performed using the method described for Figure 2.6.3 or Figure 2.6.4 in ANSI/HI 2.6. All NPSHR tests shall extend from 10 percent to 120 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 (capacity and head, efficiency or NPSHR) shall be cause for rejection. Tolerances and restrictions shall be as set forth above for witnessed tests. The CONTRACTOR shall furnish the CONSTRUCTION MANAGER with not less than two weeks' advance written notice of the date and place of the non-witnessed tests.
9. In the event of failure of any pump to meet any of the specified requirements or efficiencies, the CONTRACTOR shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and such pump shall be retested at no additional cost to the OWNER, until found satisfactory.

10. All test results (data sheets, test logs and generated performance curves) shall be signed and certified correct by an officer of the manufacturing corporation and shall be notarized.
11. Upon completion of testing, curves shall be produced showing pump performance (head, efficiency, NPSHR (if applicable), and power required versus capacity) at full speed and predicted performance at speeds required to meet all other indicated operating conditions. Contractor shall submit test plan, procedures, and a schedule with dates and times no less than 30 days prior to commencement of testing. The test results shall be certified and notarized as noted above and submitted to the CONSTRUCTION MANAGER. The pumps shall not be shipped until authorized, in writing, by the CONSTRUCTION MANAGER. Final acceptance of the equipment will depend on satisfactory operation after installation.

1.8 FIELD TESTS

- A. All pumping units, both new and modified shall be field tested after installation to demonstrate proper operation, without excessive noise, vibration, cavitation, and overheating of bearings. The field testing shall be performed in the presence of a knowledgeable field representative of the manufacturer of the equipment, who shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation and shall witness the following:
 1. Startup, checking, and operation of the equipment over the entire speed range. For pumps smaller than 50 horsepower without variable speed drives, the vibration shall be within the limits specified in Section 11020 and the vibration shall be recorded at a minimum of 4 pumping conditions which have been reviewed by the CONSTRUCTION MANAGER. Vibration requirements for pumps 50 horsepower and larger and all pumps with variable speed drives are specified in paragraph 11175-3.5.
 2. Pump performance shall be documented by obtaining concurrent readings, showing motor voltage, amperage, pump suction head, and pump discharge head, for at least 4 pumping conditions at the respective pump rpm. Each power lead to the motor shall be checked for proper current balance.
 3. Determination of bearing temperatures by a contact-type thermometer. A running time of at least 20 minutes shall be maintained for this test, unless liquid volume available is insufficient for a complete test.
 4. Ensure that electrical and instrumentation testing complies with Sections 13300 and Division 16 Sections.

Additional field testing requirements are specified in Section 11000, Part 1, and may be specified in the individual equipment specifications.

1.9 DESIGN REQUIREMENTS FOR CENTRIFUGAL AND AXIAL FLOW PUMPING EQUIPMENT

- A. **General:** Provisions and requirements contained in this paragraph (1.9) apply specifically to centrifugal and axial flow pumps, both vertical and horizontal, commonly falling into the generic types covered by ANSI/HI 1.1 through 1.6 and 2.1 through 2.6. More restrictive requirements, where found in individual pump specifications, shall supercede requirements of

this paragraph. This paragraph does not apply, except by specific reference, to positive displacement pumps of any type.

Centrifugal and axial flow pumping equipment shall conform to the requirements of paragraph 2.1.1, API 610. All components in 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 or throttled valve 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.

- B. **Pump Selection:** Pumps shall be selected to place all specified continuous duty operating conditions within the manufacturer's Allowable Operating Range as defined in ANSI/HI 9.6.3. Unless otherwise specified in individual pump specifications, rated conditions and all other continuous duty full speed operating conditions specified in the detailed pump specifications shall fall within the manufacturer's Preferred Operating Range as defined in ANSI/HI 9.6.3. The Preferred Operating Range shall be not less than that specified in paragraph 2.1.12, API 610. Proposed pump selections shall be selected to allow not less than a five percent increase in head, as specified in paragraph 2.1.4 of API 610. Variable speed operation to achieve this objective will not be considered. Pump selections proposing maximum diameter impellers for the proposed pump model and casing size will not be accepted.

Pumping equipment shall be suitable for the operating modes described in the detailed pump specifications and other relevant portions of the Contract Documents.

All pumps shall be designed in accordance with applicable portions of ANSI/HI 1.1 - 1.6, 2.1 - 2.6 and ANSI/HI 9.1 - 9.6 and the requirements of this Section. The pumps shall be specifically designed to pump the fluids described in the detailed pump specifications and shall operate without clogging or fouling caused by material in the pumped fluid at any operating condition within the range of service specified.

The pumps shall operate without cavitation or damaging vibration over the entire specified range of flow and head conditions and shall be specifically selected for NPSHR characteristics conforming to the requirements of paragraph 11175-1.9G.

Unless otherwise indicated, the 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 as described in paragraph 9.6.3.3.12 of ANSI/HI 9.6.3 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. **Critical Speeds and Natural Frequencies:** Unless otherwise specified for variable speed pumping equipment or for custom engineered pumping equipment, 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 performance characteristics specified.

The logarithmic decrement for each damped natural frequency within this range shall be greater than +0.3.

Unless otherwise specified, the CONTRACTOR shall furnish documentation under paragraph 11175-1.4 demonstrating compliance with this requirement for all pumping equipment with discharge nozzle sizes 6 inches in diameter and greater.

- D. **Impeller Clearances and Keyways:** The radial clearance between the tip of the impeller vane and diffuser or volute vanes shall be not less than 3 percent and 6 percent, respectively, of impeller diameter. The ratio of liquid channel widths (diffuser or volute/impeller) shall be not less than 1.15 nor more than 1.3 for diffuser pumps and 1.4 B 1.5 for volute-type pumps.

Impeller keyways for multistage diffuser-type pumps shall be cut at differing positions on the impeller shaft to avoid multiple simultaneous vane passing pulses.

E. **Component Design Criteria:**

1. **General:** Unless otherwise indicated, combined stresses in steel frames and supports shall not exceed those permitted by the AISC Manual of Steel Construction. 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. The term "combined stresses" in this paragraph (1.9) 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. Dynamic forces shall include both steady state and transient stresses induced by operating conditions.
2. **Anchorage:** Unless otherwise indicated, anchor bolts for vertical volute-type and vertical axial flow pumps shall be designed to restrain twice the forces developed by operation of the pump at maximum speed against a closed valve with no restraint at the pump inlet and discharge flanges.

Bases for horizontal pumps shall be designed in accordance with paragraph 11175-2.6, and shall provide common support for the pump and motor (and flywheel, if one is specified).

All vertical (column type) pumps with unit weights (including drive, if supported by the pump) weighing more than 1,000 pounds and all volute type pumps with nozzle sizes 16 inches in diameter and greater and all separately supported motors shall be supported on a sole plate provided by the pump manufacturer. Sole plates shall be designed in accordance with paragraph 11175-2.5.

Anchor bolts and connecting bolts for all assemblies supported by other assemblies furnished under this Section or sections referencing this Section, shall be designed in accordance with the requirements of this Section, Section 11000, and the individual pump specifications. Anchor bolts, nuts and washers shall comply with paragraph 11175-2.2.

3. **Torsional and Combined Shaft Stresses:** The pump rotor shall be free from torsional criticals and shall comply with all stress requirements indicated in paragraph 11000-1.12A.
 4. **Shaft Deflection:** 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 continuous operating condition within the zone described by the specified continuous duty operating conditions. Deflection at the shaft seal shall be calculated using the relationship set forth in paragraph 11175-1.10D.3.
 5. **Bearings:** Unless otherwise specified, anti-friction bearings shall be selected for an L-10 life expectancy in accordance with the requirements specified in paragraph 11000-2.8. Radial loads shall be calculated in accordance with the provisions set forth in paragraph 11175-1.10.
- F. **Rotor and Critical Speed Analysis and System Design:** Requirements for the rotor and critical speed analysis and system design are specified in paragraph 11175-1.10.
- G. **Net Positive Suction Head Required Limitations:**

1. **General:** Pumps furnished under this section and sections referencing this section shall be selected for NPSHR (Net Positive Suction Head Required) characteristics using the suction energy methodology set forth in ANSI/HI 9.6.1. NPSHR characteristics for the candidate pump shall be based upon documented test data not more than five years old, 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 NPSH characteristics as set forth in this paragraph.

Individual restrictions shall apply to NPSH margin as set forth below, depending upon the type of pumping equipment and the fluid to be pumped. The detailed specification sections provide NPSHA (Net Positive Suction Head Available or wet well elevation) 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 adjust the NPSHA information to the elevation of the pump impeller eye for the specific pump model and size proposed for the application. NPSHR, as used in the following paragraphs, shall mean the NPSHR at the impeller eye, determined in accordance with ANSI/HI 1.6 or 2.6, as applicable for the proposed pump. The CONTRACTOR shall document the method used to determine NPSHR for the proposed pump and justifying compliance with the NPSH margin limitations established under this paragraph in material submitted under paragraph 11175-1.4. The documentation shall include justification of the NPSHR tests used to develop NPSHR characteristics, including the following:

- a. Date, test procedure, and test logs of original NPSHR information used to project requirements for pump selected for the application.

- b. Test pump size, impeller diameter, impeller model, eye diameter, and speed.
- c. Calculations projecting NPSHR test information to NPSHR curve information for pump proposed for the application.
- d. Calculations demonstrating compliance with the NPSH margin requirements established in this paragraph.

The CONTRACTOR, using suction energy rules in selecting pumps proposed for each application, shall apply criteria set forth in the individual paragraphs below. Percentages stated below shall apply to pump capacity on the selected pump's head/capacity curve at the speed required to achieve the specified operating condition.

The CONTRACTOR shall submit the manufacturer's suction energy calculations justifying the proposed pumps selections with the material required under paragraph 11175-1.4.

2. **Pumps Used for Solids Bearing Liquids:** The following restrictions shall apply to pumps specified for wastewater, stormwater, primary effluent, return mixed liquor, RAS, and trickling filter service:

- a. A minimum NPSHA/NPSHR margin ratio of 1.3 shall apply at any operating condition within 85 percent and 115 percent of the best efficiency capacity. The minimum acceptable NPSHA/NPSHR margin ratio at any other locations on the pump's head/capacity curve shall be 1.8.
- b. Notwithstanding item a above, the manufacturer shall use the methodology in ANSI/HI 9.6.1 to determine the proposed pump's suction energy. In determining the proposed pump's suction energy, the inlet nozzle size shall be increased by two nozzle sizes to account for impeller design considerations. In employing the suction energy method, the minimum NPSHA/NPSHR ratio shall be not less than that recommended in ANSI/HI 9.6.1 or item a., above, whichever is greater. For submersible and wet pit pumps, suction nozzle size shall be the impeller eye diameter of the proposed pump.
- c. If the proposed pump's suction energy, as determined in item b, falls into the "high" or "very high" region, as determined from Figure 3 in ANSI/HI 9.6.1, the minimum acceptable NPSHA/NPSHR margin ratios shall be 1.5 and 2.0, respectively.

3. **Pumps Used for Clear Liquids:** The methodology set forth in ANSI/HI 9.6.1 shall be employed for determining NPSHA margin for pumps to be used on liquids which do not normally contain solids, such as potable and process water, heating water, and secondary and tertiary effluent pumping service. The acceptable minimum NPSHA less NPSHR margin shall be 5 feet at any specified operating condition falling within 85 percent and 115 percent of best efficiency capacity at the speed required to achieve the specified operating condition, and not less than 8 feet for any specified operating condition falling outside that zone. Suction nozzle size for wet pit and column-type pumps shall be the impeller eye diameter of the proposed pump.

H. **Motor Selection:** Unless otherwise specified, pumps shall be electric motor driven. Electric

motors shall conform to the requirements set forth in the Contract Documents or shall be as specified in the detailed pump specification. 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. Motors furnished with pumps specified for operation at variable speed shall be inverter duty types conforming to the requirements of Division 16 and shall be compatible with the variable speed equipment furnished with the pump.

The CONTRACTOR shall provide certified reed frequency calculations for both the motor rotor and frame for motors driving "Custom Engineered" pumps, with the data to be submitted under paragraph 11175-1.4. Upon completion of construction of the motors driving "Custom Engineered" pumps for this project, each rotor and frame and the completed assembly shall be given a bump test to confirm the reed frequency calculations. The results of the bump test, certified by an officer of the manufacturing corporation and notarized, shall be furnished to the design professional responsible for the rotor and critical speed analysis (paragraph 11175-1.10) and submitted under paragraph 11175-1.4 and included in the Owner's Manual.

1.10 ROTOR AND CRITICAL SPEED ANALYSIS AND SYSTEM DESIGN

- A. **General:** New and modified existing pumps shall be subject to the analysis. Differences, if they exist, shall be identified (example impeller shaft differences). The requirements of this paragraph shall apply to all variable speed pumping systems with pump nozzle sizes 12 inches in diameter and greater, all pumping unit specifications where the words "Custom Engineered" appear in the title or in paragraph 1.1A of the specification section, and elsewhere when a detailed pump specification makes reference to this paragraph. In addition, overhung shaft pumps operating in single volute casings shall be subject to analysis for shaft deflection in accordance with the terms of this paragraph.
- B. **Requirements:** 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.

The complete pumping unit rotating element, including pump, motor, intermediate shaft and flywheel rotors (if specified), and all other elements in the power train or powered via the power train, shall be designed to limit torsional stresses.

The torsional and rotordynamic analyses shall together be termed the pumping equipment's mass elastic design. The mass elastic design shall be the product of a registered design professional who has been responsible for the design of at least one successfully operating mass elastic design of comparable size and complexity in the recent past. The CONTRACTOR shall submit the qualifications of the proposed design professional as a part of the initial submittal information required under paragraph 11175-1.4.

Upon completion and receipt of certified results of the bump tests required for the motor rotor, frame and assembly specified under paragraph 11175-1.9H, the design professional shall review the data and submit a supplemental report 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.

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 as specified in paragraph 11175-1.4. The format and documentation for the reports shall follow the requirements of ANSI/HI 9.6.4.

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.

- C. **Critical Speeds:** Process sensitivities are such that operation of variable speed pumps at infinitely variable speed within the specified operational conditions is an absolute requirement. The CONTRACTOR is advised and warned that any remedy imposing a locked-out speed interval or intervals will not be considered an acceptable remedy for identified critical speeds. The CONTRACTOR shall adjust component sizes, and/or provide appropriate energy absorbing devices or other approved remedies to eliminate critical speeds within the operating range required to meet specified performance requirements.

D. **Methodology:**

1. **Rotordynamic Analysis:** 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 continuous operating conditions specified.
 - b. The procedure shall produce Campbell diagrams for both wet and dry conditions.
 - c. The procedure shall consider variations in assumed coefficients for seal and wearing ring clearances (Lomakin effect), bearing damping and stiffness, rotor imbalance (up to 10 percent of rotor disc weight at each disc position), impeller destabilizing forces, rotor shaft bending, hydraulic imbalance at not less than five operating conditions within the envelope of continuous operating conditions specified in addition to the specified operating conditions, and impeller vane/diffuser (cutwater) vane clearance. Unless specifically accepted by the OWNER, the range in variation of component characteristics shall comply with the ranges recommended in Corbo and Malanoski, 1998.
 - d. The final report shall include a three-dimensional graphic presentation of shaft distortion and rotor element performance at identified critical speeds within the pump's operating range.
2. **Torsional Vibration:** 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 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 the variable frequency drive. 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.

The stress analysis procedure shall be based upon a finite element analysis technique using a digital computer program that has been successfully field calibrated with at least one installation of comparable size and complexity in the recent past. 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.

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 peak 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.

3. Shaft Radial Load and Deflection:

- a. **Overhung Shaft Pumps:** Shaft radial loads and deflection for overhung shaft pumps operating in single volute casings shall be calculated using the following relationship:

$$\Delta_{MAX} = \frac{R}{3E} \left[\frac{a^2 c - abc}{I_c} + \frac{1}{I_a} \left(\frac{b^3 - 3a^2 b}{2} + a^2 \right) \right]$$

Where:

Δ_{max} = deflection, inches, at the outboard (impeller side) face of the shaft seal

E = modulus of elasticity, psi
 30 x 10⁶ for carbon steel
 28 x 10⁶ for 316 stainless steel
 Alternate materials: as accepted by OWNER

a = shaft length, inches, from the centroid of the impeller profile (from inlet to discharge nozzle) to the centerline of the radial bearing

- b = shaft length, inches, from the centroid of the impeller profile (from inlet to discharge nozzle) to outboard (impeller side) face of shaft seal
- c = shaft length between centerline of bearings, inches
- I_a = moment of inertia of the shaft at section a, in⁴
- I_c = moment of inertia of the shaft at section c, in⁴
- R = radial force, pounds, at any specified operating condition or any operating condition within the envelope of specified operating conditions resulting in peak loads imposed on the shaft:

$$R = (K)(H)(D)(Y) + W$$

where:

- K = Radial thrust factor. K shall vary with flow and specific speed in accordance with the following:

Q/Q_{BEP}	$K, N_s = 2000$	$K, N_s = 3500$
0.0	0.31	0.38
0.1	0.30	0.375
0.2	0.28	0.36
0.3	0.26	0.345
0.4	0.24	0.325
0.5	0.22	0.3
0.6	0.18	0.27
0.7	0.15	0.23
0.8	0.12	0.185
0.9	0.08	0.14
1.0	0.05	0.09
1.1	0.06	0.12
1.2	0.11	0.17
1.3	0.20	0.25

NOTES:

1. Q/Q_{BEP} in the table is the ratio of flow at the operating condition to flow developed by the pump at best efficiency
2. N_s in the table is specific speed, as defined in ANSI/HI 1.1 - 1.6
3. K for pumps with specific speeds between 2000 and 3500 shall be established by a straight line interpolation from the above values.

4. *K for pumps with specific speeds greater than 3500 shall be established by a straight line extrapolation from the above values. The manufacturer is at liberty to use differing values of K from that above so long as they are greater than those listed in the table. Under no circumstances will lesser values of K be acceptable.*

- H = Head (psi) developed by the pump at any specified duty point, including operating conditions within the envelope of conditions specified
- D = Mean impeller diameter, inches
- Y = Impeller width, inches, at discharge, including shrouds
- W = Impeller weight with wearing ring, pounds (W = 0 if vertical pump)

Radial loads calculated in accordance with the above procedure shall be used for bearing life calculations as required under paragraph 11175-1.9E.5.

Flexural stress calculations shall be based upon the loading criteria specified above and shall be incorporated into the combined stress calculations specified under paragraph 11175-1.9E.3.

- b. **Impeller between Bearings Pumps:** Shaft deflection for single volute pumps with the impeller mounted between bearings such as for split case centrifugal pumps shall be calculated in accordance with the following formula:

$$\Delta_{\max} = \frac{(R_x)(3L^2 - 4x^2)}{48EI}$$

Where:

- Δ_{\max} = deflection, inches, at the face (impeller side) of the shaft seal
- R = radial force, as defined above
- L = distance between bearings, inches
- E = modulus of elasticity for the shaft material, as defined above
- I = shaft moment of inertia at the bearings, inches⁴
- x = distance between bearing and seal face (impeller side), inches

4. **Reference Documents:** The Corbo and Malanoski documents referenced in paragraphs 11175-1.10D.1 and 11175-1.10D.2. are available from the City of San Diego, Metropolitan Wastewater Department, on an as-needed basis, to those with the need to know as determined by the CITY:

- a. Corbo and Malanoski, 1996 Practical Design Against Torsional Vibration.

From *Proceedings of the 25th Turbomachinery Symposium*, Turbomachinery Laboratory, Texas A & M University, College Station, TX, pp.189-222, 1996.

- b. Corbo and Malanoski, 1998 *Pump Rotordynamics Made Simple*. From *Proceedings of the 15th International Pump Users Symposium*, Turbomachinery Laboratory, Texas A & M University, College Station, TX, pp.167-204, 1998.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **General:** Pumping equipment shall comply with this Section, the detailed pump specification, and Section 11000. In addition, the pump manufacturer and the pump manufacturing site shall be certified under ISO 9001. Evidence of the required certifications shall be included with the initial submittal under paragraph 11175-1.4. For additional LT & HT Cooling System information, see Appendix A3 for reference.
- B. **Combinations of Equipment:** Pumping equipment shall be new and shall incorporate all necessary mechanisms, couplings, electric motor and drives, shafts, appurtenances, and mounting.
- C. **Tools:** Tools shall comply with Section 11000 and shall include one pressure grease gun for each type of grease required for pumps and motors.
- D. **Spare Parts:** Spare parts shall include for each pump 1 complete sets of seals, packing, gaskets, nuts, bolts, washers, wear rings, lantern ring removal tools, and a set of spare bearings as well as all parts indicated in the detailed pump specifications.
- E. **Nameplates:** Nameplates shall comply with Section 11000 and shall indicate rated head and flow, impeller size and pump speed. Flywheel nameplates shall include manufacturer, serial number, model, weight, and moment of inertia.
- F. **Jacket Water Cooling Loop Pumps:** The jacket water cooling loop pumps (high temperature) shall be single stage vertical in-line pumps and shall be constructed out of materials that function appropriately with process fluid temperatures up to 200F°. A combination of two (2) duty pumps and one (1) emergency pump is required for the jacket water cooling loop. The contractor shall provide one (1) spare duty pump and one (1) spare emergency pump. The pumps are as follows:

PUMP TAG #	FUNCTION	DESCRIPTION
PMP-795	DUTY	HT COOLING DUTY PUMP NO. 5
PMP-796	DUTY	HT COOLING DUTY PUMP NO. 6
PMP-797	EMERGENCY	HT COOLING DUTY EMERGENCY PUMP NO. 7

The above listed jacket water cooling loop pumps shall conform to the following requirements based on their function:

PUMP FUNCTION	QTY	MOTOR MAX (HP)	DRIVER	NOMINAL SPEED (RPM)	MAX SHUTOFF HEAD (FT)	SINGLE PUMP OPERATING POINT 1			SINGLE PUMP OPERATING POINT 2		
						MIN FLOWRATE (GPM)	@ TDH (FT)	MIN EFF. (%)	MIN FLOWRATE (GPM)	@ TDH (FT)	MIN EFF. (%)
(2) DUTY (1) SPARE	3	8	VFD	1150	49	350	42	77	500	29	60
(1) EMERGENCY (1) SPARE	2	100	VFD	1775	136	1000	128	61	1800	112	67

1. In addition to the table above, the jacket water cooling loop pumps must comply with the following:

- a. When two (2) duty pumps are operating in parallel: must meet a minimum Flowrate of 700 GPM at 42-ft of TDH with a minimum efficiency of 70%

G. Auxiliary Water Cooling Loop Pumps: The auxiliary water cooling loop pumps (low temperature) shall be single stage vertical in-line split coupled pumps and shall be constructed out of materials that function appropriately with process fluid temperatures up to 200F°. A combination of one (1) jockey pump and three (3) duty pumps is required for the auxiliary water cooling loop. The required pumps are as follows:

PUMP TAG #	FUNCTION	DESCRIPTION
PMP-791	JOCKEY	LT COOLING JOCKEY PUMP NO. 1
PMP-792	DUTY	LT COOLING DUTY PUMP NO. 2
PMP-793	DUTY	LT COOLING DUTY PUMP NO. 3
PMP-794	DUTY	LT COOLING DUTY PUMP NO. 4

The above listed auxiliary water cooling loop pumps shall conform to the following requirements based on their function:

PUMP FUNCTION	QTY	MOTOR MAX (HP)	DRIVER	NOMINAL SPEED (RPM)	MAX SHUTOFF HEAD (FT)	SINGLE PUMP OPERATING POINT 1			SINGLE PUMP OPERATING POINT 2		
						MIN FLOWRATE (GPM)	@ TDH (FT)	MIN EFF. (%)	MIN FLOWRATE (GPM)	@ TDH (FT)	MIN EFF. (%)
JOCKEY	1	1	VFD	690	10	150	12.5	65	400	8	65
DUTY	3	8	VFD	1150	49	350	42	77	500	29	60

1. In addition to the table above, the pumps must comply with the following:

- a. When two (2) duty pumps are operating in parallel: must meet a minimum Flowrate of 700 GPM at 42-ft of TDH with a minimum efficiency of 60%

- b. When three (3) duty pumps are operating in parallel: must meet a minimum Flowrate of 1100 GPM at 41-ft of TDH with a minimum efficiency of 60%

H. Drive

1. Each pump shall be provided with a vertical solid shaft, premium efficiency, high thrust, 460 volt, 3 phase, 60-hertz heavy duty, inverter duty electric motor. Each electric motor shall be designed to accept the total, unbalanced thrust imposed by the pump.

2.2 MATERIALS

- A. **General:** Materials used in the pumping equipment shall be suitable for the intended application and shall be free from defects. **Materials of construction specified under the individual pump sections take precedence. Materials of construction not specified in the individual pump sections shall conform to the requirements listed below. However, where the individual pump sections and this Section are silent with respect to materials of construction of any component, material selection shall follow the requirements of Table H-1, API 610, Materials Class I-1.**

1. **Cast Iron:** Close-grained gray cast iron conforming to ASTM A 48, with 2 to 3 percent nickel added to the cast iron for raw sewage, wastewater and sludge applications. Pressure class shall be suitable for the application but shall be not less than Class 30 for pumps 4-inch and larger.
2. **Ductile Iron (where indicated):** ASTM A 395.
3. **Pressure Casings, Inner Casing Parts such as Bowls, Diffusers and Diaphragms, and Impellers:** Cast iron conforming to the requirements of API 610, Materials Class I-1 and paragraph 2.2A.1 above.
4. **Stainless Steel Pump Impellers (where indicated):** Cast Type 316 stainless steel conforming to API 610, Materials Class S-8.
5. **Bronze Pump Impellers (where indicated):** ASTM B 62 or ASTM B 584.
6. **Pump Shafts:** Stainless steel, Type 316 unless higher strength is required.
7. All shaft sleeves for packed boxes, fretting seals and inter-stage seals shall be Type 316 stainless steel conforming to API 610, Materials Class S-8 requirements.
8. **Miscellaneous Stainless Steel Parts:** Type 316 except Type 304 in septic environments.
9. **Internal Fastener Parts of All Types in Wetted Areas:** Type 316 stainless steel conforming to API 610, Materials Class S-5.
10. **Discharge Heads and Suction Cans:** Carbon steel conforming to the requirements of API 610, Materials Class I-1.
11. **Anchor Bolts, Nuts and Washers:** Materials shall be as specified in paragraph

11000-2.20.

- B. General Quality:** Details of manufacture and assembly of equipment furnished under the individual pump sections and this Section shall follow the requirements of API 610 with respect to the following features (paragraph references, API 610):
1. Alignment aids (paragraph 2.1.24).
 2. Removal of rotating element (paragraph 2.1.25).
 3. Jackscrews for assistance in alignment on all base-plates and equipment supports (paragraph 5.3.7.3.4).
 4. Castings (paragraph 2.11.2).
 5. Welding (paragraph 2.11.3).
- C. Wearing Rings:** Unless otherwise specified, centrifugal and axial flow pumps shall be fitted with both stationary and rotating wearing rings. Wearing rings shall be of hard faced Type 316 stainless steel and shall conform to the requirements of API 610, paragraph 2.6.2, Material class S-8. Maximum wearing ring clearances shall not exceed 150 percent of the values stated in Table 2-2, API 610. Provisions shall be made for adjustment of wearing ring clearance via adjusting screws and shims in the back head design. 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. Wearing rings shall be the axial type with a wear allowance of 0.25 inches minimum. Minimum wearing ring hardness on the rotating ring shall be 350 (BHN), with the stationary ring not less than 100 hardness points greater.
- D. Spacer Coupling:** Horizontal pump and electric motor shall be connected with a flexible coupling which will not transmit backlash. The coupling shall be selected to provide sufficient gap between the pump and motor shafts to allow complete withdrawal and removal of the pump backhead, frame and rotor without disturbing the motor when the coupling is removed. Couplings shall comply with paragraph 11000-2.6.
- E. Protective Coatings:** Pumps shall be protected with coatings as specified in Section 09800, unless otherwise specified in the individual equipment specifications.
- F. Pump Construction:** Construction of vertical in-line split coupled pumps shall conform to the following requirements:

Casing	ASTM A-48 Cast-iron, internal surface enamel coated. The exterior surfaces shall be coated with 8 mils of epoxy. Coating shall be in accordance with Section 09800, Protective Coating.
Impeller	ASTM B584 Bronze statically and dynamically balanced.
Shaft	ASTM A582 Stainless Steel Type 416
Case Wearing Rings	ASTM B62 Bronze
Bushing	Carbon Graphite Matrix
Sleeve	ASTM B62 Bronze
Bracket	ASTM A48 Cast Iron

Mechanical Seal	John Crane or approved equal
Washer	Carbon
Seat	Ni-Resist
Elastomer	Buna-N
Metal Parts	303 SS
Spring	303 SS
Motor Shaft Coupling	4-piece, heavy-duty spacer coupling, with registered fit, (for vertical turbine type pumps coupling shall be adjustable to allow for impeller adjustment for solid shaft motors), with 316 stainless steel cap screws, bolts and nuts.
Bottom Bearing	Close tolerance sleeve type with length min 2-1/2 times shaft diameter, permanently grease lubricated.
Fasteners, Nuts, Bolts and Washers	316 Stainless Steel

2.3 ACCESSORIES

- A. **Solenoid Valves:** Pumps shall include solenoid valves at the inlet of water, oil lubrication, and cooling water connections. Solenoid valves shall be continuous time rated for the voltage and service conditions indicated.
- B. **Pressure Gauges:** Pressure gauges shall be installed at pump suction and discharge lines except sump pumps. Pressure gauges shall comply with Section 15034 and shall be mounted at a location selected to minimize the effect of vibrations.
- C. **Pump Suctions:** Compound gauges shall be installed at pump suction and where subject to shock or vibrations, the pressure gauges shall be wall-mounted or attached to Type 316 stainless steel channel floor stands located where they will not impede pump maintenance access and connected to the pump by means of flexible connectors.
- D. **Variable Speed Drives:** Where indicated, variable speed drives, drive motors, speed control equipment, and accessories shall comply with Division 16.
- E. **Local Control Panels:** The NEMA rating of local control panels shall comply with the area designations of Section 16050, unless indicated otherwise.
- F. **Lifting Eyes:** Pumps and nozzles shall be provided with lifting eyes to permit removal and/or disassembly.

2.4 PUMP REQUIREMENTS

- A. Pumps shall comply with the following:
 - 1. **Lubrication:** Except as otherwise indicated, line shaft bearings of vertical turbine mixed flow, and propeller pumps shall be utility water-lubricated and deep-well pumps and pumps with enclosed line shafts shall have fresh water- or oil-lubricated bearings and seals.

2. **Handholes:** Handholes, where applicable, on pump casings shall be designed to follow the contours of the casing to avoid any obstructions in the water passage.
3. **Umbrellas:** For column pumps, the inlet wet well design is based upon the geometric relationships described in ANSI/HI 9.8, and a bell intake velocity of 5.5 fps shall be assumed. If the bell intake velocity for a proposed pump will exceed 5.5 fps, the CONTRACTOR shall require the pump manufacturer to furnish an umbrella fitted to the pump inlet bell that will effectively reduce the intake velocity to 5.5 fps, at no additional cost to the OWNER.
4. **Drains:** Gland seals, air valves, and cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor drain, with galvanized steel pipe or copper tube; an air separation complying with the Uniform Plumbing Code shall be provided.
5. **Grease Lubrication:** Unless otherwise specified, all vertical propeller, mixed-flow, and turbine pumps, (other than deep well pumps), shall be equipped with a stainless steel tube designed for lubrication of bottom bearing.
6. **Stuffing Boxes:** Where shaft packing is indicated, 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 indicated for the applicable pump and operating conditions.

Unless otherwise indicated, lantern rings shall be bronze, 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. Threaded lantern ring removal tools shall be provided with spare parts for each pump. Seals shall be flushed with utility water cleaned by means of a solids separator, or with process water. Except as otherwise indicated, the packing material shall be interlaced Teflon braiding, containing 50 percent ultra fine graphite impregnation complying with the following:

Shaft speeds	-	up to 2500 fpm
Temperature	-	up to 500 degrees F
pH range	-	1 to 14

7. **Mechanical Seals:** Shafts for pumps shall have a single cartridge type mechanical seal cooled by product water routed from the backhead area into the stuffing box through a machined clearance. Pump/impeller shall be designed to provide positive pressure above atmospheric to the stuffing box area to allow seal flush line to function. Stationary portion of the seals shall have stainless steel construction. Rotating faces of the seal shall be of silicon carbide against carbon. Seal shall be manufactured by AES Engineering -C.U.R.C. Type, or Chesterton 155, no exceptions. The seals shall be constructed to allow rebuilding of the seal utilizing repair parts.

- B. **Bearing Temperatures:** Where possible, the bearing temperature at the worst loading condition and ambient temperature shall not exceed 150 degrees F. Where this is not

possible, all exposed bearings shall be effectively shielded with permanent metal safety guards to prevent accidental contact by operators.

2.5 SOLE PLATES FOR VERTICAL CENTRIFUGAL AND AXIAL FLOW PUMPS

- A. Sole plates for vertical column type pumps and separately mounted vertical pumps, shall be designed to be installed on the concrete foundation curbs shown and shall be milled flat to within 0.002-inch per foot in all directions on the face mating with the pump support. Prior to milling, sole plates shall have the words "THIS SIDE DOWN" permanently affixed to the underside using welding rod material. Unless otherwise specified, sole plates shall comply with Section 11002.

2.6 BASEPLATES AND DRIVE UNIT SUPPORTS

- A. Base-plates for horizontal pumps shall be fabricated and finished in accordance with paragraph 3.3, API 610. All base-plates shall be designed for grouting on the housekeeping pads specified.
- B. Drive unit supports for separately mounted vertical pump drives shall be of fabricated steel, ASTM A36. Drive unit 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 drive unit support pedestal with a plate milled flat within two light bands shall be provided to mate with the drive enclosure. The support shall be designed to be supported on a sole plate embedded in a housekeeping pad at the edges of the floor opening or as indicated. Other details for the drive unit support shall be as indicated.
- C. Unless otherwise specified, base plates and drive unit supports shall comply with Section 11002.

2.7 BALANCE

- A. Balancing for centrifugal and axial flow pumps with nozzle sizes 6 inches in diameter and greater shall conform to the requirements set forth in API 610, paragraph 2.8.4.1. All balance logs, certified correct and signed by an officer of the manufacturing corporation and notarized, shall be included in the Owner's Manual.

PART 3 – EXECUTION

3.1 GENERAL

- A. Installation shall comply with Section 11000, the requirements of this Section, and the requirements of the detailed pump specifications. Equipment with pump nozzle sizes 12 inches in diameter and greater 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 and anchor bolt installation procedures shall conform to the requirements of Section 11002.

3.2 SOLE PLATES

- A. Sole plates, if provided as required by this Section or where required by the equipment

manufacturer's recommendation, or any section referencing this section, 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. Equipment furnished under this Section and any referencing section shall be aligned as specified in Section 11005.

3.4 TESTING

- A. Field testing shall be performed as specified in Part 1 of this Section. Testing also shall conform to the requirements of paragraph 11000-1.7A. For all units with variable speed drives and any unit with pump nozzle size 12 inches in diameter and greater, 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.

3.5 VIBRATION

- A. Vibration of installed pumps shall be measured in accordance with ISO 10816 for all pumps with variable speed drives and pumps with shaft power requirements 50 horsepower and greater. An independent testing laboratory specializing in this work, retained by the CONTRACTOR but acceptable to the CONSTRUCTION MANAGER, shall perform the measurements and shall submit the results directly to the CONSTRUCTION MANAGER. **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 Tables 2-5 and 2-6 in API 610.** Vibration limits for pumps used for wastewater, grit, and sludge service shall be 150 percent of that established in the referenced tables. For all other installed pumps, vibration at the specified continuous duty operating conditions shall be measured by the independent testing laboratory noted above, and shall not exceed the limits specified in Section 11020. Vibration measurement results shall be included in the Owner's Manual.

3.6 TRAINING

- A. Training shall conform to the requirements of paragraph 11000-1.7B and the individual equipment specifications. Unless otherwise indicated, the training requirement is waived for constant speed pumping equipment with nozzle sizes 4 inches in diameter and smaller and for all centrifugal and axial flow pumps with connected power requirements 10 horsepower and less. The training session for maintenance personnel shall include complete field and shop disassembly and subsequent reassembly of one complete pumping unit selected by the CONSTRUCTION MANAGER.

** END OF SECTION **

**SECTION 11301
DIESEL FUEL SYSTEMS**

PART 1 - GENERAL

1.1 SCOPE

- A. This section specifies the requirements for protected outdoor aboveground storage tank (AST) and day tanks used for the Engine Generator specified in Section 11501, Diesel Fuel Engine-Generator, as well as all ancillary diesel fuel systems. The scope includes one outdoor 20,000-gallon diesel storage tank with ground level fill systems, transfer pumps, and fuel polishing systems and two indoor 330-gallon day tanks with return pumps.
- B. Not all the Contract requirements are shown in the Contract Drawings. Contractor shall procure and pay for any required construction permits as well as provide, furnish, install, and comply with all the requirements per the San Diego Fire Prevention Bureau/Technical Services for:
 - 1. Gen Set Requirements Outside Location CFC 2013.
 - 2. Requirements for Above Ground Tanks(s), Building Service Generators, and Fire Pumps for Inside of Building. CFC-2013.

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 01640 Seismic Design of Equipment and Equipment Anchorage
 - 2. Section 05500 Miscellaneous Metalwork
 - 3. Section 09800 Protective Coating
 - 4. Section 11002 Equipment Supports, Grouting and Installation
 - 5. Section 11301 Appendix A – San Diego Fire Prevention Bureau/Technical Services: Gen Set Requirements Outside Location CFC 2013
 - 6. Section 11301 Appendix B - San Diego Fire Prevention Bureau/Technical Services: Requirements for Above Ground Tanks(s), Building Service Generators, and Fire Pumps for Inside of Building. CFC-2013
 - 7. Section 13350 Commissioning
 - 8. Division 15 Mechanical, as applicable
 - 9. Division 16 Electrical, as applicable

1.3 REFERENCES

- A. General
 - 1. The publications listed below form a part of this Specification to the extent referenced.
 - 2. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36, Standard Specification for Carbon Structural Steel

2. ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 3. ASTM A179, Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes
 4. ASTM A1011, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
- C. California Building Standards Commission
1. California Building Code (CBC)
 2. California Fire Code (CFC)
- D. National Fire Protection Association (NFPA)
1. NFPA 30- Flammable and Combustible Liquids Code,
- E. Uniform Fire Code (UFC)
- F. Southwest Research Institute (SwRI)
1. SwRI Standards 95-03 and 93-01 - Testing Requirements for Protected Aboveground Flammable Liquid/Fuel Storage Tanks
- G. Underwriters Laboratories Inc (UL)
1. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids
 2. UL 2085 - Protected Aboveground Tanks for Flammable and Combustible Liquids

1.4 QUALITY

- A. In order to establish minimum standards of fabrication and welding quality the tank(s), their protection systems, and their insulation systems shall be produced only by a manufacturer that possesses a current Certificate of Authorization for fabricated steel vessels from the American Society of Mechanical Engineers.

1.5 SUBMITTALS

- A. Submittals shall be submitted and approved prior to construction. The Contractor shall provide three (3) sets of submittals including manufacturer's product data sheets, installation instructions, certificates of compliance with testing requirements, engineering data, and equipment specifications.
1. Design of seismic restraints and anchorage calculations shall conform to Section 01640, "Seismic Design of Equipment and Equipment Anchorage".

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials and equipment used in this project shall be new and shall meet or exceed the following specifications.
- B. All products shall be acceptable to the City of San Diego Fire Department.
- C. Tank monitoring systems shall have the items as shown in the P&ID's in the Contract Documents.

2.2 STEEL PLATE

- A. All steel plate used in the construction of the protected aboveground storage tank and related accessories shall conform to ASTM A36.

2.3 STEEL SHEET

- A. All steel sheets used in the construction of the protected AST and related accessories shall conform to ASTM A1011 Grade 33.

2.4 PIPE and TUBING

- A. All pipe used in the construction of the protected AST and related accessories shall conform to ASTM A53 Grade B. All tubing used in the construction of the protected AST and related accessories shall conform to ASTM A179. All couplings, unions, elbows, tees, and fittings used in the construction of the protected AST and related accessories shall conform to the ASTM standards appropriate for the pipe or tubing being connected.

2.5 TANK EQUIPMENT.

- A. The equipment that is used on the tank as part of its listing requirements or as part of the fuel transfer or storage systems shall meet the following requirements:
 - 1. All equipment installed on the tank shall be designed for use in fuel storage and transfer systems and shall be compatible with other tank components and with the fuel to be stored.
 - 2. Except for the fuel filters, all equipment that is part of the tank pumping system shall be UL Listed for use with flammable and combustible liquids.

2.6 PROTECTED ABOVEGROUND STORAGE TANK

- A. The protected aboveground storage tank shall be constructed with materials conforming to the specifications above and the entire assembly shall be listed by a nationally recognized testing laboratory. The protected aboveground storage tank shall be constructed by a manufacturer that has been regularly engaged in the manufacture of UL Listed Steel Aboveground Tanks for Flammable and Combustible Liquids for not less than three years and that has constructed at least five tanks of equal or greater capacity within the last five years.
- B. The aboveground storage tank shall be 20,000-gallon double-walled diesel compatible, with a 3-inch minimum annular space. The annular space shall be filled with an isolating material, meeting Uniform Fire Code Appendix IIF for Heat, Ballistics and Impact Protection.
- C. The primary tank shall be constructed of steel plate not less than 1/4" for tanks with a total capacity over 4,000 gallons. However, in no case shall the tank be thinner than specified by UL Standard 142.
- D. Tank shall be tested and labeled to UL 2085, "Multi-Hazard SwRI 95-03", or UFC Standard SwRI 93-01, or equivalent that is acceptable to California Certified Unified Program Agency (Cal CUPA).
- E. The tank shall be provided with a CARB-certified spill bucket.
- F. Overfill protection shall be provided by automatic shutoff valve at 90 percent capacity. The device must be capable of stopping fuel flow under delivery conditions of 50 gpm at 100 psi; devices that only limit flow are not acceptable. The automatic shutoff device shall be the F -30 valve as manufactured by Clay & Bailey, or approved equal.
- G. Tank shall have level indicator and an overfill alarm, both local and remote, which shall

be activated by a float-switch set at 85 percent capacity.

- H. The tank shall be provided with a mechanical clock gauge for measuring liquid level. Gauge shall be aluminum construction with stainless steel float and cable.
- I. The tank shall be provided with instrumentation and control as shown on the P&ID.
- J. The protected tank assembly shall be constructed with integral supports that provide the capability to rigidly anchor the tank to its concrete foundation for resistance to seismic loads.
- K. Except for the vent riser pipes, and access assembly if any, the tank shall be completely fabricated and assembled at the manufacturer's facility.
- L. Provide signs for filling connection and filling level.
- M. The tank shall be manufactured by Fireguard, Modern Welding Company Inc., or approved equal.

2.7 FUEL STORAGE SUBMERSIBLE SUPPLY PUMPS

- A. The tank shall be provided with two submersible centrifugal-type fuel transfer pumps. The tank shall also be provided with an anti-siphon system to prevent the tank contents from siphoning through the submersible pump. The manufacturer shall size the pumps based on the actual proposed installation.
- B. The pumps shall be provided with instrumentation and control as shown on the P&ID.
- C. The entire pumping assembly shall have UL Listing and shall meet all requirements of UL Standard UL 79.
- D. The pump discharge head and manifold assembly shall be manufactured from ASTM A48 Class 25 gray iron.
- E. The pump shall be manufactured to proper length as determined by the Storage Tank manufacturer.
- F. The pump motor shall have a thermal over-current overload protector with automatic reset.
- G. The pump motor assembly shall be clearly marked with pertinent information including model, horsepower, voltage, phase, and manufacturer.
- H. The pump shall have an air/vapor eliminator system that returns air or vapors to the storage tank through a tube.
- I. Pump shall be manufactured by FE Petro Inc., or approved manufacturer.

2.8 DAY TANKS

- A. Applies to TNK-312 and TNK-314.
- B. The day tank shall be constructed with materials conforming to the specifications above and the entire assembly shall be listed by a nationally recognized testing laboratory. The day tank shall be constructed by a manufacturer that has been regularly engaged in the manufacture of UL 508 Listed Systems for not less than three years and that have constructed at least five tanks of equal or greater capacity within the last five years.
- C. The day tanks shall be 330-gallons each, double-walled diesel compatible, with 150% of capacity rupture basin.
- D. The primary tank shall be constructed of steel plate not less than specified by UL Standard 142.

- E. The tank shall be provided with instrumentation and control as shown on the P&ID.
- F. Control panel shall have an explosion proof type enclosure and shall be provided with accessories as shown in the P&ID.
- G. The protected tank assembly shall be constructed with integral supports that provide the capability to rigidly anchor the tank to its concrete foundation for resistance to seismic loads.
- H. Except for the vent riser pipes, and access assembly if any, the tank shall be completely fabricated and assembled at the manufacturer's facility.
- I. The System shall have an Electronic Control Module (ECM) providing state-of-the-art control of the day tank system. The ECM shall be UL Listed, have self-diagnostic, and features a single sensor for all functions. Standard Features:
 - 1. UL 508 Listed
 - 2. Operates on standard 120 VAC, 1 phase system, 50/60 Hz
 - 3. LED indicators for all functions
 - 4. Fuel level sensor
 - 5. Motor control relay w/ LED signal, rated up to 1/2 HP
 - 6. High and low fuel level warnings
 - 7. Critical low fuel level warning for engine shutoff
 - 8. Fuel-in-rupture-basin warning interface
 - 9. ECM functional signal
 - 10. Manual control with On/Off & Test buttons
 - 11. Secure internal test button for testing warning
 - 12. LEDs and remote annunciation of warnings
 - 13. ECM shall provide continuous Smart System checks for abnormal signal
 - 14. Steady green - system is operating correctly
 - 15. Flashing green - problem, system needs to be checked
 - 16. Local and Remote contact points
- J. The tank shall be manufactured by Tramont, or approved equal.

2.9 DAY TANK RETURN PUMPS

- A. The transfer pump shall be a high lift gear pump, 1 phase, 115 VAC, 60 Hz thermally protected motor, c-mount.
- B. The pumps shall be provided with instrumentation and control as shown on the P&ID.
- C. The pump motor assembly shall be clearly marked with pertinent information including model, horsepower, voltage, phase, and manufacturer.
- D. The pumps shall be provided by the day tank manufacturer.

2.10 FUEL POLISHING SYSTEM

- A. Manufacturer: Subject to compliance with requirements, provide product by the following: Algae-X International (AXI) or approved equal.

- B. Description: Stand-alone, factory complete, automated, programmable, Green Clean Institute Certified, fuel filtration, optimization and maintenance system shall be provided for each diesel fuel storage tank to optimize and maintain the condition of fuel stored in that tank. The system shall be capable of eliminating microbial contamination and removing water, sediment and particulate to comply with ASTM D975 (Standard Specification for Diesel Fuel Oils).
1. Enclosure: All system components shall be contained within a powder coated or stainless steel, weatherproof, outdoor NEMA / UL 50 Type 4 listed enclosure with appropriate ventilation. Hinged front doors shall be equipped with quarter-turn key lockable handle. Fluid containment area with leak detection shall be an integral component of the enclosure. Literature pocket inside enclosure and external enclosure brackets for wall or rack mounting to be included.
 2. Plumbing: System shall be furnished with shutoff ball valves on the fuel inlet and fuel outlet for easy filter / water separator maintenance. A see-through flow indicator shall be installed to monitor fuel flow and flow rate, both visually and also via the PLC controller. Above mentioned components shall be located within the enclosure. Internal plumbing will be primarily executed in stainless steel.
 3. Installation: System shall provide male pipe connections protruding from the enclosure for customer plumbing connection. System shall be located as close as possible to designated fuel tank. The system's fuel supply and discharge lines shall be independent and separate from other fuel lines, with the supply line originating at the lowest point at the bottom of the tank and the discharge line as far away as possible from the supply line.
 4. Filtration / water separation: Four stage filtration / water separation process:
 - a. Stage 1: Centrifugal water and particulate separation– with water detection sensor and “push and turn” safety drain valve.
 - b. Stage 2: Primary Filtration – Coalescing elements shall be available with particulate filtration of 10 and 30 microns.
 - c. Stage 3: Fuel Conditioner – to reduce the size and mass of fuel sediments which naturally form in fuel, and to eliminate microbial contamination thus eliminating the need for toxic biocides.
 - d. Stage 4: Secondary Filtration – Uses (2) spin-on filter elements in parallel. Elements shall be identical in type and micron rating. Elements shall be available with particulate filtration of 1,3,10, and 25 microns, and dissolved and emulsified water absorbing “WB water block” filtration of 3 and 10 microns.
 - e. Primary filter shall be equipped with a liquid-filled compound vacuum/pressure gauge and secondary filter shall be equipped with at liquid-filled pressure gauge.
 5. Water Sensor: Shall be Watect Model 550 microcontroller-based water sensor alarm module to eliminate probe corrosion, or approved equal.
 6. Controls / Display functions: System control features, indicator lights and emergency stop button shall be located on a descriptive external control panel on the front door of the enclosure for easy operator access. Additional alarm and system status information shall be displayed inside system on the PLC text screen. System shall provide the following control and display functions via a PLC controller:
 - a. Programmable Digital Timer – Memory backup to retain program memory during power outages.

- b. Pump operating hour counter.
 - c. Pump control switch (Auto-Off-Manual) - Weatherproof, key operated, external front panel access.
 - d. Alarm Reset - Weatherproof pushbutton, external front panel access.
 - e. Power available indicator - Green LED indicator light, external front panel display.
 - f. Pump running indicator - Amber LED indicator light, external front panel display.
 - g. High vacuum, high pressure, no flow, high water and leak detection alarms - Red LED indicator lights, external front panel display.
 - h. Emergency Stop mushroom-top pushbutton - Red, latching with turn to reset, external front panel access.
7. Electrical enclosure / Controller: All electrical control features shall be contained within a separate UL 508A listed industrial control panel located within the mechanical enclosure. The controller shall monitor the following system alarm conditions:
- a. Leak in enclosure (system shutdown)
 - b. Primary filter high vacuum (system shutdown)
 - c. Primary filter high water level (system shutdown)
 - d. Secondary filter high pressure (system shutdown)
 - e. Flow switch inadequate flow (system shutdown after priming delay)
 - f. Motor overload (system shutdown)
 - g. External system shut down input
8. Pump: Positive displacement, internal gear, direct coupled, rotary pump with cast iron housing and built-in pressure relief bypass valve. Pump flow rate of 10 gallons per minute.
9. Motor: UL Listed, TEFC, Thermal overload protection, continuous duty.
- C. Performance / Design Criteria: System shall be capable of filtering the entire tank volume with a required filtration run-time of ideally 24 hours but no more than 48 hours. Sufficient sediment as well as water-holding capacity should be ensured. System run-time requirements will vary with climate, tank-layout, fuel delivery, refueling intervals, etc. and shall be adjusted in accordance with the input from pressure and vacuum gauges as well as water sensor.
- D. Operation: System shall provide dry contacts for trouble alarm, running indication, and ready indication to interface with the DCS. An external shut down feature shall be provided to interrupt pump operation from a remote location such as a BMS. Additionally, the System may be remotely controlled by deactivating the PLC Controller timer.

2.11 DIESEL FUEL STORAGE TANK LOCAL CONTROL PANEL

- A. Manufacturer shall be IBI Tanks or approved equal. The manufacturer shall demonstrate that they have provided equipment for similar installations. They shall provide two reference jobs. Note, control panels are custom made for each job. When contacting IBI Tank, reference MWD of Southern California Weymouth Water Treatment Plant Power

Systems Upgrade ORP Switchgear Building Project that utilized a control panel similar to what is required for this Contract.

- B. Description: The panel shall control all the functionality of the Diesel Fuel Storage Tank's systems such as the two supply pumps, level sensors, and leak detection.
1. Enclosure: Shall be NEMA-4X.
 2. Manufacturer shall provide and program the PLC.
 3. Shall meet the requirements per the Contract P&IDs and Contract Documents.
 4. Panel mounted controls on the front cover shall include the minimum following devices:
 - a. Programmable HMI display screen
 - b. Storage Tank Low Level Light
 - c. Storage Tank High Level Light
 - d. Storage Tank High-high Level Light
 - e. Storage Tank Leak Detect Light
 - f. System Ready (Control Power) Light
 - g. Supply Pump No.1 Running Light
 - h. Supply Pump No.2 Running Light
 - i. Pump No. 1 LOS
 - j. Pump No. 2 LOS
 - k. Pump No.1 Selector Switch: Auto / Manual
 - l. Pump No.2 Selector Switch: Auto / Manual
 - m. Pump No.1 Selector Switch: Run / Stop
 - n. Pump No.2 Selector Switch: Run / Stop
 - o. Solenoid Valve Selector Switch: Open/ Close (If required to integrate with the Automatic Fuel Port Control Panel)

2.12 AUTOMATIC FUEL PORT CONTROL PANEL

- A. Manufacturer shall be Simplex or approved equal.
- B. Description: The Automatic Fuel Port Control Panel is a factory packaged system for control of filling operations of aboveground tanks that are filled from pumper trucks. The Automatic Fuel Port provides a ready means of ground level connection of the fill hose, and captures spills that may occur at the fill point during filling operations. The Automatic Fuel Port alerts the operator at Tank Full with filling operations locked out at High Level. A leak detection circuit prevents filling of leaking tanks. Visual and audible level and leak alarms and continuous level indication are provided. The system shall work as follows:
1. Delivery truck arrives and driver proceeds to Automatic Fuel Port to make fuel delivery.
 2. Connect ground cable
 3. Unlock fill box and control box
 4. Turn on controller

5. Read fuel level in tank on level indicator gauge
6. Connect delivery hose to hose coupling
7. Open valve on truck
8. Start delivery pump on truck
9. Press Valve Open pushbutton on controller
10. Automatic Fuel Port valve opens
11. Fuel is delivered to tank
12. At Tank Full level, audible and visual alarm activates and alerts driver
13. Driver may stop delivery by pressing the Valve Close pushbutton and proceed to step #16
14. Driver tops off to Tank Full
15. At High Level, audible and visual alarm activates and Automatic Fuel Port valve closes (valve may not be reopened)
16. Stop fill pump
17. Drain delivery hose
18. Close truck valve
19. Disconnect delivery hose from Automatic Fuel Port
20. Turn controller off
21. Close and lock Automatic Fuel Port doors

C. Controller

1. Level transmitter for installation in 2" tank fitting minimum
2. Digital level indicator scaled in percent level
3. Tank Full visual alarm
4. High Level visual alarm
5. Tank leak alarm
6. Audible alarm horn activated by alarms above
7. Power available indicator
8. Control power On-Off switch
9. Valve Open/Close push-buttons
10. Type 3R enclosure (fuel oil version)

D. 120VAC control power shall be provide by the adjacent mounted Diesel Fuel Storage Tank Local Control Panel.

E. Shall be provided with a minimum 5-gallon effective spill containment bucket.

F. Shall also include the following:

1. Freestanding, pad or tank mountable, weatherproof and lockable enclosure
2. Quick disconnect hose coupling with dust plug
3. Check valve

4. Electrically operated shutoff valve
5. Automatic controller, described below
6. Hand pump for spill containment, with shutoff and check valve
7. Ground stud

2.13 TANK TESTING

- A. The protected tank assembly shall be constructed in accordance with a design that has been tested by a nationally recognized laboratory and is listed to maintain the primary tank average temperature rise below 260°F and the primary tank maximum temperature below 400°F after 4 hours of exposure to a 2000°F oven.
- B. The protected tank assembly shall be constructed in accordance with a design that has been tested by a nationally recognized laboratory and is listed to provide resistance, immediately after successful completion of the oven test specified in above, to impingement by the hose stream specified in UBC Standard 43-1 without penetration of the primary tank.
- C. The protected tank assembly shall be constructed in accordance with a design that has been tested by a nationally recognized laboratory and is listed to meet or exceed, after successful completion of the hose stream test specified in above, the bullet resistance specifications in Uniform Fire Code without penetration of the primary tank.
- D. The protected tank assembly shall be constructed in accordance with a design that has been tested by a nationally recognized laboratory and is listed to provide resistance, after successful completion of the bullet resistance test specified above, to an impact of 12,000 pounds traveling 10 mph at 18" above the ground surface without penetration of the primary tank.
- E. The above tests called for shall be performed on a single fully-assembled test tank. After completion of the tests the tank must pass a pressure test on the primary tank.

2.14 TANK FITTINGS

- A. The tank shall be equipped with the appropriate cam-lock adaptors to allow leak-tight, vapor-tight connection from the fuel delivery truck to the tank fill port. The adaptor shall be securely fastened to the automatic shutoff device installed in the fill port. The adaptor shall be furnished with a locking cap that, when installed, will make a vapor-tight seal on the fill port.
- B. The cam-lock adaptors and caps shall be designed for use with flammable and combustible liquid dispensing systems and shall be as manufactured by Morrison Bros., or approved equal.

2.15 TANK VENTS/PRV

- A. Normal Vents. Each compartment of the primary tank shall be equipped with vents in accordance with the requirements of NFPA 30 and CFC. The venting device shall be installed so that it exhausts above the roof. Normal vents for diesel tanks may be of the free flow type.
- B. Emergency Vents. The secondary containment tank and each compartment of the primary tank shall be equipped with an emergency vent in accordance with NFPA 30 and CFC. The venting devices shall be capable of relieving the maximum required flow rate in accordance with CFC requirements, and shall be Enardo Series 2000 or equal. The venting device shall be installed so that it exhausts above the roof.

C. Provide PRVs as shown on the P&ID.

2.16 INSTRUMENTATION

A. The instrumentation shall be as shown on the P&ID.

2.17 STORAGE TANK MONITORING PORT

- A. The tank shall be equipped with a monitor port that may be utilized for the detection of leaks from the primary tank into the secondary containment tank. The monitor port shall be a minimum of 2" steel pipe rigidly attached to the tank and suitable for manual or automatic electronic monitoring.
- B. The monitor port shall be furnished with a lockable cap and shall be marked to clearly indicate that it is not a fill port.

2.18 STORAGE TANK ACCESSORIES STAIRS

- A. An access platform shall be provided that meets the following minimum requirements:
1. The access platform shall provide a working surface not smaller than 24 inches in width and 20 inches in length.
 2. The access platform work surface shall be above the top of the tank as shown on the drawing.
 3. The design of the ladder and platform shall conform with all applicable requirements of OSHA and CAL/OSHA.
 4. Steel shall be hot dipped galvanized per Section 05500 and then coated per Section 09800.

2.19 TANK SIGNAGES

- A. Each fueling site shall be provided with warning signs prominently posted at or near the dispensing area. The signs shall generally be of red letters on a white background. The signs shall comply with San Diego Fire Prevention Bureau/Technical Services and the following:
1. Each tank shall have "Tank Fill Procedure" affixed to it at easily noticeable position.
 2. "EMERGENCY FUEL PUMP SHUTOFF" shall be prominently posted over the shutoff switch. If the sign is not visible from the dispenser additional signs and arrows shall be used to clearly identify the location of the pump shutoff switch (2" high, 1/4" stroke).
 3. "NO SMOKING- STOP ENGINE" (3" high, 1/2" stroke letters).
 4. "NO OPEN FLAME WITHIN 25 FEET" (3" high, 1/2" stroke letters).
 5. "DANGER- FLAMMABLE LIQUID" (3" high, 1/2" stroke letters).
 6. Each tank shall be provided with signs affixed to the tank exterior in a visible location. The signs shall generally be of red letters on a white background with minimum size as stated. The signs shall indicate the following:
 - a. "NO SMOKING" on all approachable sides (3" high, 1/2" stroke).
 - b. "COMBUSTIBLE LIQUID" on all approachable sides (3" high, 1/2" stroke).
 - c. Warning labels conforming to NFPA 704 Hazard Labeling System on all approachable sides (12" square, NFPA standard style and colors).
 - d. Each tank shall also be provided with a label indicating its empty lifting weight (1" high, 3/16" stroke)

- e. In addition the following labels shall be affixed to the tank exterior indicating the following information:
 - 1) "xxxx Gallons" where "xxxx" is the actual compartment capacity
 - 2) "Caution: This tank to contain only petroleum products" at the fill port
 - 3) "DIESEL" at the fill port (1" high, 3/16" stroke, red letters on white)
 - 4) "Fill" at the fill port
 - 5) "Vent" at the vent riser
 - 6) "Emer. Vent" at the emergency vent fitting
 - 7) "Monitor Tube" or "Test Well" at the monitor tube

2.20 TANK CLEARANCE

- A. The tank(s) shall be provided with minimum setback and clearances in accordance with California Fire Code.

2.21 CONCRETE TANK FOUNDATION

- A. Reinforced concrete foundations shall be as indicated on structural drawings.

2.22 LOW LEVEL FILL SYSTEM

- A. Each tank shall be provided with a low-level fill system.

PART 3 - EXECUTION

3.1 TANK FOUNDATION AND SLAB

- A. A cast-in-place concrete slab that is equipped with a containment curb shall be constructed as indicated on the drawings, and as specified in Section 03300, "Cast-in-Place Structural Concrete." The slab shall have a containment curb as indicated on the drawings.
- B. The tank shall be secured to the concrete slab with seismic restraints that meet the anchorage requirements specified in Section 01640, "Seismic Design of Equipment and Equipment Anchorage"

3.2 TANK INSTALLATION

- A. The tank shall be installed level. After setting the tank, the Contractor shall complete all electrical and mechanical connections.
- B. Upon completion of installation, the system shall be operated in the presence of the Engineer to demonstrate that it functions properly.

3.3 TANK PAINTING

- A. Tank shall be painted per Specification Section 09800, "Protective Coating"

3.4 FIRE EXTINGUISHER

- A. 20-pound fire extinguishers (minimum rating 20A:120B:C) shall be provided and mounted in the: truck unloading concrete slab area, one located in the North Generator Building, and one located in the South Generator Building in accordance with the City of San Diego Fire Department requirements.

3.5 COORDINATION WITH RELATED WORK

- A. The Contractor shall coordinate the timing of the final connection of the piping to the day tank(s) of the generator(s).

- END OF SECTION -

SAN DIEGO FIRE PREVENTION BUREAU/TECHNICAL SERVICES

Gen Set Requirements Outside Location CFC 2013

General

- F 105.7.6 Construction permit required
- F 105.6.16 Operational permit: Flammable liquids permit
- F 5704.2.9.2 Foundation and supports per CBC and NFPA 30
- F 5003.9.1 Documentation for personnel training in case of an emergency
- F 5003.4 MSDS on site
- F 5704.4.2.2 Fire Department access required
- F 5704.4.2.3 Protection against tampering required
- F 5001.3.3.15 Emergency plan required

Outside of Cabinet

- F 906.1 (3) Portable fire extinguishers required (Title 19, UFC 10-1, FPB Policy E-90-8)
- Title 19 **4A 40 BC** fire extinguisher for **High Hazard Location**
(Article 5, Sec 565.1)
- Title 19 Fire extinguishers shall not be obstructed or obscured from view
(Article 5, Sec 567i)
- Title 19 Fire extinguishers; located along paths of travel & readily available
(Article 5, Sec 567j)
- F 5003.5 704 Placard required
- F 5003.7.1 Provide “No Smoking” signs
- F 5003.7.1 Provide “No Open Flame” signs
- F 5703.5 Label or placard required for identifying the material
- F 5703.5.2 Location of warning signs per AHJ
- F 5003.7.2 Prevent or eliminate sources of ignition
- F 5703.1 Provide adequate grounding and bonding (Trailer or Chassis)
- F 5003.9.5 Prevent accumulation of static charge
- F 5003.7.2 Open flame and high temperature devices shall not create a hazardous condition
- F 5703.1 Heating equipment shall be of a type approved for hazardous locations
- F 5704.2.6 Separation from incompatible materials required and accumulation of combustibles F 5003.9.8
- F 5004.11 Remove combustible materials and vegetation **25 feet** from tank
- F 5704.4.2.1 Tank shall be located in accordance with Table 5704.4.2 and Table 5705.3.8.2
- F 5704.2.9.2 Tanks shall be securely supported for seismic protection
(CBC, NFPA 30)
- F 5704.2.9.1.3 Fire protection required for supports or pilings (Elevated more than 12 inches)

- F 5703.4 Secondary containment & Spill Control required/
 1. Requires monitoring and record keeping
- F 5703.6.5 Provide for corrosion protection
- F 5703.6.4 Provide physical protection from vehicles (Sec 312.2)
- F 5703.6.4 **Guard posts requirements:**
 1. Constructed of steel not less than 4 inches in diameter and concrete filled
 2. Spaced not more than 4 feet between posts on center
 3. Set not less than 3 feet deep in a concrete footing of not less than 15 inch diameter
 4. Set with the top of the posts not less than 3 feet above the ground
 5. Located not less than 5 feet from the tank

Inside Cabinet

- F 5705.2.4 **Cam Lock connection on Fill Port-Closed system**
- F 5704.2.7 **Leak Detection/Rupture Basin Alarms-Audible-**
- F 907.5.2.1.1 **Audible alarms**-Audible alarm notification appliances shall be provided and emit A distinctive sound that is not to be used for any purpose. Average sound pressure. The audible alarm notification appliances shall provide a sound pressure level of 15 decibels (dBA) above the average ambient sound level, whichever is greater, The minimum sound pressure levels shall be: 90 dBA in mechanical equipment rooms. **Or install Alarm and Strobe Outside of Genset Cabinet**
If a Remote Annunciation Panel is involved-AHJ required to check and verify signals Report to the Panel.
- F 5704.2.9.6.6 Overfill prevention required (90% of capacity):
 1. Post sign “Do Not Over-Fill- Total Gallons = 124 gals”
 2. Manual gauge by gallons
 3. Electronic gauge calls for audible and visual signal-(See Audible Alarms)
- F 5704.2.9.6.2 Normal and emergency venting required
- F 5704.2.7.3.3 Atmospheric venting required (1¼ inch minimum)
12 feet above ground and 5 feet from building openings/property lines,
Over 500 gals.
- F 5704.2.7.3.6 Emergency venting required (UL Listed) per NFPA 30, Sec 4.2.5.2

DO NOT FILL BELLY TANK UNTIL AFTER FINAL INSPECTION AND OPERATIONAL PERMIT ISSUED BY AHJ (60 TO 500 GALS)

BELLY TANKS > 500 GALS OR MORE, FUEL FILL WILL BE WITNESSED BY AHJ, TO VERIFY OVERFILL PROTECTION

FORMS

1. Complete and return the Hazardous Materials Permit Application [FPB-365]
 - Copy of contractor license and liability/compensation insurance.
2. **Amount of fuel required on premises for Emergency Generator (6 hrs) and Fire Pump: (8hr.)CFC-604.2.14.1.1**
 - **Maximum amount of fuel storage allowed-660 gals. In a 2 hour room. Over 660 gals up to 3,000 gals maximum- a tank or multiple tanks are required to be in a PAST tank.(Protected Above Ground Storage Tank)CFC-603.3.2.1 through 603.3.2.5-Piping in a closed system.**
 - **Any Additional Generators for Stand-By Power. Permitted amounts per Control Area. (Table 307.1(1)-F-CBC)/CFC-27-Per floor Table-2703.8.3.2-Percentage of Maximum Quantities Allowed.**

PLANS

1. Plans for the aboveground storage tank(s) shall be submitted and approved. [CFC 105.4.2]
2. Provide manufacturers cut sheets for tank(s), pumps, piping, valves, or other related components. (CFC 5705.2.3)
3. Aboveground storage tank(s) shall be located per CFC Table 5705.3.4 (1) & 5705.3.4 (2)
4. Provide scale able site plans showing distanced to property lines, buildings on property and on adjacent properties.
5. Show any walls used in lieu of distance, 2 hr minimum resistance [CFC 5003.9.8] *Verify seismic and structural review by Bldg. Dept.*
6. Footings and supports shall be suitable for seismic zone-4. Provide P.E. stamp verifying design. [CFC 5704.2.7.7]
7. Corrosion Protection required. *Provide PE (Corrosion) wet stamp for design.* [CFC 5704.2.7.9]
8. Anchoring required [CFC 5704.2.7.8]
9. Atmospheric venting required to the outside [CFC 5704.2.7.3] 12'ft AFG/ 10'ft from Bldg Openings
10. Emergency vent required to the outside [CFC 5704.2.7.4] 12'ft AFG/ 10'ft from Bldg Openings

review/permit this installation. Provide Plan File #.

12. Provide approved vehicular protection. [CFC 5703.6.4]
13. Secondary containment required. [CFC 5703.4]
14. Spill Control required.(5004.2.1)
15. Leak detection/monitoring required on secondary containment. [CFC 5004.2.2.5]
16. Emergency Alarm-Pull station on outside of room containing Diesel Tank (CFC 5004.9,5004.10) Supervised
17. Provide approved fire lane and approved water supply. [CFC 5704.2.4] [FHPS Policy A-00-1] *Have Fire Dept. New Const. review/permit this installation. Provide Plan File #.*

PIPING

1. Piping and sealing compound shall be compatible with the material and pressure used. [CFC 5704.6]
2. Pipe joints shall be welded when in building. [CFC 5703.6.10]
3. Leak detection required on the underground piping. [CFC 5704.2.11.5.2]
4. Secondary containment required on underground piping. [CFC 5004.2.5]
5. Provide 12" minimum bury on underground with 1% slope to monitoring.[API 1615]
6. Approved corrosion protection required. [CFC 5704.2.7.9]
7. Provide approved piping support. [CFC 5703.6.8]
8. Leak detection/monitoring required on secondary containment. [CFC 5004.2.2.5]
9. Remote filling, outside of building, 5'Ft from operable windows, doors, public access ways. Overfill alarms for 90% and 95% located at the Remote Fill (CFC 5704.2.7.5.5)
10. Overfill Protection- 90% and 95% alarms at the tank location and Remote fill location. Electric solenoid valve installed 12" to 18" in. from Remote Fill on fill pipe. Closes valve at 95% and actuates alarm. (CFC-5704.2.9.7.6)

SECTION 11373 – COMPRESSOR SYSTEM

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing base plate mounted reciprocating compressors complete with all necessary appurtenances and accessories including but not limited to with pre-filter, air dryer, after-filter, compressed air receivers, and final filter to provide a workable installation as indicated.

1.2 RELATED SECTIONS

- A. The WORK of the following Section 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 09800 – Protective Coating
 2. Section 11000 – Equipment General Provisions
 3. Section 11020 – Vibration and Critical Speed Limitations
 4. Section 16460 – Electric Motors

1.3 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: An authorized service representative of the manufacturer shall visit the site for not less than one day to furnish the indicated services.
- B. Instruction of OWNER'S Personnel: The authorized service representative shall also furnish the indicated services for instruction of the OWNER'S personnel in the operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment for not less than one day. Instruction shall take place separately from inspection, startup, and field adjustment.

PART 2 -- PRODUCTS

2.1 GENERAL - Compressors

- A. Operating Conditions: Compressor operating conditions shall be as follows:

Working Pressure (psig)	-	400
Compressor Capacity – FAD (scfm)	-	15-25
Discharge pressure (psig)	-	500-600
Motor size, min (hp)	-	10 - 15
Max compressor speed (rpm)	-	1000 - 2000
Minimum Ambient Air Temp (°F)	-	15
Maximum Ambient Air Temp (°F)	-	115

- B. Equipment Requirements: Base plate mounted compressors shall be of the horizontal, positive displacement, air-cooled, 2-stage, 2 cylinder, single acting, and lubricated type. Each compressor shall be provided with a manual isolating valve adjacent to the equipment. The air compressor piping shall include flexible connectors as shown in the contract drawings.
- C. Drive: Direct Drive via flange mounting with flexible coupling by an 6 pole, 10 hp, (IP55), 460 volt 3 phase 60 Hz, IP55, Electric Motor suitable for indoor installation, in accordance with Section 16460.

D. Accessories: Each compressor shall be provided and installed complete with the following minimum accessories and all other controls and appurtenances indicated:

- 1 - Steel or cast-iron base plate,
- 1 - Set of restrained spring-type vibration isolators,
- 1 - Set of stainless steel anchor bolts and nuts,
- 1 - Intake filter-silencer,
- 1 - Flexible connector, stainless steel, corrugated or braided,
- 1 - Pressure relief valve,
- 1 - Check valve, silent, spring-loaded,
- 1 - Shut-off valve,
- 1 - Pressure switches,
- 1 - Safety guard,
- 1 - Pressure gauge with valve
- 1 - Low oil level switch

E. Equipment Construction: Basic equipment construction and materials required shall be as follows:

- | | |
|-------------------------------|--|
| Common base-plate | - cast-iron or steel, with sliding motor base |
| Crankcase | - cast-iron |
| Pistons | - cast-iron or aluminum |
| Rings | - oil control and compression rings |
| Heads | - cast-iron or aluminum |
| Crankshaft | - ductile iron or carbon steel |
| Bearings | - heavy duty anti-friction bearings with a minimum L-10 life of 50,000 hours |
| Lubrication | - splash-type oil lubrication |
| Valves | - stainless steel |
| Flywheel | - cast-iron |
| Suction filter-silencer | - dry-type |
| Starting unloader | - built-in centrifugal type |
| Safety shut-down switches | - low oil level and high temperature |
| Starter and disconnect switch | - automatic start and stop control, as indicated |

2.2 Air Dryer

- A. Refrigerated air driers (RAD) shall be provided and installed in accordance with the contract drawings. Each dryer shall be a 45 scfm refrigerated air dryer rated at 600psig max, 115/1/60 electrics, and air-cooled. Each dryer shall be sized to fit within the provided area without impeding the walkways or interfering with the installation or operations of any other pieces of equipment, piping, or other. Each RAD shall be provided with a bypass pipe and manual isolating valves as shown in the contract drawings.

2.3 Compressed Air Receiver

- A. The compressed air receivers shall be 1000 gal, vertical air receivers rated at 550psig and shall include manual drain, pressure gauge and safety relief valve. Receiver coatings shall be in accordance with specification 09800.

2.4 Air Filters

- A. As shown in the contract drawings the compressed air shall be filtered before and after the air dryer and after leaving the compressed air tank.
- B. The pre-filter shall be a separator/filter that removes bulk liquid and particles to 3 micron operating at approximately 45 scfm. Gardner-Denver model FHP12B, or equal.
- C. The after-filter shall be a general purpose 1 micron particulate filter operating at approximately 45 scfm, Gardner-Denver model FHP12C, or equal.
- D. The final filter shall be a high efficiency oil removal filter that eliminates oil, aerosols to 0.008 ppm (0.01 mg/m³) operating at approximately 45 scfm, Gardner-Denver model FHP12E, or equal.
- E. All filters (except final filter) shall be equipped with drains that include internal pilot operated diaphragm solenoid valve, removable stainless steel strainers resistant to large particles, and are designed for standard system pressures of 5-1500 psi (0.3-103 bar).

2.5 Pressure Control Valves

- A. Pressure control valves for the compressed air system shall be provided where shown and shall comply with specification 15114.

2.6 NAMEPLATES, TOOLS AND SPARE PARTS

- A. **Nameplate:** Nameplates shall be included on all air compressors, air dryers, and air receivers and shall be stainless steel engraved attached to units with stainless steel hardware and affixed to units per manufacturer's recommendation. Air filters shall be marked with round stainless steel tags with engraved valve names/numbers and attached with stainless steel hardware.
- B. **Spare Parts:** The WORK includes the following spare parts:
 - 1. 2 sets of all gaskets, O-rings and washers
 - 2. 1 set of all piston rings
 - 3. 2 sets of drive belts
 - 4. 4 sets of all intake filter elements

2.7 MANUFACTURERS

- A. Compressors of the type or model indicated shall be manufactured by one of the following (or equal):
 - 1. Gardner-Denver Co., (Comp Air) model 5209
 - 2. Ingersoll-Rand
 - 3. Kellogg-American
 - 4. Quincy (Colt Industries)
 - 5. Worthington

2.8 Appurtenances

- A. Isolating valves for drains, unions for threaded piping, or other items as required for a complete and operational system shall be provided.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: The compressors with all the auxiliary equipment shall be installed in accordance with the manufacturer's written instructions.

3.2 FIELD TESTING

- A. Field testing of the compressors shall be performed as follows:
 - 1. The units shall be started and stopped several times and checked for proper operation without excessive vibration and overheating.
 - 2. The setting of all pressure switches, relief valves, and pressure reducing valves shall be verified and adjusted with the pressure gauges. The automatic starting and shutoff functions shall be checked as well as the functioning of the condensate traps.

**** END OF SECTION ****

SECTION 11500 – NATURAL GAS-ENGINE GENERATOR SET

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide two (2) natural gas (NG) engine-driven electrical generating systems, complete and operable, in accordance with the Contract Documents, the Control Strategies as described in 13300, and Commissioning activities and responsibilities per Section 13350. In addition, the engine-generator set and apparatus shall fit within the building space constraints shown throughout the Contract Drawings.
- B. The CONTRACTOR shall be responsible for coordination of interface with other equipment and for any special construction necessary to complete the WORK of this Section in an acceptable manner.
- C. The supplier of the generator sets shall also be the manufacturer of the engines for the generator systems; however, the CONTRACTOR shall be responsible to the CITY for the WORK of this Section.
- D. Prior to approval of the Engine Generator Set, the CONTRACTOR shall determine the existing starting inrush KVA (thousand-volt-amperes) for the existing liquid rheostat driven motors and the existing RVAT driven motors. The engine generator set shall be capable of meeting the load step starting scenarios required in Section 13300 Appendix A2. To confirm the CONTRACTOR'S selected engine generator set can meet the starting requirements, field testing is required by the CONTRACTOR. Main sewage pumps 1, 3, and 6 have liquid rheostat driven motors and RVAT synchronous driven motors are connected to pump 6, 7 and 8. The CONTRACTOR shall provide and setup a digital meter to one of the 3 liquid rheostats and to one of the three RVATs in order to determine the inrush starting KVA. The CITY will coordinate and select the most convenient motors for testing. The drives shall be locked and tagged out by CITY forces. Once a drive is safely locked out, the CONTRACTOR shall temporarily install the digital meter. The testing shall take place in the evenings during low flow conditions, and the CITY'S Operators will start and stop each of the selected pump 3 times so the CONTRACTOR can obtain an average starting KVA value.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- 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 13300 – Instrumentation and Control
 - 2. Section 13350 – Commissioning
 - 3. Section 15020 – Pipe Supports
 - 4. Section 15250 – Pipe and Equipment Insulation
 - 5. Section 16450 – Medium Voltage Load Bank
- B. Materials shall conform to applicable requirements of the National Electrical Code (NEC), and any other State or Municipal codes which apply. Generator ancillary systems and equipment shall meet applicable standards and codes, including IEEE, NEMA, ANSI, OSHA, and UL. The

generator system as a whole shall meet NEMA MG-1-22 and 33 as applicable, ISO 3046 and 8528, and SAE J1349.

1.3 CONTRACTOR SUBMITTALS

- A. The Contractor shall include detailed cooling piping drawings, power and control drawings, and exhaust piping diagrams.
- B. Shop Drawings
 - 1. Detailed, dimensioned Shop Drawings and data demonstrating adherence to the requirements of these specifications shall be submitted and approved before fabrication, shipment, or other WORK under this Section begins. Include the manufacturer's certification that engine atmospheric emissions will comply with the limitations.
 - 2. Certified custom drawings and custom wiring diagrams of each component in the system and a master wiring diagram showing the entire system. This diagram shall include all AC and DC power control connections between the generator, engine, NG supply system, batteries, and circuit breakers and shall be a custom drawing for this specific installation. A master drawing of the engine/generator set shall also be provided, showing general dimensions, bill of materials, location and size of all connections for NG, cooling, exhaust, direct current connections, conduit locations, and connections for control and power wiring. Include wire and terminal numbers for all diagrams. Furnish KW output curves, NG consumption curves, and certified air emission data sheets.
 - 3. Outline drawings and connection diagrams shall be complete enough to enable the installation to be designed completely, and connection diagrams shall give both internal and external connections. Include foundation loading and clearances.
 - 4. Ten copies of complete and detailed instructions for the operation, lubrication, and maintenance of equipment in the system. The manuals shall be furnished after final approval of Shop and working drawings but prior to shipment of equipment. Manuals shall be complete with wiring diagrams, lubrication schedules and recommended lubricants, drawings, cuts, parts lists, and other necessary data. All parts shall be numbered or otherwise clearly identified to facilitate ordering of replacements. Descriptions of all operational control devices and their functions shall also be included.

1.4 QUALITY ASSURANCE

- A. The engine/generator shall be the product of a manufacturer who has been regularly engaged in the design and production of similar engine/generator sets for a minimum of 10 years.
- B. The supplier shall maintain a local parts and 24-hour service facility within the State of California. The supplier shall have factory trained and authorized service representatives to furnish necessary installation, test, and start-up supervision as well as operation and maintenance training necessary for final approval and acceptance.

PART 2 -- PRODUCTS

2.1 SYSTEM COMPONENTS

- A. Provide two new NG engine-powered electric generator sets, each with their own steel foundation for permanent installation indoors. The engine generator shall have a nominal prime duty rating of 3,000 KW, 4,160 volts, three phase, four wire, high impedance grounded neutral, 60 Hertz, and

a guaranteed minimum rating of 3,599 KVA at 0.8 power factor. The equipment package shall include in general, and as applicable, engine and generator on a common vibration isolating base, with auxiliaries, accessories, and controls, including intake filters, discharge silencer, turbocharger, heat exchangers, foundation bolts, isolators, piping, flexible couplings, supports, complete exhaust piping, ring, and silencer, insulation, lubrication system, water jacket heaters, cooling system, air start system, spare parts, and all materials necessary to permit installation, testing and placing the system in successful operation.

- B. Control panel(s), hardware (controllers, sensors, human-machine interfaces, circuit boards, monitors, etc.) and software details to describe control sequences of engine-generator and accessories, all control components, all signals including control, alarms and safety sequences, and interconnection with other control systems as specified. Include dimensional data and clearance and access requirements for all panels.
- C. Fluid Coolers for cooling the turbocharged combustion air via the aftercooler, as specified in this section.
- D. Continuous Emission Monitoring System (CEMS): Oxidation Catalyst, engine low NO_x control and tuning, SCR system, and exhaust blower for low loading.
- E. The generator-sets (2), and accessories shall be assembled and shipped to the Site as a complete, coordinated package, ready for installation. The engine generator base, etc., shall be factory painted before installation in the field.
- F. Appurtenances required for proper engine generator operation that are not physically attached to the engine generator (shipped loose) such as heat exchangers, pumps, etc. shall be of a size that does not prohibit their installation in their respective locations as shown in the contract drawing. The CONTRACTOR shall coordinate with the manufacturer to ensure that all pieces of equipment, as well as piping, valves and other items are of a size which does not inhibit their installation nor interfere with the installation or operation of other equipment, piping, etc.

2.2 SYSTEM OPERATION

- A. The system shall operate per the Control Strategy in Section 13300 and as follows:
 - 1. Automatic Control
 - a. A maintained remote contact closure from the DCS system shall cause the generator-set to start and run.
 - b. When the remote start contact opens, the engine shall continue to operate for an adjustable cool-down time (typically 5 to 30 minutes).
 - 2. Local Control: The generator-set shall be capable of manual initiation or stopping from the locally mounted generator control panel. The local generator control panel shall be provided as part of this Contract.
 - 3. Emergency Stop Control: An emergency stop pushbutton shall be provided at the generator control panel that shall cause the unit to stop without any delay.
 - 4. The unit shall be operated in standalone mode and/or synchronized to the existing utility grid. The unit governor response time shall be rapid enough to allow stand-alone operation. Controls and operation shall be suitable for operation in parallel with the utility electrical grid, and as a stand-alone emergency generator.

2.3 ENGINE

- A. The CONTRACTOR shall provide a complete NG engine-powered electrical generating system of the type and capacity indicated.
- B. The engine shall be mounted on a common base with the generator and shall be rated for prime service, continuous operation, with engine jacket water cooled by means of a remote mounted water-to-air radiator under SAE conditions at 85 degrees F, 500 feet above sea level. It should be noted that this is the rating of the engine.
- C. The NG engines shall be four-cycle, turbocharged, after cooled, 900 rpm, with individual injection valve for each cylinder. The engine shall have 12 cylinders. There shall be no gear reduction or gearbox allowed for the mechanical connection between the engine and generator. The generator-set shall be Caterpillar or approved equal.
- D. The engine shall have a dry type air cleaner with service indicator, NG filter, lubrication with full-flow oil filters, thermostatic regulated oil cooling system, and crankcase drain with valving to be able to drain the crankcase oil without reaching under the engine.
- E. The engine shall be equipped with thermostatically controlled jacket water heaters, 208VAC and 480VAC power is available to the manufacturers auxiliary control panel.
- F. The engine shall perform as indicated when operating on a utility grade of NG.
- G. The engine shall be equipped with a starting system, including air motor and air control valves. The starting pinion shall disengage automatically when the engine starts. The starting system shall include relays for fully automatic operation from a remote signal.
- H. The engine shall be provided with a speed control and electronic governor.
- I. The engine shall comply with the discharge limitations of the San Diego Air Pollution Control District (SDAPCD). The CONTRACTOR shall furnish a certification from the manufacturer that the proposed generator set will comply with the limitations.
- J. Specific limitations are:

Air Pollutant	g/bhp-hr	ppmvd @ 15% O2
NO _x	0.1-0.15	7
VOC (CH ₄)	0.15	30
NH ₃	-	10 @15%
CO*	2	270

*Per USEPA Standards of Performance for Stationary Spark Ignition Combustion Engines

2.4 EXHAUST SYSTEM

- A. The engine shall be provided with an exhaust system consisting of flexible connection, exhaust silencer, steel piping, fittings, stainless steel hardware and supports, brackets, and rain collar. Provide a shield for external roof mounting.
- B. The flexible connection shall be of the stainless steel bellows type with flanged ends. Flexible elements shall be stainless steel suitable for exhaust temperatures recommended by the engine

manufacturer. The flexible connection shall be suitable for vibration isolation and for relieving stress caused by thermal expansion.

- C. In general, exhaust piping shall be pitched upward from the engine and be provided with sufficient drains to eliminate condensation and rainwater; the turbocharger shall be pitched downwards, away from the engine to prevent condensate return. Exhaust piping shall be welded 316 stainless steel pipe. Elbows shall be welding type, standard wall. Flanges shall be welding slip-on type, 125-pound, either forged or plate 316 stainless steel. Exhaust piping shall be supported independently of the engine-generator. The exhaust piping shall be insulated per Section 15250. The weight of the exhaust and silencer shall not be supported by the engine. The noise as measured from anywhere along the perimeter of the parapet wall roofline shall not exceed 72 dBA. The engine and exhaust manufacture shall provide their anticipated noise levels of the exhaust stack, and if those levels are not anticipated to meet the noise requirements, then the Contractor shall provide an additional exhaust silencer as required to meet this requirement. The engine manufacturer is required to provide a complete and functional exhaust system meeting all the requirements of the Contract Documents.

2.5 COOLING SYSTEM

- A. The Natural Gas Generator's complete cooling system shall conform to associated P&IDs and control strategies and shall include, at a minimum, the following:
 - 1) The engine shall be equipped with a cooling system having sufficient capacity to effectively cool the engine when delivering full rated horsepower at the conditions stated above.
 - 2) Plate and frame style heat exchangers shall be provided to exchange heat between the engine's cooling waters (jacket or auxiliary/aftercooler) and the soft water cooling loops. The soft water cooling loop runs between the plate/frame HEX and the wastewater HEX as shown in the P&ID's.
 - 3) Lube oil heat exchangers as required by the manufacturer and as shown in the P&ID's.
- B. All piping components that carry water or water-glycol mixtures for cooling purposes are subject to expansion and contraction due to thermal effects. All pipe including, but not limited to, AWS, AWR, JWS, and JWR shall be supported by appropriate expansion type rollers, slide plates, or other to allow for material expansion and contraction. Fixed anchor points shall also be included; at a minimum each straight run of pipe shall include one fixed anchor point as acceptable by the CONSTRUCTION MANAGER. All pipe supports shall comply with specification 15020.
- C. The overall cooling system process shall function as follows and as shown on drawing 7I-10:
 - 1) The overall cooling schematic shall be as shown in drawing 7I-10 which lists heat transfer rates and cooling water flow rates. The CONTRACTOR shall provide heat transfer calculations stamped by a professional engineer licensed in California for each piece of equipment that transfers heats. The calculations shall be submitted as a package and shall confirm that the equipment being provided will meet the engine generator's heat transference requirements. The CONTRACTOR shall hold final responsibility for providing a total cooling system that meets or exceeds the heat transfer required for all engine generators running simultaneously at full load capacity.
 - 2) Engine: The engine will reject heat to the internal jacket water and auxiliary water cooling systems. This cooling medium shall be a mixture of glycol and water (glycol loop) as recommended by the engine manufacturer to accommodate the engine's cooling

requirements. The glycol loop will run only between the engine and its associated plate and frame decoupling heat exchanger.

- a.) The designed cooling system is based on auxiliary/aftercooler heat rejection of 1,562 MBtu/ hr and jacket heat rejection of 7,328 MBtu/hr for a single engine.
- 3) Plate and Frame Heat Exchanger: After accepting the engine's heat the water-glycol mix is considered "return" water. The glycol loop is pumped to a plate and frame style heat exchanger installed adjacent to the engines as shown in the 7M drawings; pump and plate and frame HEX shall be provided as part of the engine manufacturer's package. At the plate and frame HEX the glycol loop rejects its heat to a softened water loop before returning to the engine as "supply" water. The supply glycol loop may travel through a lube oil HEX, as required by the manufacturer, prior to returning to the engine. Lube oil HEX shall be provided by engine manufacturer.
- a.) The soft water loop is designed to deliver to the plate and frame HEXs 100°F low temp (auxiliary/aftercooler) water and 160°F high temp (jacket) cooling water as shown on drawing 7I-10.
 - b.) Design:
 - i. The plate and frame HEX's shall be vertical type and shall be limited to a footprint no larger than 24" x 40".
 - ii. Unit shall be of a single pass design with all connections located on the frame plate to allow for removal and plates and inspection without dismantling the process piping.
 - iii. All connections should be located on the frame plate (fixed head), allowing the pressure plate (movable head) to slide back and have plates added, removed, or replaced from the plate pack without disturbing the connections or associated piping.
 - iv. The design should allow for the removal of any plate in the plate pack without requiring the removal of any other plates.
 - v. The unit shall be provided with an aluminum splash shield covering the sides and top of the plate pack. The bottom should be left open for leak detection.
 - vi. The unit shall be designed, tested, and U stamped in accordance with ASME Section VIII Division 1 and registered with the National Board. A U-1 data report to be furnished upon request.
 - vii. Manufacturer must be certified and registered with ISO 9001:2008. A certificate of registration shall be supplied upon request.
 - viii. Unit must be factory pressure tested with ASME U stamp applied on nameplate prior to leaving the factory.
 - c.) Frame:
 - i. The frame and pressure plates shall be carbon steel SA 516 grade 70.

- ii. The frame and pressure plates shall be of sufficient thickness to meet the ASME design pressure without the use of stiffeners or other type of reinforcement.
- iii. Carbon steel frame components, except hardware, shall be painted with gray macro epoxy paint to a minimum of 4 mils dry film thickness.
- iv. Carbon steel frame and pressure plates shall be steel grit blasted to SSPC-SP6/NACE 3 (Commercial Blast Cleaning) with surface profile of 2 mils on either face. All surfaces and openings must have a recoatable epoxy primer applied within 8 hours of blast or before flash rusting occurs.
- v. Frame plates shall have integral lifting eyes in the upper corners. Bolted or welded on lifting lugs not allowed.
- vi. Units with studded port connections shall have unlined or alloy lined studded ports to mate with a raised face or flat faced ANSI flange where 150# ANSI flanges are acceptable. Rubber liners are not allowed.
- vii. Units with NPT connections, except 1" port sizes, shall have the frame plate tapped with carbon steel female NPT connections or, if alloy material is required, extended male NPT nozzles.
- viii. Units with 1" ports shall have carbon steel or 316 stainless steel female tapped NPT or alloy material male NPT connections.
- ix. For units with studded port type connections, the studs around the ports must be provided by the manufacturer.
- x. Units with connections greater than 3" require that the thermal plates be supported by the top carry bar. The bottom guide bar shall only assist in properly aligning the plates.
- xi. The design for units with 2.5" connections or smaller shall allow the plates to be supported by the bottom guide bar and the top carry bar shall help properly align the plates.
- xii. The carry and guide bar for 2" port models shall be stainless steel. For models with 2.5" ports and greater, the thermal plate contact surfaces of the carry and guide bar shall be stainless steel. For units with 1" connections, the carry and guide bars shall be zinc plated carbon steel.
- xiii. For ease of movement during assembly and maintenance, the movable pressure plate shall be supported by a roller assembly over the carry bar for 4" ported models greater than 90" in height and for all 6" and larger ported models. For 4" ported models less than 90" in height, a glide clip made of ultra high molecular weight polyethylene shall be used on the movable pressure plate.
- xiv. Units shall have a minimum of two mounting feet at the frame plate and one at the support column, if a support column is used in the design.
- xv. For units with 300 psig design pressure or less, excluding "wide gap" designs, frames must be designed to withstand full test pressure in one circuit with zero pressure in the opposite circuit.

- xvi. The nominal connection size shall match the nominal thermal plate port hole diameter.

d.) Plates

- i. Plates shall be pressed in a one-step stamping process, except for plates 132" and greater in length, where multi step pressing is allowed.
- ii. Plates shall use an integral rolled edge hanging system to provide a rigid hanger device between the plate and carry bar and guide bar. Welded on hanging brackets or stiffeners are not acceptable.
- iii. The plate pack shall use a positive plate to plate alignment system to ensure proper plate to gasket seals throughout the plate pack. The positive alignment system shall either be a gasket lug which fits within a plate recess on the preceding plate (tongue in groove) to align successive plates or an extended rolled edge hanger which nests successive plates through direct contact around the entire plate hanger. Plate designs which only offer alignment through contact with the carry and guide bar are unacceptable.
- iv. Plates shall have an enclosing groove for the entire gasket designed to contain the gasket while allowing for thermal expansion.
- v. Plates shall be permanently marked to indicate plate material and thickness.
- vi. Double wall plates shall have an air gap with a leak detection path.
- vii. Stainless steel double wall plates shall be pressed at the same time to ensure a close fit with minimal loss of heat transfer.
- viii. For units with 300 psig design pressure or less, excluding "wide gap" designs, thermal plates must be designed to withstand full test pressure in one circuit with zero pressure in the opposite circuit.

e.) Gaskets

- i. All gaskets for single pass designs, except the gasket on the first plate, shall be identical.
- ii. The gaskets shall be a one-piece construction with a double gasket barrier at the port region. The area isolated by the double gasket shall be vented to the atmosphere, so that a gasket failure is detected by leakage to the exterior prior to any possible cross contamination.
- iii. Gaskets shall have tapered sides to assure positive seating of the compressed gasket and assist in aligning the thermal plates during compression.
- iv. When available, glue-free gaskets are preferred to glued-on gaskets. Glue-free gasket attachment methods which break during gasket removal or plate maintenance, thus destroying the gasket, are not allowed.
- v. Care should be taken in the selection

f.) Thermal/Hydraulic Design and Certification

- i. The manufacturer shall guarantee the accuracy of the heat exchanger thermal and hydraulic design. Should the heat exchanger not perform to the specified conditions, within industry standard testing methods, accuracy and tolerances for plate and frame heat exchangers, the manufacturer is responsible to replace or repair the exchanger to achieve the stated performance.
- 4) The softened water loop will accept the heat from the glycol loop at the plate frame HEX and is now considered "return" water. The soft water travels through the cooling loop pumps to the refurbished wastewater heat exchangers (WWHEX). At the WWHEX units the soft water loop rejects its heat to the wastewater. The rates of heat rejection based on flow rate are shown in drawing 7I-10. Once the soft water has rejected its heat to the wastewater the cooling process may be fully or partially completed and the water is considered "supply".
 - a.) WWHEX heat transference is based on the materials and configuration as shown in the 4M-X drawings and heat rejection is based on the flow rate and heat transference as shown on drawing 7I-10. CONTRACTOR shall include heat transfer calculations for the WWHEX with the overall heat transfer calculation package referenced above.
- 5) The softened water loop is routed from the WWHEX units to the air handling unit's air-water heat exchangers (AHEX) atop the generator building roof. Based on the number of engines running the softened water may travel directly back to the plate and frame HEX described above or when multiple engines are running, or when the supply water temperature is lower than what the current situation calls for, the softened water will travel through the AHEX to reject heat to air before returning to the engine's plate and frame HEX.
 - a.) Reference specification 15855 for AHU construction requirements.

2.6 GENERATOR

- A. The generator shall be nominally rated 3000 KW at .8 PF, 4,160 V 3 phase, 60 Hz, 4 wire wye high impedance grounded and shall be a brushless design with solid state permanent magnet generator (PMG) exciter. Other excitation methods are not acceptable. The voltage regulator shall be solid state, generator mounted. Provide radio-interference suppression meeting commercial standards.
- B. **Voltage Regulation Tolerance:** Plus or minus 1 percent of any present value over the 3 phase load range. Instantaneous voltage dip or rise, when measured with an oscilloscope, shall not exceed 25 percent upon full load application or rejection, and shall return to preset value within 0.5 seconds.
- C. **Waveform:** Deviation factor of output voltage shall not exceed 5 percent and the value of any individual harmonic shall not exceed 2 percent of the fundamental when operating with an unbalanced load.
- D. **Temperature Rise:** Temperature rise of any component shall not exceed the rise permitted by NEMA standards. The voltage regulator shall be adjustable minus 25 percent to plus 10 percent.
- E. **Bearing:** Greasable roller type.

2.7 VIBRATION ISOLATORS

- A. The engine and generator shall be mounted on a common system base and shall be provided with vibration isolators of number and size as recommended by the engine supplier to meet and IBC Ip=1.5 support of the engine, generator, auxiliary equipment, and base. The isolation mountings shall consist of steel or cast iron top and bottom housings incorporating steel springs or "donut" style isolators, located between the genset and the base, and shall be provided with built-in leveling bolts and built-in resilient chocks to control isolation and withstand lateral forces in all directions.
- B. The vibration isolators shall be **Korfund Dynamics Corporation Series L**, or equal.

2.8 LUBRICATION AND COOLING FLUIDS

- A. The supplier shall furnish the engine fully charged with lubricating oil and grease as specified by the manufacturer for continuous service. The cooling system shall be furnished with a full charge of 30 percent ethylene glycol.

2.9 GENERATOR SYSTEM CONTROL PANEL

- A. The engine shall be provided with a locally mounted instrument and control panel, vibration isolated, NEMA 12 compliant, dead front, constructed of 14 gauge steel and containing at least the following equipment:

Coolant temperature gauge
Oil pressure gauge
Four position selector switches marked for "auto," "manual," "stop," and "stop/reset."
Automatic starting controls (2 wire start/stop)
Coolant level pre-alarm
Coolant temperature pre-alarms (low and high)
NG pressure pre-alarm
Electrical contacts and "push to test" pilot lights for shutting down the engine on low oil pressure, high oil temperature, overcrank, high coolant temperature, and overspeed condition
Individual electrical contacts for remote indication of any pre-alarm or alarm condition
Running Time Meter (Non Resettable)
Emergency stop switch
Voltmeter and switch, ammeter and switch, frequency meter

- B. Wiring

1. Signal wiring shall be segregated from power wiring and be arranged neatly to facilitate tracing of circuits.
2. Plastic wiring wraps shall be used to bundle wires, except within wiring ducts. The bundles shall be securely fastened to the steel structure at suitable intervals not exceeding 12-inches in length. No open space hanging of wires will be permitted. Flexible stranded copper wiring shall be used throughout. No solid conductor wire shall be permitted.
3. Terminal blocks shall be provided for interconnections between remote devices and local control panel wiring. The terminal blocks shall be factory assembled on a mounting channel, and the channel shall be bolted to the inside of the panel. The terminals shall have a continuous marking strip using the nomenclature on the schematic diagrams. No more than 2 wires shall be terminated at any one terminal. Wire terminals shall have sleeve wire markers properly marked to match the schematic diagrams.

2.10 SPARE PARTS

A. The following spare parts with quantity indicated shall be furnished:

1. Engine parts

Description	Qty
Pneumatic Starter	01
Ex-change Cylinder Head	02
Assembling Set	02
Gasket Cyl. Head Cover	02
Gasket Cyl. Head	02
O-Seal	08
O-Seal	10
Filter Insert	04
O-Seal	10
O-Seal	10
O-Seal	08
O-Seal	10
Float Switch	01
Strainer	04
O-Seal	04
Cleaner elements	08
Prechamber Spark Plug	16
Sealing Ring SP	80
Filter stage 1 UPF	01
Filter Stage 2 UPF	01
Master Valve	01
Press.reduc.valve	01
Safety valve	01
Repair kit ASM	01
Thermocouple	08
Thermocouple	04
Sealing Ring	36

Sealing Ring	20
Tors Vibr Damper	01
Pressure Switch	01
Power Booster ATL	01
Gasket ASM	01
Gasket ASM	01
Cylinder Liner	02
O-Seal	04
O-Seal	02
Coke Scraper Ring	02
Piston	02
Rectangular Ring	02
Taper-Faced Ring	02
Oil Control Ring	02
Piston Pin	02
Circlip	04
4 Bolt Big End Bearing	02
Bonded Coating	01
Safety/Locking Agent	05
Packing Compound	05
O-Seal	02
Safety/Locking Agent	05
Gasket Cy. Jacket	04
Cylinder Jacket	01
Ball bearing	04
Lubrication Oil Pump	01
O-Seal for Lube oil pump	02
Actuator	01
Compensator	02
Clip	04
Sealing Ring	04
Flange	03
Stud	02
Hexagon Nut	02
O-Seal	08
Parallel Pin	02
Fine Filter	02
Tappet	02
Rocker Arm Bracket	01
Screw/Bolt	02
Screw/Bolt	02
Rocker Arm	02
Valve Bridge	02
Adjusting Screw	02
Pushrod	02
Electric Motor	01
Plain Washer	08

Hexagon Bolt	08
Gasket	01
Spring Lock Washer	08
Screw Plug	01
Sealing Ring	04
Flange gasket	02
Stud	04
Hexagon Nut	04

2. Sensors

Description	Qty
Pressure Transformer	01
Temperature Sensor	02
Pressure Switch	01
Thermal Release	01
Three-way valve	01
Temperature Sensor	02
Temperature Sensor	02
Installation Parts	01
Water level limiter	01
Resist. Thermometer	02
Resist. Thermometer	02
Thermocouple	01
Pressure transmitter	01
Tacho generator	01
Gasket Tacho generator	06
Thermocouple	01
Pressure Switch	01
Proximity Switch Gas train	01
Ignition Coil	02
Measuring Transducer	01
Pressure Switch	01
Pick Up	01
Speed Pickup	01
Temperature Sensor	02

3. SCR Emission Control System

Description	Qty
Injector Flange Gasket	1
Sample Pressure Switch	2

Description	Qty
Condensate Pump Head	2
Sample Gas Filter	6
Urea Filter	2
VPN20 Maintenance Pack	1
Urea Pump Kit SE27	1
Dosing Cabinet Maintenance Pack	1
Air Pressure Switch	1
Dosing Valve 3..20	1
Booster Pump Maintenance Pack	1
DEX20.XXX Maintenance Pack	1
Injector O-Ring DEN20 - Large	2
Injector O-Ring DEN20 - Small	2
Nozzle Gasket - DEN20	2
Injector Nozzle - DEN20	2
Air Adjustment Cap - DEN20	2
Air Adjustment Ring 20L	2

4. Maintenance tools

Description	Qty
Torque wrench (Measuring range 0-210 Nm)	01
Test case for lubricating oil and coolant	01
Dial gauge	01
Tapper	01
Disassembly and assembly tool for mixture cooler	01
Tool kit basic equipment	01

PART 3 – EXECUTION

3.1 FACTORY TESTING

- A. The generator system shall be witness tested at the factory before shipment to the Site. The manufacturer's standard testing procedure shall be followed, and in the event the system does not satisfy the test criteria or the requirements of this Section, it shall be repaired, modified, or replaced until it conforms.
- B. Furnish the ENGINEER 2 weeks prior notice of the testing date and a copy of the manufacturer's test procedure. The CITY and the ENGINEER will witness the factory testing and sign the test data as witnesses. The ENGINEER will not review nor approve the test procedure.

- C. The CONTRACTOR shall pay the costs for the CITY and ENGINEER to observe the tests. Such costs will include travel and subsistence for 2 persons excluding salaries.
- D. Witnessed test results shall be submitted to the ENGINEER for the project file, not for review.

3.2 OPERATION AND MAINTENANCE MANUAL

- A. The Contractor shall provide ten (10) hard copies of the O&M manual inclusive of all details addressed in this specification.

3.3 START-UP ASSISTANCE AND TRAINING

- A. The manufacturer's representative shall furnish on-Site start-up assistance and shall inspect the installation prior to start-up to verify that equipment is installed in accordance with the manufacturer's requirements.
- B. In addition, the manufacturer's representative shall provide on-Site training for operation and maintenance of all equipment included in this Section.
- C. The following times shall be included, as a minimum, for the above tasks. A day is defined as 8 hours on-Site, exclusive of meals and travel. Each task shall be considered a separate trip to the site. Dates and times for the trips shall be coordinated with the CITY.

- 1. Inspection of the installation: 2 days
- 2. Startup assistance: 3 days
- 3. Operation and Maintenance Training: 2 days

3.4 SERVICE AND SUPPORT

- A. The manufacturer shall present documentation for approval demonstrating their ability to meet the below criteria as part of this submittal requirements.
 - 1. The manufacturer shall be able to respond and send to the site trained maintenance personal to an emergency call for maintenance within 1 hour.
 - 2. All spare parts necessary to keep the engine-generators operational shall be available able to be delivered to the site within 24 hours if an order being placed.

- END OF SECTION -

SECTION 11501 – DIESEL FUEL ENGINE-GENERATOR SET

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide two (2) diesel engine-driven electrical generating systems, complete and operable, in accordance with the Contract Documents, the Control Strategies as described in 13300, and Commissioning activities and responsibilities per Section 13350. In addition, the engine-generator set and apparatus shall fit within the building space constraints shown throughout the Contract Drawings.
- B. The CONTRACTOR shall be responsible for coordination of interface with other equipment and for any special construction necessary to complete the WORK of this Section in an acceptable manner.
- C. The supplier of the generator sets shall also be the manufacturer of the engines for the generator systems; however, the CONTRACTOR shall be responsible to the CITY for the WORK of this Section.
- D. Prior to approval of the Engine Generator Set, the CONTRACTOR shall determine the existing starting inrush KVA (thousand-volt-amps) for the existing liquid rheostat driven motors and the existing RVAT driven motors. The engine generator set shall be capable of meeting the load step starting scenarios required in Section 13300 Appendix A2. To confirm the CONTRACTOR'S selected engine generator set can meet the starting requirements, field testing is required by the CONTRACTOR. Main sewage pumps 1, 3, and 6 have liquid rheostat driven motors and RVAT synchronous driven motors are connected to pump 6, 7 and 8. The CONTRACTOR shall provide and setup a digital meter to one of the 3 liquid rheostats and to one of the three RVATs in order to determine the inrush starting KVA. The CITY will coordinate and select the most convenient motors for testing. The drives shall be locked and tagged out by CITY forces. Once a drive is safely locked out, the CONTRACTOR shall temporarily install the digital meter. The testing shall take place in the evenings during low flow conditions, and the CITY's Operators will start and stop each of the selected pump 3 times so the CONTRACTOR can obtain an average starting KVA value.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- 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 13300 – Instrumentation and Control
 - 2. Section 13350 – Commissioning
 - 3. Section 15020 – Pipe Supports
 - 4. Section 15250 – Pipe and Equipment Insulation
 - 5. Section 16450 – Medium Voltage Load Bank
- B. Materials shall conform to applicable requirements of the National Electrical Code (NEC), and any other State or Municipal codes which apply. Generator ancillary systems and equipment shall meet applicable standards and codes, including IEEE, NEMA, ANSI, OSHA, and UL. The

generator system as a whole shall meet NEMA MG-1-22 and 33 as applicable, ISO 3046 and 8528, and SAE J1349.

1.3 CONTRACTOR SUBMITTALS

- A. The Contractor shall include detailed cooling piping drawings, power and control drawings, and exhaust piping diagrams.
- B. Shop Drawings
 - 1. Detailed, dimensioned Shop Drawings and data demonstrating adherence to the requirements of these specifications shall be submitted and approved before fabrication, shipment, or other WORK under this Section begins. Include the manufacturer's certification that engine atmospheric emissions will comply with the limitations.
 - 2. Certified custom drawings and custom wiring diagrams of each component in the system and a master wiring diagram showing the entire system. This diagram shall include all AC and DC power control connections between the generator, engine, diesel supply system, batteries, and circuit breakers and shall be a custom drawing for this specific installation. A master drawing of the engine/generator set shall also be provided, showing general dimensions, bill of materials, location and size of all connections for diesel fuel, cooling, exhaust, direct current connections, conduit locations, and connections for control and power wiring. Include wire and terminal numbers for all diagrams. Furnish KW output curves, diesel consumption curves, and certified air emission data sheets.
 - 3. Outline drawings and connection diagrams shall be complete enough to enable the installation to be designed completely, and connection diagrams shall give both internal and external connections. Include foundation loading and clearances.
 - 4. Ten copies of complete and detailed instructions for the operation, lubrication, and maintenance of equipment in the system. The manuals shall be furnished after final approval of Shop and working drawings but prior to shipment of equipment. Manuals shall be complete with wiring diagrams, lubrication schedules and recommended lubricants, drawings, cuts, parts lists, and other necessary data. All parts shall be numbered or otherwise clearly identified to facilitate ordering of replacements. Descriptions of all operational control devices and their functions shall also be included.

1.4 QUALITY ASSURANCE

- A. The engine/generator shall be the product of a manufacturer who has been regularly engaged in the design and production of similar engine/generator sets for a minimum of 10 years.
- B. The supplier shall maintain a local parts and 24-hour service facility within the State of California. The supplier shall have factory trained and authorized service representatives to furnish necessary installation, test, and start-up supervision as well as operation and maintenance training necessary for final approval and acceptance.

PART 2 -- PRODUCTS

2.1 SYSTEM COMPONENTS

- A. Provide two new diesel engine-powered electric generator sets, each with their own steel foundation for permanent installation indoors. The engine generator shall have a nominal prime duty rating of 4,000 KW, 5,000 KVA, 0.8 power factor, 4160 volts, three phase, four wire, high

impedance grounded neutral, 60 Hertz. The equipment package shall include in general, and as applicable, engine and generator on a common vibration isolating base, with auxiliaries, accessories, and controls, including intake filters, discharge silencer, turbocharger, heat exchangers, foundation bolts, isolators, piping, flexible couplings, supports, complete exhaust piping, ring, and silencer, insulation, lubrication system, water jacket heaters, cooling system, air start system, spare parts, and all materials necessary to permit installation, testing and placing the system in successful operation.

- B. Control panel(s), hardware (controllers, sensors, human-machine interfaces, circuit boards, monitors, etc.) and software details to describe control sequences of engine-generator and accessories, all control components, all signals including control, alarms and safety sequences, and interconnection with other control systems as specified. Include dimensional data and clearance and access requirements for all panels.
- C. Fluid Coolers for cooling the turbocharged combustion air via the aftercooler, as specified in section.
- D. Emission control systems: Oxidation Catalyst, engine low NOx control and tuning, SCR, and particulate filter.
- E. The generator-sets (2), and accessories shall be assembled and shipped to the Site as a complete, coordinated package, ready for installation. The engine generator base, etc., shall be factory painted before installation in the field.
- F. Appurtenances required for proper engine generator operation that are not physically attached to the engine generator (shipped loose) such as heat exchangers, pumps, etc. shall be of a size that does not prohibit their installation in their respective locations as shown in the contract drawings. The CONTRACTOR shall coordinate with the manufacturer to ensure that all pieces of equipment, as well as piping, valves and other items are of a size which does not inhibit their installation nor interfere with the installation or operation of other equipment, piping, etc.

2.2 SYSTEM OPERATION

- A. The system shall operate per the Control Strategy in Section 13300 and as follows:
 - 1. Automatic Control
 - a. A maintained remote contact closure from the DCS system shall cause the generator-set to start and run.
 - b. When the remote start contact opens, the engine shall continue to operate for an adjustable cool-down time (typically 5 to 30 minutes).
 - 2. Local Control: The generator-set shall be capable of manual initiation or stopping from the locally mounted generator control panel. The local generator control panel shall be provided as part of this Contract.
 - 3. Emergency Stop Control: An emergency stop pushbutton shall be provided at the generator control panel that shall cause the unit to stop without any delay.

2.3 ENGINE

- A. The CONTRACTOR shall provide a complete diesel engine-powered electrical generating system of the type and capacity indicated.

- B. The engine shall be mounted on a common base with the generator and shall be rated for standby service, continuous operation, with engine jacket water cooled by means of a remote mounted water-to-air radiator under SAE conditions at 85 degrees F, 500 feet above sea level. It should be noted that this is the rating of the engine.
- C. The diesel engines shall be four-cycle, turbocharged, aftercooled, 1800 rpm, with individual injection valve for each cylinder. The engine shall have 20 cylinders. There shall be no gear reduction or gearbox allowed for the mechanical connection between the engine and generator. The generator-set shall be Caterpillar or approved equal.
- D. The engine shall have a dry type air cleaner with service indicator, diesel filter, lubrication with full-flow oil filters, thermostatic regulated oil cooling system, and crankcase drain with valving to be able to drain the crankcase oil without reaching under the engine.
- E. The engine shall be equipped with thermostatically controlled jacket water heater(s), 208VAC and 480VAC power is available to the manufacturers control panel.
- F. The engine shall be equipped with a starting system, including air motor and air control valves. The starting pinion shall disengage automatically when the engine starts. The starting system shall include relays for fully automatic operation from a remote signal.
- G. The engine shall be provided with a speed control and electronic governor.
- H. The engine shall comply with the discharge limitations of the San Diego Air Pollution Control District (SDAPCD). The CONTRACTOR shall furnish a certification from the manufacturer that the proposed generator set will comply with the limitations.
- I. Specific limitations are:

Air Pollutant	USEPA Prime** (Tier 4) (g/kW-hr)
Particulate Matter (PM)	0.03
NO _x + NMHC*	0.67+0.19
Carbon Monoxide (CO)	3.5

*Non-methane Hydrocarbons

2.4 EXHAUST SYSTEM

- A. The engine shall be provided with an exhaust system consisting of flexible connection, exhaust silencer, steel piping, fittings, stainless steel hardware and supports, brackets, and rain collar. Provide a shield for external roof mounting.
- B. The flexible connection shall be of the stainless steel bellows type with flanged ends. Flexible elements shall be stainless steel suitable for exhaust temperatures recommended by the engine manufacturer. The flexible connection shall be suitable for vibration isolation and for relieving stress caused by thermal expansion.
- C. In general, exhaust piping shall be pitched upward from the engine and be provided with sufficient drains to eliminate condensation and rainwater; the turbocharger shall be pitched downwards, away from the engine to prevent condensate return. Flanges shall be welding slip-on type, 125-pound, either forged or plate 316 stainless steel. Exhaust piping shall be supported independently of the engine-generator. The exhaust piping shall be insulated per Section 15250.

The weight of the exhaust and silencer shall not be supported by the engine. The noise as measured from anywhere along the perimeter of the parapet wall roofline shall not exceed 72 dBA. The engine and exhaust manufacture shall provide their anticipated noise levels of the exhaust stack, and if those levels are not anticipated to meet the noise requirements, then the Contractor shall provide an additional exhaust silencer as required to meet this requirement. The engine manufacturer is required to provide a complete and functional exhaust system meeting all the requirements of the Contract Documents.

2.5 COOLING SYSTEM

- A. The Diesel Fuel Engine Generator's complete cooling system shall conform to associated P&IDs and control strategies and shall include, at a minimum, the following:
- 1) The engine shall be equipped with a cooling system having sufficient capacity to effectively cool the engine when delivering full rated horsepower at the conditions stated above.
 - 2) Plate and frame style heat exchangers shall be provided to exchange heat between the engine's cooling waters (jacket or auxiliary/aftercooler) and the soft water cooling loops. The soft water cooling loop runs between the plate/frame HEX and the wastewater HEX as shown in the P&ID's.
- B. All piping components that carry water or water-glycol mixtures for cooling purposes are subject to expansion and contraction due to thermal effects. All pipe including, but not limited to, AWS, AWR, JWS, and JWR shall be supported by appropriate expansion type rollers, slide plates, or other to allow for material expansion and contraction. Fixed anchor points shall also be included; at a minimum each straight run of pipe shall include one fixed anchor point as acceptable by the CONSTRUCTION MANAGER. All pipe supports shall comply with specification 15020.
- C. The overall cooling system process shall function as follows and as shown on drawing 7I-10:
- 1) The overall cooling schematic shall be as shown in drawing 7I-10 which lists heat transfer rates and cooling water flow rates. The CONTRACTOR shall provide heat transfer calculations stamped by a professional engineer licensed in California for each piece of equipment that transfers heats. The calculations shall be submitted as a package and shall confirm that the equipment being provided will meet the engine generator's heat transference requirements. The CONTRACTOR shall hold final responsibility for providing a total cooling system that meets or exceeds the heat transfer required for all engine generators running simultaneously at full load capacity.
 - 2) Engine: The engine will reject heat to the internal jacket water and auxiliary water cooling systems. This cooling medium shall be a mixture of glycol and water (glycol loop) as recommended by the engine manufacturer to accommodate the engine's cooling requirements. The glycol loop will run only between the engine and its associated plate and frame decoupling heat exchanger.
 - a.) The designed cooling system is based on auxiliary/aftercooler heat rejection of 1,562 MBtu/ hr and jacket heat rejection of 7,328 MBtu/hr for a single engine.
 - 3) Plate and Frame Heat Exchanger: After accepting the engine's heat the water-glycol mix is considered "return" water. The glycol loop is pumped to a plate and

frame style heat exchanger installed adjacent to the engines as shown in the 7M drawings; pump and plate and frame HEX shall be provided as part of the engine manufacturer's package. At the plate and frame HEX the glycol loop rejects its heat to a softened water loop before returning to the engine as "supply" water. The supply glycol loop may travel through a lube oil HEX, as required by the manufacturer, prior to returning to the engine. Lube oil HEX shall be provided by engine manufacturer.

a.) The soft water loop is designed to deliver to the plate and frame HEXs 100°F low temp (auxiliary/aftercooler) water and 170°F high temp (jacket) cooling water as shown on drawing 7I-10.

b.) Design:

- i. The plate and frame HEX's shall be vertical type and shall be limited to a footprint no larger than 24" x 40".
- ii. Unit shall be of a single pass design with all connections located on the frame plate to allow for removal and plates and inspection without dismantling the process piping.
- iii. All connections should be located on the frame plate (fixed head), allowing the pressure plate (movable head) to slide back and have plates added, removed, or replaced from the plate pack without disturbing the connections or associated piping.
- iv. The design should allow for the removal of any plate in the plate pack without requiring the removal of any other plates.
- v. The unit shall be provided with an aluminum splash shield covering the sides and top of the plate pack. The bottom should be left open for leak detection.
- vi. The unit shall be designed, tested, and U stamped in accordance with ASME Section VIII Division 1 and registered with the National Board. A U-1 data report to be furnished upon request.
- vii. Manufacturer must be certified and registered with ISO 9001:2008. A certificate of registration shall be supplied upon request.
- viii. Unit must be factory pressure tested with ASME U stamp applied on nameplate prior to leaving the factory.

c.) Frame:

- i. The frame and pressure plates shall be carbon steel SA 516 grade 70.
- ii. The frame and pressure plates shall be of sufficient thickness to meet the ASME design pressure without the use of stiffeners or other type of reinforcement.
- iii. Carbon steel frame components, except hardware, shall be painted with gray macro epoxy paint to a minimum of 4 mils dry film thickness.

- iv. Carbon steel frame and pressure plates shall be steel grit blasted to SSPC-SP6/NACE 3 (Commercial Blast Cleaning) with surface profile of 2 mils on either face. All surfaces and openings must have a recoatable epoxy primer applied within 8 hours of blast or before flash rusting occurs.
- v. Frame plates shall have integral lifting eyes in the upper corners. Bolted or welded on lifting lugs not allowed.
- vi. Units with studded port connections shall have unlined or alloy lined studded ports to mate with a raised face or flat faced ANSI flange where 150# ANSI flanges are acceptable. Rubber liners are not allowed.
- vii. Units with NPT connections, except 1" port sizes, shall have the frame plate tapped with carbon steel female NPT connections or, if alloy material is required, extended male NPT nozzles.
- viii. Units with 1" ports shall have carbon steel or 316 stainless steel female tapped NPT or alloy material male NPT connections.
- ix. For units with studded port type connections, the studs around the ports must be provided by the manufacturer.
- x. Units with connections greater than 3" require that the thermal plates be supported by the top carry bar. The bottom guide bar shall only assist in properly aligning the plates.
- xi. The design for units with 2.5" connections or smaller shall allow the plates to be supported by the bottom guide bar and the top carry bar shall help properly align the plates.
- xii. The carry and guide bar for 2" port models shall be stainless steel. For models with 2.5" ports and greater, the thermal plate contact surfaces of the carry and guide bar shall be stainless steel. For units with 1" connections, the carry and guide bars shall be zinc plated carbon steel.
- xiii. For ease of movement during assembly and maintenance, the movable pressure plate shall be supported by a roller assembly over the carry bar for 4" ported models greater than 90" in height and for all 6" and larger ported models. For 4" ported models less than 90" in height, a glide clip made of ultra high molecular weight polyethylene shall be used on the movable pressure plate.
- xiv. Units shall have a minimum of two mounting feet at the frame plate and one at the support column, if a support column is used in the design.
- xv. For units with 300 psig design pressure or less, excluding "wide gap" designs, frames must be designed to withstand full test pressure in one circuit with zero pressure in the opposite circuit.

- xvi. The nominal connection size shall match the nominal thermal plate port hole diameter.

d.) Plates

- i. Plates shall be pressed in a one-step stamping process, except for plates 132" and greater in length, where multi step pressing is allowed.
- ii. Plates shall use an integral rolled edge hanging system to provide a rigid hanger device between the plate and carry bar and guide bar. Welded on hanging brackets or stiffeners are not acceptable.
- iii. The plate pack shall use a positive plate to plate alignment system to ensure proper plate to gasket seals throughout the plate pack. The positive alignment system shall either be a gasket lug which fits within a plate recess on the proceeding plate (tongue in groove) to align successive plates or an extended rolled edge hanger which nests successive plates through direct contact around the entire plate hanger. Plate designs which only offer alignment through contact with the carry and guide bar are unacceptable.
- iv. Plates shall have an enclosing groove for the entire gasket designed to contain the gasket while allowing for thermal expansion.
- v. Plates shall be permanently marked to indicate plate material and thickness.
- vi. Double wall plates shall have an air gap with a leak detection path.
- vii. Stainless steel double wall plates shall be pressed at the same time to ensure a close fit with minimal loss of heat transfer.
- viii. For units with 300 psig design pressure or less, excluding "wide gap" designs, thermal plates must be designed to withstand full test pressure in one circuit with zero pressure in the opposite circuit.

e.) Gaskets

- i. All gaskets for single pass designs, except the gasket on the first plate, shall be identical.
- ii. The gaskets shall be a one-piece construction with a double gasket barrier at the port region. The area isolated by the double gasket shall be vented to the atmosphere, so that a gasket failure is detected by leakage to the exterior prior to any possible cross contamination.
- iii. Gaskets shall have tapered sides to assure positive seating of the compressed gasket and assist in aligning the thermal plates during compression.
- iv. When available, glue-free gaskets are preferred to glued-on gaskets. Glue-free gasket attachment methods which break during gasket

removal or plate maintenance, thus destroying the gasket, are not allowed.

v. Care should be taken in the selection

f.) Thermal/Hydraulic Design and Certification

i. The manufacturer shall guarantee the accuracy of the heat exchanger thermal and hydraulic design. Should the heat exchanger not perform to the specified conditions, within industry standard testing methods, accuracy and tolerances for plate and frame heat exchangers, the manufacturer is responsible to replace or repair the exchanger to achieve the stated performance.

4) The softened water loop will accept the heat from the glycol loop at the plate frame HEX and is now considered "return" water. The soft water travels through the cooling loop pumps to the refurbished wastewater heat exchangers (WWHEX). At the WWHEX units the soft water loop rejects its heat to the wastewater. The rates of heat rejection based on flow rate are shown in drawing 7I-10. Once the soft water has rejected its heat to the wastewater the cooling process may be fully or partially completed and the water is considered "supply".

a.) WWHEX heat transference is based on the materials and configuration as shown in the 4M-X drawings and heat rejection is based on the flow rate and heat transference as shown on drawing 7I-10. CONTRACTOR shall include heat transfer calculations for the WWHEX with the overall heat transfer calculation package referenced above.

5) The softened water loop is routed from the WWHEX units to the air handling unit's air-water heat exchangers (AHEX) atop the generator building roof. Based on the number of engines running the softened water may travel directly back to the plate and frame HEX described above or when multiple engines are running, or when the supply water temperature is lower than what the current situation calls for, the softened water will travel through the AHEX to reject heat to air before returning to the engine's plate and frame HEX.

a.) Reference specification 15855 for AHU construction requirements.

2.6 GENERATOR

- A. The generator shall be nominally rated 4000 KW at .8 PF, 4,160 V 3 phase, 60 Hz, 4 wire wye high impedance grounded and shall be a brushless design with solid state permanent magnet generator (PMG) exciter. Other excitation methods are not acceptable. The voltage regulator shall be solid state, generator mounted. Provide radio-interference suppression meeting commercial standards.
- B. **Voltage Regulation Tolerance:** Plus or minus 1 percent of any present value over the 3 phase load range. Instantaneous voltage dip or rise, when measured with an oscilloscope, shall not exceed 25 percent upon full load application or rejection, and shall return to preset value within 0.5 seconds.
- C. **Waveform:** Deviation factor of output voltage shall not exceed 5 percent and the value of any individual harmonic shall not exceed 2 percent of the fundamental when operating with an unbalanced load.

- D. **Temperature Rise:** Temperature rise of any component shall not exceed the rise permitted by NEMA standards. The voltage regulator shall be adjustable minus 25 percent to plus 10 percent.
- E. **Bearing:** Double sealed ball bearing, lubricated for life.

2.7 VIBRATION ISOLATORS

- A. The engine and generator shall be mounted on a common system base and shall be provided with vibration isolators of number and size as recommended by the engine supplier to meet and IBC $I_p=1.5$ support of the engine, generator, auxiliary equipment, and base. The isolation mountings shall consist of steel or cast iron top and bottom housings incorporating steel springs or "donut" style isolators, located between the genset and the base, and shall be provided with built-in leveling bolts and built-in resilient chocks to control isolation and withstand lateral forces in all directions.
- B. The vibration isolators shall be **Korfund Dynamics Corporation Series L**, or equal.

2.8 LUBRICATION AND COOLING FLUIDS

- A. The supplier shall furnish the engine fully charged with lubricating oil and grease as specified by the manufacturer for continuous service. The cooling system shall be furnished with a full charge of 30 percent ethylene glycol.

2.9 GENERATOR SYSTEM CONTROL PANEL

- A. The engine shall be provided with a locally mounted instrument and control panel, vibration isolated, NEMA 12 compliant, dead front, constructed of 14 gauge steel and containing at least the following equipment:

Coolant temperature gauge
Oil pressure gauge
Four position selector switches marked for "auto," "manual," "stop," and "stop/reset."
Automatic starting controls (2 wire start/stop)
Coolant level pre-alarm
Coolant temperature pre-alarms (low and high)
Diesel pressure pre-alarm
Electrical contacts and "push to test" pilot lights for shutting down the engine on low oil pressure, high oil temperature, overcrank, high coolant temperature, and overspeed condition
Individual electrical contacts for remote indication of any pre-alarm or alarm condition
Running Time Meter (Non Resettable)
Emergency stop switch
Voltmeter and switch, ammeter and switch, frequency meter

B. Wiring

1. Signal wiring shall be segregated from power wiring and be arranged neatly to facilitate tracing of circuits.
2. Plastic wiring wraps shall be used to bundle wires, except within wiring ducts. The bundles shall be securely fastened to the steel structure at suitable intervals not exceeding 12-inches in length. No open space hanging of wires will be permitted. Flexible stranded copper wiring shall be used throughout. No solid conductor wire shall be permitted.
3. Terminal blocks shall be provided for interconnections between remote devices and local control panel wiring. The terminal blocks shall be factory assembled on a mounting channel, and the channel shall be bolted to the inside of the panel. The terminals shall have a continuous marking strip using the nomenclature on the schematic diagrams. No more than 2 wires shall be terminated at any one terminal. Wire terminals shall have sleeve wire markers properly marked to match the schematic diagrams.

2.10 SPARE PARTS

- A. Two sets of the following spare parts shall be furnished for the Diesel Engine:

Item	Qty	Description
1	8	Air Filter - Primary
2	6	Fuel Filter - Primary
3	2	Drive Belt - Alternator
4	10	SOS - Oil Sample Kit and Pump
5	2	Coolant Sample Kit
6	8	Oil Filter
7	6	Fuel Filter - Water Separator
8	1	Voltage Regulator
9	1	Air Start Motor and Solenoid Valve
10	2	Pressure Regulator Kit - Air Starter

- B. Two sets of the following spare parts shall be furnished for the Diesel Particulate Filter:

Item	Qty	Description
1	6	Filter Element Gasket
2	2	RTD Temp Sensor
3	2	Differential Pressure Transducer
4	1	Maintenance Fittings and Gaskets

- C. Two sets of the following maintenance tools shall be furnished for the Diesel Engine:

Item	Qty	Description
1	1	Customer ET - Diagnostic Adapter/SW
2	1	Oil Fitter Cutter
3	1	Engine Turning Tool 50:1
4	1	Digital Manometer
5	1	Basic Mechanic Hand Tool Group
6	1	Basic Electrical Test Meter

PART 3 -- EXECUTION

3.1 FACTORY TESTING

- A. The generator system shall be witness tested at the factory before shipment to the Site. The manufacturer's standard testing procedure shall be followed, and in the event the system does not satisfy the test criteria or the requirements of this Section, it shall be repaired, modified, or replaced until it conforms.
- B. Furnish the ENGINEER 2 weeks prior notice of the testing date and a copy of the manufacturer's test procedure. The CITY and the ENGINEER will witness the factory testing and sign the test data as witnesses. The ENGINEER will not review nor approve the test procedure.
- C. The CONTRACTOR shall pay the costs for the CITY and ENGINEER to observe the tests. Such costs will include travel and subsistence for 2 persons excluding salaries.
- D. Witnessed test results shall be submitted to the ENGINEER for the project file, not for review.

3.2 OPERATION AND MAINTENANCE MANUAL

- A. The Contractor shall provide ten (10) hard copies of the O&M manual inclusive of all details addressed in this specification.

3.3 START-UP ASSISTANCE AND TRAINING

- A. The manufacturer's representative shall furnish on-Site start-up assistance and shall inspect the installation prior to start-up to verify that equipment is installed in accordance with the manufacturer's requirements.
- B. Upon completion of startup and after acceptance by the CITY, the CONTRACTOR shall completely fill the fuel tank.
- C. In addition, the manufacturer's representative shall provide on-Site training for operation and maintenance of all equipment included in this Section.
- D. The following times shall be included, as a minimum, for the above tasks. A day is defined as 8 hours on-Site, exclusive of meals and travel. Each task shall be considered a separate trip to the site. Dates and times for the trips shall be coordinated with the CITY.

1. Inspection of the installation: 2 days

2. Startup assistance: 3 days
3. Operation and Maintenance Training: 2 days

3.4 SERVICE AND SUPPORT

- A. The manufacturer shall present documentation for approval demonstrating their ability to meet the below criteria as part of this submittal requirements.
 1. The manufacturer shall be able to respond and send to the site trained maintenance personal to an emergency call for maintenance within 1 hour.
 2. All spare parts necessary to keep the engine-generators operational shall be available able to be delivered to the site within 24 hours if an order being placed.

- END OF SECTION -

SECTION 12346 – OFFICE FURNISHINGS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing office furnishings.

1.2 CODES

- A. The 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. California Building Code

1.3 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:

- 1. Manufacturer's product specifications, standard details, installation instructions and general recommendations.
- 2. Manufacturer's color charts consisting of sections of actual exposed components with integral or applied finishes showing full range of colors, and materials available for selection by the CONSTRUCTION MANAGER.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Products 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.

PART 2 -- PRODUCTS

2.1 FURNISHINGS

- A. CH-01-A to be Steelcase Amia or approved equal. Chair base shall be a five-point base with 2½" dual-wheel hard casters for carpeted areas. Chair shall feature multiple ergonomic functions to include: seat height adjustment, seat depth adjustment, flexible seat edge, live lumbar, lumbar height adjustment, back tension, and back lock. Arms shall be black plastic with soft cap and also have ergonomic adjustments to include height, width, depth and pivot adjustments. Chair seat shall have grade 3 or higher upholstery. Chair back shall be mesh-knit fabric. Chair frame shall be black. Overall dimensions are as follows: 21 ¾" to 24 ¾" adjustable depth x 26 5/8" width x 37 ¼" to 42 ½" adjustable height.
- B. CH-01-B to be Steelcase Amia or approved equal. Chair base shall be a five-point base with 2½"

dual-wheel soft casters for hard surfaces. Chair shall feature multiple ergonomic functions to include: seat height adjustment, seat depth adjustment, flexible seat edge, live lumbar, lumbar height adjustment, back tension, and back lock. Arms shall be black plastic with soft cap and also have ergonomic adjustments to include height, width, depth and pivot adjustments. Chair seat shall have grade 3 or higher upholstery. Chair back shall be mesh-knit fabric. Chair frame shall be black. Overall dimensions are as follows: 21 3/4" to 24 3/4" adjustable depth x 26 5/8" width x 37 1/4" to 42 1/2" adjustable height.

- C. CH-02 to be Steelcase Reply or approved equal. Chair base shall be a five-point base with 2 1/2" dual-wheel hard casters for carpeted areas. Chair shall feature ergonomic functions to include: 5" pneumatic seat height adjustment, minimum 1 1/2" seat depth adjustment, lumbar height adjustment, tilt tension and back lock. Arms shall be black plastic with soft cap with height adjustment only. Chair seat shall have grade 3 or higher upholstery. Chair back shall be mesh-knit fabric. Upholstery patterns and colors to be selected from manufacturer's standard offering. Chair frame shall be black. Overall dimensions are as follows: 24" to 25" adjustable depth x 25 3/4" width x 37 3/4" to 42 3/4" adjustable height.
- D. DK-01 to be configured using KI Workzone Series components or approved equal. Refer to furniture plans for configuration and locations. General configuration includes a desk featuring a curvilinear contour on user side with box/box pedestal, a corner unit worksurface and return with 2-high lateral file. Surface supports/legs shall not interfere with knee space, especially at the corner unit. Layout includes both right and left handed desks, refer to plan for quantity and locations. Frame shall be constructed of heavy-gauge, seam-welded, powder-coat finished tubular steel. Worksurface shall be 1-1/4" thick high pressure laminate top with phenolic backer sheet over a particle board core. Edge treatment shall be vinyl t-mold edge. Worksurface shall have grommets and horizontal wire management troughs. All tops shall be pre-drilled for mounting of end panels, modesty panels, wire management channels and connectors. End panels shall feature full leg end panel to completely enclose the end of the desk. Intermediate supports under the work surface shall allow clearance for knee space, especially at desk corner. Full height modesty panels shall only be provided on exposed faces of desks. Desk components that are placed against a wall as indicated on the furniture plan shall have a beam frame support that does not limit access to electrical and data outlets. Pedestals shall be constructed of steel. Box drawers shall be 6" tall and file drawers shall be 12" tall. Box/Box/File shall be 15" wide. Lateral file shall be 2-drawer high, 30" wide and feature file hanging bars. Drawers shall operate on full extension ball bearing slides. Locks shall be provided and desk components shall be keyed alike. Floor supporting pedestal shall have four glides, adjustable from the outside of the cabinet. Metal, laminate, and vinyl edge to be selected from manufacturer's full range of colors and patterns. Overall dimensions for the desk used as basis of design are as follows: Desk: 24" d x 60" w x 29" h; Corner: 42" w x 36" d x 29" h; Return: 30" d x 48" w x 29" h. Overall footprint: 8'6" x 7'0".
- E. TB-01 to be KI Workzone Corner Transitional Worksurface or approved equal. Worksurface shall be supported by attaching to fixed, adjacent surfaces. A 7/8" square tubular corner support leg and modesty panels or other structural members shall be provided and attached in the field to coordinate with architectural conditions. Work surfaces shall be 1 1/4" thick high-density particle board with high pressure laminate finish and phenolic backing to be selected from manufacturer's full range. Exposed edges shall be vinyl T-mold pressed into the particle board edge and spot nailed from underside of worksurface. Work surface shall feature two grommets located centered along the rear edge of the surface. Some worksurfaces may have to be field cut to coordinate with architectural conditions, Refer to furniture plans for configuration and locations. Overall dimensions are as follows: 30" D x 48" W x 29".

- F. TB-02 to be Global Total Office Laminate Boat Top, Arch Base Conference Table (GCT10WBABN) or approved equal. Table top shall be 1-1/8" thick, 45lb. density particle board covered on both sides with high performance thermally fused laminate. Tops shall be premarked to be attached to bases on site using slot and hook assembly. Edge treatment shall be t-mold edge. Laminate finish shall be selected from manufacturers full range and t-mold edge shall match laminate selection. Overall dimensions are as follows: 48" W x 120" L x 29" H.
- G. FL-01 to be KI 700 Series 2-high Lateral File Cabinet or approved equal. File shall be constructed of 18- and 20-gauge steel. Uprights and top and bottom reinforcements shall be welded into a rigid box frame. Back and top shall be seamless with reinforced corners. Drawer fronts and shelf body shall be constructed of 20-gauge steel. Drawer glides shall feature heavy duty three section ball bearing suspensions. Each drawer shall have folder bars. File shall feature adjustable glides. Finish shall be selected from manufacturer's full range. Overall dimensions are as follows: 30" W x 18" D x 27" H.
- H. FL-02 to be KI 2-high Bookcase or approved equal. Shell shall be constructed from 18-gauge and 20-gauge steel with reinforced corners and seamless back. Shelves shall be constructed of 22-gauge steel formed with 7/8" lip for reinforcement. Bookcases shall have four (4) adjustable glides providing adjustment from the outside of the bookcase. Shelves shall accommodate standard three-ring binders and be adjustable on 1" increments. Finish shall be powder-coated and selected from manufacturer's full range. Overall dimensions are as follows: 36" W x 15" D x 24" H.
- I. PT-01 to be configured using Steelcase Montage series components or approved equal. Refer to furniture plans for configuration and locations. General configuration includes a 4 workstation areas surrounded by 55" partition walls, refer to plan for quantity of partitions and configuration. Partitions shall be arranged so that the minimum entry into work area is no less than 3'-4". Frame shall be constructed of heavy-gauge, seam-welded, powder-coat finished steel. Partition corner junctions shall be the full height of the partitions with a chamfered edge cover. Partitions shall be coordinated with/and shall not interfere with typical desk shapes and structures DK-01. Manufacturer floor anchor brackets shall be provided for anchoring partitions to concrete floor. Metal frame, tack able acoustic tiles, enhanced tiles to be selected from manufacturer's full range of colors and patterns. Overall footprint dimensions of workstation spaces used as basis of design are as follows: 9'6" w x 8' 1-1/2" d x 4'7" h.

2.2 SCHEDULE

CODE	DESCRIPTION	MANUFACTURER	MODEL NAME / NUMBER	QTY. & NOTES
CH-01-A	OFFICE CHAIR - HARD CASTERS	STEELCASE	AMIA	2 CONTROL ROOM #102
CH-01-B	OFFICE CHAIR - SOFT CASTERS	STEELCASE	AMIA	10 OFFICES & OPEN WORK AREA

CH-02	OFFICE CHAIR	STEELCASE	REPLY	10 CONFERENCE #202
DK-01	TYPICAL L SHAPE DESK	KI	WORKZONE SERIES	7 OFFICES & OPEN WORK AREA
TB-01	IT WORK BENCH CORNER UNIT	KI	WORKZONE TABLE	1 CONTROL ROOM #102
TB-02	CONFERENCE TABLE	GLOBAL TOTAL OFFICE	BOAT TOP ARCH BASE GCT10WBAB N	1 CONFERENCE #202
FL-01	2-HIGH LATERAL FILE CABINET	KI	700 SERIES	9
FL-02	2-HIGH BOOKCASE	KI	700 SERIES	4
PT-01	CUBICLE PARTITION	STEELCASE	MONTAGE	4 WORKSTATIONS AT OPEN WORK AREA #201

2.3 MANUFACTURERS

A. Products shall be manufactured by the following (or equal):

1. STEELCASE
2. KI
3. GLOBAL TOTAL OFFICE

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** CONTRACTOR shall be responsible for complete delivery, disposal of packing materials, assembly and set-up of all items.
- B. **Discrepancies:** CONTRACTOR shall notify OWNER immediately of any discrepancies between drawings, specification's dimensions, field conditions, and manufacturer's specifications before ordering any items and request clarification.
- C. **Schedules:** At the commencement of this project, CONTRACTOR shall provide the owner and Architect with a schedule indicating projected manufacturer ship dates, order acknowledgements and any other documentation indicating shipping dates and schedules. In reasonable time prior to delivery, the vendor and owner shall agree upon a schedule for access to the unloading facilities, elevator, and building for delivery and installation. The vendor shall provide written updates on a monthly basis detailing the status of the delivery and installation schedule. Any delays reported by a manufacturer due to any specified item, C.O.M., etc., which the manufacturer states is out of stock, discontinued or would otherwise affect the initially agreed-upon schedule in any way shall be brought to the attention of the Architect and OWNER immediately.

- D. Field Verification: Prior to delivery of furniture, the vendor shall inspect the project premises and verify status of the building and site construction is suitable for delivery and installation. The vendor shall determine and coordinate with the owner best access for delivery trucks, unloading and staging. Any conditions the vendor finds that would impede on the ability of the vendor to perform the work shall be brought to the attention of the OWNER.
1. The vendor shall field verify measurements of any locations as noted on the contract drawings.
 2. CONTRACTOR shall at all times while performing work on the project premises have a project superintendent on site to represent the vendor and coordinate the work with the OWNER and Architect as necessary. The superintendent is also responsible for supervision of vendor's employees and other persons contracted to carry out the work. The superintendent shall maintain a safe working environment.
 3. Installation: The successful vendor in entering, passing through, or working in any space of the building in the performance of the work shall at all times furnish and maintain proper protection for the floors, ceilings, walls, fixtures, equipment or any other property of the City. Vendor will see that all items, whose dimensions may require careful maneuvering through doorways, corridors, etc., will be properly padded in advance to reduce the hazard of marring and scratching either the premises or the items being installed.
 4. Vendors shall be solely responsible for the removal and proper disposal of all packaging materials from the job site on the same work day of unpacking.
- E. CONTRACTOR shall protect installed units against damage, blemishes, or any indication of use at completion of project. Damaged units shall be repaired or replaced as directed by the CONSTRUCTION MANAGER.

** END OF SECTION **

SECTION 12510 - HORIZONTAL LOUVER BLINDS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing operating horizontal louver blinds and all appurtenant work, complete and operable.

1.2 CODES

- A. The 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. California Building Code

1.3 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:

- 1. Manufacturer's product specifications, standard details, installation instructions and general recommendations.
- 2. Manufacturer's color charts consisting of sections of actual exposed components with integral or applied finishes showing full range of colors, and materials available for selection by the CONSTRUCTION MANAGER.
- 3. Shop drawings for special components and application conditions of horizontal louver blind units which are not fully dimensioned or detailed in manufacturer's product data. Relationships to adjoining work shall be clearly indicated.
 - a. Typical elevation layout shall be included indicating proposed division between blind units and meeting edges at corners. Sections and details shall be provided at head and sill between blind units and corners including inclined installations.
 - b. A schedule shall be provided of all units to be furnished, including field measurements at each location.
- 4. Physical sample of louver blind in color and finish specified.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Products 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.

PART 2 -- PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS

- A. **General:** Horizontal louver blinds shall be provided which are complete assemblies produced by one manufacturer, including hardware, accessory items, mounting brackets, and fastenings.
- B. Horizontal louver blinds shall be provided in colors and material finishes as indicated, or, if not indicated, as selected by the CONSTRUCTION MANAGER from manufacturer's standard colors and material finishes.
- C. **Headrail:** Headrail shall be manufacturer's standard headrail consisting of channel shaped section complete with tilting mechanism, top and end braces, top cradles, cord lock, and accessory items required for the type of blind and installation indicated.
- D. **Bottom Rail:** Bottom rail shall be manufacturer's standard tubular bottom rail, designed to withstand twisting or sagging. Top surface shall be contoured to match slat curvature, with flat or slightly curved bottom. Ends shall be closed with manufacturer's standard metal or plastic end caps, of same color as rail. Rail shall be finished the same color as slats, unless otherwise indicated.
- E. **Slats:** Slats shall be manufacturer's standard, spring-tempered PERFORATED aluminum slats, nominal 0.008-inch thick by nominal 1-inch wide, with rounded corners and with forming burrs removed. Other components shall be sized to suit slat width indicated. Slats shall be designed and spaced to achieve maximum overlap and closure for optimum light exclusion. Rear of blades shall be notched at ladders, and rout holes shall be offset at lift cords to enable blades to touch one another when closed.
- F. **Ladders:** Ladders shall be manufacturer's standard ladder construction, designed to support and maintain slats at proper spacing and alignment in open and closed positions. Ladders shall be braided polyester cord design consisting of vertical components of not less than 0.043-inch nor more than 0.068-inch in diameter and integrally braided ladder rungs of not less than 4 threads. Ladders shall be spaced not further than 23 inches apart nor more than 7 inches from ends of slats.
- G. **Tilting Mechanism:** Tilting mechanism shall be manufacturer's standard assembly including disengaging worm and gear mechanism to eliminate overdrive, low friction gear tilter, drum and cradle at each ladder, tilt rod, tape clips, and grommet guides to prevent wear on ladder and cords. Mechanism shall be designed to hold slats at any angle and prevent movement of slats due to vibration, operated as follows:
 - 1.. Wand Operation: Operation shall be through manufacturer's standard, detachable clear plastic wand, of proper length to suit blind installation, to provide convenient operation, and detachable without tools by raising locking sleeve.
- H. **Lifting Mechanism:** Lifting mechanism shall be manufacturer's standard, including crash- proof cord locks with cord separators and braided polyester or nylon lift cords with plastic tassels at ends. Cord shall be sized to suit blind type. Cord equalizers shall be included of self-aligning type designed to maintain horizontal blind position.
- I. **Installation Brackets:** Brackets shall be manufacturer's standard, designed to facilitate removal of head channels. Intermediate brackets shall be provided at spacings recommended by the blind manufacturer. Necessary hardware shall be included for securely attaching brackets to adjoining construction and to head rails. Brackets shall be designed to safely support the weight of the blind assembly plus forces applied to operate the blinds.

- J. **Finish:** Finishes shall be provided as indicated below. Exposed accessories and hardware shall be finished to match rail color. Manufacturer's standard corrosion resistant finish shall be applied to concealed items of hardware.
1. **Steel Components:** Exposed steel surfaces shall be galvanized and either phosphate coated or prime coated, followed by manufacturer's standard baked-on synthetic resin enamel finish.
 2. **Aluminum Slats:** Aluminum slats shall be provided with manufacturer's standard factory- applied finish system consisting of chemical conversion coating followed by baked-on synthetic resin enamel finish coat.

2.2 FABRICATION AND OPERATION

- A. Prior to fabrication, CONTRACTOR shall verify actual opening dimensions by accurate site measurements. Dimensions shall be adjusted for proper fit at openings.
- B. CONTRACTOR shall properly coordinate necessary trades for securing tracks to substrates and other finished surfaces.
- C. Horizontal louver blind components shall be fabricated from non-corrosive, non-staining, non-fading materials which are completely compatible with each other, and which do not require lubrication during normal expected life.
- D. Blind units shall be fabricated to completely fill the openings as shown from head-to-sill and jamb-to-jamb.
 1. At continuous window wall installations, blinds shall be fabricated so that ends occur only over mullions or other defined vertical separations, unless otherwise indicated.
 2. Supporting ladders shall be spaced to comply with manufacturer's standards, unless otherwise indicated.
 3. Slats shall be spaced to provide overlap for light exclusion when in fully closed position.
- E. Horizontal louver blind units shall be equipped for the following operations, unless otherwise indicated:
 1. Full-tilting operation with slats rotating approximately 180 degrees. Tilt operating controls shall be placed on the left-hand side of blind units, unless otherwise indicated.
 2. Full-height raising function, to manufacturer's minimum stacking dimension, with lifting cord locks for stopping blind at any point of ascending or descending travel. Place pull cords on the right-hand side of blind units, unless otherwise indicated.

2.3 MANUFACTURERS

- A. Products shall be manufactured by the following (or equal):
 1. Levelor Lorentzen, Inc.
 2. Hunter Douglas, Inc.
 3. Marathon Manufacturing Co.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** CONTRACTOR shall install horizontal louver blind units in compliance with manufacturer's instructions. Units shall be positioned level, plumb, secure, at proper height and location relative to adjoining window units and other related work. Units shall be securely anchored with proper clips, brackets, anchorages, suited to the type of mounting indicated.
- B. Adequate clearance shall be provided between sash and blinds to permit unencumbered operation of sash hardware, where present.
- C. Metal parts shall be isolated from concrete and mortar to prevent galvanic action. Tape or thick coating or other means recommended by the manufacturer shall be used for separation.
- D. CONTRACTOR shall protect installed units against damage, blemishes, or any indication of use at completion of project. Damaged units shall be repaired or replaced as directed by the CONSTRUCTION MANAGER.

**** END OF SECTION ****

City of San Diego

CONTRACT DOCUMENTS for



Pump Station No. 2 – Power Reliability and Surge Protection

VOLUME 02

MASTER TECHNICAL SPECIFICATIONS – DIVISIONS 13 THROUGH 16

SPECIFICATION NO. 38027

WBS NO. S-00312

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VOLUME 3 - FTP References, <ftp://ftp.sannet.gov/OUT/ECP/AEP/P2/>

1. Metro Pump Station No.2 – Additional Pumps Installation of 8th Pump and Engine Drives, 26275-D, 1991
2. Pump Station 1 & Pump Station 2 Electrical Upgrade and New Building at Pump Station 2, 35265-D, 2010
3. Pump Station No. 2, 11053-D, 1960
4. Hawthorne Power Systems Drawing 11090-2E, 1992
5. General Fiber Optic Between PS 1 and PS 2, 30708-D, 2001
6. North Metro Interceptor Fiber Optic Conduit, 30192-D, 2000
7. Pump Station No.2 Instrumentation Upgrade – Comnet Implementation, 31822-D, 2008
8. October 2014 Topographic Survey of a Portion of Pump Station 2.
9. Preliminary Survey from City
10. Pump Station 2 Loop Drawings

VOLUME 4 - FTP References, <ftp://ftp.sannet.gov/OUT/ECP/AEP/P2/>

1. Pump Station 1 & 2 San Diego, CA BEC WO#11575 Medium Voltage Switchgear, Submittal No. 16300.001.4
2. Field Revisions to Switchgear No. 1 & 2.
3. Deck/Ramps for Planning Trailers at Pump Station No.2
4. Updated Final Report of Geotechnical Investigation Pump Station No.2 Power Reliability and Surge Protection Dated November 17, 2014.
5. Pump Stations 1 & 2 WO#11575 Unit Substation (Pump Station 2), Submittal #16310.001.4
6. Lead Related Construction Specifications

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2

SECTION 13300 - INSTRUMENTATION AND CONTROL

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes the general specification and requirements for the instrumentation and control WORK under this and other applicable Specifications. The WORK also includes providing instrumentation and all related wiring as shown in these Contract Documents.
- B. All DCS programming shall be provided and paid by the CITY. The CONTRACTOR shall be responsible for a complete and functional system. The CONTRACTOR shall meet the functionality, intent, and requirements provided in the control strategies, equipment specific specification, control diagrams, P&ID's, Commissioning, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for providing their subs with all the required information.
- C. All DCS related panels and internal devices shall be provided by Emerson Process Management Power & Water Solutions, Inc (Emerson). Equivalent products will not be accepted.
- D. All ELC programming and configuration shall be provided by Emerson. All network switch configurations shall be provided by Emerson. Any associated third party I/O development hardware addressing shall be supplied by the vendor.
- E. Communication protocols between equipment shall be the responsibility of the CONTRACTOR and Emerson.
- F. The CONTRACTOR shall be responsible for the design, procurement, installation, testing, training, and documentation for instrumentation and control systems provided under this Contract. The CONTRACTOR shall be responsible for installing and terminating DCS inputs and outputs (I/O), providing power, data links to the DCS, and for installing and testing all equipment.
- G. The CONTRACTOR shall be responsible for providing instrument submittals to be used in the generation of panel wiring diagrams and loop drawings which depict the interconnection between all devices shown in the Contract Documents.
- H. The CONTRACTOR shall generate complete loop drawings for each measuring or control loop. The loop shall include a minimum of 3 sheets as required in paragraph 1.5 B.3. The CONTRACTOR shall furnish Project-wide Loop Drawing Submittal (PLDS) that completely defines and documents the contents of each monitoring, alarming, interlock, and control loop associated with equipment provided under the instrumentation sections, and equipment provided under sections in other Divisions.

- I. The CONTRACTOR is responsible for providing a complete and functional system. The CONTRACTOR and their associated vendors shall provide input, coordination, and oversight with regards to the CITY provided DCS programming. This teamwork shall be per the Commissioning Section 13350.
- J. All control system field tests including loop tests, plant commissioning, and plant startup, shall be the responsibility of the CONTRACTOR. The CONTRACTOR shall provide knowledgeable personnel including electrical engineer, I&C engineer, and process engineer during all field tests. The CONTRACTOR shall be responsible for providing field and control room personnel to witness the simulation of field inputs associated with the DCS I/O and points that are data linked to the DCS. The CONTRACTOR shall be responsible for providing all competent personnel and NIST certified, current within a year, equipment (current drivers, jumpers, read out devices, oscilloscopes, voltage-resistance meters, etc.) required to perform the loop test simulations. All devices used shall be traceable to the National Institute of Standards and Technology (NIST).
- K. The CONTRACTOR shall perform field engineering design as required for mounting and supporting all field mounted components. The CONTRACTOR shall develop any additional schematic and interconnection diagrams which may be required for complete and operable instrumentation.
- L. The CONTRACTOR shall provide all components, system installation services, as well as all required and specified ancillary services in connection with the I&C system. The system includes all materials, labor, tools and documentation required to furnish, install, test and place in operation a complete and operable I&C system as shown and/or specified in the contract drawings. The CONTRACTOR shall include, but is not limited to, witnessing the functional testing of all control loops ensuring instruments and wiring for each loop have been correctly installed. The CONTRACTOR shall also ensure, amongst other tasks that, all wires are correctly numbered, drawings are correctly updated and within the required time frame and that all parties concerned work to the project time line to meet project milestones. During commissioning the CONTRACTOR shall coordinate between the relevant subcontractors to ensure that the necessary stage of completion is reached by all involved parties and all functional tests have been performed satisfactorily before that particular phase of the project is scheduled for commissioning. This shall include polarity and functional tests of all field devices, all data communication links are functional and all devices being controlled and monitored are adequately represented on the graphic display including any associated functions, which may be required.

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 09800 Protective Coating
 - 2. Division 11 Equipment, as applicable
 - 3. Section 13350 Commissioning
 - 4. Section 13400 Distributed Control System (DCS)
 - 5. Division 15 Mechanical, as applicable
 - 6. Division 16 Electrical, as applicable

1.3 CODES

A. 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

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

ANSI/ASME B 16.5	Pipe Flanges and Flanged Fittings
API RP-550	Manual on Installation of Refinery Instruments and Control Systems, Part 1 - Process Instrumentation and Control Sections 1 Through 13
ASTM A 105	Specification for Forgings, Carbon Steel for Piping Components
ASTM A 193	Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
ASTM A 194	Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
ASTM A 283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars
ASTM A 312	Stainless Steel Piping
ISA-RP60.6	Nameplates, Labels, and Tags for Control Centers
ISA-RP7.1	Pneumatic Control Circuit Pressure Test
ISA-RP12.6	Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations
ISA-S5.1	Instrument Symbols and Identification
ISA-S5.4	Instrument Loop Diagrams
ISA-S12.4	Instrument Purging for Reduction of Hazardous Area Classification
ISA-S20	Specification Forms for Process Measurement and Control Instrumentation; Primary Elements and Control Valves
ANSI - B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In Through 144 In.
ANSI/AWWA C701	Cold-Water Meters - Turbine Type for Customer Service
ANSI/AWWA C702	Cold-Water Meters - Compound Type
AWWA C704	Cold-Water Meters - Propeller Type for Main Line Applications
ASTM A 126	Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
ASTM B 61	Specification for Steam or Valve Bronze Castings
ANSI/AWWA	Ductile-Iron and Gray-Iron Fittings, 3-In Through C110/A21.10 48-In for Water and Other Liquids
ASME REPORT	Fluid Meters, Sixth Edition, 1971

1.5 SHOP DRAWINGS AND SAMPLES

A. 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 his responsibilities for shop drawing submittal on the WORK to be provided under this Section. The CONTRACTOR and the CONSTRUCTION MANAGER shall attend. Both the CONTRACTOR and the CONSTRUCTION MANAGER may invite additional parties at their discretion.
2. The CONTRACTOR shall allot one, 4-hour day for the Conference
3. The CONTRACTOR shall prepare the following for discussion at the Conference:
 - a. List of equipment and materials for the instrumentation 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.
 - 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 CONSTRUCTION MANAGER.
 - e. A bar chart type schedule for the WORK provided under this Section, covering the time period beginning with the conference and ending after startup and training. Dates for the beginning and ending of submittal preparation, submittal review, 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 furnish 3 copies of all the items above to the CONSTRUCTION MANAGER.
5. The CONTRACTOR shall take formal minutes of the Conference, including all events, questions, and resolutions. Prior to adjournment, all parties must concur with the accuracy of the minutes and sign accordingly.

B. Shop Drawings:

1. **General:**
 - a. Preparation of shop drawings shall not commence until adjournment of the Presubmittal Conference.
 - b. Preliminary Shop Drawings shall be submitted as a single package at one time within 90 days of the commencement data stated in the Notice to Proceed.

- c. Both paper (hard copy) and electronic copies are required for both Preliminary and Final Shop Drawing submittals.
- d. In the Contract Documents, all systems, meters, instruments, and other elements are represented by symbology derived from the latest version of ANSI/ISA S5.1. The 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.
- e. During the period of shop drawing preparation, the CONTRACTOR shall maintain a direct, informal liaison with the CONSTRUCTION MANAGER for exchange of technical information. As a result of the exchange, certain minor refinements and revisions to the indicated systems may be authorized informally by the CONSTRUCTION MANAGER but these shall not alter the WORK or cause increase or decrease in the Contract Price. During informal exchanges, no statement by the CONSTRUCTION MANAGER shall be construed as approval of any component or method or exception to or variation from these Contract Documents.

2. **Submittals:**

- a. Preliminary Submittal: Four hardcopies copies of the preliminary submittal shall be provided for the City's review. Documents in a PDF format shall also be provided.
- b. Final Submittal: All documents, including design and O&M documents, shall be provided on CD-ROM. One set of CD-ROMS shall contain the native file formats (MicroStation, MS Word, MS Excel, etc.), and the other in PDF format, using the same file name with "PDF" or "TIF" as the file extension. Four hard copies of the final submittal shall be provided as well as a pdf copy.
- 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
 - i) P&IDs
 - ii) Loop Drawings
 - iii) Instrument Data Sheets
 - iv) Other
 - (b) Manufacturer's data

- (c) Maintenance instructions
 - (d) Training
 - (5) Facility Name
 - (6) Specification Number
 - (7) Process Name
 - (8) Unit Process Number
- d. Electronic Document Submittal Requirements:
- (1) All documents shall be submitted in electronic format, including shop drawings manufacturer's data and O&M manuals.
 - (2) Documents shall be in Adobe Acrobat PDF format, version as specified by the Contract Manager. Vendor and Contractor shop drawings developed under the Contract shall be in Bentley MicroStation (.DGN) format. Documents in electronic format (WordPerfect, Microsoft Word, Excel, Lotus, etc.) shall be electronically converted to standard PDF format. In order to minimize file size, drawing conversion from MicroStation files to Acrobat PDF shall be in monochrome.
 - (3) Deviation from this standard will be accepted only if advance approval is given by the Owner
 - (4) Documents not available in electronic format shall be scanned at 300 dpi, bitonal (black and white) for documents without graphics, or 300 dpi color for documents with graphics where color is required for legibility, and converted into Adobe Acrobat (PDF). Scanned image enhancement software shall be used. PDF sub-format shall be full Image + Hidden Text PDF file format.
 - (5) All PDF documents shall be reviewed, and corrected if necessary, for orientation and legibility.
 - (6) Individual document files shall not exceed 3 megabytes in size.
- e. Paper Document Submittal Requirements
- (1) 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 the content of the drawing.
 - (2) Shop drawing copies shall be submitted as standard size 3-ring, loose-leaf, vinyl plastic binders suitable for bookshelf storage. Maximum binder size shall be 2 inches.

- (3) A complete index shall be placed at the front of each binder.
 - (4) 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.
 - (5) All shop drawings shall be produced in using MicroStation CAD formats. Each shop drawing submittal shall include the requisite number of hard copies and one (1) MicroStation electronic copy. Upon completion of this project, the Contractor shall submit four (4) electronic copies of all current shop drawings.
3. **Loop Diagrams:** The CONTRACTOR shall be responsible for the accuracy of the information within the loop drawings. Upon completion of the loop drawings, the CONTRACTOR shall review and upon satisfaction of the accuracy of the documents shall provide a letter to the OWNER stating that the loop drawings properly reflect the projects as-built condition. Sample loop drawings are provided at the end of this Section in **Volume IV – Item 10. Pump Station 2 Loop Drawings**. The PLDS shall be a singular complete bound package submitted 80 days prior to SUBSTANTIAL COMPLETION. Loop diagrams shall be provided conforming to ISA 5.4 to verify the DCS interfaces with all instrumentation and devices being provided or installed under the project. The loop diagrams shall also define all interfaces with equipment provided by area Contractors. The following three-sheet format is required:
- a. Sheet 1: 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:
 - (1) 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
 - (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) Calibrated Range/Remarks
 - (11) Data Sheet No.
 - (12) I/O Signal type (AI, AO, DI, or DO)
 - (13) Signal Level
 - (14) Device Range (full available instrument range)
 - (15) Engineering Units
 - (16) Process Set Point
 - (17) Loop Diagram No., reflecting the field instrument tag number.
 - (18) Loop Drawing File Name
 - (19) Interconnect Drawing File Name
- b. Sheet 2: Loop drawing meeting the Requirements of ANSI/ISA S5.4, except that intermediate terminal junction boxes may be omitted and 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.
- c. 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.
- d. 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

4. **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
5. 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 CONSTRUCTION MANAGER, 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. 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
6. Assembly and construction drawings for each alarm annunciator, local indicating panel and for other special enclosed assemblies for field installation. 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.
7. Installation, mounting, and anchoring details for all components and assemblies to be field-mounted, including conduit connection or entry details.
8. Complete control panel layouts, all drawn to a 1-1/2 inch=1 foot scale showing:
 - a. 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.
 - b. All cutout locations fully dimensioned. All outside panel dimensions shall be shown.
 - c. Locations of back-of-panel stiffeners.
 - d. 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.
 - e. Nameplate engraving list.

- f. 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

1.6 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:
 1. Two copies of the OWNER'S MANUAL shall be submitted after acceptance of all submittals under Paragraph 1.5. One set will be returned to the CONTRACTOR with comments.
 2. Final copies of the OWNER'S MANUAL, after revisions, shall be submitted to the CONSTRUCTION MANAGER 15 days prior to startup.
- C. The following shall be included in the OWNER'S MANUAL:
 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 equipment.

1.7 AS-BUILT DRAWINGS

- A. As-built drawings shall be prepared 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 Divisions 11, 13, 14, 15, and 16 of this Contract.
 2. One set of original drawings and two copies of each as-built drawing under this Section shall be submitted to the CONSTRUCTION MANAGER 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)

1.8 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 devices.
 - 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 Paragraph 3.4.

1.9 SPECIAL GUARANTEE

- A. The CONTRACTOR shall guarantee the WORK of this section for two 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.

1.10 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.

1.11 CABLE NUMBERING

- A. The first two characters denote the facility or area number.
- B. The second group of characters identifies the device being served.
- 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 not case-sensitive, and written in upper case.

SUFFIX	CIRCUIT TYPE	EXAMPLE
(A)	24 v dc analog (4-20 mA)	01FIT022(A)-1(+)
(C)	120 volt AC control	05P320(C)-2

(D)	24v dc digital status or control	55LSH201(D)-1(+)
(P)	Power (120 volt, 480 V, 5 KV, 15 KV, etc.)	01MCC6101(P)-2

PART 2 – PRODUCTS

2.1 COMMUNICATION EQUIPMENT; See Section 13400 - Distributed Control System (DCS) for additional requirements.

A. **Existing DCS No.1 - PCM:** Emerson shall provide all hardware and the CONTRACTOR shall make all cabinet(s) modifications, and terminate all CONTRACTOR provided field connections to the existing cabinets located at the second floor of the existing PS2 building. The City will provide all terminal block designations. Summary of work includes:

1. New 1.1.1 MAU
2. New 1.2.8 MAU
3. New ELC

Existing DCS Network Cabinet: Emerson shall provide all hardware and the CONTRACTOR shall make all cabinet(s) modifications, and terminate all CONTRACTOR provided field connections to the existing cabinets located at the second floor of the existing PS2 building. Summary of work includes:

1. New 24 Port F/O Patch Panel, quantity 2
2. New Media Converters, quantity 8

New DCS Remote IO Drop No.1: Emerson shall provide a new DCS remote I/O cabinet(s) with all required devices. The CONTRACTOR shall install the cabinet(s) and terminate all incoming field connections. Summary of work includes:

1. New 24 Port F/O Patch Panel
2. New Media Converters, quantity 2
3. RIO Module, quantity 2
4. 24P Gigabit E-Switch
5. Hard I/O Cards per Contract Drawing I-5

New DCS No.2 - PCM: Emerson shall provide new DCS cabinet(s) with all required devices. The CONTRACTOR shall install the cabinets and terminate all incoming field connections. Summary of work includes:

1. ELC Modules, quantity 4

New DCS No.2 – Network Cabinet: Emerson shall provide new DCS cabinet(s) with all required devices. The CONTRACTOR shall install the cabinets and terminate all incoming field connections. Summary of work includes:

1. Controller
2. Hard I/O Cards per Contract Drawing I-5
3. New Media Converters, quantity 8
4. 24P Gigabit E-Switch, quantity 4

5. Field LAN Router
6. 24 Port F/O Patch Panel
7. PC - Monitor (Shipped Loose)

2.2 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. Electrical signals outside control board(s) shall be 4 to 20 milliamperes DC except as noted. Signals within enclosures shall be 1-5 volts DC unless otherwise specified. Dropping resistors shall be installed at all field side terminations in the control panels to ensure loop integrity.
- G. 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 ± 0.5 percent of full scale and a minimum repeatability of ± 0.25 percent of full scale unless otherwise indicated. Instruments which do not conform to or improve upon these criteria are not acceptable.
- H. Each control loop shall be individually fused.
- I. **Color Conventions:** Lens covers for indicating lights on all panels will be colored as follows:
 1. Red-ON when;
 - Motor not running (STOPPED)
 - Valve CLOSED (not fully opened)
 - Device not energized.
 - Circuit breaker OPENED

2. Green-ON when;
 - Motor running in forward direction (fast speed for multi-speed motors).
 - Valve OPEN (not fully closed)
 - Device energized.
 - Circuit breaker CLOSED
3. White-ON when;
 - Power available
 - System in AUTOMATIC mode.
 - Monitoring taking place.
4. Amber-ON when;
 - Malfunction trip.
 - Equipment locked out.
 - Alarm condition

J. **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.

K. **Factory Inspection:**

1. Panels shall be inspected for compliance with requirements at the factory before shipment to the site. The CONTRACTOR shall notify the CONSTRUCTION MANAGER 2 weeks in advance of the testing date. A representative of the CONSTRUCTION MANAGER will visit the factory to make the inspection.
2. CONTRACTOR shall perform the following tests prior to arrival of the CONSTRUCTION MANAGER:
 - a. All alarm circuits rung out to determine their operability.
 - b. Electrical circuits checked for continuity and where applicable, operability.
 - c. Nameplates checked for correct spelling and correct size of letters.
 - d. 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 CONSTRUCTION MANAGER 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 CONSTRUCTION MANAGER, the CONTRACTOR shall reimburse the OWNER for the cost of the extra time required for the inspector's services and travel expenses.

L. 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

2.3 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. 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.
2. 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.
3. Freestanding panels shall be provided with switched back-of-panel 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.
4. 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 3-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, 2 duplex outlets shall be provided for each panel.
5. Smaller panels shall be sized to adequately dissipate heat generated by equipment mounted in or on the panel.
6. 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.
7. Smaller panels shall be provided with a hand-switch controlled LED light and a breaker protected 120-volt, 15-amp duplex receptacle.
8. **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.

9. **Construction:** Shall meet the following unless otherwise shown on the Contract Drawings.
- 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.
10. **Power Supply Wiring:**
- a. Unless otherwise indicated, all instruments, all alarm systems, and all motor controls shall operate on 24 VDC 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 fuse holder, 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.

11. Signal Wiring:

- a. **Computer and Non-Computer 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 sound 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.

12. **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.

2.4 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 120 volts 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 120-volts 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.

2.5 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 4-20 mA DC or 1-5 VDC. 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 120 VAC, 60 Hz.

B. **Selector and Pushbutton Switches:** Selector and pushbutton switches shall be rated 10 A at 600 volts, shall be heavy-duty, oil-tight, and shall have the number of positions and poles indicated. Operators shall be corrosion resistant.

C. **Indicating Lights:** Indication lights shall be LED push-to-test type and shall be heavy-duty, oil-tight. Each light shall have a screwed-on glass lens approximately 1-inch in diameter. Each light shall have a factory-engraved legend plate as indicated. Indicating lights shall be 120 VAC type with transformers for use with LED.

2.6 FIELD INSTRUMENTATION

A. All field instrumentation shall first meet the requirements shown in the Contract Drawings, then in addition meet the following standard requirements set forth in the Contract Specifications. If any conflicts arise regarding Field Instrumentation, the Contract Drawings shall prevail over the Contract Specifications.

B. For the following type of field instruments see respective Sections:

- 1. 15150 Meters, General
- 2. 15156 Magnetic Flow Meters
- 3. 15172 Mass Flow Gas Meters
- 4. 15178 Ultrasonic Level Meters

C. **Propeller Flow Measuring Systems:** The flowmeter shall be designed to operate

continuously at any flow rate within the rated range. Meter accuracy shall be +/- 2 percent of rate at any flow from the minimum rating to 150 percent of maximum rating. The meter shall be wet flow calibrated against a primary standard accurate to +/- 0.25 percent. Two copies of the calibrations taken at or near minimum flow rating, at mid-range and at the highest flow rate within the range attainable by the test facility shall be furnished to the Construction Manager. Meter-mounted indicators, totalizer, and transmitters, or any combination thereof, shall be of the same manufacture as the propeller meters. The meterhead shall be mounted on a flanged connection for ease of removal from the pipe, for inspection or service. The meterhead shall consist of a cast iron or steel cover plate bronze or cast iron gear box, stainless steel, Delrin, hard rubber or ceramic wetted working parts and acceptable injection molded engineered grade thermoplastic propeller. The drive mechanism shall be by means of stainless steel worm, worm gear shafting with O-ring packing or a ring angle or ceramic radial sleeve magnetic drive, as shown in Schedule. The meter shall be equipped with a 6-digit straight reading totalizer with center sweep test hand, protected by an all metal or sealed, injection molded plastic register box and cover assembly, with locking hasp and a 4-20 mA dc output, protected by an all metal, or sealed, injection molded plastic register box and cover assembly, with locking hasp. Use of external converters shall not be acceptable. Zero and span shall be field adjustable and shall not cause loss of local totalization while in operation. Meters, 2-inch to 4-inch in size, shall be furnished with straightening vanes in cast iron tubes lined with stainless steel, or fusion epoxy coating. The ends shall be flanged to ANSI standards. Meters 6-inch through 36-inch in size, shall be furnished with either saddles and straightening vanes, or with flanged tubes with integral vanes. Vanes shall be fabricated of carbon steel with AWWA Class D flanges. The tubes and straightening vanes shall be lined and coated with a 7-mil minimum coating of epoxy polyamide or equal with the outside of the tube further protected by the manufacturer's standard protective coating. Meters, 42-inch to 72-inch in size, shall be furnished with saddles and straightening vanes.

- D. **Differential Pressure Transmitters:** Electronic gauge pressure transmitters shall be of the differential pressure type and consist of a capsule assembly, bottom works, weatherproof and bugproof atmospheric vent assembly, drain plug, cover, flange, process connector and connection, Teflon gaskets, amplifier unit, integral indicator, terminal box with cover, block and bleed valves, and conduit connections. Pressure applied to the transmitter shall be transmitted by a sealed fill fluid to both sides of a sensing diaphragm. The sensing diaphragm and the sensor body shall function as the moving and fixed electrodes of a differential capacitor respectively. As the applied pressure causes the diaphragm to move, the capacitance of the cell shall change. The transmitter enclosure (topworks) shall be rotatable to facilitate access to the electronics with an over-rotation stop to prevent damage to sensor wires. The amplifier unit shall convert the change in capacitance to a 4-20 mA DC signal, 2 wire type, with an allowable loop load of no less than 575 ohms. Transmitter design shall incorporate voltage surge and RFI protection. Static pressure rating shall be a minimum of 500 psig. The maximum over-range pressure limit shall be a minimum of 150 percent of the maximum range. Span shall be adjustable over a minimum of a 5:1 range. External adjustments shall include zero and span. Output signal damping shall be provided as an internal adjustment. Square root extraction circuitry shall be provided which can easily be added or removed from the transmitter. All equipment shall be suitable for an ambient operating range of minus 40 degree F to plus 212 degrees F. All wetted parts shall be constructed of 316 stainless steel. All block and bleed valves shall be constructed of 316 stainless steel. Bolts from process covers and process connectors shall be of the same material as that specified for the process covers. The topworks shall be constructed of low copper die-cast aluminum and finished with epoxy paint. The integral indicator shall have

a linear scale and be calibrated in process units. Accuracy, including linearity and repeatability, shall be a +/- 0.2 percent of span. Hysteresis shall be limited to 0.05 percent of span. Drift, over a six month period shall not exceed 0.1 percent of reference minus 0.5 percent of maximum span per 100 degrees F.

- E. **Differential Pressure Indicators:** Indicators shall have digital display. The indicator shall be actuated by 316 stainless steel bellows. The housing material shall be 316 stainless steel with a safe working pressure of 500 psi minimum. Accuracy shall be +/- 2 percent of full scale. Each indicator shall be furnished with a 316 stainless steel three valve manifold.
- F. **Electronic Pressure Transmitters:** Electronic pressure transmitters shall be two wire devices with continuously adjustable span, zero and damping adjustments, integral indicators scaled in engineering units, solid state circuitry and 4-10 mA outputs. Accuracy shall be plus or minus 0.25 percent of calibrated span. Process wetted and body materials shall be 316 SS.
- G. **Diaphragm Piston Pressure Switches:** Pressure switches shall consist of a pressure transducer and a precision switch. Pressure transducer shall be the diaphragm piston type with wetted materials as recommended by the switch manufacturer. Piston shall be backed by a cylinder disc to permit 10 times over range pressure without affecting calibration. Range spring and piston shall be isolated from process fluids by the diaphragm. Switch shall be provided with two 3/4-inch conduit connections. The pressure transducer shall be selected so that setpoint falls between 30 and 70 percent of maximum range. Approximate setpoint and, if applicable, reset point shall be indicated on calibrated scales. Repeatability and sensitivity shall be 1.0 percent of operating range or better. Unless otherwise specified, switches shall be non-adjustable deadband type.
- H. **Differential Pressure Switch:** Differential pressure sensing switches shall be single-pole, double-throw with an adjustable differential range. Minimum differentials shall be less than 10 percent of range. Differential pressure switches shall be able to withstand surge pressure 1.5 times range or better. Each pressure switch shall have a visible scale contact operation. Pressure switches shall have a contact rating of 10 amperes at 125 volts AC. Pressure switches shall be snap-action switches and shall be in general purpose enclosures. A 316SS three valve manifold shall be supplied with each switch.
- I. **RTD Temperature Measuring Systems:** Temperature transmitters shall be two wire devices with continuously adjustable span and zero adjustments, integral direct reading indicator, solid state circuitry and 4-20 mA output linearly proportional to the specified temperature span. Accuracy including temperature element shall be +/- 0.1 percent of span. The temperature sensor shall be a spring loaded platinum RTD with Type 316 stainless steel Thermowells. The RTD and Thermowells length shall be as required or as indicated. The RTD and Thermowells shall be directly or remotely mounted as indicated. All necessary RTD wire shall be provided in conformance with the instrument manufacturer's recommendations.
- J. **Bimetallic Dial Temperature Measuring Systems:** Temperature indicators shall have 5-inch nominal diameter "all single" indicating scales, Type 316 stainless steel stems, and be suitable for stainless steel wells. Accuracy shall be plus or minus 1 percent of full range.
- K. **Thermowells:** Unless indicated otherwise, Thermowells shall be provided for the following:
 - 1. As part of a thermocouple or resistance bulb assembly
 - 2. For a filled system

3. For test wells
4. For dial thermometers

All Thermowells shall have a 2-inch NPT female thread for connection of the measuring element. Well mounting connections may be screwed, socket-welded, or flanged. Screwed connections shall be 3/4-inch or 1-inch NPT. Flanged connections shall be 1-1/2-inch minimum. Socket-weld connections shall be 1-inch or 1-1/2-inch.

Thermowells shall be bored from solid barstock with a minimum thickness of 3/16-inch. The well material shall be Type 316 stainless steel unless indicated otherwise. Well lengths are based on vessel or pipe size.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The CONTRACTOR shall employ installers who are skilled and knowledgeable 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 CONSTRUCTION MANAGER. 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.
- C. It is the intent of the Contract Documents that all wiring external to Control Panels be provided under the requirements of Division 16. Further, it is the general intent that all 4-20 mA signal circuits, process equipment control wiring, signal wiring to field instruments, and Control Panel input and output wiring, be provided under Division 16 and be terminated and identified under Division 13.

- 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 the 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.

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 CONSTRUCTION MANAGER. Complete records of all tests shall be made and delivered to the CONSTRUCTION MANAGER. Each form shall be

signed by the CONSTRUCTION MANAGER or the CONSTRUCTION MANAGER'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 megohmmeter 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 16050. 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. All power and all signal wires shall be terminated with spade type lugs.
 - 5. All connectors shall be, as a minimum, water tight.
 - 6. 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.
 - 7. 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 CONSTRUCTION MANAGER. These test forms shall verify compliance with all. A report shall be delivered to the CONSTRUCTION MANAGER for each instrument, certifying that the instrument has been calibrated in the presence of the CONSTRUCTION MANAGER or the CONSTRUCTION MANAGER's designated 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. 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 CONSTRUCTION MANAGER at no additional cost to the OWNER.
1. At least 15 days before installation testing begins, the CONTRACTOR shall submit to the CONSTRUCTION MANAGER 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. 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. 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 CONSTRUCTION MANAGER or the CONSTRUCTION MANAGER's representative as a witness, with test data entered, shall be submitted together with a clear and unequivocal statement that all instrumentation has been successfully calibrated, fully inspected, and fully tested.

D. General System Pre-commissioning: The CONTRACTOR shall be responsible for demonstrating the operability of all systems provided under this specification. The CSP will assist and coordinate the operability assessment with the CONTRACTOR. Pre-commissioning shall commence after acceptance of all wire, all calibrating and loop tests, and all inspections have been conducted. Pre-commissioning 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 CONSTRUCTION MANAGER for approval a Pre-Commissioning Plan which describes detailed test procedures, checklists, blank forms and data to be recorded, test equipment to be used and calculated tolerance limits.
2. System pre-commissioning activities shall include means 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 electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset or rate setting(s) as required to achieve a proper response. Measured final control element variable position/speed setpoint 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 indicated accuracy tolerances. Accuracy tolerances are defined as the root-mean-square summation of individual component accuracy tolerances.

Individual component accuracy tolerances shall be as indicated in the Contract Documents or as specified by published manufacturer accuracy specifications whenever not indicated.

4. The CONTRACTOR shall submit an instrumentation and control system pre-commissioning 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 CONSTRUCTION MANAGER must accept the instrumentation and control system pre-commissioning testing before the seven day operational testing may begin. Final acceptance of the control system shall coincide with final acceptance of the WORK.
- E. **7-Day Operational Testing:** The CONTRACTOR shall furnish his own personnel, electrical personnel, and any instrument manufacturers' representatives as required during the testing period 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 3 weeks in advance of the first session. The training shall be performed concurrent with the pre-commissioning 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 at least 2 years of 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 CONSTRUCTION MANAGER at least 30 days in advance of when the lesson is to be given. The CONSTRUCTION MANAGER 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 CONSTRUCTION MANAGER 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 A1 complement 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 CITY 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.

3.6 DCS INPUT/OUTPUT (I/O) LIST

- A. **General:** The I/O Tagging List contained in Appendix B itemizes real inputs and outputs to and from the DCS. The City will provide an excel template that the Contractor shall utilize when preparing the Final I/O List. The Contractor shall provide a final master I/O list based on approved submittals, field installation, and Contract Document requirements. In addition, the I/O list shall show which card and address point each I/O is assigned and wired up to; the I/O List shall be submitted by the Contractor and approved by the Engineer.

3.7 INSTRUMENT TAGGING LIST

- A. **General:** The Instrument Tagging List contained in Appendix C is provided for Contractors use but may not contain all the instruments required per the Contract Documents. The Contractor shall provide a final master Instrument List based on approved submittals, field installation, and Contract Document requirements. In addition, the Instrument Tagging List shall show critical instrument parameters data fields; Instrument Tagging List shall be submitted by the Contractor and approved by the Engineer. The Instrument List shall reference the Contractor provided O&M Manual for cross-referencing.

3.8 EQUIPMENT TAGGING LIST

- A. **General:** The Equipment Tagging List contained in Appendix D is provided for Contractors use but may not contain all the equipment required per the Contract Documents. The Contractor shall provide a final master Equipment List based on approved submittals, field installation, and Contract Document requirements. The Equipment List shall reference the Contractor provided O&M Manual for cross-referencing.

3.9 SAMPLE LOOPS

- A. **General:** Sample loops are presented at the end of this Section in **Volume IV – Item 10. Pump Station 2 Loop Drawings** to show the formatting and layout of the loops per City’s current standards so that the CONTRACTOR can comply with the requirements of this specification.

** END OF SECTION **

APPENDIX A1 - CONTROL STRATEGIES GENERAL
SECTION 13300 - INSTRUMENTATION AND CONTROL

LEGEND

PCM - Process Control Module (Transmits process data to and from the field and **provides** plant automation)

DCS - Distributed Control System (Plant Computer Control System)

UPS - Uninterruptable Power System (Provides battery back-up power to the PCM)

DH – Data Highway (Plant process network where PCM, workstation, and **historian communications** take place)

DIN - District Information Network (Fiber Optic Transmission to COMC)

LCP - Local Control Panels

PID - Proportional-Integral-Derivative

PLC - Programmable Logic Controller

GENERAL CONTROL AND MONITORING

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 PCM(s) 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 alarms shall be fail safe and activate upon loss of power.

COMMON DCS/PLC FUNCTIONS

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.

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 desired 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

DH = full scale digitized 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.

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 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.

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 wired alarms such as a High-High pressure switch that **interfaces** directly with the PLC.

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 PLC or 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 remote 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.

COMMON DCS/PLC SOFTWARE FUNCTIONS

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.

The following provides for common PLC and DCS software functions:

1. All equipment status items monitored by the DCS/PLC and generated within the DCS/PLC control strategies are displayed at the DCS. Unless otherwise specified the following is displayed for each equipment item:
 - a. Equipment READY status
 - b. Equipment RUNNING or ON status
 - c. Equipment OFF status
 - d. Equipment FAILURE alarm
 - e. Equipment FAIL-TO-OPERATE alarm

f. Equipment OUT-OF-SERVICE

2. 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.
3. 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. A discrete alarm shall be generated based on a tunable set point of 10 seconds after the discrete event is initiated.
4. 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.
5. 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:
 - Level 1 - Life Threatening or Danger Conditions
 - Level 2 - Critical process alarms that shall create a plant shutdown condition, cause a critical process failure or severely hinder plant operation.
 - Level 3 - Minor process alarms associated with warning conditions and minor equipment failures.
 - Level 4 - Informational alarms shall not hinder operation or cause equipment failure.
6. All process related analog inputs are trended at the discretion of the operator.
7. All flow inputs and equipment run times are totalized, recorded and displayed at the DCS. Totalizers are resettable at the engineer level only.
8. **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.
9. 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 a minimum 2 seconds, then remove the signal.
10. 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 be 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.
11. 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.
12. 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. 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.
13. 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.
14. **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.

**APPENDIX A2 -
PROCESS AND CONTROL STRATEGIES
AND DESIGN PHILOSOPHY**

SECTION 13300 - INSTRUMENTATION AND CONTROL

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GENERAL DESCRIPTION

The existing Pump Station No.2 (PS2) is the CITY's largest sewage pump station. PS2 was first designed in 1961 and placed into operation in 1963. Over the years, there have been numerous improvement projects at the site. PS2 receives the entire wastewater flow from the Metropolitan Wastewater System and pumps the wastewater to the Point Loma Wastewater Treatment Plant. PS2 receives flows from the North Metro Interceptor which serves the northern San Diego region and the South Metro Interceptor which serves the southern communities of San Diego.

PS2 has a design capacity of 432 mgd and houses a total of 8 main sewage pumps, six of these pumps are currently driven by 2,250 hp electric motors, and the other two pumps are directly-driven by 2,400 hp natural gas engines. Presently, an average daily flow of approximately 160 mgd is being experienced by the pump station. The wastewater collected at PS2 is conveyed by two (2) 87-inch diameter forcemains, to the Point Loma Wastewater Treatment Plant. Forcemain #1 (Rosecrans Forcemain) is primarily routed along Harbor Drive and Scott Street. Forcemain #2 (Bayside Forcemain) is primarily routed under San Diego Bay.

The EPA recommends facilities like PS2 be equipped with two separate and independent sources of electrical power provided from either two separate utility substations or from a single substation and a plant base generator. PS2 has three SDG&E electric utility feeds. Each SDG&E feeder can normally provide power for up to two main sewage pumps including all of PS2 ancillary 480V loads; during an emergency each SDG&E feed can provide power for up to three main sewage pumps including PS2 ancillary 480V loads. Two of the three SDG&E electric utility feeds that are currently in place are from the same substation and all three SDG&E electric utility feeds are ultimately connected to the same electrical power transmission system.

If PS2 lost two of the three utility feeds, that emergency scenario limits the pump station to a total of five pumps, three electric-driven pumps and two natural gas engine-driven pumps; with only five main sewage pumps operating, PS2 would not have the capacity to meet the peak sewage demands. Thus, two new onsite diesel engine generator sets for standby power shall be installed per this project.

PS2's two existing natural gas engine-driven pumps are near the end of their useful life. These two existing natural gas engine-driven pumps are primarily utilized for sewage forcemain surge mitigation. The sewage forcemains are susceptible to pipeline rupture from hydraulic surge if multiple pumps were to suddenly lose power and stop. The existing onsite natural gas engine-driven pumps provide redundancy to the off-site utility power system to ensure that no single point of failure shall cause all the operating pumps to suddenly stop. Thus, prevention of hydraulic surge is the primary purpose of the existing natural gas engine-driven pumps.

Sewage Forcemain Surge Mitigation

To provide greater flexibility, the two existing natural gas engine-driven pumps shall be replaced with new 2,250hp electric motors and VFDs. PS2 shall have two new natural gas reciprocating engine generator sets for prime power per this project. These natural gas engine generator sets shall provide sewage forcemain surge mitigation, similar to the functionality of the old natural gas engine-driven pumps.

The new natural gas engine generator sets main purpose is to provide an independent power source for PS2 to prevent a hydraulic surge from damaging the sewage forcemain. During a typical PS2 system configuration, when more than 3 sewage pumps are operating, it is critical that a least one sewage

pump remain in operation during a power failure event or a hydraulic surge to the forcemain may occur. Approximately 150 days of the year, PS2 requires at least four pumps to operate during the day. Thus, under that scenario, there shall be at least two independent power sources powering the pumps when 4 or more sewage pumps at PS2 are operating.

PS2 Operation Summary	
Total No. of Operating Pumps	Historical Probability of Operating Scenario ¹
1	~100% each day
2	~100% each day
3	~100% each day
4	150 days/year
5	5 days/year
6	2 days/year
7	2 days every 5 years
8	2 days every 5 years

Note:

1. PS2 sewage flows vary throughout a typical day. During nighttime periods the sewage flows are reduced and only require one sewage pump to operate at approximately 60% load. But during a typical day, PS2 requires up to 3 or 4 sewage pumps operating to meet the peak daily demands.

Dual Forcemain Operation (Normal): PS2's forcemains have crossover valves that are normally open, thus the two forcemains operate in parallel.

Scenario 2A. Up to 3 pumps may operate without an independent pumping source of power.

Scenario 2B Up to 6 pumps may operate as long as one pump has an independent pumping source of power.

Scenario 2C Up to 8 pumps may operate as long as two pumps have an independent pumping source of power.

Dual Forcemain Operation Summary (Normal)				
Scenario	Total No. of Operating Pumps	No of Pumps on Independent Source No.1	No of Pumps on Independent Source No.2	Historical Probability of Operating Scenario ¹
2A	1	1	0	~100% each day
2A	2	2	0	~100% each day
2A	3	3	0	~100% each day
2B	4	3	1	150 days/year
2B	5	4	1	5 days/year
2B	6	5	1	2 days/year
2C	7	5	2	2 days every 5 years
2C	8	6	2	2 days every 5 years

Single Forcemain Operation (Maintenance or Emergency Repairs Only): If PS2's forcemain crossover valves are closed, all the wastewater is forced through one forcemain. Hydraulic surge is largely based on forcemain velocity. A single forcemain will have higher velocities than a dual forcemain, thus the number of independent sources required is different.

Scenario 1A. Up to 2 pumps may operate without an independent pumping source of power.

Scenario 1B. Up to 6 pumps may operate as long as one pump has an independent pumping source of power.

Scenario 1C. Up to 8 pumps may operate as long as two pumps have an independent pumping source of power.

Single Forcemain Operation Summary (Maintenance or Emergency Repairs Only)				
Scenario	Total No. of Operating Pumps	No of Pumps on Independent Source No.1	No of Pumps on Independent Source No.2	Historical Probability of Operating Scenario (Maintenance, Emergency Repairs)
1A	1	1	0	1 day in every 2.5 yrs
1A	2	2	0	1 day in every 2.5 yrs
1B	3	2	1	1 day in every 2.5 yrs
1B	4	3	1	1 day in every 6.5 yrs
1B	5	4	1	1 day in every 300 yrs
1B	6	5	1	1 day in every 800 yrs
1C	7	5	2	N/A
1C	8	6	2	N/A

4160VAC Power Sources

This project, when completed shall have seven 4160VAC power sources.

- SDG&E Service No. 134: Offsite Electric Utility Feed
- SDG&E Service No. 367: Offsite Electric Utility Feed
- SDG&E Service No. 496: Offsite Electric Utility Feed
- GEN-110: Onsite Natural Gas Generator
- GEN-210: Onsite Natural Gas Generator
- GEN-120: Onsite Diesel Generator
- GEN-220: Onsite Diesel Generator

Any combination of the three offsite utility sources shall be considered only one single independent source since they are all ultimately tied to the overall electric utility grid. Any of the four onsite generators can be considered an independent source as long as they are electrically isolated from one another. Simply stated, for any of the seven sources to be considered a single independent source in terms of the control strategies discussed herein, no one single point of failure can cause the other power source to fail.

For example:

- For two sources to be independent, they must be electrically isolated via the breakers at switchgear (SWG) SWG-01, SWG-02, SWG-03 (ie not in parallel).
- The natural gas driven generator sets are not independent to one another since they are both powered by the same natural gas source.
- The diesel engines are independent from one another regarding their fuel source since each engine generator has it's own independent diesel fuel day tank.

Any of the four new onsite generators shall be able to electrically parallel with any combination of the other onsite generators or in any combination to the SDG&E utility electric grid. At no time shall the switchgear breakers allow paralleling of any of the SDG&E electric utility sources to another SDG&E electric utility source.

Any combination of parallel or islanded onsite sources shall be able to load follow PS2's actual loads or base load per Operator input.

Methods of Operations

PS2 has nearly infinite modes of operation when you consider there are:

- Seven 4160VAC power sources
- Three 4160VAC Switchgears
- Any source can parallel with any other source
- Any power sources can load follow or base load
- There are eight main sewage pumps driven by:
 - Three liquid rheostats
 - Three Reduced Voltage Auto Transformers (RVAT)
 - Two VFDs
- Two sewage forcemain modes, single or dual
- And at all times the system shall meet the sewage forcemain mitigation requirement for independent sources.

The Operator shall determine the system configuration. The following generalizes a possible typical day at PS2 and how the system may operate, but the following example is only one of infinite possibilities.

During the nighttime low loading, the designated lead natural gas generator shall remain in operation. The lead natural gas generator would already be seeing the stations ancillary 480VAC loads as well as one of the main sewage pump loads.

As peak daily sewage demand approaches, the sewage demands increase at which point the lag natural gas generator shall be called to start. Once started, the second lag natural gas generator shall synchronize with the first operating lead natural gas generator. Once synchronized, the corresponding breakers shall close, paralleling the two natural gas generators. The second sewage pump could then be started. The two paralleled natural gas generators would load follow the connected PS2 loads.

As the sewage flows increase, the two parallel natural gas generators could then start the third main sewage pump.

As sewage flows continue to rise, the SDG&E utility electric power grid shall pick up the fourth pump, while electrically isolated from the natural gas generators. Any additional sewage pumps called to start shall also be picked up from the isolated and independent SDG&E utility electric grid.

Emergency Operations: If either the natural gas or the electric utility grid were to fail, and the sewage demand warranted, then the diesel emergency generators would be required to start. A load bank is provided to help comply with emission requirements during possible low loading of the diesel generators under emergency conditions.

Black Starting: PS2 currently has a 500kW emergency diesel generator. In case of a black start scenario, the new power generation facility would require the 500kW diesel generator for black starting the required ancillary loads of the new power generation facility.

SDG&E Interconnect Agreement: The control strategy and devices provided shall comply with the Interconnect and Power Purchase Agreements with SDG&E. The diesel engine generator sets shall not be allowed to connect and parallel to the SDG&E electric utility grid. Note, even though the interconnect agreement will not be submitted for the diesels, the diesel generator shall be fully capable of interconnection incase at a future date the interconnect agreement is modified. The two natural gas engine generator shall have a Continuous Export Interconnect Agreement with Net Metering through a Power Purchase Agreement.

SDG&E Demand Response Agreement: The control strategy and devices provided shall comply with the Demand Response Agreement with SDG&E. If SDG&E calls for demand response power, SDG&E will utilize the natural gas generators for exporting power to the grid while the diesel generators island and power the pump station loads.

Process and Control Strategies

The following systems below are necessary to support the project described above in the general description. Note, none of these control strategies herein are intended to be standalone control strategies and descriptions, and many of the control strategies sections are tied to other sections throughout this appendix and the Contract Documents. They are organized in approximant sequential order of the contract P&IDs.

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

1.A1 MAIN SEWAGE PUMP MOTORS - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

MAIN SEWAGE PUMP MOTORS (TYP OF 2)

A. ELECTRIC MOTOR: The two existing pumps P-4 and P-5 are currently driven by natural gas engines directly coupled to the pump shaft via a right-angled gearbox. This project shall demolish the existing engine and right-angled gearbox. The pumps will now be driven by new electric motors. The control strategy will be similar to the existing engine. The current control strategy varies the speed of the natural gas engine to meet the wetwell level criteria. Instead of sending a start and speed signal to the natural gas engine, this project will send a start and speed signal to a VFD.

- BREAKER: The breaker shall protect the power distribution system feeding the VFD and electric motor. Trip settings shall be per Section 16431 Short Circuit and Coordination Report, and Section 13350 Commissioning.
- FEEDER MANAGEMENT RELAY: The FMR provides additional supervisory control, protection, and monitoring of the feeder breaker and receives information from: the DCS, 52-breaker, MMR, line side bus potential transformers and current transformers, and ground bus current transformer. See contract drawings 7E-10, 4.16KV POWER PROTECTION DEVICE SCHEDULES and 7E-11 4.16KV POWER PROTECTION DEVICE FUNCTION SCHEMATICS for complete requirements. Device internal protective setpoints shall be determined during the commissioning meetings per Section 13350 Commissioning.
- MOTOR MANAGEMENT RELAY: The MMR provides additional supervisory control, protection, and monitoring of the electric motor and receives information from: the DCS, winding temperatures, bearing temperatures, motor shaft speed, motor case temperature, ambient temperature, vibration sensors, differential current transformers, ground current transformer, VFD output bus current transformers, VFD input bus potential transformers. See contract drawings 7E-10, 4.16KV POWER PROTECTION DEVICE SCHEDULES and 7E-11 4.16KV POWER PROTECTION DEVICE FUNCTION SCHEMATICS for complete requirements. Device internal protective setpoints shall be determined during the commissioning meetings per Section 13350 Commissioning. During the commissioning meetings, the team shall determine the setpoints and alarm conditions that warrant shutting down a motor or alarming only. Note, if the VFD manufacturer can provide all the functionality of the MMR, then the MMR can be removed, and all corresponding MMR functionality and control logic shall merge with the VFD requirements.
- VARIABLE FREQUENCY DRIVE: The VFD shall ramp up and down to meet the wetwell level criteria. The ramp rates shall be tuned not-to-exceed the response capabilities of the new

natural gas generators and shall be determined during the commissioning meetings per Section 13350 Commissioning.

- VIBRATION TRANSMITTER: The vibration transmitters shall monitor the vibration of the new motor to assure smooth operation.

1.A2 Local Control

- BREAKER: The breaker when placed in local control can be opened or closed locally.
- FEEDER MANAGEMENT RELAY: The FMR shall have an HMI screen for viewing and Operator input. Operator shall require a physical key to change any internal setpoints.
- MOTOR MANAGEMENT RELAY: The MMR shall have an HMI screen for viewing and Operator input. Operator shall require a physical key to change any internal setpoints.
- VARIABLE FREQUENCY DRIVE: The VFD shall have an HMI screen for viewing and Operator input. When placed in local control, the VFD can be stopped, started, and speed varied. The VFD shall also have a lock-out-stop, fused disconnect switch, and reset switch.
- VIBRATION TRANSMITTER: N/A, monitoring only.

1.A3 DCS Manual Control

- BREAKER: Operators may manually open and close the breakers from the DCS workstation when the breakers are available for remote control.
- FEEDER MANAGEMENT RELAY: N/A, monitoring only.
- MOTOR MANAGEMENT RELAY: N/A, monitoring only.
- VARIABLE FREQUENCY DRIVE: Operators may manually run the VFD from the DCS workstation when the VFD is available for remote control. The VFD can be stopped or started via the run command, speed varied, and reset.
- VIBRATION TRANSMITTER: N/A, monitoring only.

1.A4 DCS Automatic Control

- BREAKER: N/A, monitoring only.
- FEEDER MANAGEMENT RELAY: N/A, monitoring only.
- MOTOR MANAGEMENT RELAY: N/A, monitoring only.
- VARIABLE FREQUENCY DRIVE: The VFD shall be run by DCS control for normal operations. All setpoints, ramp rates, and proportional integral derivative tuning parameters shall be determined during the commission meetings per Section 13350 Commissioning for complete and functional DCS control.

- VIBRATION TRANSMITTER: N/A.

1.A5 Failure Modes

- BREAKER: The breaker shall have the following alarm failures: breaker tripped and trouble alarm.
- FEEDER MANAGEMENT RELAY: The FMR shall have a trouble alarm.
- MOTOR MANAGEMENT RELAY: The MMR shall have a trouble alarm and a high winding alarm.
- VARIABLE FREQUENCY DRIVE: The VFD shall have a pump fail alarm triggered by either the VFD or the MMR.
- VIBRATION TRANSMITTER: The vibration transmitter shall have a high vibration alarm.

1.A6 Software Interlocks

See sections above.

1.A7 Restart after Power Failure Strategy

The DCS existing logic controls the start sequence of each of the main sewage pumps. The existing logic shall be modified to assure that there is adequate power before restarting a main sewage pump electric motor.

1.A8 Phased Shutdown on Power Failure

N/A.

1.A9 Out of Service

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

1.A10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
TAH-400	MMR High Winding Alarm	2
YA-400C	MMR Trouble Alarm	2
YA-2312	Breaker Tripped	3
YA-2312A	Breaker Trouble Alarm	2
YA-400B	FMR Trouble Alarm	2
YA-400A	Pump Fail	3
VSH-400	High Vibration Alarm	2

TAG	DESCRIPTION	PRIORITY
TAH-500	MMR High Winding Alarm	2
YA-500C	MMR Trouble Alarm	2
YA-1111	Breaker Tripped	3
YA-1111A	Breaker Trouble Alarm	2
YA-500B	FMR Trouble Alarm	2
YA-500A	Pump Fail	3
VSH-500	High Vibration Alarm	2

1.A11 Communications Interfaces

Communication is available via MODBUS over Ethernet IP for the FMR, MMR, VFD, and vibration transmitter. The CONTRACTOR shall provide the signals for each device as shown on sheet 7E-10, 4.16KV POWER PROTECTION DEVICE SCHEDULES and up to 30 additional signals to be determined during the construction commissioning meetings per Section 13350 Commissioning; at the discretion of the CITY; and what is available from the manufacturer. The CONTRACTOR shall provide standard vendor computer monitoring software for each device to monitor and control the devices remotely.

**2.1 SEWAGE HEAT EXCHANGERS COOLING WATER TEMP (TYP OF 12)
- Overview of Strategy**

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

The existing sewage heat exchangers shall be demolished and replaced with new sewage heat exchangers. The new heat exchangers shall have 4-20mA loop powered temperature monitoring for the supply and return lines for the following process flow streams: wastewater, low temperature cooling loops, and the high temperature cooling loops. The output temperature of the chilled water sewage heat exchangers shall be utilized for the Cooling System Control Strategy described herein to control the circulation pumps and the air heat exchanger modulating bypass valves.

2.2 Local Control N/A

2.3 DCS Manual Control N/A

2.4 DCS Automatic Control N/A

2.5 Failure Modes N/A

2.6 Software Interlocks N/A

2.7 Restart after Power Failure Strategy N/A

2.8 Phased Shutdown on Power Failure N/A.

2.9 Out of Service

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

2.10 Alarms

Internal DCS alarms shall be generated from the analog signal to the DCS. Each device shall have a high temperature setpoint alarm (Level 2) to be determined during the construction commissioning meetings per Section 13350 Commissioning.

2.11 Communications Interfaces N/A

3.1 500KW EMERGENCY GENERATOR / USS-1 MODIFICATIONS - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

500KW EMERGENCY GENERATOR / USS-1 MODIFICATIONS: PS2 has an existing 500KW, 480VAC emergency diesel generator set onsite. The 500KW emergency generator was originally intended to be connected to USS-1, but is instead temporary connected to an ATS only feeding MCC-5 critical loads. The existing ATS can only be run locally by an Operator in a manual mode. The reason the ATS is not properly connected to USS-1 is that the ATS is not rated for full generator load and can only handle the loads on MCC-5. This project shall demolish the ATS.

The existing USS-1 has five breakers that are controlled by the DCS. Note, two of these breakers G-1, and G-2 are temporarily racked out and this project shall have these two breakers racked back in. The CITY shall supply the CONTRACTOR with these two breakers.

The existing USS-1 is currently unable to perform a closed transition back to the utility when the emergency generator is powering USS-1 and the utility power is restored. Thus, USS-1 is only capable of performing an open transition back to the utility. During an open transition, all of PS2's 480VAC loads would have to temporarily go dark again before the 480VAC power is fully restored back to the utility, thus all of PS2's ancillary 480VAC loads would also have to be restarted again. This project shall fix the open transition deficiency of USS-1, and allow the USS-1 to perform a closed transition. This cannot be fixed with only DCS reprogramming, since the DCS is too slow to perform the operation.

A new synch check/ closed transition panel shall be installed adjacent the USS-1 to provide local fast acting control of USS-1's breakers. USS-1 shall be modified with PT's installed on the generator source, and on the two normal sources. In addition, the existing hardwired breakers controls for M-1, M-2, G-1, G-2, and M-T shall be modified.

Once the utility has been restored for at least five minutes, the Operator can initiate a closed transition back to the utility source; the system shall then automatically perform a closed transition back to the normal source. The DCS shall assure that that prior to sending a closed transition command, USS-1 is in the following configuration: both M-1 and M-2 shall be open, only one breaker G-1 or G-2 shall be closed, and breaker M-T shall be closed. Since the lag time in the DCS is too slow to control the breakers during this period, the local hardwired fast-acting synch check/ closed transition panel shall operate and monitor the breakers. The general logic is as follows:

- The Operator, via the DCS, initiates a closed transition command to the synch check/ closed transition panel.
- The DCS sends a communication signal to the 500KW emergency generator that it is attempting to synchronize to the utility grid. The 500kW shall already be configured/ calibrated to match the 480VAC utility frequency and voltage of the utility; note, this

should be a constant. The frequency will actually require a slight slip for the phase angle to rotate into the permissive window. During the commissioning meetings this slip frequency shall be determined.

- The DCS output breaker open and close commands are locked out locally (hardwired) by the synch check/ closed transition panel.
- The synch check/ closed transition panel shall select the first hot main breaker as the source it will synchronize to (M-1 or M-2).
- Based on the synchronization settings, the synchronization (phase angle) window shall occur every 10 to 20 seconds. This type of synchronization is passive, and sometimes takes several windows.
- The new synch check/ closed transition panel monitors the synchronization permissives between the generator source and the restored normal source thru the PTs.
- Once the synchronization permissive is clear, the assigned M-1 or M-2 breaker shall close, upon receipt of breaker closed, then the generator breaker (G-1 or G-2) shall open. This whole process shall take less than 1 second.
- A hardwired breaker open position auxiliary contact for G-1 and G-2 shall be wired to the existing 500KW diesel generator so it does not trip and the generator shall shutdown for a normal cool down cycle.
- The synch check/ closed transition panel shall send a signal to the DCS that the closed transition is complete. The DCS own monitoring of the breakers shall confirm status. DCS shall maintain open and closed commands per current configuration.
- The synch check/ closed transition panel shall release hardwired control of breakers back to the DCS.
- DCS now has full control again of USS-1 breakers.

This project shall also have new “black start” feed from USS-1 feeding the new USS-2, that is located in the new power generation facility electrical building. This black start feed shall only be utilized during a complete 4160VAC outage. This black start shall feed 480VAC emergency power that shall allow the main engine generators 480VAC ancillary loads to start. Note under a black start scenario, the DCS load shedding subroutine shall give first priority to start the required ancillary 480VAC loads of the selected engine generators(s).

The main 4160VAC diesels can black start on their own, but require the 480VAC loads up and running within a few seconds (manufacture dependent) or the engines may trip and alarm/fault. The main 4160VAC natural gas engine generators cannot black start on their own and shall require the 480VAC ancillary loads to be running to meet the permissives necessary to start the engine.

3.2 Local Control

N/A, no new local control USS-1. Provide PNL-610 with vendor specific local controls and the system shall meet the intent of the Contract Documents.

3.3 DCS Manual Control

N/A, no new DCS manual control.

3.4 DCS Automatic Control

Operator initiated closed transition as described above.

- 3.5 **Failure Modes** N/A.
- 3.6 **Software Interlocks** N/A.
- 3.7 **Restart after Power Failure Strategy** N/A.
- 3.8 **Phased Shutdown on Power Failure** N/A.
- 3.9 **Out of Service** N/A.
- 3.10 **Alarms**

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
YA-610	Alarm	2

3.11 **Communications Interfaces**

Communication is available via MODBUS over Ethernet IP for the new synch check/ closed transition panel per Contract Documents. The CONTRACTOR shall provide up to 30 signals for each device to be determined during the construction commissioning meetings per Section 13350 Commissioning; at the discretion of the CITY; and what is available from the manufacturer. The CONTRACTOR shall provide standard vendor computer monitoring software for each device to monitor and control the devices remotely.

4.1 SWITCHGEAR NO.3- Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

SWITCHGEAR NO.3: SWG-3 distributes the power generated from the four-onsite power generators to switchgears No.1 & 2. The Operator shall determine the flow of power (from source to load) and the breaker configuration based on the Operator selected pump sequence. The DCS shall warn the Operator if they are attempting to open or close a breaker that would violate the hydraulic surge protection rules described in the front of this appendix. Based on the Operator selected pump sequence, the DCS shall verify if the system is configured to properly provide power to the main sewage pumps. If the system is not properly configured, the DCS shall provide the Operator with a suggested breaker configuration to meet their goals. To prevent the breakers from overloading and tripping, the DCS shall not allow an Operator to power more than 4 main sewage pump loads through any single distribution/tie breakers within the system; this power flow load accounts for all of PS2 ancillary 4160/480VAC loads. Note, Switchgear No.1 & 2 shall also have the same permissives to close since they are the same size breakers. See the control strategy for the natural gas and diesel engine generator sets for additional control philosophy with regards to paralleling loads across the breakers.

- A. 52-BREAKER (TYP OF 13): Trip settings shall be per Section 16431 Short Circuit and Coordination Report, Section 13350 Commissioning, and per Rule 21 requirements. All the breakers except the two breakers feeding the load bank shall have a sync check feature via the FMR. The two load bank breakers shall have local hardwired interlocks so that a maximum of only one breaker may be closed at any given point of operation.
- B. FEEDER MANAGEMENT RELAY (TYP OF 13): The FMR provides additional supervisory control, protection, and monitoring of the feeder breaker and receives information from: the DCS, 52-breaker, MMR, line side bus potential transformers and current transformers, ground bus current transformer, and load side bus potential transformer (for sync check). See contract drawings 7E-10, 4.16KV POWER PROTECTION DEVICE SCHEDULES and 7E-11 4.16KV POWER PROTECTION DEVICE FUNCTION SCHEMATICS for complete requirements. Device internal protective setpoints shall be determined during the commissioning meetings per Section 13350 Commissioning.
- C. GENERATOR MANAGEMENT RELAY (TYP OF 4): The GMR provides additional supervisory control, protection, and monitoring of the generator and receives information from: the DCS, 52-breaker, high resistance grounding system, generator current transformer, input bus voltage transformers and potential transformers, exciter, bearing RTDs, stator RTDs, tachometer, and bearing vibration. Device internal protective setpoints shall be determined during the commissioning meetings per Section 13350 Commissioning. Note, if the generator manufacturers local control panel can provide all

the functionality of the GMR, then the GMR can be removed, and all corresponding GMR functionality and control logic shall merge with the generator manufacturers requirements.

4.A1 52-BREAKER (TYP OF 13)

4.A2 Local Control

The breaker when placed in local control can be open or closed locally.

4.A3 DCS Manual Control

Only highly skilled and trained Operators who fully understanding the complexities of PS2's power generation facility shall attempt to remotely open or close a breaker via the DCS workstation. This level of operation shall be password protected. Also, during normal operations, the breakers shall be typically set and ready to go to meet the load demands which are based on the daily projected sewage demands of PS2. Operators may manually open and close the breakers from the DCS workstation when the breakers are available for remote control. If an Operator attempts to open or close a breaker, the DCS shall first warn the Operator of any potential negative consequences (described throughout this appendix). Also, the local hardwired FMR shall not allow a breaker to close until all the safety conditions are satisfied such a synch check. The DCS shall provide the Operator the status of the breaker if it is waiting on a permissive to clear and appropriate time durations shall be set to alarm if the action does not occur within the expected period.

4.A4 DCS Automatic Control

There shall be no true fully automatic DCS logic to open and close breaker! All open and close logic must be Operator initiated for safety reasons. The only exception is the four generator breakers in SWG-3. These four breakers shall open automatically and close automatically based on engine generator permissive signal transmitted via the DCS; this is so the engines can warm up and cool down and not affect the power quality on the bus.

4.A5 Failure Modes

The breaker shall have the following alarm failures: breaker tripped and trouble alarm.

4.A6 Software Interlocks

Check to verify the loads do not exceed the breaker capacity prior to closing. Check to verify the surge mitigations rules are met. DCS shall not allow any of the SDG&E feeds to be paralleled together through switching of SWG-3 breakers. The DCS shall not allow the SDG&E utility to feed the load bank.

4.A7 Restart after Power Failure Strategy

N/A, the systems is on 125VDC UPS.

4.A8 Phased Shutdown on Power Failure

N/A, the systems is on 125VDC UPS.

4.A9 Out of Service

An Operator shall be able to place any of the breakers out of service via the DCS workstation.

4.A10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
YA-3112	Breaker Tripped	3
YA-3112A	Breaker Trouble Alarm	2
YA-3114	Breaker Tripped	3
YA-3114A	Breaker Trouble Alarm	2
YA-3223	Breaker Tripped	3
YA-3223A	Breaker Trouble Alarm	2
YA-3222	Breaker Tripped	3
YA-3222A	Breaker Trouble Alarm	2
YA-3101	Breaker Tripped	3
YA-3101A	Breaker Trouble Alarm	2
YA-3120	Breaker Tripped	3
YA-3120A	Breaker Trouble Alarm	2
YA-3100	Breaker Tripped	3
YA-3100A	Breaker Trouble Alarm	2
YA-3110	Breaker Tripped	3
YA-3110A	Breaker Trouble Alarm	2
YA-3001	Breaker Tripped	3
YA-3001A	Breaker Trouble Alarm	2
YA-3210	Breaker Tripped	3
YA-3210A	Breaker Trouble Alarm	2
YA-3200	Breaker Tripped	3
YA-3200A	Breaker Trouble Alarm	2
YA-3220	Breaker Tripped	3
YA-3220A	Breaker Trouble Alarm	2
YA-3201	Breaker Tripped	3
YA-3201A	Breaker Trouble Alarm	2

4.A11 Communications Interfaces N/A

4.B1 FEEDER MANAGEMENT RELAY (TYP OF 13)

4.B2 Local Control

The FMR shall have an HMI screen for viewing and Operator input. Operator shall require a physical key to change any internal setpoints.

4.B3 DCS Manual Control

N/A, monitoring only.

4.B4 DCS Automatic Control

N/A, monitoring only.

4.B5 Failure Modes

The FMR shall have a trouble alarm.

4.B6 Software Interlocks

N/A

4.B7 Restart after Power Failure Strategy

N/A, the systems is on 125VDC UPS.

4.B8 Phased Shutdown on Power Failure

N/A, the systems is on 125VDC UPS.

4.B9 Out of Service

An Operator shall be able to place any of the FMRs out of service via the DCS workstation.

4.B10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
YA-3112B	Breaker Trouble Alarm	2
YA-3114B	Breaker Trouble Alarm	2
YA-3223B	Breaker Trouble Alarm	2
YA-3222B	Breaker Trouble Alarm	2
YA-3101B	Breaker Trouble Alarm	2
YA-3120B	Breaker Trouble Alarm	2
YA-3100B	Breaker Trouble Alarm	2
YA-3110B	Breaker Trouble Alarm	2
YA-3001B	Breaker Trouble Alarm	2
YA-3210B	Breaker Trouble Alarm	2
YA-3200B	Breaker Trouble Alarm	2
YA-3220B	Breaker Trouble Alarm	2
YA-3201B	Breaker Trouble Alarm	2

4.B11 Communications Interfaces

Communication is available via MODBUS over Ethernet IP for the FMR. The CONTRACTOR shall provide the signals for each device as shown on sheet 7E-10, 4.16KV POWER PROTECTION DEVICE SCHEDULES and up to 30 additional signals to be determined during the construction commissioning meetings per Section 13350 Commissioning; at the discretion of the CITY; and what is available from the manufacturer. The CONTRACTOR shall provide standard vendor computer monitoring software for each device to monitor and control the devices remotely.

4.C1 GENERATOR MANAGEMENT RELAY (TYP OF 4)

4.C2 Local Control

The GMR shall have an HMI screen for viewing and Operator input. Operator shall require a physical key to change any internal setpoints.

4.C3 DCS Manual Control

N/A, monitoring only.

4.C4 DCS Automatic Control

N/A, monitoring only.

4.C5 Failure Modes

The GMR shall have a trouble alarm.

4.C6 Software Interlocks

N/A

4.C7 Restart after Power Failure Strategy

N/A, the systems is on 125VDC UPS.

4.C8 Phased Shutdown on Power Failure

N/A, the systems is on 125VDC UPS.

4.C9 Out of Service

An Operator shall be able to place any of the GMRs out of service via the DCS workstation.

4.C10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
YA-3110A	High Winding Temp Alarm	2
YA-3110B	High Bearing Temp Alarm	2
YA-3110C	High Vibration Alarm	2
YA-3110D	Trouble Alarm	2
YA-3210A	High Winding Temp Alarm	2
YA-3210B	High Bearing Temp Alarm	2
YA-3210C	High Vibration Alarm	2
YA-3210D	Trouble Alarm	2
YA-3120A	High Winding Temp Alarm	2

TAG	DESCRIPTION	PRIORITY
YA-3120B	High Bearing Temp Alarm	2
YA-3120C	High Vibration Alarm	2
YA-3120D	Trouble Alarm	2
YA-3220A	High Winding Temp Alarm	2
YA-3220B	High Bearing Temp Alarm	2
YA-3220C	High Vibration Alarm	2
YA-3220D	Trouble Alarm	2

4.C11 Communications Interfaces

Communication is available via MODBUS over Ethernet IP for the GMR. The CONTRACTOR shall provide the signals for each device as shown on sheet 7E-10, 4.16KV POWER PROTECTION DEVICE SCHEDULES and up to 30 additional signals to be determined during the construction commissioning meetings per Section 13350 Commissioning; at the discretion of the CITY; and what is available from the manufacturer. The CONTRACTOR shall provide standard vendor computer monitoring software for each device to monitor and control the devices remotely.

5.A1 ENGINE GENERATOR (TYP OF 4) - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

- A. ENGINE GENERATOR: The engine generator system shall provide 4160VAC power at PS2. There are two 3MW natural gas engine generators for daily prime power use and two 4MW diesel engine generators for use when the SDG&E electric utility or if any part of the natural gas powered generation system is unavailable.

Any of the four new onsite generators shall be able to electrically parallel with any combination of the other onsite generators or to any combination to the SDG&E utility electric grid. Any combination of parallel or islanded onsite sources shall be able to load follow PS2's actual loads or base load per Operator input.

The generators shall be able to synchronize across any of the breakers in SWG-1, SWG-2, or SWG-3. Each breaker has a FMR that shall transmit (via a local MODBUS Network) the following signals for the generator manufacturer to use to synchronize across the breaker:

- Synchronization Voltage (load side)
- Synchronization Voltage Angle (load side)
- Synchronization Frequency Angle (load side)
- Synchronization Voltage Difference
- Synchronization Angle Difference
- Synchronization Frequency Difference

The generator manufacturer shall determine, what method of synchronization they shall use, either slip frequency or phase angle. The synchronization will be semi-passive. The generator manufacture shall adjust their governor to meet the system conditions required for sync check. The DCS shall initiate the close signal to the breaker when the generator is ready to sync and the breaker shall close when its internal 25-syncheck relay meets the required permissive settings. The status of the sync breaker's position shall be provided to the engine-generator controller.

All four generators shall be fully capable of paralleling to the utility, even though the current scheme will not typically require the diesel engine generators to parallel to the utility, but in the future via a SDG&E Interconnect Agreement, the CITY still requires this full capability as part of this Contract.

When a second main sewage pump is called to operate, it is not recommended that the Operator power the second main sewage pump on an isolated generator for the following two reasons: First, the engine generators are more stable when they are paralleled to one another. The second reason is that the 120VAC control voltage comes from the 4160VAC side. Once it is time for the second pump to shutdown, and the corresponding generator powers down, the 4160VAC bus would be dead and all your 120VAC controls would also be dead; to prevent this you would have to sync to

another 4160VAC source before shutting down the generator to keep the 4160VAC bus hot. If operations staff determine they want this feature, it can be implemented in the DCS and details determined during the commissioning meetings.

Following paragraph is for natural gas generator only. If a single natural gas engine generator is operating while powering the 4160/480VAC bus, and the generator is required to shutdown for any reason, such as maintenance or nighttime low loading, the PS2 Operator must consider how to operationally keep the 480V loads running continuously to prevent the station from going dark. In order to shutdown the natural gas engine generator, a closed transition to any of the SDG&E electric utility grid sources via the breakers at SWG-1 & 2, shall be required to keep the ancillary 480V station loads hot. It is assumed the natural gas engines will require at least a 30 second soft unload.

Following paragraph is for natural gas generator only. There is another scenario in which an Operator may want to temporarily parallel the generators to the utility and then soft unload some of PS2's loads to the SDG&E utility. For example, consider when two natural generators are paralleled and operating three main sewage pumps. Switchgear No.1 & No.2 tie breakers are only capable of tying pumps into groups of two. Thus, when PS2 is operating three pumps on the natural gas generators, the fourth pump will not have enough available power to start. Thus, if the Operator wants to start the fourth pump, they'll need to first unload the third pump to the SDG&E utility. The fourth pump could then be started by the SDG&E electric utility power source.

When any of the onsite power generators are paralleled to any combination of one another, as PS2 loads decrease, it shall be required to unload and stop a generator at some point. The DCS will provide the generator controller the required system information so the generator manufacture can properly control this functionality upon Operator/DCS initiation.

Under all operating scenarios, the power generation systems shall meet SDAPCD requirements. All kVA loads shown herein are estimated steady state running loads only. It is assumed the natural gas engines will be incapable of starting the existing RVAT driven pump/motors, so that shall not be a requirement, but the emergency diesel engines shall be required to start the RVAT driven pump/motors. Under certain extreme starting scenarios, the Operators may need to load shed some non-critical PS2 loads to prevent the generators from tripping when starting the 2,250hp sewage pumps; Operators could then gradually re-start the remaining non-critical loads.

It may not always be cost effective to economically baseload the natural gas generators against the grid during low load conditions, thus the natural gas engine generate shall be able to operate up to 20 hours each day at 45% constant continuous load while meeting SDAPCD requirements. The remaining four hours of each day operations will operate the engines at a load required to get the exhaust stack temperature hot enough to unload the SCR equipment.

The DCS shall show the current KVA loads, calculate the estimated starting KVA and running KVA available before starting any new load. The DCS shall give the Operator a warning before attempting to start any unsafe load.

The table below shows estimated loads of PS2. Note these loads vary throughout the daytime and nighttime and also vary during the wet season vs dry season.

GENERATOR REQUIREMENTS

(1) Natural Gas Engine Generator Nominal Requirement (Nominal 3MW) At 80% PF	2,879 KW 3,599 KVA
(1) Diesel Engine Generator Nominal Requirement At 80% PF	4,000 KW 5,000 KVA

Basis for Existing PS-2 Anticipated Loads		(KVA)		
		Low Avg Nighttime (L)	Normal Average (A)	Peak (P)
1	Existing MCC Loads (MCC-3 thru MCC-7)	198	330	406
2	Single Sewage Pump Load 2,250Hp ²	1,260	1,680	2,100

Notes:

- ex: "2" = 2nd Row - Single Sewage Pump Load 2,250Hp; Column "P" is Peak Load of 2,100 KVA.
- An isolated generator must be able to start Liquid Rheostat and VFD driven motors.

Basis for Anticipated MCC-8 & MCC-9 Ancillary Loads		(KVA)	
3L	(1) Natural Gas Engine Generator Running, Ancillary Loads	193	Low Average (L)
4P	(2) Natural Gas Engine Generators Running, Ancillary Loads	550	Normal Peak (P)
5EP	(2) Natural Gas & (2) Diesel-Engine Generators Running, Ancillary Loads	1220	Emergency Peak (EP)
6EP	(2) Diesel-Engine Generators Running, Ancillary Loads	527	Emergency Peak (EP)

The CONTRACTOR shall meet in the tables on the following pages, the load steps and running loads while maintaining proper frequency and voltage and while meeting SDAPCD permit requirements. It is also assumed that the worst-case power factor is 0.8.

Natural Gas Engine Generator Starting Load Step

The following are some typical examples of anticipated starting load steps at PS2. Note, this is not intended to show every scenario since the system has almost unlimited starting scenarios.

Starting NGEG Case - 1			Estimated (kVA)
Islanded-Lag Natural Gas Engine Generator (NGEG) Starting Scenario			
Most common islanded starting scenario.			
2P	Load Step 1	Sewage Pump Load 2,250Hp	2,100
Running Loads			2,100
Percent Loaded based on a (1) Natural Gas Generator			58%

Starting NGEG Case - 2			Estimated (kVA)
Paralleling-Lag Natural Gas Engine Generator (NGEG) Starting Scenario			
Most common parallel starting scenario.			
-	-	Synchronize Generator w/ Lead NGEG	-
-	-	Arrange 4160V Breakers and Parallel the two NGEG's	-
-	Load Step 1	Load Share (Operating NGEG Case - 2)	3,056
2P	Load Step 2	Sewage Pump Load 2,250Hp	2,100
Running Loads			5,156
Percent Loaded based on a (2) Parallel Natural Gas Generator			72%

Starting NGEG Case - 3			Estimated (kVA)
Paralleled Natural Gas Engine Generator (NGEG) Starting Scenario			
Addition of a 3rd pump and then preparation for starting diesel generators.			
-	-	Already operating and load Sharing (Operating NGEG Case - 5)	5,156
2P	Load Step 1	Sewage Pump Load 2,250Hp	2,100
Running Loads			7,256
Percent Loaded based on a (2) Parallel Natural Gas Generators			101%

Natural Gas Engine Generator Operating Loads

The following are some typical examples of anticipated running loads at PS2. Note, this is not intended to show every scenario since the system has almost unlimited starting scenarios.

Operating NGEG Case - 1			Estimated (kVA)
Islanded (1) Natural Gas Engine Generator (NGEG) Load Requirements			
Shall be able to operate up to 20 hrs/day uninterrupted at this load.			
2A	Sewage Pump Load 2,250Hp		1,680
Running Loads			1,680
Percent Loaded based on a (1) Natural Gas Generator			47%

Operating NGEG Case - 2			Estimated (kVA)
Islanded (1) Natural Gas Engine Generator (NGEG) Load Requirements			
Basis for load scenario just prior to paralleling with Lag NGEG, when PS2 has 3 or less pumps operating.			
(See Starting NGEG Case-2)			
1P	Existing MCC Loads		406
4P	(2) Natural Gas Engine Generators Running, Ancillary Loads		550
2P	Sewage Pump Load 2,250Hp		2,100
Running Loads			3,056
Percent Loaded based on a (1) Natural Gas Generator			85%

Operating NGEG Case - 3		Estimated
Islanded (1) Natural Gas Engine Generator (NGEG) Load Requirements		(kVA)
Anticipated average daily loads, when PS2 has 3 or less pumps operating. May to run up to 20 hrs/day.		
1A	Existing MCC Loads	330
3L	(1) Natural Gas Engine Generator Running, Ancillary Loads	193
2A	Sewage Pump Load 2,250Hp	1,680
Running Loads		2,203
Percent Loaded based on a (1) Natural Gas Generator		61%

Operating NGEG Case - 4		Estimated
Islanded (1) Natural Gas Engine Generator (NGEG) Load Requirements		(kVA)
Shall be able to operate up to 8 hrs/day, when PS2 has 3 or less pumps operating uninterrupted at this load.		
1L	Existing MCC Loads	198
3L	(1) Natural Gas Engine Generator Running, Ancillary Loads	193
2L	Sewage Pump Load 2,250Hp	1,260
Running Loads		1,651
Percent Loaded based on a (1) Natural Gas Generator		46%

Operating NGEG Case - 5		Estimated
(2) Parallel Natural Gas Engine Generators (NGEG) Load Requirements		(kVA)
May run up to 20 hrs/day, when PS2 has 3 or less pumps operating.		
1P	Existing MCC Loads	406
4P	(2) Natural Gas Engine Generators Running, Ancillary Loads	550
2P	Sewage Pump Load 2,250Hp	2,100
2P	Sewage Pump Load 2,250Hp	2,100
Running Loads		5,156
Percent Loaded based on a (2) Parallel Natural Gas Generators		72%

Operating NGEG Case - 6		(kVA)
100% Base Loaded, (1) Islanded Natural Gas Engine Generator (NGEG)		
Base Loaded		3,599
Percent Loaded based on a (1) Natural Gas Generator		100%

Operating NGEG Case - 7		(kVA)
100% Base Loaded, (2) Paralleled Natural Gas Engine Generators (NGEG)		
Base Loaded		3,599
Percent Loaded based on a (2) Parallel Natural Gas Generators		100%

Diesel Engine Generator Starting Load Step

The following are some typical examples of anticipated starting load steps at PS2. Note, this is not intended to show every scenario since the system has almost unlimited starting scenarios.

Starting DEG Case - 1 (1) Islanded Diesel Engine Generator (DEG) Starting Scenario Worst case islanded scenario requirement.			Estimated (kVA)
2P	Load Step 1	Sewage Pump Load 2,250Hp	2,100
6EP	Load Step 2	(2) Diesel-Engine Generators Running, Ancillary Loads	527
2P	Load Step 3	Sewage Pump Load 2,250Hp	2,100
Running Loads			4,727
Percent Loaded based on a (1) Diesel Generator			95%

Diesel Engine Generator Operating Loads

The following are some typical examples of anticipated running loads at PS2. Note, this is not intended to show every scenario since the system has almost unlimited starting scenarios.

Operating DEG Case - 1 (2) Parallel Diesel Engine Generators (DEG) Load Requirements Anticipated worst case operating scenario requirement.			Estimated (kVA)
1P	Existing MCC Loads		406
6EP	(2) Diesel-Engine Generators Running, Ancillary Loads		527
2P	Sewage Pump Load 2,250Hp		2,100
2P	Sewage Pump Load 2,250Hp		2,100
2P	Sewage Pump Load 2,250Hp		2,100
2P	Sewage Pump Load 2,250Hp		2,100
Running Loads			9,333
Percent Loaded based on a (2) Parallel Diesel Generators			93%

- ZAS: The Generator manufacture shall be responsible for internal governor control of the engines. The ZAS panel (common to all 4 generators) provided by the natural gas engine manufacture shall provide the coordination required to parallel any of the four onsite generators together in any combination, this includes the diesel generators. The DCS systems shall provide required communication data inputs "word messages" to the ZAS panel as necessary for control; the CONTRACTOR's generator manufacturer shall utilize these data inputs to control their generators to meet the systems requested configuration. At a minimum, the DCS shall provide Operator selected system configuration such as: breaker configuration, the system configuration such as what sources are paralleled, and if the selected engines shall load follow or base load. These details shall be determined during the commissioning meetings per Section 13350 Commissioning. The Operator shall determine the system configuration based on the power demands at PS2.
- TEMS: This device is the local control panel for the engine generator.
- HAS: This device is the remote control panel for the natural gas engine generator. Note, it is assumed the diesel generator does not require this device since many manufacturers combine all this functionality into the TEMS device.

- Battery: Shall provide local UPS power for the TEMS panel per manufacturer requirements. Note, this battery is not for starting and turning over the engine; to start the engine an air driven-motor shall be utilized.

5.A2 Local Control

Vendor specific local controls and the system shall meet the intent of the Contract Documents.

The generators and all ancillary control panels must be able to run the system isolated from the DCS under a complete DCS failure scenario. Under a DCS failure scenario, the gensets shall be able to control the first generator breaker and properly synchronize across that breaker. All other system configurations shall be manually inputted into the generator control panel(s) locally via the generator manufacturers HMI device. The ZAS, TEMS, and HAS panels shall have an HMI screen for viewing and Operator input.

5.A3 DCS Manual Control

The Operator via the DCS can start/stop, emergency stop, and reset the generator sets. The Operator shall also set the generator to either base load (KVA) or instruct the generator to load follow.

5.A4 DCS Automatic Control

The DCS shall initiate a start or stop command for the engine-generator(s) based on PS2 power load requirements. The Operator shall determine the main sewage pumps starting sequencing and select which generator is the lead or lag generator. Once the main sewage pumps starting sequence is determined, the DCS shall analyze the system configuration to determine if a generator shall start so the corresponding main sewage pump can have available power to start. Conversely, once the pump is shut off based on the sewage demand, the system shall send a shutdown command to the corresponding engine-generator.

When the gensets and loads are starting in automatic mode, the DCS shall not allow a load to be added that will trip the system.

5.A5 Failure Modes

Vendor specific failures modes and the system shall meet the intent of the Contract Documents.

5.A6 Software Interlocks N/A

5.A7 Restart after Power Failure Strategy

- ZAS: N/A, this is powered by a UPS.
- TEMS: N/A, this is powered by a UPS.
- HAS: The engine generator control panel, has 480VAC distributive loads that shall be required to operate first during a main 4160VAC generator black start scenario. PS2's 500KW, 480VAC diesel emergency generator shall be first utilized to restore ancillary 480VAC power during a black start. PS2's existing DCS load shedding scheme shall assure the ancillary 480VAC loads associated with the main 4160VAC engine-generator shall have the highest

priority over all existing PS2 loads. This scheme shall assure the main 4160VAC generator shall start, restoring primary 4160VAC power to PS2.

- Battery: N/A, this is powered by a UPS.

5.A8 Phased Shutdown on Power Failure N/A

5.A9 Out of Service

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

5.A10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
YA-110A	Common Shutdown Alarm	2
YA-110B	General Alarm	2
YA-110C	Emergency Shutdown	1
YA-210A	Common Shutdown Alarm	2
YA-210B	Common Warning	2
YA-210C	Emergency Shutdown	1
YA-120A	Common Shutdown Alarm	2
YA-120B	Common Warning	2
YA-120C	Emergency Shutdown	1
YA-220A	Common Shutdown Alarm	2
YA-220B	Common Warning	2
YA-220C	Emergency Shutdown	1
YA-210C	Emergency Shutdown	1

5.A11 Communications Interfaces

Communication is available via MODBUS over Ethernet IP for the generator and associated devices per Contract Documents. The CONTRACTOR shall provide up to 60 signals for each device to be determined during the construction commissioning meetings per Section 13350 Commissioning; at the discretion of the CITY; and what is available from the manufacturer. The CONTRACTOR shall provide standard vendor computer monitoring software for each device to monitor and control the devices remotely.

6.1 NATURAL GAS SUPPLY (TYP OF 2) - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

The natural gas generators receive their natural gas supply from SDG&E. Downstream of the SDG&E meter, the pressure is further reduced to meet the manufacturer's requirements for natural gas pressure at the engines. The main natural gas feed to the power generation building shall have a pressure transmitter to monitor the natural gas pressure and alarm on low pressure. Each generator shall have its own temperature correcting totalizing meter to measure the amount of natural gas each engine-generator receives. The DCS shall log flow as well as calculate the total volume of gas utilized. Each month the DCS Operator shall manually input the corrected total volume from the actual meter verse the DCS calculated volume. Note, these meters are intended for internal staff monitoring only, and the CONTRACTOR shall provide any additional SDAPCD natural gas consumption monitoring requirements per the permit.

6.2 Local Control N/A.

6.3 DCS Manual Control N/A.

6.4 DCS Automatic Control N/A.

6.5 Failure Modes N/A.

6.6 Software Interlocks N/A.

6.7 Restart after Power Failure Strategy N/A.

6.8 Phased Shutdown on Power Failure N/A.

6.9 Out of Service

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

6.10 Alarms

DCS internally derived alarm on low natural gas pressure (Level 1 alarm). All additional internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning.

6.11 Communications Interfaces N/A.

7.1 DIESEL FUEL SYSTEM - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

DIESEL FUEL SYSTEM: The diesel fuel system consists of three main parts, the main above grade diesel fuel storage tank, a diesel fuel polishing system, and two diesel day tanks.

- A. **FUEL STORAGE TANK:** The system will operate automatically independent of the DCS. The fuel storage tank stores the bulk of the diesel fuel for emergency operations at PS2. The diesel fuel storage tank shall have two pumps that supply the two diesel day tanks inside the power generation building. The main storage tank local control panel control shall control the two supply pumps and monitor levels within the tank. An automatic fuel port control panel shall provide an Operator with information to safely fill the tank. The DCS shall monitor the fuel level.
- B. **FUEL POLISHING SYSTEM:** The system will operate automatically independent of the DCS. The system will circulate and turn over the diesel fuel on a regular basis to filter and clean the diesel fuel within the storage tank. The DCS shall only monitor when and how often the fuel polishing system is operating, if the system is ready to operate, and if there are any failures of the system.
- C. **DAY TANK (TYP OF 2):** The system will operate automatically independent of the DCS. The day tank provides a local tank to the engine generators to provide fuel during emergencies and testing. The tank shall have a return pump that will pump fuel back to the diesel fuel storage tank. The associated diesel fuel storage tank supply pump and day tank return pump shall work together to circulate diesel flow when in operation to assure proper level is maintained and to aid in cooling the fuel. The diesel day tank local control panel will control the return pump, monitor level, and send a call signal to the diesel fuel storage tank local control panel. The DCS shall monitor if the system is in auto, when the diesel fuel storage tank supply pump is called to start, and if there are any failures of the system.

The fuel/oil storage area shall have a float switch to indicate when the area sump is full of liquid. This is an alarm condition (Level 4), and could indicate there is a fuel or lube oil leak.

7.A1 **FUEL STORAGE TANK**

7.A2 Local Control

Vendor specific local controls and the system shall meet the intent of the Contract Documents.

7.A3 DCS Manual Control N/A.

7.A4 **DCS Automatic Control** N/A.

7.A5 **Failure Modes**

The supply pumps are normally tied to a specific diesel day tank for normal operations. If a supply pump were to fail, the Operator via valving can direct diesel to the opposite diesel day tank. The diesel fuel storage tank local control panel shall have sufficient operator controls to handle this scenario.

7.A6 **Software Interlocks** N/A.

7.A7 **Restart after Power Failure Strategy** N/A.

7.A8 **Phased Shutdown on Power Failure** N/A.

7.A9 **Out of Service**

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

7.A10 **Alarms**

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
LAH-310	High Fuel Level	4
LAH-310A	Fuel Leak	1

7.A11 **Communications Interfaces** N/A.

7.B1 **FUEL POLISHING SYSTEM**

7.B2 **Local Control**

Vendor specific local controls and the system shall meet the intent of the Contract Documents.

7.B3 **DCS Manual Control** N/A.

7.B4 **DCS Automatic Control** N/A.

7.B5 **Failure Modes** N/A.

7.B6 **Software Interlocks** N/A.

7.B7 **Restart after Power Failure Strategy** N/A.

7.B8 **Phased Shutdown on Power Failure** N/A.

7.B9 **Out of Service**

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

7.B10 Alarms

TAG	DESCRIPTION	PRIORITY
LA-311	Trouble	4

7.B11 Communications Interfaces N/A.

7.C1 DAY TANK (TYP OF 2)

7.C2 Local Control

Vendor specific local controls and the system shall meet the intent of the Contract Documents.

7.C3 DCS Manual Control N/A.

7.C4 DCS Automatic Control N/A.

7.C5 Failure Modes N/A.

7.C6 Software Interlocks N/A.

7.C7 Restart after Power Failure Strategy N/A.

7.C8 Phased Shutdown on Power Failure N/A.

7.C9 Out of Service

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

7.C10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
LAH-312	High Fuel Level	3
LAH-312A	Fuel Leak	3
LAL-312	Low Fuel Level	3
LALL-312	Low-Low Fuel Level	2
YA-312	Pump Fail	2
LAH-314	High Fuel Level	3
LAH-314A	Fuel Leak	3
LAL-314	Low Fuel Level	3
LALL-314	Low-Low Fuel Level	2

TAG	DESCRIPTION	PRIORITY
YA-314	Pump Fail	2

7.C11 Communications Interfaces N/A.

8.1 COMPRESSED AIR SYSTEM (TYP OF 2) - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

The compressed air system is used to mechanically turn over the four-onsite power generators engines for starting. The system shall have a compressed air receiver suitable for multiple engine starts. The system works independently of the DCS. The DCS will monitor the trouble alarm and low-low air pressure.

8.2 Local Control See Contract Drawings for requirements.

8.3 DCS Manual Control N/A.

8.4 DCS Automatic Control N/A.

8.5 Failure Modes N/A.

8.6 Software Interlocks N/A.

8.7 Restart after Power Failure Strategy N/A.

8.8 Phased Shutdown on Power Failure N/A.

8.9 Out of Service

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

8.10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
YA-140	Trouble	2
PAL-140A	Low-Low Pressure	2
YA-240	Trouble	2
PAL-240A	Low-Low Pressure	2

8.11 Communications Interfaces N/A.

9.1 ENGINE EXHAUST SYSTEM - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

ENGINE EXHAUST SYSTEM: The CITY is responsible for emissions permitting with SDAPCD, and the CONTRACTOR is required to provide a complete and functional system to meet SDAPCD emissions requirements. The CONTRACTOR shall also provide all requested documents required for permitting with SDAPCD.

The diesel engine generators shall be bid by the CONTRACTOR as prime engines for up to 200 hours a year, and that permit will require an SCR system. The CITY's first preference is to permit the engines for emergency use with explicit exceptions to what counts as an emergency. The CITY will attempt to reach an agreement with SDAPCD that the diesel engine generators can be utilized at the CITY's discretion for up to 50 hours a year to prevent and mitigate a possible hydraulic surge event even while the SDG&E electric grid is fully operational. Typically, SDAPCD does not consider it an emergency if the SDG&E electric grid is operational. In the CONTRACTOR's bid item in the schedule of values, a line item is reserved for the credit due back to the CITY in case the diesel engines can be permitted without the SCR systems and SDAPCD agrees to the CITY's condition.

- A. UREA TANK (TYP OF 2): The north and south generator buildings shall both have a 2,500 gallon urea tank. Regardless of the permitting outcome, each building shall have a 2,500 gallon tank. There are a cross over valves between the two tanks to balance the level when required; these valves shall be normally closed. The DCS shall monitor the tank level.
- B. ENGINE EXHAUST EMISSIONS PACKAGE (TYP OF 4): The diesels engines shall have a particulate filter regardless if the engines get permitted for prime or emergency use. The natural gas engines shall have an oxidation catalyst and SCR system, and if the diesels get permitted as prime, they shall also require an oxidation catalyst and SCR system.

The natural gas engines shall require an exhaust air blower fan during the periods of low engine loads (nighttime) to avoid overheating of the system since temperatures are typically over 950 F. The blower is required for a highly reliable and durable SCR catalyst solution.

Each engine shall have an exhaust emissions package unit that consists of a SCR controllers, a continuous emissions monitoring system, and urea dosing pumps.

9.A1 UREA TANK (TYP OF 2)

9.A2 Local Control N/A.

9.A3 DCS Manual Control N/A.

- 9.A4 **DCS Automatic Control** N/A.
- 9.A5 **Failure Modes** N/A.
- 9.A6 **Software Interlocks** N/A.
- 9.A7 **Restart after Power Failure Strategy** N/A.
- 9.A8 **Phased Shutdown on Power Failure** N/A.
- 9.A9 **Out of Service**

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

9.A10 **Alarms**

The DCS shall derive a low level alarm (Level 2) based on the level input. All additional internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning.

- 9.A11 **Communications Interfaces** N/A.

9.B1 **ENGINE EXHAUST EMISSIONS PACKAGE (TYP OF 4):**

- 9.B2 **Local Control** N/A.
- 9.B3 **DCS Manual Control** N/A.
- 9.B4 **DCS Automatic Control** N/A.
- 9.B5 **Failure Modes** N/A.
- 9.B6 **Software Interlocks** N/A.
- 9.B7 **Restart after Power Failure Strategy** N/A.
- 9.B8 **Phased Shutdown on Power Failure** N/A.
- 9.B9 **Out of Service**

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

9.B10 **Alarms**

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning.

9.B11 Communications Interfaces

Communication is available via MODBUS over Ethernet IP for the exhaust emissions package unit and associated devices per Contract Documents. The CONTRACTOR shall provide up to 30 signals for each device to be determined during the construction commissioning meetings per Section 13350 Commissioning; at the discretion of the CITY; and what is available from the manufacturer. The CONTRACTOR shall provide standard vendor computer monitoring software for each device to monitor and control the devices remotely.

10.1 BUILDING VENTILATION SYSTEM (TYP OF 2) - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

The north and south generator building each have their own dedicated supply and exhaust air handling unit (AHU)'s. There are four supply and four exhaust AHU's on the roof. Each supply and exhaust AHU each have multiple fans driven by VFDs. Each supply and return AHU is tied to a specific engine-generator in the building directly below and the respective AHU shall be in operation when the corresponding engine is running.

The supply AHU's have a moisture filter and a particulate filter in series. Each filter has a differential pressure transmitter to detect when the filter requires replacement.

Delta-T Control:

When operating, the engine-generators produce waste heat that is radiated out into the building's interior space. To remove this waste heat from the air, supply and exhaust fans change out the air to keep the temperature rise (delta-T) within the room to a reasonable level.

The AHU's first priority is to maintain the delta-T setpoint, the difference between the outside air and inside air temperature as set by the Operator. This shall determine the number of fans in the AHU that is required to run. The fans in each AHU shall be a lead-lag type configuration, with a pair of fans (one supply and one exhaust fan), starting one pair at a time. After a preset time delay, the next pair of fans can start. The DCS shall control the fans to run as few and at a low as speed as possible that is required to meet the Operators delta-T setpoint. The DCS shall set the exhaust fan(s) speed to meet the delta-T setpoint, then the correspond supply fan(s) speed setpoint shall meet the delta-P requirements (explained later below).

The fans are mechanically setup in the associated natural gas engine's AHUs with 3-duty and 1-standby fan and the associated diesel engine's AHUs setup with 2-duty and 1-standby fan. The standby fan is essentially an installed spare. If the AHU's are operating all the duty fans on both the supply and exhaust AHU, that will closely match the delta for combustion air of the associated engine running at 100% full speed and the worst case design maximum delta-T of 18-degrees Fahrenheit; the DCS shall still be required to vary the supply fans to balance the delta-P.

At no time shall either the north or south generator building have more than 5 supply and 5 exhaust fans operating in each building (mechanically this would exceed 100 air changes an hour). If only one engine is operating in a building and the associated AHU number of fans are maxed out, then the lag AHU may start to meet the Operators request for more ventilation. Note, if the standby fan is operating in an AHU, an annunciator warning (Level 4) in the DCS shall initiated because this is not normally required.

Health & Safety Control:

While a single engine is running, a minimum of one supply and one exhaust fan must run. Note, if none of the engines are operating, and the delta-T is within the Operators setpoint, at least one pair of fans shall operate at a minimum of 60% speed in each of the north and south generator buildings. This is required to meet air quality requirements of the buildings, 6 air changes per hour. The DCS shall maintain delta-P during this scenario. The Operator shall select the lead-lag AHU's for each building for this type of health & safety control.

Delta-P Control:

The number of operating fans shall be determined by the delta-T logic. The DCS shall also control the AHU fans to meet the delta-P requirement (-4" wc setpoint), the difference between the inside air and outside air pressure. Several things will affect the building's delta-P: the amount of combustions air utilize by the engine and the airflow difference between the supply and return fan; the DCS will control the later. Note, all the exterior doors of the north and south power generation building shall have door switch sensors. If any of the exterior doors are left open, the DCS will not able to control the AHU's on delta-P, and an alarm will annunciate (Level 4) within the DCS; the DCS logic for control of the AHU's would then default to delta-T control until the doors are closed (the supply fans shall then be set to the same speed as the exhaust fans). The DCS must provide a stable delta-P at all times for the engines to run properly.

Temperature Control:

Each exhaust AHU has a high temperature (HT) and low temperature (LT) air-to-water heat exchanger. If the associated bypass modulating valve is open, then the AHU shall be on temperature control. The DCS shall maintain the requirements of the delta-T and delta-P control as described above in addition to the follow requirements. If either the LT or HT bypass modulating valve is open, then the output water temperature shall be controlled to meet the setpoint. If the temperature is above the setpoint for a preset period of time, then the operating exhaust fans shall ramp up to 100% speed while the corresponding supply fans maintain delta-P. If the temperature is still above the setpoint for a preset period of time, then the next lag pair of fans shall start (and so forth); the exhaust fan shall ramp to 100% speed, while all the supply fans maintain delta-P. Temperature control shall ramp up in ascending order and never in descending order. Once the associated bypass modulating valve(s) are closed, then the system shall revert back to delta-T and delta-P control and the number of fans and speed can then ramp down accordingly to the logic.

Fire Protection Control: See Section 13.

10.2 Local Control

The Operator can place the VFD in local control for maintenance purposes.

Each fan is equipped with an automatic damper. This damper can be manually actuated at the AHU for testing.

10.3 DCS Manual Control

The Operator can place the VFD in manual DCS control, but this feature should only be utilized for maintenance and testing purposes.

10.4 DCS Automatic Control

See above for DCS automatic control. The DCS shall send a start signal and vary the VFD speed to meet the operational philosophy described above. All setpoints, ramp rates, and proportional integral derivative tuning parameters shall be determined during the commission meetings per Section 13350 Commissioning for a complete and functional DCS control of the AHUs.

10.5 Failure Modes

Each AHU has 2 or 3 duty and one standby fan selected by the Operator. If a VFD were to fail, the standby fan should be the next lag fan.

10.6 Software Interlocks N/A.

10.7 Restart after Power Failure Strategy N/A.

10.8 Phased Shutdown on Power Failure N/A.

10.9 Out of Service

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

10.10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
YA-111	Supply Fan VFD Fail	3
YA-112	Supply Fan VFD Fail	3
YA-113	Supply Fan VFD Fail	3
YA-114	Supply Fan VFD Fail	3
YA-115	Exhaust Fan VFD Fail	3
YA-116	Exhaust Fan VFD Fail	3
YA-117	Exhaust Fan VFD Fail	3
YA-118	Exhaust Fan VFD Fail	3
YA-121	Supply Fan VFD Fail	3
YA-122	Supply Fan VFD Fail	3
YA-123	Supply Fan VFD Fail	3
YA-124	Supply Fan VFD Fail	3
YA-125	Exhaust Fan VFD Fail	3
YA-126	Exhaust Fan VFD Fail	3
YA-127	Exhaust Fan VFD Fail	3
YA-128	Exhaust Fan VFD Fail	3
YA-211	Supply Fan VFD Fail	3
YA-212	Supply Fan VFD Fail	3
YA-213	Supply Fan VFD Fail	3
YA-214	Supply Fan VFD Fail	3
YA-215	Exhaust Fan VFD Fail	3
YA-216	Exhaust Fan VFD Fail	3

TAG	DESCRIPTION	PRIORITY
YA-217	Exhaust Fan VFD Fail	3
YA-218	Exhaust Fan VFD Fail	3
YA-221	Supply Fan VFD Fail	3
YA-222	Supply Fan VFD Fail	3
YA-223	Supply Fan VFD Fail	3
YA-224	Supply Fan VFD Fail	3
YA-225	Exhaust Fan VFD Fail	3
YA-226	Exhaust Fan VFD Fail	3
YA-227	Exhaust Fan VFD Fail	3
YA-228	Exhaust Fan VFD Fail	3

10.11 Communications Interfaces

Communication is available via MODBUS over Ethernet IP for the VFDs per Contract Documents. The CONTRACTOR shall provide up to 30 signals for each device to be determined during the construction commissioning meetings per Section 13350 Commissioning; at the discretion of the CITY; and what is available from the manufacturer. The CONTRACTOR shall provide standard vendor computer monitoring software for each device to monitor and control the devices remotely.

11.1 COOLING SYSTEM - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

COOLING SYSTEM: The main cooling system primarily circulates softened water through the sewage heat exchangers to feed the decoupling heat exchangers. On the other side of the decoupling heat exchangers, the engine's cooling loop is de-coupled from PS2 primary cooling system. The engine side cooling loop shall utilize a water glycol mixture. This water glycol mixture shall circulate through the engine generator's separate low temperature (LT) and high temperature (HT) cooling loops. The engines require two different temperature loops for greater system efficiency. The LT loop removes waste heat from items such as the engines after coolers and ancillary devices. The HT loop removes waste heat from the engines jacket water and the lube oil heat exchangers. The Contractor and engine manufacturer shall be responsible for designing and controlling their own cooling loops on the engine side of the de-coupling heat exchanger.

The sewage heat exchangers can removal all the heat during typical day-to-day normal operations, but under certain scenarios, they are not designed to remove the full heat load of the entire system. When the sewage heat exchangers are not providing enough cooling, then there are secondary loops that direct flow through the buildings AHU that have air heat exchangers. These secondary loops during normal operations benefit from being pre-cooled by the sewage heat exchangers.

The sewage heat exchangers will meet all the LT needs for the two natural gas engines. If the diesel engines are also running at the same time as the natural gas engines, then the system is designed to handle all of the LT load most of the time. In rare circumstances (likely equipment failure), if the sewage heat exchangers cannot keep up with the LT heat load demands, then the LT air heat exchangers located in the associated diesel AHU will provide the balance of cooling when required.

The sewage heat exchangers will meet the HT cooling needs for the two natural gas engines most of the time. If however the two natural gas engines are running during hot weather days near full load, the sewage heat exchangers may not be able to provide adequate HT cooling; the sewage heat exchangers will then provide some precooling, and the associated HT air heat exchangers will provide the balance of cooling when required. If three or more engines are running, the sewage heat exchangers cannot provide all the cooling and can only precool; the associated air heat exchangers shall provide the balance of cooling.

If for any reason both of the sewage heat exchangers are out of service, then the AHU's are designed to take the full load of all the engines as long as the ambient air temperature in the generator building is below 90-degrees Fahrenheit.

A. LT AUXILIARY WATER COOLING SYSTEM

- **LT COOLING CIRCULATION PUMP (TYP OF 2):** LT cooling circulating pumps shall provide the circulation required for the LT system. The output temperature of

the chilled water from the sewage heat exchangers shall be utilized to control the flow rate setpoint of the circulation pumps. The pumps shall be setup per a lead-lag scheme based on a flow rate setpoint (derived by temperature setpoint).

- 1 Engine: The minimum flow rate setpoint is 150gpm.
- 2 Engines: The minimum flow rate setpoint is 250gpm.
- 3 Engines: The minimum flow rate setpoint is 500gpm.
- 4 Engines: The minimum flow rate setpoint is 800gpm.

For additional LT & HT Cooling System information, see Appendix A3 for reference.

Event	LT Loads	Expected Flow Range based on Engine BTU Requirements		Expected Cooling Circulation Pumps Running			
		min (gpm)	max (gpm)	jockey	Duty	Duty	Duty
				(3/4 HP)	(10 HP)	(10 HP)	(10 HP)
Normal	Nat Gas Engine	150+*	250	(X)	-	N/A	N/A
Normal	Nat Gas Engine	250	500	N/A	(X)	-	N/A
Emergency	Diesel Engine	500	800	N/A	(X)	x	-
Emergency	Diesel Engine	800	1100	N/A	(X)	(X)	X

* Ramp VFD as low as electrically possible, but no less than the flowrate shown.	
** Emergency pump and duty pumps shall not run at the same time except: when ramping up to the emergency pump, shut the duty pumps off after a preset time; and when ramping down from the emergency pump to 2 duty pumps, shut the emergency pump off after a preset time.	
Legend:	
Based on expected flowrate requirement to meet engine heat load of the running	
(X)	Pump is required to run.
x	Pump will run based on demand.
-	Pump may occasionally need to run based on unusually high demand.
N/A	Pump is never allowed to run.

The control scheme shall step up to another pump, after the running pumps have reached 100% speed for a preset time. The control scheme shall step down, and turn off a pump after the pumps have reached 60% speed for a preset time.

If one engine is on, at least one circulation pump is required to also be running. If all the engines are off, then the circulating water loops shall also be off.

The flow rate setpoint shall be based on the output temperature of the chilled water from the sewage heat exchangers.

After a preset time when no engines are brought on or off line:

The system flow rate setpoint shall make 25 gpm step changes with a preset lag time between intervals. If the temperature is still climbing above the temperature setpoint threshold (100-deg + x), for the preset time, then the pump shall step-up another 25 gpm to attempt to lower the system temperature. The reverse logic shall apply on decreasing temperature.

During the preset time when a lag engines is brought on or off line:

The system flow rate setpoint shall make 50 gpm step changes with a preset lag time between intervals. If the temperature is still climbing above the temperature setpoint threshold (100-deg + x), for the preset time, then the pump shall step-up another 50 gpm to attempt to lower the system temperature. The reverse logic shall apply on decreasing temperature.

The system shall utilize the higher of the two temperature readings of the operational heat exchanger(s) for control. Typically, both heat exchangers are operating, but if a heat exchanger is out-of-service, then the associated temperature sensor shall not be utilized in the control logic.

- LT SEWAGE HEAT EXCHANGERS BYPASS VALVES (TYP OF 3): When the Operator places the three valves in a configuration to bypass the sewage heat exchangers, the pumps shall be controlled by the discharge water temperatures of the operating AHU's.
- LT MODULATING VALVE (TYP OF 10): The valves shall be normally controlled via the DCS in an automatic mode. The valves shall be able to modulate and hold to any position between 0 and 100% open.
 - LT Supply Manifold Isolation Valve (Typ of 2): Each LT water supply loop either feeds the north or south generator buildings. In general, if the any of the corresponding engines in that corresponding building are called to start, then the valve shall be open; if the engines are not are not running, then the valves shall be closed. Note, once an engine is called to start, the corresponding cooling loops shall start right away; the actual engines may have a programmed delay before actually starting. Conversely, once the engine is off, the chilled water loops shall continue to run for a preset time.
 - LT Air Heat Exchanger Bypass Valve (Typ of 2): This valve has three modes of operations.

Mode 1: If the available circulation pumps are running at 100% speed and cannot maintain the sewage heat exchangers discharge chilled water temperature setpoint, then the LT Air Heat Exchanger Bypass Valve shall close forcing the water through the air heat exchanger to be cooled. Once the heat load has passed and the sewage heat exchangers chilled water discharge temperature falls below the setpoint threshold, the valve shall then open bypassing the LT Air Heat Exchanger.

Mode 2: If the sewage heat exchangers discharge temperature setpoint is being maintained by the system, but the corresponding engine is sending a high temperature signal, then the bypass valve shall close. Once the engine

high temperature alarm is cleared, and after a preset time, the bypass valve shall go back to Mode 1 control described above.

Mode 3: Inhibit Modes 1 & 2 from forcing flow thru the air heat exchanger when the corresponding building temperature is equal to or greater than the water temperature setpoint. During this high temperature scenario, the air heat exchangers are not effective when the buildings inside ambient air temperature is high.

- LT Decoupling Heat Exchanger Feed Valve (Typ of 4): The associated engine's LT Decoupling Heat Exchanger Feed Valve shall be normally full open when the engine is called to operate, otherwise it is normally closed. If both the natural gas and diesel engine in the same building are both called to start, both valves shall be open. If both engines are operating, and one engine sends a signal that it is starting to overheat, then the opposite valve shall close down a bit on a slow acting PID loop based on engine water temperature. If the this overheating is chronic, the valve position setpoint can be determined based on historical data and set to a fixed position less than 100% open to better balance the flow and not require modulation. Thus, the flow will be better balanced based on actual use.
- LT Return Manifold Isolation Valve (Typ of 2): Same logic as LT Supply Manifold Isolation Valve.

B. HT JACKET WATER COOLING SYSTEM

- HT COOLING CIRCULATION PUMP (TYP OF 3): Similar logic as described in the LT section except for the following:

After a preset time when no engines are brought on or off line:

The system flow rate setpoint shall make 50 gpm step changes with a preset lag time between intervals. If the temperature is still climbing above the temperature setpoint threshold (100-deg + x), for the preset time, then the pump shall step-up another 50 gpm to attempt to lower the system temperature. The reverse logic shall apply on decreasing temperature.

During the preset time when a lag engines is brought on or off line:

The system flow rate setpoint shall make 100 gpm step changes with a preset lag time between intervals. If the temperature is still climbing above the temperature setpoint threshold (100-deg + x), for the preset time, then the pump shall step-up another 100 gpm to attempt to lower the system temperature. The reverse logic shall apply on decreasing temperature.

1 Engine: The minimum flow rate setpoint is 250gpm.

2 Engines: The minimum flow rate setpoint is 350gpm.

3 Engines: The minimum flow rate setpoint is 700gpm.

4 Engines: The minimum flow rate setpoint is 1250gpm.

For additional LT & HT Cooling System information, see Appendix A3 for reference.

Event	HT Loads	Expected Flow Range based on Engine BTU Requirements		Expected Cooling Circulation Pumps Running		
		min (gpm)	max (gpm)	Duty (10 HP)	Duty (10 HP)	Emergency Pump** (75 HP)
		Normal	Nat Gas Engine	250+*	350	(x)
Normal	Nat Gas Engine	350	700	(x)	x	-
Emergency	Diesel Engine	700	1250	x	x	x
Emergency	Diesel Engine	1250	1800	N/A	N/A	(x)

* Ramp VFD as low as electrically possible, but no less than the flowrate shown.

** Emergency pump and duty pumps shall not run at the same time except: when ramping up to the emergency pump, shut the duty pumps off after a preset time; and when ramping down from the emergency pump to 2 duty pumps, shut the emergency pump off after a preset time.

Legend:

Based on expected flowrate requirement to meet engine heat load of the running

(x)	Pump is required to run.
x	Pump will run based on demand.
-	Pump may occasionally need to run based on unusually high demand.
N/A	Pump is never allowed to run.

- HT SEWAGE HEAT EXCHANGERS MANUAL BYPASS VALVES (TYP OF 3):
When the Operator places the three valves in a configuration to bypass the sewage heat exchangers, the pumps shall be controlled by the discharge water temperatures of the operating AHU's.
- HT MODULATING VALVE (TYP OF 12)
 - HT Supply Manifold Isolation Valve (Typ of 4): Same logic as described in the LT Supply Manifold Isolation Valve section.
 - HT Air Heat Exchanger Bypass Valve (Typ of 4): Same logic as described in the LT section, except Mode 3 shall not apply, since HT cooling is effective even during high ambient air temperatures.
 - HT Return Manifold Isolation Valve (Typ of 4): Same logic as described in the LT section.

11.A1 LT Auxiliary Water Cooling System

11.A2 Local Control

- CIRCULATION PUMP: The VFD shall have an HMI screen for viewing and Operator input.
- MANUAL BYPASS VALVE: N/A.
- MODULATING VALVE: L/R SS, and Open and Close pushbuttons. Local position indication.

11.A3 DCS Manual Control

- CIRCULATION PUMP: Operator may manually select speed or flow rate setpoint.
- MANUAL BYPASS VALVE: N/A.
- MODULATING VALVE: Operators may manually run the VFD from the DCS workstation when the VFD is available for remote control. The VFD can be stopped or started via the run command, speed varied, and reset.

11.A4 DCS Automatic Control

- CIRCULATION PUMP: All setpoints, ramp rates, and proportional integral derivative tuning parameters shall be determined during the commission meetings per Section 13350 Commissioning for complete and functional DCS control.
- MANUAL BYPASS VALVE: N/A.
- MODULATING VALVE: All setpoints, ramp rates, and proportional integral derivative tuning parameters shall be determined during the commission meetings per Section 13350 Commissioning for complete and functional DCS control.

11.A5 Failure Modes

- CIRCULATION PUMP: If there is a flowmeter failure, or flow rate out of expected range, VFD failure, or speed fails to reach setpoint within the preset time an alarm shall trigger.
- MANUAL BYPASS VALVE: N/A.
- MODULATING VALVE: Valve fails to go to position setpoint within the preset time.

11.A6 Software Interlocks

- CIRCULATION PUMP: The valves shall be configured to allow a circulation loop.
- MANUAL BYPASS VALVE: N/A.
- MODULATING VALVE: N/A.

11.A7 Restart after Power Failure Strategy

- The pumps and valves 480VAC loads shall be required to operate first during a main 4160VAC generator black start scenario. PS2's 500KW, 480VAC diesel emergency generator shall be first utilized to restore ancillary 480VAC power during a black start. PS2's existing DCS load shedding scheme shall assure the ancillary 480VAC loads associated with the main 4160VAC engine-generator shall have the highest priority over all existing PS2 loads. This scheme shall assure the main 4160VAC generator shall start, restoring primary 4160VAC power to PS2.

11.A8 Phased Shutdown on Power Failure N/A.

11.A9 Out of Service

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

11.A10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
YA-791A	PUMP FAIL	2
YA-792A	PUMP FAIL	2
YA-793A	PUMP FAIL	2
YA-794A	PUMP FAIL	2
YA-791	TROUBLE ALARM	2

11.A11 Communications Interfaces

Communication is available via MODBUS over Ethernet IP for the VFDs per Contract Documents. The CONTRACTOR shall provide up to 30 signals for each device to be determined during the construction commissioning meetings per Section 13350 Commissioning; at the discretion of the CITY; and what is available from the manufacturer. The CONTRACTOR shall provide standard vendor computer monitoring software for each device to monitor and control the devices remotely.

11.B1 HT Jacket Water Cooling System

11.B2 Local Control Similar to LT scheme Section A2.

11.B3 DCS Manual Control Similar to LT scheme Section A3.

11.B4 DCS Automatic Control Similar to LT scheme Section A4.

11.B5 Failure Modes Similar to LT scheme Section A5.

11.B6 Software Interlocks Similar to LT scheme Section A6.

11.B7 Restart after Power Failure Strategy Similar to LT scheme Section A7.

11.B8 Phased Shutdown on Power Failure N/A.

11.B9 Out of Service Similar to LT scheme Section A9.

11.B10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
YA-795A	PUMP FAIL	2
YA-796A	PUMP FAIL	2
YA-797A	PUMP FAIL	2
YA-795	TROUBLE ALARM	2

11.B11 Communications Interfaces

Communication is available via MODBUS over Ethernet IP for the VFDs per Contract Documents. The CONTRACTOR shall provide up to 30 signals for each device to be determined during the construction commissioning meetings per Section 13350 Commissioning; at the discretion of the CITY; and what is available from the manufacturer. The CONTRACTOR shall provide standard vendor computer monitoring software for each device to monitor and control the devices remotely.

12.1 LUBE OIL SYSTEM - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

LUBE OIL SYSTEM: The natural gas engines will require regular lube oil per the engine manufactures requirements, while the diesel engines shall require a different special low ash lube oil. As the engines operate, they will naturally burn off some of the lube oil and it will need to be topped off on a regular basis. Also, just like an automotive engine, the lube oil will need to be completely changed out on a regular maintenance schedule. Due to the large volume of lube oil required, the system requires supply and waste storage tanks with associated pumping, piping, and valving to distribute the lube oil.

- A. WASTE LUBE OIL SYSTEM: The waste lube oil tank will contain the regular waste lube oil as well as the low ash lube oil. These two separate waste lube oils can be mixed together. On a regular basis, the CITY shall have a tanker truck haul off the mixed waste lube oil for recycling.
- WASTE LUBE OIL TRANSFER PUMP (TYP OF 4): Each engine has its own dedicated waste lube oil pump for regularly scheduled lube oil changes. These pumps shall be controlled locally. The DCS shall send a permissive signal to the hardwired pump controls to prevent the waste lube oil tank from being overfilled. If the manufacture of the engine-generator supplies an integrated waste lube oil transfer pump as part of their normal packaged unit, then this separate external pump shall not be required, but the controls of the pump shall be such that the waste tank is full permissive signal can be integrated into the controls.
 - WASTE LUBE OIL STORAGE TANK: The DCS shall monitor the tank level and monitor for any leaks.
- B. LUBE OIL TRANSFER SYSTEM (TYP OF 2): The lube oil transfer system has two main transfer modes to the engines, slow gravity fill and fast pump fill. The slow gravity fill mode is utilized to top off the engines during routine lube oil changes or to top off the engines during normal burn off of the lube oil. The fast pump fill mode is used to bulk transfer the lube oil to the engine during routine lube oil changes.
- LUBE OIL STORAGE TANK: The DCS shall monitor the tank level and monitor for any leaks.
 - SUPPLY LUBE OIL PUMP: The supply lube oil pump is utilized for the fast pump fill mode. The pump can be run in local manual control via the VFD for maintenance, but it is strongly not recommended. The supply lube oil pump shall normally be operated via the local lube oil system control panel whose logic is controlled by the DCS for safe pump operation.

The pump can either directly transfer lube oil to the engines, or to fill the day tank.

- **LUBE OIL DAY TANK:** The lube oil day tank is utilized to slowly gravity fill the engines. The DCS shall monitor the tank level and monitor if the tank is overfilled with the flow switch. If the lube oil day tank is overfilled, the lube oil will safely flow back to the lube oil storage tank.
- **LUBE OIL TRANSFER PIPING:** The lube oil piping has a series of solenoid valves that will switch the flow to the proper branch pipe based on Operator input from the lube oil system control panel. The lube oil piping shall have a flow meter, so the Operator can monitor the flow rate as well as the total volume of lube oil transferred to the engine.
- **LUBE OIL SYSTEM CONTROL PANEL:** The power generation facility is split into two major buildings, the north and south generator buildings. Each building contains both a natural gas and diesel engine. A common control panel, one in each building shall be able to control either the regular lube oil system or the low ash lube oil system. In addition to the main lube oil control panel, a separate portable lube oil control panel can be utilized by the Operator so they may walk around and inspect the engine while filling.

12.A1 Waste Lube Oil System

12.A2 Local Control

The Operator shall run the pump manually with a momentary push button that must stay pressed down. The following permissives must be met for the pump to run: suction valve open, pressure switch not high, waste lube oil storage tank not high, and pump must have been off for 15 seconds. Once the pump is running, and the Operator depresses the run push button, a timer shall start to not allow the pump to start again for a preset time, (15 seconds). This is to prevent the Operator from repeatedly hammering the pump off and on quickly, for example if the Operator's finger slips off the pushbutton. All these features are in place to mitigate the risk of a lube oil spill.

12.A3 DCS Manual Control N/A

12.A4 DCS Automatic Control N/A

12.A5 Failure Modes N/A.

12.A6 Software Interlocks N/A.

12.A7 Restart after Power Failure Strategy N/A.

12.A8 Phased Shutdown on Power Failure N/A.

12.A9 Out of Service

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

12.A10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
LAH-331	Level Alarm High	3
LAH-332	Level Alarm High	3
LAH-333	Level Alarm High	3
LAH-334	Level Alarm High	3
LAH-347	Tank Level Float Switch High	3
LAH-347A	Tank Leak	3

12.A11 Communications Interfaces N/A.

12.B1 Lube Oil Transfer System

12.B2 Local Control

- LUBE OIL STORAGE TANK: N/A.
- SUPPLY LUBE OIL PUMP: The VFD shall have an HMI screen for viewing and Operator input.
- LUBE OIL DAY TANK: N/A.
- LUBE OIL TRANSFER PIPING: Each solenoid shall have an integral push button for testing and actuating the valve for maintenance staff.
- LUBE OIL SYSTEM CONTROL PANEL: All Operator actions are initiated locally at this panel, but the logic resides fully in the DCS. See DCS automatic control descriptions below.

12.B3 DCS Manual Control

- LUBE OIL STORAGE TANK: N/A.
- SUPPLY LUBE OIL PUMP: N/A.
- LUBE OIL DAY TANK: N/A.
- LUBE OIL TRANSFER PIPING: Maintenance staff may initiate manually thru the DCS an open command for the solenoid valves.
- LUBE OIL SYSTEM CONTROL PANEL: N/A.

12.B4 DCS Automatic Control

- LUBE OIL STORAGE TANK: N/A.

- SUPPLY LUBE OIL PUMP: The DCS controls the speed of the VFD initiated by the Operator from the lube oil system control panel. All setpoints, ramp rates, and proportional integral derivative tuning parameters shall be determined during the commission meetings per Section 13350 Commissioning for complete and functional DCS control.
- LUBE OIL DAY TANK: N/A.
- LUBE OIL TRANSFER PIPING: The DCS opens the appropriate valves based on selector switch positions initiated by the Operator from the lube oil system control panel. During normal engine operations, if the engine manufacturer transmits the engine lube oil level via Modbus communication, the appropriate solenoid valve may pulse for 15 seconds on and 15 seconds off until the engine is topped off. The DCS shall track and log separately the burn rate of the engine oil. The Operator shall reset this after a lube oil change.
- LUBE OIL SYSTEM CONTROL PANEL: The following describes the control philosophy for the lube oil system control panel. The DCS shall have the following inputs and outputs.
 - Lube Oil System SS (SS1: Natural Gas Lube Oil, SS2: Diesel Low Ash Lube Oil): The Operator shall place the selector switch (SS) to the system they desire to control. This is a DCS input.
 - Pump Discharge SS (SS1: To Engine, SS2: To Lube Oil Day Tank): The Operator shall place the selector switch to where they desire the supply lube oil pump to transfer the lube oil to. This is a DCS input.
 - Run Lube Oil Pump: Momentary push button is a DCS input. Once pressed and continuously hold down, the supply lube oil pump shall run as long as the permissives are met.
 - Lube Oil Speed Command (30-100%): Operator shall dial in the speed setpoint. This is a DCS input.
 - Lube Oil Pump Speed Setpoint Indication (30-100%): This is a DCS output based on the Operators input of the lube oil speed command above. An identical DCS output will also send the same value to the supply lube oil pump VFD.
 - Selected Day Tank Lube Oil Level (0-100%): This is a DCS output of the selected tank level. The selected day tank is per the Lube Oil System SS position described above.
 - Gallons Dispensed (0-999.9 Gal): This is a DCS output based on the selected flow meter. The selected flow meter is per the Lube Oil System SS position described above. The DCS shall calculate the total volume based on the flow rate over time.
 - Gallons Dispensed/ System Reset: This is a DCS input. This pushbutton shall reset to zero the total volume of lube oil dispensed to the engine of the selected system.
 - System Alarm: This is a DCS output of any alarms generated by the lube oil systems selected.

12.B5 Failure Modes

- LUBE OIL STORAGE TANK: N/A.
- SUPPLY LUBE OIL PUMP: N/A.
- LUBE OIL DAY TANK: N/A.
- LUBE OIL TRANSFER PIPING: N/A.
- LUBE OIL SYSTEM CONTROL PANEL: N/A.

12.B6 Software Interlocks

- LUBE OIL STORAGE TANK: N/A.
- SUPPLY LUBE OIL PUMP: The supply oil pump shall only run if the following permissives are met: suction valve open, high pressure return PRV not high, VFD not failed, VFD in remote. When pumping to the lube oil day tank the additional permissives shall be met: tank level not high and overflow flow switch not high. When pumping to the engine the following permissives shall be met if available from the engine manufacturer: engine lube oil not high.
- LUBE OIL DAY TANK: N/A.
- LUBE OIL TRANSFER PIPING: N/A.
- LUBE OIL SYSTEM CONTROL PANEL: N/A.

12.B7 Restart after Power Failure Strategy N/A

12.B8 Phased Shutdown on Power Failure N/A

12.B9 Out of Service

An Operator shall be able to place any of the equipment out of service via the DCS workstation.

12.B10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
FAH-315	Flow Alarm High	3
FAH-316	Flow Alarm High	3
HS-321	System Alarm	3
HS-322	System Alarm	3
YS-335	VFD Fail	3
YS-336	VFD Fail	3
LAH-345A	Tank High Level	2
LAH-345B	Tank Leak	2

12.B11 Communications Interfaces N/A.

13.1 FIRE PROTECTION (TYP OF 3) - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

FIRE PROTECTION (TYP OF 3): The power generation facility is made up of three interconnected buildings: north generator building, south generator building, and the electrical building. Each building shall have carbon monoxide detectors, combustible gas detectors, and smoke detectors per the Contract Documents. In addition, the north and south ventilation systems have duct smoke detectors. If any of these inputs are received by the DCS, then the DCS shall output an alarm to the corresponding audible alarm(s) and strobe light(s) located at each building. The Operator shall take immediate action and alert the appropriate authority and take further action to troubleshoot the alarm based on their training and developed protocols. All fire protection alarm(s) shall be latching in the DCS. After two minutes of continuous alarming, the Operator may silence the output alarm from the DCS at their discretion. Once the conditions are deemed safe by CITY Staff, then the system shall be reset, and alarm condition unlatched within the DCS.

If either the north or south generator building systems shall receive any of the fire protection alarm(s), then the corresponding engine(s) located in the alarming building shall safely initiate an automatic emergency shutdown as long as it does not violate the surge protection permissives and as long as there is an alternate source of power feeding USS-1 ancillary 480VAC systems. If the surge protection permissives are not currently met to allow the engine(s) to safely shutdown, then the DCS shall automatically initiate a safe shutdown of the main sewage pumps that are on the effected source. Note, each main sewage pump sequentially takes a minimum of 100 seconds to safely shut down because of the automated discharge cone valves used for surge protection. The Operator must manually take corrective actions to place USS-1 an alternate source. If the Operator does not take action to place USS-1 on an alternate source within 5 minutes, and the fire protection alarm is still latched, the engine shall initiated an emergency shutdown regardless of the USS-1 permissive being met (note, the surge protection permissive must still be met, however if everything was in auto and working properly the surge protection permissive should have been met within the five minute window).

After the engine(s) emergency shutdown, the corresponding supply ventilation shall shut off, and at least three exhaust fans tied to the building shall run at 100% speed for two additional minutes, then also shutdown. This may help ventilate the room.

Immediately after the adjacent building's fire protection devices alarm, the non-alarming building running AHU(s) shall control based on a positive delta-P setpoint vs a normal negative delta-P setpoint. The system shall slowly ramp the delta-P setpoint (engine manufacture provided safe ramp rate). This will pressurize the non-alarming building, and help prevent foul air from the adjacent alarming building from seeping into the non-alarming building.

If the alarming condition persists for more than two minutes after the adjacent building's engine(s) shutdown, then the DCS shall automatically shutdown the engine(s) in the adjacent non-alarming room as long as it does not violate the surge protection permissives and as long as there is an alternate power

source for USS-1 ancillary systems. Once the engine(s) are off, then the AHU's corresponding to the non-alarmed building, shall then shut down any operating exhaust fans, then the DCS shall run at least two supply fans at 100% speed for four minutes then also shutdown.

Based on Staff input from people at the site, they may request via radio for the DCS Operator to override the AHU permissives and pressurize or depressurize a specific building to help clear the building of foul air. This function should be semi-automatic initiated by the DCS Operator with a simple click of the mouse.

The electrical building has duct smoke detectors so the DCS can monitor the air-conditioning units; upon DCS alarm, the Operator shall take immediate action and alert the appropriate authority and take further action to troubleshoot the alarm based on their training and developed protocols.

13.2 **Local Control** N/A.

13.3 **DCS Manual Control** N/A.

13.4 **DCS Automatic Control** N/A.

13.5 **Failure Modes** N/A.

13.6 **Software Interlocks** N/A.

13.7 **Restart after Power Failure Strategy** N/A.

13.8 **Phased Shutdown on Power Failure** N/A.

13.9 **Out of Service**

If any of the fire protection devices are faulty, then the Operator may place the defective device out-of-service in the DCS and the DCS shall inhibit all associated alarms. This level of action shall be password protective, and take an authorized CITY employee to initiate.

13.10 **Alarms**

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
SAH-061	SUPPLY SMOKE ALARM	1
SAH-062	SUPPLY SMOKE ALARM	1
SAH-071	CARBON MONOXIDE HIGH ALARM	1
SAH-072	LEL HIGH ALARM	1
SAH-073	SMOKE ALARM	1
SAH-075	CARBON MONOXIDE HIGH ALARM	1
SAH-076	LEL HIGH ALARM	1
SAH-077	SMOKE ALARM	1
SAH-171	CARBON MONOXIDE HIGH ALARM	1
SAH-172	LEL HIGH ALARM	1

TAG	DESCRIPTION	PRIORITY
SAH-173	SMOKE ALARM	1
SAH-271	CARBON MONOXIDE HIGH ALARM	1
SAH-272	LEL HIGH ALARM	1
SAH-273	SMOKE ALARM	1

13.11 Communications Interfaces N/A.

14.1 DOOR SWITCHES - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

DOOR SWITCHES (TYP OF 7): The door switches primary purpose is for pressure control of the north and south buildings for the building ventilation system. These are DCS inputs. If the doors are open, the building ventilations system shall not control on pressure differential.

14.2 Local Control N/A.

14.3 DCS Manual Control N/A.

14.4 DCS Automatic Control N/A.

14.5 Failure Modes N/A.

14.6 Software Interlocks N/A.

14.7 Restart after Power Failure Strategy N/A.

14.8 Phased Shutdown on Power Failure N/A.

14.9 Out of Service N/A.

14.10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning.

14.11 Communications Interfaces N/A.

15.1 SAFETY EYEWASH & SHOWER - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

SAFETY EYEWASH: The combination eyewash and safety showers have both a flow switch and a hand switch when in operation. This shall only be used in an emergency and will trigger a DCS alarm. The on duty Operator shall take immediate action per their training and developed protocols. These alarms shall latch within the DCS, and shall not be reset by Operator until the situation is deemed back to normal.

15.2 Local Control N/A.

15.3 DCS Manual Control N/A.

15.4 DCS Automatic Control N/A.

15.5 Failure Modes N/A.

15.6 Software Interlocks N/A.

15.7 Restart after Power Failure Strategy N/A.

15.8 Phased Shutdown on Power Failure N/A.

15.9 Out of Service N/A.

15.10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
FAH-070	Eyewash Alarm 1	1
HS-070A	Eyewash Alarm 2	1
FAH-170	Eyewash Alarm 1	1
HS-170A	Eyewash Alarm 2	1
FAH-270	Eyewash Alarm 1	1
HS-270A	Eyewash Alarm 2	1

15.11 Communications Interfaces N/A.

16.1 UPS/BYPASS SWITCH - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

UPS/BYPASS SWITCH: The new power generation facility has two UPS systems, a 125VDC system that feeds power panel DC-3 primarily utilized for Switchgear No.3, and a 208/120VAC system that feeds UPS power to power panel AC-3 primarily utilized for the DCS, emergency lights, diesel systems, and field instruments. The DCS only monitors the UPS.

16.2 Local Control The external bypass switch has a 3-way selector switch with the following positions:

- Test: This mode is for diagnostic testing to see if the internal UPS bypass system is working properly. During this mode, the power flows through the external bypass breakers to power the load and to the UPS input; no power flows out of the UPS.
- Bypass: Operator can force the system to bypass the UPS entirely so maintenance can be safely performed on the UPS.
- UPS: This is the normal position, and power shall flow thru the UPS system.

The UPS system shall have manufacturers standard control features for local control and compatible with use of an external bypass switch.

16.3 DCS Manual Control N/A.

16.4 DCS Automatic Control N/A.

16.5 Failure Modes N/A.

16.6 Software Interlocks N/A.

16.7 Restart after Power Failure Strategy N/A.

16.8 Phased Shutdown on Power Failure N/A.

16.9 Out of Service N/A.

16.10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
YA-081A	UPS On Bypass	2

TAG	DESCRIPTION	PRIORITY
YA-081B	UPS Trouble	2
YA-081C	Loss of Utility	2
EAL-081	Battery Low	2
YA-082A	UPS On Bypass	2
YA-082B	UPS Trouble	2
YA-082C	Loss of Utility	2
EAL-082	Battery Low	2

16.11 Communications Interfaces N/A.

17.1 LOAD BANK - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

LOAD BANK: The bank shall be able to step the restive loads up and down to meet the desired KVA input based on either local or DCS Operator actions. The DCS shall control the 4160VAC breakers to control the flow of power. The load banks primary purpose is for routine testing of the engines. The system is sized to run one 4MW diesel engine generator set at 60% of full load while completely isolated.

If during commissioning, nighttime low loading of the natural gas engine causes SDAPCD permit violations, then the following logic shall be provided: The DCS shall determine the minimum additional KVA load required for the engines to meet SDAPCD requirements.

17.2 Local Control

The load bank shall have an HMI screen and vendors specific controls to operate the load bank.

17.3 DCS Manual Control N/A.

17.4 DCS Automatic Control

KVA setpoint to be determined by the Operator via the DCS.

17.5 Failure Modes N/A.

17.6 Software Interlocks N/A.

17.7 Restart after Power Failure Strategy N/A.

17.8 Phased Shutdown on Power Failure N/A.

17.9 Out of Service N/A.

17.10 Alarms

Manufactures alarms shall be sent via communications. All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning.

17.11 Communications Interfaces

Communication is available via MODBUS over Ethernet IP for the load bank per the Contract Documents. The CONTRACTOR shall provide up to 30 signals to be determined during the construction commissioning meetings per Section 13350 Commissioning; at the discretion of the CITY; and what is available from the manufacturer. The CONTRACTOR shall provide standard vendor computer monitoring software for the load bank to monitor and control the devices remotely.

18.1 USS-2 - Overview of Strategy

The CONTRACTOR shall meet the functionality, intent, and requirements provided in this specific control strategy, other related control strategies, equipment specific specification, control diagrams, P&ID's, and all other related Contract Documents. Not all information is explicitly provided in each of these documents, but all of the Contract Documents as a whole constitute the requirements to be provided by the CONTRACTOR. It is the intent of the Contract Documents to show information once, and not to repeat that information again and again throughout all the other related documents. The CONTRACTOR is responsible for a complete and functional system. The CONTRACTOR is responsible for providing their subs with all the required information.

USS-2: Trip settings shall be per Section 16431 Short Circuit and Coordination Report, and Section 13350 Commissioning. The USS-2 shall typically have the bus tie and "black start" breakers open. During typical operations, MCC-8 and MCC-9 will be electrically isolated from each other while being fed from two opposite sides of the USS bus for safety.

18.2 Local Control

The breaker when placed in local control can be open or closed locally.

18.3 DCS Manual Control

Only highly skilled and trained Operators who fully understanding the complexities of PS2's power generation facility shall attempt to remotely open or close a breaker via the DCS workstation. This level of operation shall be password protected. Operators may manually open and close the breakers from the DCS workstation when the breakers are available for remote control. If an Operator attempts to open or close a breaker, the DCS shall first warn the Operator of any potential negative consequences. Also, the local hardwired FMR shall not allow a breaker to close until all the safety conditions are satisfied.

18.4 DCS Automatic Control

All open and close logic must be Operator initiated for safety reasons.

18.5 Failure Modes

The breaker shall have the following alarm failures: breaker tripped.

18.6 Software Interlocks

DCS shall not allow any of the feeds to that are not already paralleled on the 4160VAC side to be paralleled together through switching of the USS-2 480VAC breakers.

18.7 Restart after Power Failure Strategy

N/A, the systems is on 125VDC UPS.

18.8 Phased Shutdown on Power Failure

N/A, the systems is on 125VDC UPS.

18.9 Out of Service

An Operator shall be able to place any of the breakers out of service via the DCS workstation.

18.10 Alarms

All internal DCS generated software alarms shall be determined during the construction commissioning meetings per Section 13350 Commissioning. Below are the hardwired alarms.

TAG	DESCRIPTION	PRIORITY
YA-002A	Breaker Tripped	3
YA-002B	Breaker Tripped	3
YA-002C	Breaker Tripped	3
YA-002D	Breaker Tripped	3
YA-002E	Breaker Tripped	3

18.11 Communications Interfaces N/A

LT AND HT COOLING SYSTEM

Piping and Valving Configurations		
	Start	End
Section 1	Cooling Pump	WWHEX
Section 2		WWHEX
Section 3	WWHEX	Supply Manifold
Section 4	Supply Manifold	AHEX
Section 5		AHEX
Section 6	AHEX	Plate/Frame HEX
Section 7		Decoupling Plate/Frame HEX (DXH)
Section 8	Plate/Frame HEX	Cooling Pump

Engine Running Options	
Option 1	1 NAT GAS ENGINE
*Option 2	2 NAT GAS ENGINES
Option 3	1 NAT GAS AND 1 DIESEL ENGINE
Option 4	2 NAT GAS AND 1 DIESEL
Option 5	ALL ENGINES

* Standard, Typical Operation.

Note:

Flow rates shown in tables below are anticipated requirements based on heat load of engines running at 100% load
 "Shaded Gray" = No flow.

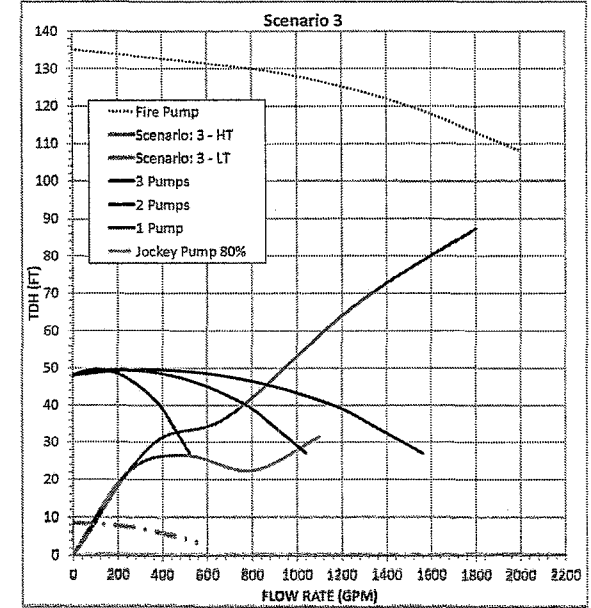
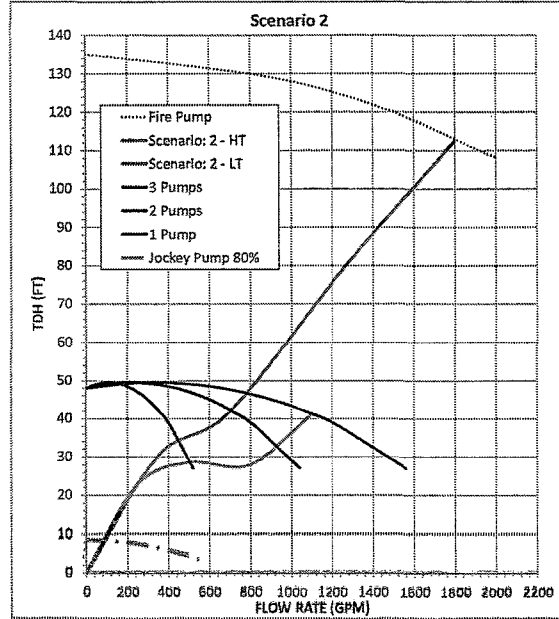
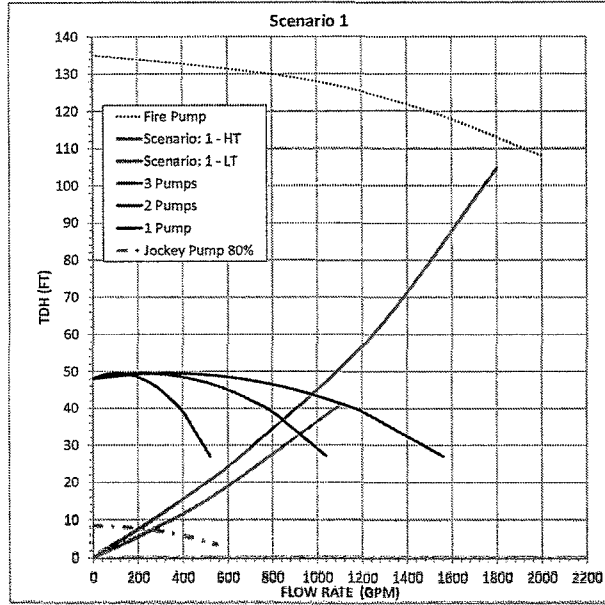
Abbreviations:

AHEX Air Heat Exchanger
 DXH Decoupling Heat Exchanger
 HT High Temperature
 HEX Heat Exchanger
 LT Low Temperature
 WWHEX Waste Water Heat Exchanger

SCENARIO 1: Cooling System Running on WWHEX (AHEX not in use)											
		Section								TDH SUM (ft)	
Equip. or Pipe $\phi \rightarrow$	Q (GPM)	12	WWHEX	12	8	AHEX	6	DXH	6		
OPTION	LOOP	1	2	3	4	5	6	7	8		
1	LT 250	0	0	0	0		2	2	2	7	
	HT 350	0	0	0	1		4	4	3	13	
2*	LT 500	1	1	1	1		4	4	3	15	
	HT 700	2	1	2	2		8	8	6	29	
3	LT 550	1	1	1	1		5	5	4	18	
	HT 900	2	2	2	3		14	14	10	46	
4	LT 800	2	2	2	2		8	8	5	28	
	HT 1250	4	4	4	3		16	16	12	60	
5	LT 1100	3	3	3	2		11	11	8	41	
	HT 1800	9	7	9	6		27	27	19	105	

SCENARIO 2: Cooling System Running on WWHEX and AHEX											
		Section								TDH SUM (ft)	
Equip. or Pipe $\phi \rightarrow$	Q (GPM)	12	WWHEX	12	8	AHEX	6	DXH	6		
OPTION	LOOP	1	2	3	4	5	6	7	8		
1	LT 250	0	0	0	0	10	2	8	2	23	
	HT 350	0	0	0	1	13	4	8	3	30	
2*	LT 500	1	1	1	1	10	4	8	3	29	
	HT 700	2	1	2	2	13	8	8	6	42	
3	LT 550	1	1	1	1	10	5	8	4	31	
	HT 900	2	2	2	3	25	14	10	10	68	
4	LT 800	2	2	2	2	8	8	5	5	28	
	HT 1250	4	4	4	3	25	16	10	12	79	
5	LT 1100	3	3	3	2	11	11	8	8	41	
	HT 1800	9	7	9	6	25	27	10	19	112	

SCENARIO 3: Cooling System Running on AHEX only (WWHEX not in use)											
		Section								TDH SUM (ft)	
Equip. or Pipe $\phi \rightarrow$	Q (GPM)	12	WWHEX	12	8	AHEX	6	DXH	6		
OPTION	LOOP	1	2	3	4	5	6	7	8		
1	LT 250					0	10	2	8	22	
	HT 350					1	13	4	8	29	
2*	LT 500					1	10	4	8	26	
	HT 700					2	13	8	8	37	
3	LT 550					1	10	5	8	28	
	HT 900					3	25	14	10	61	
4	LT 800					2	8	8	5	22	
	HT 1250					3	25	16	10	66	
5	LT 1100					2	11	11	8	31	
	HT 1800					6	25	27	10	87	



Printed copy shall be in color to properly see the graphs.

LT AND HT COOLING SYSTEM

TDH for Anticipated Flowrates for Options 1 and 2; Scenario 1
 with Engines Operating at only 60% Load.
 (FYI, only, not graphed.)

OPTION	Equip. or Pipe Ø →	@ gpm	Section								TDH SUM (ft)
			12	WWHEX	12	8	AHEX	6	DHX	6	
1 Natural Gas Engine Running at 60%	LT	150	0.1	0.1	0.1	0.2	0.8	1.3	0.6	3.1	
	HT	210	0.2	0.2	0.2	0.5	2.2	2.5	1.6	7.4	
2 Natural Gas Engines Running at 60%	LT	300	0.2	0.2	0.3	0.3	1.7	2.7	1.2	6.5	
	HT	420	0.4	0.3	0.4	0.9	4.4	5.0	3.1	14.7	

Pump Curves

1 Pump @ 100%		2 Pumps @ 100%		3 Pumps @ 100%		1 Pump @ 60%		Jockey Pmp @ 80%		"Fire Pump" @ 100%		"Fire Pump" @ 80%		"Fire Pump" @ 60%	
Q	H	Q	H	Q	H	Q	H	Q	H	Q	H	Q	H	Q	H
gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft
0	48	0	48	0	48	0	17	0	8	0	135	0	86	0	49
50	49	100	49	150	49	50	18	50	8	500	132	500	84	500	48
100	50	200	50	300	50	100	18	100	8	1000	128	1000	82	1000	46
150	49	300	49	450	49	150	18	150	8	1500	120	1500	77	1500	43
200	49	400	49	600	49	200	17	200	8	2000	108	2000	68	2000	39
250	47	500	47	750	47	250	17	250	7	2500	81	2500	52	2500	29
300	45	600	45	900	45	300	16	300	7	2600	76	2600	49	2600	27
350	42	700	42	1050	42	350	15	350	6						
400	39	800	39	1200	39	400	14	400	6						
450	34	900	34	1350	34	450	12	450	5						
500	29	1000	29	1500	29	500	10	500	4						
520	27	1040	27	1560	27	520	10	550	3						

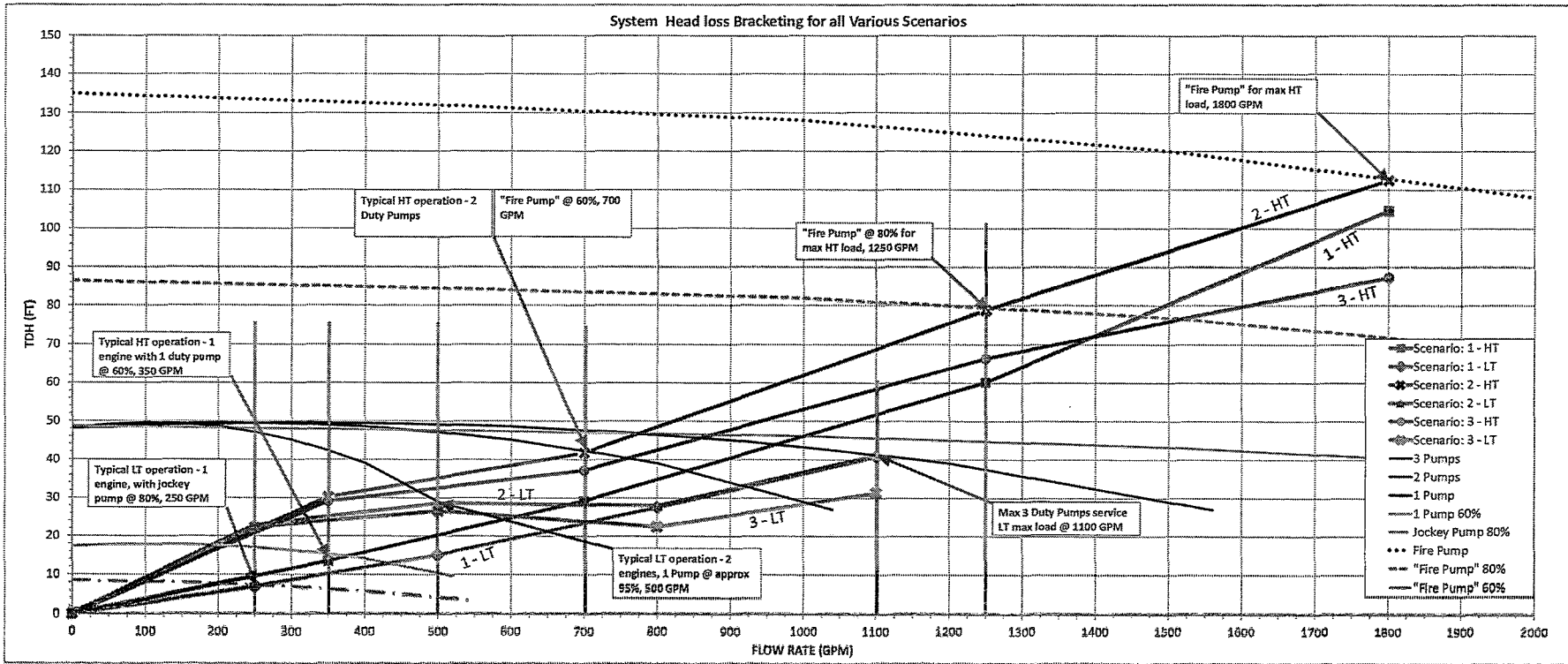
Note:
 "Fire Pump" is the emergency pump
 for Engine Running Options 4 & 5.

LT-System Curves

Q	Scenario		
	1	2	3
0	0	0	0
250	7	23	22
500	15	29	26
800	28	28	22
1100	41	41	31

HT-System Curves

Q	Scenario		
	1	2	3
0	0	0	0
350	13	30	29
700	29	42	37
1250	60	79	66
1800	105	112	87



Printed copy shall be in color to properly see the graphs.

13300 Instrumentation and Control
APPENDIX B - I/O TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION	I/O TYPE	P&ID DESCRIPTION
REAL I/O	1F-1	SI	400	A	PNL-400	MOTOR 400	(E) ENGINE ROOM	SEWAGE PUMP 400	AI	SPEED	
REAL I/O	1F-1	SI	500	A	PNL-500	MOTOR 500	(E) ENGINE ROOM	SEWAGE PUMP 500	AI	SPEED	
REAL I/O	1F-1	SC	400	A	PNL-400	MOTOR 400	(E) ENGINE ROOM	SEWAGE PUMP 400	AO	SPEED CONTROL	
REAL I/O	1F-1	SC	500	A	PNL-500	MOTOR 500	(E) ENGINE ROOM	SEWAGE PUMP 500	AO	SPEED CONTROL	
REAL I/O	1F-1	YA	400	A	PNL-400	MOTOR 400	(E) ENGINE ROOM	SEWAGE PUMP 400	DI	PUMP FAIL	
REAL I/O	1F-1	YA	400	B	FEEDER MANAGEMENT RELAY	FEEDER MANAGEMENT RELAY	SWITCHGEAR NO.2	4160VAC	DI	TROUBLE	
REAL I/O	1F-1	YA	400	C	MOTOR MANAGEMENT RELAY	MOTOR 400	PNL-400	SEWAGE PUMP 400	DI	TROUBLE	
REAL I/O	1F-1	HS	400		PNL-400	MOTOR 400	(E) ENGINE ROOM	SEWAGE PUMP 400	DI	REMOTE	
REAL I/O	1F-1	JL	400		PNL-400	MOTOR 400	(E) ENGINE ROOM	SEWAGE PUMP 400	DI	CONTROL POWER ON	
REAL I/O	1F-1	TAH	400		MOTOR MANAGEMENT RELAY	MOTOR 400	PNL-400	SEWAGE PUMP 400	DI	HIGH WINDING	
REAL I/O	1F-1	VSH	400		VIBRATION CONTROLLER	MOTOR 400	PUMP MOTOR ROOM	SEWAGE PUMP 400	DI	HIGH VIBRATION	
REAL I/O	1F-1	YL	400		PNL-400	MOTOR 400	(E) ENGINE ROOM	SEWAGE PUMP 400	DI	RUNNING	
REAL I/O	1F-1	YA	500	A	PNL-500	MOTOR 500	(E) ENGINE ROOM	SEWAGE PUMP 500	DI	PUMP FAIL	
REAL I/O	1F-1	YA	500	B	FEEDER MANAGEMENT RELAY	FEEDER MANAGEMENT RELAY	SWITCHGEAR NO.1	4160VAC	DI	TROUBLE	
REAL I/O	1F-1	YA	500	C	MOTOR MANAGEMENT RELAY	MOTOR 500	PNL-500	SEWAGE PUMP 500	DI	TROUBLE	
REAL I/O	1F-1	HS	500		PNL-500	MOTOR 500	(E) ENGINE ROOM	SEWAGE PUMP 500	DI	REMOTE	
REAL I/O	1F-1	JL	500		PNL-500	MOTOR 500	(E) ENGINE ROOM	SEWAGE PUMP 500	DI	CONTROL POWER ON	
REAL I/O	1F-1	TAH	500		MOTOR MANAGEMENT RELAY	MOTOR 500	PNL-500	SEWAGE PUMP 500	DI	HIGH WINDING	
REAL I/O	1F-1	VSH	500		VIBRATION CONTROLLER	MOTOR 500	PUMP MOTOR ROOM	SEWAGE PUMP 500	DI	HIGH VIBRATION	
REAL I/O	1F-1	YL	500		PNL-500	MOTOR 500	(E) ENGINE ROOM	SEWAGE PUMP 500	DI	RUNNING	
REAL I/O	1F-1	YA	1111	A	52 BREAKER	MOTOR 500	SWITCHGEAR NO.1	4160VAC	DI	TROUBLE ALARM	
REAL I/O	1F-1	HS	1111	C	52 BREAKER	MOTOR 500	SWITCHGEAR NO.1	4160VAC	DI	LOCAL CONTROL	
REAL I/O	1F-1	HS	1111	D	52 BREAKER	MOTOR 500	SWITCHGEAR NO.1	4160VAC	DI	DCS CONTROL	
REAL I/O	1F-1	YA	1111		52 BREAKER	MOTOR 500	SWITCHGEAR NO.1	4160VAC	DI	BREAKER TRIPPED	
REAL I/O	1F-1	ZLC	1111		52 BREAKER	MOTOR 500	SWITCHGEAR NO.1	4160VAC	DI	BREAKER CLOSED	
REAL I/O	1F-1	ZLO	1111		52 BREAKER	MOTOR 500	SWITCHGEAR NO.1	4160VAC	DI	BREAKER OPENED	
REAL I/O	1F-1	YA	2312	A	52 BREAKER	MOTOR 400	SWITCHGEAR NO.2	4160VAC	DI	TROUBLE ALARM	
REAL I/O	1F-1	HS	2312	C	52 BREAKER	MOTOR 400	SWITCHGEAR NO.2	4160VAC	DI	LOCAL CONTROL	
REAL I/O	1F-1	HS	2312	D	52 BREAKER	MOTOR 400	SWITCHGEAR NO.2	4160VAC	DI	DCS CONTROL	
REAL I/O	1F-1	YA	2312		52 BREAKER	MOTOR 400	SWITCHGEAR NO.2	4160VAC	DI	BREAKER TRIPPED	
REAL I/O	1F-1	ZLC	2312		52 BREAKER	MOTOR 400	SWITCHGEAR NO.2	4160VAC	DI	BREAKER CLOSED	
REAL I/O	1F-1	ZLO	2312		52 BREAKER	MOTOR 400	SWITCHGEAR NO.2	4160VAC	DI	BREAKER OPENED	
REAL I/O	1F-1	HS	400	A	PNL-400	MOTOR 400	(E) ENGINE ROOM	SEWAGE PUMP 400	DO	RUN	
REAL I/O	1F-1	HS	400	B	PNL-400	MOTOR 400	(E) ENGINE ROOM	SEWAGE PUMP 400	DO	RESET	
REAL I/O	1F-1	HS	500	A	PNL-500	MOTOR 500	(E) ENGINE ROOM	SEWAGE PUMP 500	DO	RUN	
REAL I/O	1F-1	HS	500	B	PNL-500	MOTOR 500	(E) ENGINE ROOM	SEWAGE PUMP 500	DO	RESET	
REAL I/O	1F-1	HS	1111	A	52 BREAKER	MOTOR 500	SWITCHGEAR NO.1	4160VAC	DO	OPEN BREAKER	
REAL I/O	1F-1	HS	1111	B	52 BREAKER	MOTOR 500	SWITCHGEAR NO.1	4160VAC	DO	CLOSE BREAKER	
REAL I/O	1F-1	HS	2312	A	52 BREAKER	MOTOR 400	SWITCHGEAR NO.2	4160VAC	DO	OPEN BREAKER	
REAL I/O	1F-1	HS	2312	B	52 BREAKER	MOTOR 400	SWITCHGEAR NO.2	4160VAC	DO	CLOSE BREAKER	
REAL I/O	2F-1	YA	610		SYNC CHECK/CLOSED TRANSITION PANEL	USS-1	(E) ELECTRICAL ROOM	SYNCH CHECK/ CLOSED TRANSITION PANEL	DI	ALARM	
REAL I/O	2F-1	YS	610		SYNC CHECK/CLOSED TRANSITION PANEL	USS-1	(E) ELECTRICAL ROOM	SYNCH CHECK/ CLOSED TRANSITION PANEL	DI	CLOSED TRANSITION FINISHED	
REAL I/O	2F-1	HS	610		SYNC CHECK/CLOSED TRANSITION PANEL	USS-1	(E) ELECTRICAL ROOM	SYNCH CHECK/ CLOSED TRANSITION PANEL	DO	INITIATE CLOSED TRANSITION	
REAL I/O	4F-1	TI	970	A	TEMPERATURE INDICATOR TRANSMITTER	WWW SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970	AI	TEMP	
REAL I/O	4F-1	TI	970	B	TEMPERATURE INDICATOR TRANSMITTER	WWW RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970	AI	TEMP	
REAL I/O	4F-1	TI	970	C	TEMPERATURE INDICATOR TRANSMITTER	LT COOLING SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970	AI	TEMP	
REAL I/O	4F-1	TI	970	D	TEMPERATURE INDICATOR TRANSMITTER	LT COOLING RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970	AI	TEMP	
REAL I/O	4F-1	TI	970	E	TEMPERATURE INDICATOR TRANSMITTER	HT COOLING SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970	AI	TEMP	
REAL I/O	4F-1	TI	970	F	TEMPERATURE INDICATOR TRANSMITTER	HT COOLING RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970	AI	TEMP	
REAL I/O	4F-1	TI	974	A	TEMPERATURE INDICATOR TRANSMITTER	WWW SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974	AI	TEMP	
REAL I/O	4F-1	TI	974	B	TEMPERATURE INDICATOR TRANSMITTER	WWW RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974	AI	TEMP	
REAL I/O	4F-1	TI	974	C	TEMPERATURE INDICATOR TRANSMITTER	LT COOLING SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974	AI	TEMP	
REAL I/O	4F-1	TI	974	D	TEMPERATURE INDICATOR TRANSMITTER	LT COOLING RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974	AI	TEMP	
REAL I/O	4F-1	TI	974	E	TEMPERATURE INDICATOR TRANSMITTER	HT COOLING SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974	AI	TEMP	
REAL I/O	4F-1	TI	974	F	TEMPERATURE INDICATOR TRANSMITTER	HT COOLING RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974	AI	TEMP	
REAL I/O	7F-1	YA	110	A	GEN-110	GEN-110	NORTH BUILDING	GEN-110	DI	COMMON SHUTDOWN ALARM	
REAL I/O	7F-1	YS	110	A	GEN-110	GEN-110	NORTH BUILDING	GEN-110	DI	GENERATOR RUNNING	
REAL I/O	7F-1	YA	110	B	GEN-110	GEN-110	NORTH BUILDING	GEN-110	DI	GENERAL ALARM	
REAL I/O	7F-1	YS	110	B	GEN-110	GEN-110	NORTH BUILDING	GEN-110	DI	GENERATOR READY	
REAL I/O	7F-1	YA	110	C	GEN-110	GEN-110	NORTH BUILDING	GEN-110	DI	EMERGENCY SHUTDOWN	
REAL I/O	7F-1	YS	110	C	GEN-110	GEN-110	NORTH BUILDING	GEN-110	DI	GENERATOR IN REMOTE	
REAL I/O	7F-1	YA	120	A	GEN-120	GEN-120	NORTH BUILDING	GEN-120	DI	COMMON SHUTDOWN ALARM	
REAL I/O	7F-1	YS	120	A	GEN-120	GEN-120	NORTH BUILDING	GEN-120	DI	GENERATOR RUNNING	
REAL I/O	7F-1	YA	120	B	GEN-120	GEN-120	NORTH BUILDING	GEN-120	DI	GENERAL ALARM	
REAL I/O	7F-1	YS	120	B	GEN-120	GEN-120	NORTH BUILDING	GEN-120	DI	GENERATOR READY	
REAL I/O	7F-1	YA	120	C	GEN-120	GEN-120	NORTH BUILDING	GEN-120	DI	EMERGENCY SHUTDOWN	
REAL I/O	7F-1	YS	120	C	GEN-120	GEN-120	NORTH BUILDING	GEN-120	DI	GENERATOR IN REMOTE	
REAL I/O	7F-1	SAH	175		SMOKE DETECTOR	NORTH BUILDING	SUPPLY DUCTS	LIFE SAFETY	DI	SUPPLY SMOKE ALARM	

13300 Instrumentation and Control
APPENDIX B - I/O TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION	I/O TYPE	P&ID DESCRIPTION
REAL I/O	7I-1	SAH	176			SMOKE DETECTOR	NORTH BUILDING	EXHAUST DUCTS	LIFE SAFETY	DI	EXHAUST SMOKE ALARM
REAL I/O	7I-1	SAH	275			SMOKE DETECTOR	NORTH BUILDING	SUPPLY DUCTS	LIFE SAFETY	DI	SUPPLY SMOKE ALARM
REAL I/O	7I-1	SAH	276			SMOKE DETECTOR	NORTH BUILDING	EXHAUST DUCTS	LIFE SAFETY	DI	EXHAUST SMOKE ALARM
REAL I/O	7I-1	YA	3110	A		GENERATOR MANAGEMENT RELAY	GEN-110	SWITCHGEAR NO.3	4160VAC	DI	HIGH WINDING TEMP ALARM
REAL I/O	7I-1	YA	3110	A		52 BREAKER	GEN-110	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	7I-1	YA	3110	B		FEEDER MANAGEMENT RELAY	GEN-110	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	7I-1	YA	3110	B		GENERATOR MANAGEMENT RELAY	GEN-110	SWITCHGEAR NO.3	4160VAC	DI	HIGH BEARING TEMP ALARM
REAL I/O	7I-1	HS	3110	C		52 BREAKER	GEN-110	SWITCHGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	7I-1	YA	3110	C		GENERATOR MANAGEMENT RELAY	GEN-110	SWITCHGEAR NO.3	4160VAC	DI	HIGH VIBRATION ALARM
REAL I/O	7I-1	HS	3110	D		52 BREAKER	GEN-110	SWITCHGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	7I-1	YA	3110	D		GENERATOR MANAGEMENT RELAY	GEN-110	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	7I-1	YA	3110			52 BREAKER	GEN-110	SWITCHGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	7I-1	ZLC	3110			52 BREAKER	GEN-110	SWITCHGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	7I-1	ZLO	3110			52 BREAKER	GEN-110	SWITCHGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	7I-1	YA	3210	A		GENERATOR MANAGEMENT RELAY	GEN-210	SWITCHGEAR NO.3	4160VAC	DI	HIGH WINDING TEMP ALARM
REAL I/O	7I-1	YA	3210	A		52 BREAKER	GEN-210	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	7I-1	YA	3210	B		FEEDER MANAGEMENT RELAY	GEN-210	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	7I-1	YA	3210	B		GENERATOR MANAGEMENT RELAY	GEN-210	SWITCHGEAR NO.3	4160VAC	DI	HIGH BEARING TEMP ALARM
REAL I/O	7I-1	HS	3210	C		52 BREAKER	GEN-210	SWITCHGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	7I-1	YA	3210	C		GENERATOR MANAGEMENT RELAY	GEN-210	SWITCHGEAR NO.3	4160VAC	DI	HIGH VIBRATION ALARM
REAL I/O	7I-1	HS	3210	D		52 BREAKER	GEN-210	SWITCHGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	7I-1	YA	3210	D		GENERATOR MANAGEMENT RELAY	GEN-210	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	7I-1	YA	3210			52 BREAKER	GEN-210	SWITCHGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	7I-1	ZLC	3210			52 BREAKER	GEN-210	SWITCHGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	7I-1	ZLO	3210			52 BREAKER	GEN-210	SWITCHGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	7I-1	HS	110	A		GEN-110	GEN-110	NORTH BUILDING	GEN-110	DO	EMERGENCY SHUTDOWN
REAL I/O	7I-1	HS	110	B		GEN-110	GEN-110	NORTH BUILDING	GEN-110	DO	RESET
REAL I/O	7I-1	HS	110			GEN-110	GEN-110	NORTH BUILDING	GEN-110	DO	COMMON START
REAL I/O	7I-1	HS	120	A		GEN-120	GEN-120	NORTH BUILDING	GEN-120	DO	EMERGENCY SHUTDOWN
REAL I/O	7I-1	HS	120	B		GEN-120	GEN-120	NORTH BUILDING	GEN-120	DO	RESET
REAL I/O	7I-1	HS	120			GEN-120	GEN-120	NORTH BUILDING	GEN-120	DO	COMMON START
REAL I/O	7I-1	HS	3110	A		52 BREAKER	GEN-110	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-1	HS	3110	B		52 BREAKER	GEN-110	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-1	HS	3210	A		52 BREAKER	GEN-210	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-1	HS	3210	B		52 BREAKER	GEN-210	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-2	PI	100	A		TEMP CORRECTED TOTALIZING METER	GEN-110	NORTH BUILDING	NAT GAS	AI	GAS FLOW
REAL I/O	7I-2	PI	100	B		TEMP CORRECTED TOTALIZING METER	GEN-210	SOUTH BUILDING	NAT GAS	AI	GAS FLOW
REAL I/O	7I-2	PI	100			PRESSURE TRANSMITTER	POWER GENERATION FACILITY	NORTH BUILDING	NAT GAS	AI	PRESSURE
REAL I/O	7I-3	YA	210	A		GEN-210	GEN-210	SOUTH BUILDING	GEN-210	DI	COMMON SHUTDOWN ALARM
REAL I/O	7I-3	YS	210	A		GEN-210	GEN-210	SOUTH BUILDING	GEN-210	DI	GENERATOR RUNNING
REAL I/O	7I-3	YA	210	B		GEN-210	GEN-210	SOUTH BUILDING	GEN-210	DI	GENERAL ALARM
REAL I/O	7I-3	YS	210	B		GEN-210	GEN-210	SOUTH BUILDING	GEN-210	DI	GENERATOR READY
REAL I/O	7I-3	YA	210	C		GEN-210	GEN-210	SOUTH BUILDING	GEN-210	DI	EMERGENCY SHUTDOWN
REAL I/O	7I-3	YS	210	C		GEN-210	GEN-210	SOUTH BUILDING	GEN-210	DI	GENERATOR IN REMOTE
REAL I/O	7I-3	YA	220	A		GEN-220	GEN-220	SOUTH BUILDING	GEN-220	DI	COMMON SHUTDOWN ALARM
REAL I/O	7I-3	YS	220	A		GEN-220	GEN-220	SOUTH BUILDING	GEN-220	DI	GENERATOR RUNNING
REAL I/O	7I-3	YA	220	B		GEN-220	GEN-220	SOUTH BUILDING	GEN-220	DI	GENERAL ALARM
REAL I/O	7I-3	YS	220	B		GEN-220	GEN-220	SOUTH BUILDING	GEN-220	DI	GENERATOR READY
REAL I/O	7I-3	YA	220	C		GEN-220	GEN-220	SOUTH BUILDING	GEN-220	DI	EMERGENCY SHUTDOWN
REAL I/O	7I-3	YS	220	C		GEN-220	GEN-220	SOUTH BUILDING	GEN-220	DI	GENERATOR IN REMOTE
REAL I/O	7I-3	YA	3120	A		GENERATOR MANAGEMENT RELAY	GEN-120	SWITCHGEAR NO.3	4160VAC	DI	HIGH WINDING TEMP ALARM
REAL I/O	7I-3	YA	3120	A		52 BREAKER	GEN-120	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	7I-3	YA	3120	B		FEEDER MANAGEMENT RELAY	GEN-120	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	7I-3	YA	3120	B		GENERATOR MANAGEMENT RELAY	GEN-120	SWITCHGEAR NO.3	4160VAC	DI	HIGH BEARING TEMP ALARM
REAL I/O	7I-3	HS	3120	C		52 BREAKER	GEN-120	SWITCHGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	7I-3	YA	3120	C		GENERATOR MANAGEMENT RELAY	GEN-120	SWITCHGEAR NO.3	4160VAC	DI	HIGH VIBRATION ALARM
REAL I/O	7I-3	HS	3120	D		52 BREAKER	GEN-120	SWITCHGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	7I-3	YA	3120	D		GENERATOR MANAGEMENT RELAY	GEN-120	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	7I-3	YA	3120			52 BREAKER	GEN-120	SWITCHGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	7I-3	ZLC	3120			52 BREAKER	GEN-120	SWITCHGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	7I-3	ZLO	3120			52 BREAKER	GEN-120	SWITCHGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	7I-3	YA	3220	A		GENERATOR MANAGEMENT RELAY	GEN-220	SWITCHGEAR NO.3	4160VAC	DI	HIGH WINDING TEMP ALARM
REAL I/O	7I-3	YA	3220	A		52 BREAKER	GEN-220	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	7I-3	YA	3220	B		FEEDER MANAGEMENT RELAY	GEN-220	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	7I-3	YA	3220	B		GENERATOR MANAGEMENT RELAY	GEN-220	SWITCHGEAR NO.3	4160VAC	DI	HIGH BEARING TEMP ALARM
REAL I/O	7I-3	HS	3220	C		52 BREAKER	GEN-220	SWITCHGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	7I-3	YA	3220	C		GENERATOR MANAGEMENT RELAY	GEN-220	SWITCHGEAR NO.3	4160VAC	DI	HIGH VIBRATION ALARM
REAL I/O	7I-3	HS	3220	D		52 BREAKER	GEN-220	SWITCHGEAR NO.3	4160VAC	DI	DCS CONTROL

13300 Instrumentation and Control
APPENDIX B - I/O TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION	I/O TYPE	P&ID DESCRIPTION
REAL I/O	7I-3	YA	3220	D		GENERATOR MANAGEMENT RELAY	GEN-220	SWITCHGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	7I-3	YA	3220			52 BREAKER	GEN-220	SWITCHGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	7I-3	ZLC	3220			52 BREAKER	GEN-220	SWITCHGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	7I-3	ZLO	3220			52 BREAKER	GEN-220	SWITCHGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	7I-3	HS	210	A		GEN-210	GEN-210	SOUTH BUILDING	GEN-210	DO	EMERGENCY SHUTDOWN
REAL I/O	7I-3	HS	210	B		GEN-210	GEN-210	SOUTH BUILDING	GEN-210	DO	RESET
REAL I/O	7I-3	HS	210			GEN-210	GEN-210	SOUTH BUILDING	GEN-210	DO	COMMON START
REAL I/O	7I-3	HS	220	A		GEN-220	GEN-220	SOUTH BUILDING	GEN-220	DO	EMERGENCY SHUTDOWN
REAL I/O	7I-3	HS	220	B		GEN-220	GEN-220	SOUTH BUILDING	GEN-220	DO	RESET
REAL I/O	7I-3	HS	220			GEN-220	GEN-220	SOUTH BUILDING	GEN-220	DO	COMMON START
REAL I/O	7I-3	HS	3120	A		52 BREAKER	GEN-120	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-3	HS	3120	B		52 BREAKER	GEN-120	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-3	HS	3220	A		52 BREAKER	GEN-220	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-3	HS	3220	B		52 BREAKER	GEN-220	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-4	LI	310			LEVEL	DIESEL FUEL	PNL-310	FUEL / OIL STORAGE AREA	AI	TANK LEVEL
REAL I/O	7I-4	LAHH	300			FLOAT SWITCH	DIESEL FUEL	SUMP	FUEL / OIL STORAGE AREA	DI	FUEL/OIL LEAK
REAL I/O	7I-4	LAHH	310	A		LEVEL ALARM	DIESEL FUEL	PNL-310	FUEL / OIL STORAGE AREA	DI	FUEL LEAK
REAL I/O	7I-4	LAHH	310			LEVEL ALARM	DIESEL FUEL	PNL-310	FUEL / OIL STORAGE AREA	DI	HIGH FUEL LEVEL
REAL I/O	7I-4	YL	311	A		FUEL POLISHING SYSTEM	FUEL POLISHING SYSTEM	PNL-311	FUEL POLISHING SYSTEM	DI	READY
REAL I/O	7I-4	YA	311			FUEL POLISHING SYSTEM	FUEL POLISHING SYSTEM	PNL-311	FUEL POLISHING SYSTEM	DI	TROUBLE
REAL I/O	7I-4	YL	311			FUEL POLISHING SYSTEM	FUEL POLISHING SYSTEM	PNL-311	FUEL POLISHING SYSTEM	DI	RUNNING
REAL I/O	7I-5	LAH	312	A		DIESEL DAY TANK	NORTH BUILDING	PNL-312	DIESEL FUEL	DI	FUEL LEAK
REAL I/O	7I-5	HS	312			DIESEL DAY TANK	NORTH BUILDING	PNL-312	DIESEL FUEL	DI	AUTO
REAL I/O	7I-5	LAH	312			DIESEL DAY TANK	NORTH BUILDING	PNL-312	DIESEL FUEL	DI	HIGH LEVEL
REAL I/O	7I-5	LAL	312			DIESEL DAY TANK	NORTH BUILDING	PNL-312	DIESEL FUEL	DI	LOW LEVEL
REAL I/O	7I-5	LALL	312			DIESEL DAY TANK	NORTH BUILDING	PNL-312	DIESEL FUEL	DI	LOW-LOW LEVEL
REAL I/O	7I-5	YA	312			DIESEL DAY TANK	NORTH BUILDING	PNL-312	DIESEL FUEL	DI	PUMP FAIL
REAL I/O	7I-5	YL	312			DIESEL DAY TANK	NORTH BUILDING	PNL-312	DIESEL FUEL	DI	CALL SUPPLY PUMP
REAL I/O	7I-5	LAH	314	A		DIESEL DAY TANK	NORTH BUILDING	PNL-314	DIESEL FUEL	DI	FUEL LEAK
REAL I/O	7I-5	HS	314			DIESEL DAY TANK	NORTH BUILDING	PNL-314	DIESEL FUEL	DI	AUTO
REAL I/O	7I-5	LAH	314			DIESEL DAY TANK	NORTH BUILDING	PNL-314	DIESEL FUEL	DI	HIGH LEVEL
REAL I/O	7I-5	LAL	314			DIESEL DAY TANK	NORTH BUILDING	PNL-314	DIESEL FUEL	DI	LOW LEVEL
REAL I/O	7I-5	LALL	314			DIESEL DAY TANK	NORTH BUILDING	PNL-314	DIESEL FUEL	DI	LOW-LOW LEVEL
REAL I/O	7I-5	YA	314			DIESEL DAY TANK	NORTH BUILDING	PNL-314	DIESEL FUEL	DI	PUMP FAIL
REAL I/O	7I-5	YL	314			DIESEL DAY TANK	NORTH BUILDING	PNL-314	DIESEL FUEL	DI	CALL SUPPLY PUMP
REAL I/O	7I-6	PALL	140	A		COMPRESSED AIR	PNL-140	NORTH BUILDING	COMPRESSED AIR	DI	LOW-LOW PRESSURE
REAL I/O	7I-6	YA	140			COMPRESSED AIR	PNL-140	NORTH BUILDING	COMPRESSED AIR	DI	TROUBLE
REAL I/O	7I-6	PALL	240	A		COMPRESSED AIR	PNL-240	SOUTH BUILDING	COMPRESSED AIR	DI	LOW-LOW PRESSURE
REAL I/O	7I-6	YA	240			COMPRESSED AIR	PNL-240	SOUTH BUILDING	COMPRESSED AIR	DI	TROUBLE
REAL I/O	7I-7	LI	160			LEVEL TRANSMITTER	UREA TANK	NORTH BUILDING	UREA	AI	LEVEL
REAL I/O	7I-7	LI	260			LEVEL TRANSMITTER	UREA TANK	SOUTH BUILDING	UREA	AI	LEVEL
REAL I/O	7I-8	PIT	111	A		DIFFERENTIAL PRESSURE TRANSMITTER	NORTH BUILDING IAT VS OAT	ROOF	SUPPLY FAN NO.1	AI	DIFF PRESS
REAL I/O	7I-8	TT	111	A		TEMPERATURE TRANSMITTER	OAT	ROOF	SUPPLY FAN NO.1	AI	TEMP
REAL I/O	7I-8	PIT	111	B		DIFFERENTIAL PRESSURE TRANSMITTER	FILTER	ROOF	AHU-111	AI	DIFF PRESS
REAL I/O	7I-8	TT	111	B		TEMPERATURE TRANSMITTER	NORTH BUILDING IAT	ROOF	SUPPLY FAN NO.1	AI	TEMP
REAL I/O	7I-8	PIT	111	C		DIFFERENTIAL PRESSURE TRANSMITTER	FILTER	ROOF	AHU-111	AI	DIFF PRESS
REAL I/O	7I-8	PIT	121	A		DIFFERENTIAL PRESSURE TRANSMITTER	NORTH BUILDING IAT VS OAT	ROOF	SUPPLY FAN NO.1	AI	DIFF PRESS
REAL I/O	7I-8	PIT	121	B		DIFFERENTIAL PRESSURE TRANSMITTER	FILTER	ROOF	AHU-121	AI	DIFF PRESS
REAL I/O	7I-8	TT	121	B		TEMPERATURE TRANSMITTER	NORTH BUILDING IAT	ROOF	SUPPLY FAN NO.1	AI	TEMP
REAL I/O	7I-8	PIT	121	C		DIFFERENTIAL PRESSURE TRANSMITTER	FILTER	ROOF	AHU-121	AI	DIFF PRESS
REAL I/O	7I-8	PIT	211	A		DIFFERENTIAL PRESSURE TRANSMITTER	SOUTH BUILDING IAT VS OAT	ROOF	SUPPLY FAN NO.1	AI	DIFF PRESS
REAL I/O	7I-8	PIT	211	B		DIFFERENTIAL PRESSURE TRANSMITTER	FILTER	ROOF	AHU-211	AI	DIFF PRESS
REAL I/O	7I-8	TT	211	B		TEMPERATURE TRANSMITTER	SOUTH BUILDING IAT	ROOF	SUPPLY FAN NO.1	AI	TEMP
REAL I/O	7I-8	PIT	211	C		DIFFERENTIAL PRESSURE TRANSMITTER	FILTER	ROOF	AHU-211	AI	DIFF PRESS
REAL I/O	7I-8	SC	111			SUPPLY FAN NO.1	AHU-111	ROOF	SUPPLY FAN NO.1	AO	SPEED CONTROL
REAL I/O	7I-8	SC	112			SUPPLY FAN NO.2	AHU-111	ROOF	SUPPLY FAN NO.2	AO	SPEED CONTROL
REAL I/O	7I-8	SC	113			SUPPLY FAN NO.3	AHU-111	ROOF	SUPPLY FAN NO.3	AO	SPEED CONTROL
REAL I/O	7I-8	SC	114			SUPPLY FAN NO.4	AHU-111	ROOF	SUPPLY FAN NO.4	AO	SPEED CONTROL
REAL I/O	7I-8	SC	121			SUPPLY FAN NO.1	AHU-121	ROOF	SUPPLY FAN NO.1	AO	SPEED CONTROL
REAL I/O	7I-8	SC	122			SUPPLY FAN NO.2	AHU-121	ROOF	SUPPLY FAN NO.2	AO	SPEED CONTROL
REAL I/O	7I-8	SC	123			SUPPLY FAN NO.3	AHU-121	ROOF	SUPPLY FAN NO.3	AO	SPEED CONTROL
REAL I/O	7I-8	SC	211			SUPPLY FAN NO.1	AHU-211	ROOF	SUPPLY FAN NO.1	AO	SPEED CONTROL
REAL I/O	7I-8	SC	212			SUPPLY FAN NO.2	AHU-211	ROOF	SUPPLY FAN NO.2	AO	SPEED CONTROL

13300 Instrumentation and Control
APPENDIX B - I/O TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION	I/O TYPE	P&ID DESCRIPTION
REAL I/O	7I-8	SC	213			SUPPLY FAN NO.3	AHU-211	ROOF	SUPPLY FAN NO.3	AO	SPEED CONTROL
REAL I/O	7I-8	SC	214			SUPPLY FAN NO.4	AHU-211	ROOF	SUPPLY FAN NO.4	AO	SPEED CONTROL
REAL I/O	7I-8	SC	221			SUPPLY FAN NO.1	AHU-221	ROOF	AHU-221	AO	SPEED CONTROL
REAL I/O	7I-8	SC	222			SUPPLY FAN NO.2	AHU-221	ROOF	SUPPLY FAN NO.2	AO	SPEED CONTROL
REAL I/O	7I-8	SC	223			SUPPLY FAN NO.3	AHU-221	ROOF	SUPPLY FAN NO.3	AO	SPEED CONTROL
REAL I/O	7I-8	HS	111			SUPPLY FAN NO.1	AHU-111	ROOF	SUPPLY FAN NO.1	DI	REMOTE
REAL I/O	7I-8	YA	111			SUPPLY FAN NO.1	AHU-111	ROOF	SUPPLY FAN NO.1	DI	VFD FAIL
REAL I/O	7I-8	ZC	111			SUPPLY FAN NO.1	AHU-111	ROOF	SUPPLY FAN NO.1	DI	DC CLOSED
REAL I/O	7I-8	HS	112			SUPPLY FAN NO.2	AHU-111	ROOF	SUPPLY FAN NO.2	DI	REMOTE
REAL I/O	7I-8	YA	112			SUPPLY FAN NO.2	AHU-111	ROOF	SUPPLY FAN NO.2	DI	VFD FAIL
REAL I/O	7I-8	ZC	112			SUPPLY FAN NO.2	AHU-111	ROOF	SUPPLY FAN NO.2	DI	DC CLOSED
REAL I/O	7I-8	HS	113			SUPPLY FAN NO.3	AHU-111	ROOF	SUPPLY FAN NO.3	DI	REMOTE
REAL I/O	7I-8	YA	113			SUPPLY FAN NO.3	AHU-111	ROOF	SUPPLY FAN NO.3	DI	VFD FAIL
REAL I/O	7I-8	ZC	113			SUPPLY FAN NO.3	AHU-111	ROOF	SUPPLY FAN NO.3	DI	DC CLOSED
REAL I/O	7I-8	HS	114			SUPPLY FAN NO.4	AHU-111	ROOF	SUPPLY FAN NO.4	DI	REMOTE
REAL I/O	7I-8	YA	114			SUPPLY FAN NO.4	AHU-111	ROOF	SUPPLY FAN NO.4	DI	VFD FAIL
REAL I/O	7I-8	ZC	114			SUPPLY FAN NO.4	AHU-111	ROOF	SUPPLY FAN NO.4	DI	DC CLOSED
REAL I/O	7I-8	HS	121			SUPPLY FAN NO.1	AHU-121	ROOF	SUPPLY FAN NO.1	DI	REMOTE
REAL I/O	7I-8	YA	121			SUPPLY FAN NO.1	AHU-121	ROOF	SUPPLY FAN NO.1	DI	VFD FAIL
REAL I/O	7I-8	ZC	121			SUPPLY FAN NO.1	AHU-121	ROOF	SUPPLY FAN NO.1	DI	DC CLOSED
REAL I/O	7I-8	HS	122			SUPPLY FAN NO.2	AHU-121	ROOF	SUPPLY FAN NO.2	DI	REMOTE
REAL I/O	7I-8	YA	122			SUPPLY FAN NO.2	AHU-121	ROOF	SUPPLY FAN NO.2	DI	VFD FAIL
REAL I/O	7I-8	ZC	122			SUPPLY FAN NO.2	AHU-121	ROOF	SUPPLY FAN NO.2	DI	DC CLOSED
REAL I/O	7I-8	HS	123			SUPPLY FAN NO.3	AHU-121	ROOF	SUPPLY FAN NO.3	DI	REMOTE
REAL I/O	7I-8	YA	123			SUPPLY FAN NO.3	AHU-121	ROOF	SUPPLY FAN NO.3	DI	VFD FAIL
REAL I/O	7I-8	ZC	123			SUPPLY FAN NO.3	AHU-121	ROOF	SUPPLY FAN NO.3	DI	DC CLOSED
REAL I/O	7I-8	HS	211			SUPPLY FAN NO.1	AHU-211	ROOF	SUPPLY FAN NO.1	DI	REMOTE
REAL I/O	7I-8	YA	211			SUPPLY FAN NO.1	AHU-211	ROOF	SUPPLY FAN NO.1	DI	VFD FAIL
REAL I/O	7I-8	ZC	211			SUPPLY FAN NO.1	AHU-211	ROOF	SUPPLY FAN NO.1	DI	DC CLOSED
REAL I/O	7I-8	HS	212			SUPPLY FAN NO.2	AHU-211	ROOF	SUPPLY FAN NO.2	DI	REMOTE
REAL I/O	7I-8	YA	212			SUPPLY FAN NO.2	AHU-211	ROOF	SUPPLY FAN NO.2	DI	VFD FAIL
REAL I/O	7I-8	ZC	212			SUPPLY FAN NO.2	AHU-211	ROOF	SUPPLY FAN NO.2	DI	DC CLOSED
REAL I/O	7I-8	HS	213			SUPPLY FAN NO.3	AHU-211	ROOF	SUPPLY FAN NO.3	DI	REMOTE
REAL I/O	7I-8	YA	213			SUPPLY FAN NO.3	AHU-211	ROOF	SUPPLY FAN NO.3	DI	VFD FAIL
REAL I/O	7I-8	ZC	213			SUPPLY FAN NO.3	AHU-211	ROOF	SUPPLY FAN NO.3	DI	DC CLOSED
REAL I/O	7I-8	HS	214			SUPPLY FAN NO.4	AHU-211	ROOF	SUPPLY FAN NO.4	DI	REMOTE
REAL I/O	7I-8	YA	214			SUPPLY FAN NO.4	AHU-211	ROOF	SUPPLY FAN NO.4	DI	VFD FAIL
REAL I/O	7I-8	ZC	214			SUPPLY FAN NO.4	AHU-211	ROOF	SUPPLY FAN NO.4	DI	DC CLOSED
REAL I/O	7I-8	HS	221			SUPPLY FAN NO.1	AHU-221	ROOF	SUPPLY FAN NO.1	DI	REMOTE
REAL I/O	7I-8	YA	221			SUPPLY FAN NO.1	AHU-221	ROOF	SUPPLY FAN NO.1	DI	VFD FAIL
REAL I/O	7I-8	ZC	221			SUPPLY FAN NO.1	AHU-221	ROOF	SUPPLY FAN NO.1	DI	DC CLOSED
REAL I/O	7I-8	HS	222			SUPPLY FAN NO.2	AHU-221	ROOF	SUPPLY FAN NO.2	DI	REMOTE
REAL I/O	7I-8	YA	222			SUPPLY FAN NO.2	AHU-221	ROOF	SUPPLY FAN NO.2	DI	VFD FAIL
REAL I/O	7I-8	ZC	222			SUPPLY FAN NO.2	AHU-221	ROOF	SUPPLY FAN NO.2	DI	DC CLOSED
REAL I/O	7I-8	HS	223			SUPPLY FAN NO.3	AHU-221	ROOF	SUPPLY FAN NO.3	DI	REMOTE
REAL I/O	7I-8	YA	223			SUPPLY FAN NO.3	AHU-221	ROOF	SUPPLY FAN NO.3	DI	VFD FAIL
REAL I/O	7I-8	ZC	223			SUPPLY FAN NO.3	AHU-221	ROOF	SUPPLY FAN NO.3	DI	DC CLOSED
REAL I/O	7I-8	HS	111			SUPPLY FAN NO.1	AHU-111	ROOF	SUPPLY FAN NO.1	DO	RUN
REAL I/O	7I-8	HS	112			SUPPLY FAN NO.2	AHU-111	ROOF	SUPPLY FAN NO.2	DO	RUN
REAL I/O	7I-8	HS	113			SUPPLY FAN NO.3	AHU-111	ROOF	SUPPLY FAN NO.3	DO	RUN
REAL I/O	7I-8	HS	114			SUPPLY FAN NO.4	AHU-111	ROOF	SUPPLY FAN NO.4	DO	RUN
REAL I/O	7I-8	HS	121			SUPPLY FAN NO.1	AHU-121	ROOF	SUPPLY FAN NO.1	DO	RUN
REAL I/O	7I-8	HS	122			SUPPLY FAN NO.2	AHU-121	ROOF	SUPPLY FAN NO.2	DO	RUN
REAL I/O	7I-8	HS	123			SUPPLY FAN NO.3	AHU-121	ROOF	SUPPLY FAN NO.3	DO	RUN
REAL I/O	7I-8	HS	211			SUPPLY FAN NO.1	AHU-211	ROOF	SUPPLY FAN NO.1	DO	RUN
REAL I/O	7I-8	HS	212			SUPPLY FAN NO.2	AHU-211	ROOF	SUPPLY FAN NO.2	DO	RUN
REAL I/O	7I-8	HS	213			SUPPLY FAN NO.3	AHU-211	ROOF	SUPPLY FAN NO.3	DO	RUN
REAL I/O	7I-8	HS	214			SUPPLY FAN NO.4	AHU-211	ROOF	SUPPLY FAN NO.4	DO	RUN
REAL I/O	7I-8	HS	221			SUPPLY FAN NO.1	AHU-221	ROOF	SUPPLY FAN NO.1	DO	RUN
REAL I/O	7I-8	HS	222			SUPPLY FAN NO.2	AHU-221	ROOF	SUPPLY FAN NO.2	DO	RUN
REAL I/O	7I-8	HS	223			SUPPLY FAN NO.3	AHU-221	ROOF	SUPPLY FAN NO.3	DO	RUN
REAL I/O	7I-9	TI	115	A		TEMPERATURE TRANSMITTER	HEX-115	ROOF	AHU-115	AI	TEMP
REAL I/O	7I-9	TI	115	B		TEMPERATURE TRANSMITTER	HEX-115	ROOF	AHU-115	AI	TEMP
REAL I/O	7I-9	TI	115	C		TEMPERATURE TRANSMITTER	HEX-115A	ROOF	AHU-115	AI	TEMP
REAL I/O	7I-9	TI	115	D		TEMPERATURE TRANSMITTER	HEX-115A	ROOF	AHU-115	AI	TEMP
REAL I/O	7I-9	TI	125	A		TEMPERATURE TRANSMITTER	HEX-125	ROOF	AHU-125	AI	TEMP
REAL I/O	7I-9	TI	125	B		TEMPERATURE TRANSMITTER	HEX-125	ROOF	AHU-125	AI	TEMP
REAL I/O	7I-9	TI	125	C		TEMPERATURE TRANSMITTER	HEX-125A	ROOF	AHU-125	AI	TEMP

13300 Instrumentation and Control
APPENDIX B - I/O TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION	I/O TYPE	P&ID DESCRIPTION
REAL I/O	7I-9	TI	-125	D		TEMPERATURE TRANSMITTER	HEX-125A	ROOF	AHU-125	AI	TEMP
REAL I/O	7I-9	TI	-215	A		TEMPERATURE TRANSMITTER	HEX-215	ROOF	AHU-215	AI	TEMP
REAL I/O	7I-9	TI	-215	B		TEMPERATURE TRANSMITTER	HEX-215	ROOF	AHU-215	AI	TEMP
REAL I/O	7I-9	TI	-215	C		TEMPERATURE TRANSMITTER	HEX-215A	ROOF	AHU-215	AI	TEMP
REAL I/O	7I-9	TI	-215	D		TEMPERATURE TRANSMITTER	HEX-215A	ROOF	AHU-215	AI	TEMP
REAL I/O	7I-9	TI	-225	A		TEMPERATURE TRANSMITTER	HEX-225	ROOF	AHU-225	AI	TEMP
REAL I/O	7I-9	TI	-225	B		TEMPERATURE TRANSMITTER	HEX-225	ROOF	AHU-225	AI	TEMP
REAL I/O	7I-9	TI	-225	C		TEMPERATURE TRANSMITTER	HEX-225A	ROOF	AHU-225	AI	TEMP
REAL I/O	7I-9	TI	-225	D		TEMPERATURE TRANSMITTER	HEX-225A	ROOF	AHU-225	AI	TEMP
REAL I/O	7I-9	SC	-115			EXHAUST FAN NO.5	AHU-115	ROOF	EXHAUST FAN NO.5	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-116			EXHAUST FAN NO.6	AHU-115	ROOF	EXHAUST FAN NO.6	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-117			EXHAUST FAN NO.7	AHU-115	ROOF	EXHAUST FAN NO.7	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-118			EXHAUST FAN NO.8	AHU-115	ROOF	EXHAUST FAN NO.8	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-125			EXHAUST FAN NO.5	AHU-125	ROOF	EXHAUST FAN NO.5	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-126			EXHAUST FAN NO.6	AHU-125	ROOF	EXHAUST FAN NO.6	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-127			EXHAUST FAN NO.7	AHU-125	ROOF	EXHAUST FAN NO.7	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-215			EXHAUST FAN NO.5	AHU-215	ROOF	EXHAUST FAN NO.5	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-216			EXHAUST FAN NO.6	AHU-215	ROOF	EXHAUST FAN NO.6	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-217			EXHAUST FAN NO.7	AHU-215	ROOF	EXHAUST FAN NO.7	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-218			EXHAUST FAN NO.8	AHU-215	ROOF	EXHAUST FAN NO.8	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-225			EXHAUST FAN NO.5	AHU-225	ROOF	EXHAUST FAN NO.5	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-226			EXHAUST FAN NO.6	AHU-225	ROOF	EXHAUST FAN NO.6	AO	SPEED CONTROL
REAL I/O	7I-9	SC	-227			EXHAUST FAN NO.7	AHU-225	ROOF	EXHAUST FAN NO.7	AO	SPEED CONTROL
REAL I/O	7I-9	HS	-115			EXHAUST FAN NO.5	AHU-115	ROOF	EXHAUST FAN NO.5	DI	REMOTE
REAL I/O	7I-9	YA	-115			EXHAUST FAN NO.5	AHU-115	ROOF	EXHAUST FAN NO.5	DI	VFD FAIL
REAL I/O	7I-9	ZC	-115			EXHAUST FAN NO.5	AHU-115	ROOF	EXHAUST FAN NO.5	DI	DC CLOSED
REAL I/O	7I-9	HS	-116			EXHAUST FAN NO.6	AHU-115	ROOF	EXHAUST FAN NO.6	DI	REMOTE
REAL I/O	7I-9	YA	-116			EXHAUST FAN NO.6	AHU-115	ROOF	EXHAUST FAN NO.6	DI	VFD FAIL
REAL I/O	7I-9	ZC	-116			EXHAUST FAN NO.6	AHU-115	ROOF	EXHAUST FAN NO.6	DI	DC CLOSED
REAL I/O	7I-9	HS	-117			EXHAUST FAN NO.7	AHU-115	ROOF	EXHAUST FAN NO.7	DI	REMOTE
REAL I/O	7I-9	YA	-117			EXHAUST FAN NO.7	AHU-115	ROOF	EXHAUST FAN NO.7	DI	VFD FAIL
REAL I/O	7I-9	ZC	-117			EXHAUST FAN NO.7	AHU-115	ROOF	EXHAUST FAN NO.7	DI	DC CLOSED
REAL I/O	7I-9	HS	-118			EXHAUST FAN NO.8	AHU-115	ROOF	EXHAUST FAN NO.8	DI	REMOTE
REAL I/O	7I-9	YA	-118			EXHAUST FAN NO.8	AHU-115	ROOF	EXHAUST FAN NO.8	DI	VFD FAIL
REAL I/O	7I-9	ZC	-118			EXHAUST FAN NO.8	AHU-115	ROOF	EXHAUST FAN NO.8	DI	DC CLOSED
REAL I/O	7I-9	HS	-125			EXHAUST FAN NO.5	AHU-125	ROOF	EXHAUST FAN NO.5	DI	REMOTE
REAL I/O	7I-9	YA	-125			EXHAUST FAN NO.5	AHU-125	ROOF	EXHAUST FAN NO.5	DI	VFD FAIL
REAL I/O	7I-9	ZC	-125			EXHAUST FAN NO.5	AHU-125	ROOF	EXHAUST FAN NO.5	DI	DC CLOSED
REAL I/O	7I-9	HS	-126			EXHAUST FAN NO.6	AHU-125	ROOF	EXHAUST FAN NO.6	DI	REMOTE
REAL I/O	7I-9	YA	-126			EXHAUST FAN NO.6	AHU-125	ROOF	EXHAUST FAN NO.6	DI	VFD FAIL
REAL I/O	7I-9	ZC	-126			EXHAUST FAN NO.6	AHU-125	ROOF	EXHAUST FAN NO.6	DI	DC CLOSED
REAL I/O	7I-9	HS	-127			EXHAUST FAN NO.7	AHU-125	ROOF	EXHAUST FAN NO.7	DI	REMOTE
REAL I/O	7I-9	YA	-127			EXHAUST FAN NO.7	AHU-125	ROOF	EXHAUST FAN NO.7	DI	VFD FAIL
REAL I/O	7I-9	ZC	-127			EXHAUST FAN NO.7	AHU-125	ROOF	EXHAUST FAN NO.7	DI	DC CLOSED
REAL I/O	7I-9	HS	-215			EXHAUST FAN NO.5	AHU-215	ROOF	EXHAUST FAN NO.5	DI	REMOTE
REAL I/O	7I-9	YA	-215			EXHAUST FAN NO.5	AHU-215	ROOF	EXHAUST FAN NO.5	DI	VFD FAIL
REAL I/O	7I-9	ZC	-215			EXHAUST FAN NO.5	AHU-215	ROOF	EXHAUST FAN NO.5	DI	DC CLOSED
REAL I/O	7I-9	HS	-216			EXHAUST FAN NO.6	AHU-215	ROOF	EXHAUST FAN NO.6	DI	REMOTE
REAL I/O	7I-9	YA	-216			EXHAUST FAN NO.6	AHU-215	ROOF	EXHAUST FAN NO.6	DI	VFD FAIL
REAL I/O	7I-9	ZC	-216			EXHAUST FAN NO.6	AHU-215	ROOF	EXHAUST FAN NO.6	DI	DC CLOSED
REAL I/O	7I-9	HS	-217			EXHAUST FAN NO.7	AHU-215	ROOF	EXHAUST FAN NO.7	DI	REMOTE
REAL I/O	7I-9	YA	-217			EXHAUST FAN NO.7	AHU-215	ROOF	EXHAUST FAN NO.7	DI	VFD FAIL
REAL I/O	7I-9	ZC	-217			EXHAUST FAN NO.7	AHU-215	ROOF	EXHAUST FAN NO.7	DI	DC CLOSED
REAL I/O	7I-9	HS	-218			EXHAUST FAN NO.8	AHU-215	ROOF	EXHAUST FAN NO.8	DI	REMOTE
REAL I/O	7I-9	YA	-218			EXHAUST FAN NO.8	AHU-215	ROOF	EXHAUST FAN NO.8	DI	VFD FAIL
REAL I/O	7I-9	ZC	-218			EXHAUST FAN NO.8	AHU-215	ROOF	EXHAUST FAN NO.8	DI	DC CLOSED
REAL I/O	7I-9	HS	-225			EXHAUST FAN NO.5	AHU-225	ROOF	EXHAUST FAN NO.5	DI	REMOTE
REAL I/O	7I-9	YA	-225			EXHAUST FAN NO.5	AHU-225	ROOF	EXHAUST FAN NO.5	DI	VFD FAIL
REAL I/O	7I-9	ZC	-225			EXHAUST FAN NO.5	AHU-225	ROOF	EXHAUST FAN NO.5	DI	DC CLOSED
REAL I/O	7I-9	HS	-226			EXHAUST FAN NO.6	AHU-225	ROOF	EXHAUST FAN NO.6	DI	REMOTE
REAL I/O	7I-9	YA	-226			EXHAUST FAN NO.6	AHU-225	ROOF	EXHAUST FAN NO.6	DI	VFD FAIL
REAL I/O	7I-9	ZC	-226			EXHAUST FAN NO.6	AHU-225	ROOF	EXHAUST FAN NO.6	DI	DC CLOSED
REAL I/O	7I-9	HS	-227			EXHAUST FAN NO.7	AHU-225	ROOF	EXHAUST FAN NO.7	DI	REMOTE
REAL I/O	7I-9	YA	-227			EXHAUST FAN NO.7	AHU-225	ROOF	EXHAUST FAN NO.7	DI	VFD FAIL
REAL I/O	7I-9	ZC	-227			EXHAUST FAN NO.7	AHU-225	ROOF	EXHAUST FAN NO.7	DI	DC CLOSED
REAL I/O	7I-9	HS	-115			EXHAUST FAN NO.5	AHU-115	ROOF	EXHAUST FAN NO.5	DO	RUN
REAL I/O	7I-9	HS	-116			EXHAUST FAN NO.6	AHU-115	ROOF	EXHAUST FAN NO.6	DO	RUN
REAL I/O	7I-9	HS	-117			EXHAUST FAN NO.7	AHU-115	ROOF	EXHAUST FAN NO.7	DO	RUN

13300 Instrumentation and Control
APPENDIX B - I/O TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION	I/O TYPE	P&ID DESCRIPTION
REAL I/O	71-9	HS	118			EXHAUST FAN NO.8	AHU-115	ROOF	EXHAUST FAN NO.8	DO	RUN
REAL I/O	71-9	HS	125			EXHAUST FAN NO.5	AHU-125	ROOF	EXHAUST FAN NO.5	DO	RUN
REAL I/O	71-9	HS	126			EXHAUST FAN NO.6	AHU-125	ROOF	EXHAUST FAN NO.6	DO	RUN
REAL I/O	71-9	HS	127			EXHAUST FAN NO.7	AHU-125	ROOF	EXHAUST FAN NO.7	DO	RUN
REAL I/O	71-9	HS	215			EXHAUST FAN NO.5	AHU-215	ROOF	EXHAUST FAN NO.5	DO	RUN
REAL I/O	71-9	HS	216			EXHAUST FAN NO.6	AHU-215	ROOF	EXHAUST FAN NO.6	DO	RUN
REAL I/O	71-9	HS	217			EXHAUST FAN NO.7	AHU-215	ROOF	EXHAUST FAN NO.7	DO	RUN
REAL I/O	71-9	HS	218			EXHAUST FAN NO.8	AHU-215	ROOF	EXHAUST FAN NO.8	DO	RUN
REAL I/O	71-9	HS	225			EXHAUST FAN NO.5	AHU-225	ROOF	EXHAUST FAN NO.5	DO	RUN
REAL I/O	71-9	HS	226			EXHAUST FAN NO.6	AHU-225	ROOF	EXHAUST FAN NO.6	DO	RUN
REAL I/O	71-9	HS	227			EXHAUST FAN NO.7	AHU-225	ROOF	EXHAUST FAN NO.7	DO	RUN
REAL I/O	71-11	TI	771			TEMPERATURE INDICATING TRANSMITTER	HT LOOP	NORTH BUILDING	GEN-110	AI	HT COOLING TEMP
REAL I/O	71-11	TI	772			TEMPERATURE INDICATING TRANSMITTER	LT LOOP	NORTH BUILDING	GEN-110	AI	LT COOLING TEMP
REAL I/O	71-11	TI	773			TEMPERATURE INDICATING TRANSMITTER	HT LOOP	NORTH BUILDING	GEN-120	AI	HT COOLING TEMP
REAL I/O	71-11	TI	774			TEMPERATURE INDICATING TRANSMITTER	LT LOOP	NORTH BUILDING	GEN-120	AI	LT COOLING TEMP
REAL I/O	71-11	TI	781			TEMPERATURE INDICATING TRANSMITTER	HT LOOP	SOUTH BUILDING	GEN-210	AI	HT COOLING TEMP
REAL I/O	71-11	TI	782			TEMPERATURE INDICATING TRANSMITTER	LT LOOP	SOUTH BUILDING	GEN-210	AI	LT COOLING TEMP
REAL I/O	71-11	TI	783			TEMPERATURE INDICATING TRANSMITTER	HT LOOP	SOUTH BUILDING	GEN-220	AI	HT COOLING TEMP
REAL I/O	71-11	TI	784			TEMPERATURE INDICATING TRANSMITTER	LT LOOP	SOUTH BUILDING	GEN-220	AI	LT COOLING TEMP
REAL I/O	71-11	ZSC	741			LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE CLOSED
REAL I/O	71-11	ZSO	741			LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE OPENED
REAL I/O	71-11	ZSC	742			LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE CLOSED
REAL I/O	71-11	ZSO	742			LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE OPENED
REAL I/O	71-11	ZSC	743			LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE CLOSED
REAL I/O	71-11	ZSO	743			LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE OPENED
REAL I/O	71-11	ZSC	744			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE CLOSED
REAL I/O	71-11	ZSO	744			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE OPENED
REAL I/O	71-11	ZSC	745			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE CLOSED
REAL I/O	71-11	ZSO	745			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE OPENED
REAL I/O	71-11	ZSC	746			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE CLOSED
REAL I/O	71-11	ZSO	746			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM	DI	VALVE OPENED
REAL I/O	71-12	ZI	701			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	702			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	703			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	704			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	705			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	706			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	707			MOTORIZED VALVE	LT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	708			MOTORIZED VALVE	LT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	709			MOTORIZED VALVE	LT NAT GAS ENG DECOUPLING FEED VLV	NORTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	710			MOTORIZED VALVE	LT DIESEL ENG DECOUPLING FEED VLV	NORTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	711			MOTORIZED VALVE	LT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	721			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	722			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	723			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	724			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	725			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	726			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	727			MOTORIZED VALVE	LT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	728			MOTORIZED VALVE	LT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	729			MOTORIZED VALVE	LT NAT GAS ENG DECOUPLING FEED VLV	SOUTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	730			MOTORIZED VALVE	LT DIESEL ENG DECOUPLING FEED VLV	SOUTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	ZI	731			MOTORIZED VALVE	LT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AI	VALVE POS IND
REAL I/O	71-12	FI	791			FLOW METER	LT COOLING CIRCULATION	TBD	COOLING SYSTEM	AI	FLOW
REAL I/O	71-12	SI	791			JOCKEY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	AI	SPEED
REAL I/O	71-12	SI	792			DUTY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	AI	SPEED
REAL I/O	71-12	SI	793			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	AI	SPEED
REAL I/O	71-12	SI	794			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	AI	SPEED
REAL I/O	71-12	FI	795			FLOW METER	HT COOLING CIRCULATION	TBD	COOLING SYSTEM	AI	FLOW
REAL I/O	71-12	SI	795			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	AI	SPEED
REAL I/O	71-12	SI	796			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	AI	SPEED
REAL I/O	71-12	SI	797			EMERGENCY PUMP	HT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	AI	SPEED
REAL I/O	71-12	ZC	701			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	71-12	ZC	702			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	71-12	ZC	703			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	71-12	ZC	704			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	71-12	ZC	705			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	71-12	ZC	706			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD

13300 Instrumentation and Control
APPENDIX B - I/O TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION	I/O TYPE	P&ID DESCRIPTION
REAL I/O	7I-12	ZC	-707			MOTORIZED VALVE	LT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-708			MOTORIZED VALVE	LT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-709			MOTORIZED VALVE	LT NAT GAS ENG DECOUPLING FEED VLV	NORTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-710			MOTORIZED VALVE	LT DIESEL ENG DECOUPLING FEED VLV	NORTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-711			MOTORIZED VALVE	LT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-721			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-722			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-723			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-724			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-725			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-726			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-727			MOTORIZED VALVE	LT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-728			MOTORIZED VALVE	LT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-729			MOTORIZED VALVE	LT NAT GAS ENG DECOUPLING FEED VLV	SOUTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-730			MOTORIZED VALVE	LT DIESEL ENG DECOUPLING FEED VLV	SOUTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	ZC	-731			MOTORIZED VALVE	LT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	AO	VALVE POS CMD
REAL I/O	7I-12	SC	-791			JOCKEY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	AO	SPEED CMD
REAL I/O	7I-12	SC	-792			DUTY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	AO	SPEED CMD
REAL I/O	7I-12	SC	-793			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	AO	SPEED CMD
REAL I/O	7I-12	SC	-794			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	AO	SPEED CMD
REAL I/O	7I-12	SC	-795			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	AO	SPEED CMD
REAL I/O	7I-12	SC	-796			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	AO	SPEED CMD
REAL I/O	7I-12	SC	-797			EMERGENCY PUMP	HT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	AO	SPEED CMD
REAL I/O	7I-12	HS	-701			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-702			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-703			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-704			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-705			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-706			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-707			MOTORIZED VALVE	LT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-708			MOTORIZED VALVE	LT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-709			MOTORIZED VALVE	LT NAT GAS ENG DECOUPLING FEED VLV	NORTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-710			MOTORIZED VALVE	LT DIESEL ENG DECOUPLING FEED VLV	NORTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-711			MOTORIZED VALVE	LT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-721			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-722			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-723			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-724			MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-725			MOTORIZED VALVE	HT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-726			MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-727			MOTORIZED VALVE	LT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-728			MOTORIZED VALVE	LT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-729			MOTORIZED VALVE	LT NAT GAS ENG DECOUPLING FEED VLV	SOUTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-730			MOTORIZED VALVE	LT DIESEL ENG DECOUPLING FEED VLV	SOUTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	HS	-731			MOTORIZED VALVE	LT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	YA	-791	A		JOCKEY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	PUMP FAIL
REAL I/O	7I-12	HS	-791			JOCKEY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	JL	-791			JOCKEY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	CONTROL POWER ON
REAL I/O	7I-12	YA	-791			FLOW METER	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	TROUBLE ALARM
REAL I/O	7I-12	YL	-791			JOCKEY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	RUNNING
REAL I/O	7I-12	YA	-792	A		DUTY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	PUMP FAIL
REAL I/O	7I-12	HS	-792			DUTY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	JL	-792			DUTY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	CONTROL POWER ON
REAL I/O	7I-12	YL	-792			DUTY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	RUNNING
REAL I/O	7I-12	YA	-793	A		DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	PUMP FAIL
REAL I/O	7I-12	HS	-793			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	JL	-793			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	CONTROL POWER ON
REAL I/O	7I-12	YL	-793			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	RUNNING
REAL I/O	7I-12	YA	-794	A		DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	PUMP FAIL
REAL I/O	7I-12	HS	-794			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	JL	-794			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	CONTROL POWER ON
REAL I/O	7I-12	YL	-794			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	RUNNING
REAL I/O	7I-12	YA	-795	A		DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	PUMP FAIL
REAL I/O	7I-12	HS	-795			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	JL	-795			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	CONTROL POWER ON
REAL I/O	7I-12	YA	-795			FLOW METER	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	TROUBLE ALARM
REAL I/O	7I-12	YL	-795			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	RUNNING
REAL I/O	7I-12	YA	-796	A		DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	PUMP FAIL

13300 Instrumentation and Control
APPENDIX B - I/O TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION	I/O TYPE	P&ID DESCRIPTION
REAL I/O	7I-12	HS	796			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	JL	796			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	CONTROL POWER ON
REAL I/O	7I-12	YL	796			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DI	RUNNING
REAL I/O	7I-12	YA	797	A		EMERGENCY PUMP	HT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	PUMP FAIL
REAL I/O	7I-12	HS	797			EMERGENCY PUMP	HT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	REMOTE
REAL I/O	7I-12	JL	797			EMERGENCY PUMP	HT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	CONTROL POWER ON
REAL I/O	7I-12	YL	797			EMERGENCY PUMP	HT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DI	RUNNING
REAL I/O	7I-12	HS	791			JOCKEY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DO	RUN
REAL I/O	7I-12	HS	791			JOCKEY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DO	RESET
REAL I/O	7I-12	HS	792			DUTY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DO	RUN
REAL I/O	7I-12	HS	792			DUTY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DO	RESET
REAL I/O	7I-12	HS	793			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DO	RUN
REAL I/O	7I-12	HS	793			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DO	RESET
REAL I/O	7I-12	HS	794			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DO	RUN
REAL I/O	7I-12	HS	794			DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DO	RESET
REAL I/O	7I-12	HS	795			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DO	RUN
REAL I/O	7I-12	HS	795			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DO	RESET
REAL I/O	7I-12	HS	796			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DO	RUN
REAL I/O	7I-12	HS	796			DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM	DO	RESET
REAL I/O	7I-12	HS	797			EMERGENCY PUMP	HT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DO	RUN
REAL I/O	7I-12	HS	797			EMERGENCY PUMP	HT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM	DO	RESET
REAL I/O	7I-13	LI	347			WASTE LUBE OIL TANK	WASTE LUBE OIL STORAGE TANK	FUEL/OIL STORAGE AREA	WASTE LUBE OIL	AI	TANK LEVEL
REAL I/O	7I-13	LAH	347	A		WASTE LUBE OIL TANK	WASTE LUBE OIL STORAGE TANK	FUEL/OIL STORAGE AREA	WASTE LUBE OIL	DI	TANK LEAK
REAL I/O	7I-13	LAH	347			WASTE LUBE OIL TANK	WASTE LUBE OIL STORAGE TANK	FUEL/OIL STORAGE AREA	WASTE LUBE OIL	DI	TANK LEVEL HIGH
REAL I/O	7I-13	LAH	331			GEN-110 WASTE PUMP CONTROL PANEL	WASTE LUBE OIL	FUEL/OIL STORAGE AREA	WASTE LUBE OIL PUMP	DO	LEVEL ALARM HIGH
REAL I/O	7I-13	LAH	332			GEN-120 WASTE PUMP CONTROL PANEL	WASTE LUBE OIL	FUEL/OIL STORAGE AREA	WASTE LUBE OIL PUMP	DO	LEVEL ALARM HIGH
REAL I/O	7I-13	LAH	333			GEN-210 WASTE PUMP CONTROL PANEL	WASTE LUBE OIL	FUEL/OIL STORAGE AREA	WASTE LUBE OIL PUMP	DO	LEVEL ALARM HIGH
REAL I/O	7I-13	LAH	334			GEN-220 WASTE PUMP CONTROL PANEL	WASTE LUBE OIL	FUEL/OIL STORAGE AREA	WASTE LUBE OIL PUMP	DO	LEVEL ALARM HIGH
REAL I/O	7I-14	FI	315			FLOW METER	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	AI	FLOW RATE IND
REAL I/O	7I-14	LI	315			LEVEL	LUBE OIL DAY TANK	LUBE OIL	NAT GAS ENGINE SUPPLY LUBE OIL	AI	TANK LEVEL
REAL I/O	7I-14	FI	316			FLOW METER	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	AI	FLOW RATE IND
REAL I/O	7I-14	LI	316			LEVEL	LUBE OIL DAY TANK	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	AI	TANK LEVEL
REAL I/O	7I-14	SC	321			LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL	AI	SPEED COMMAND
REAL I/O	7I-14	SC	322			LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL	AI	SPEED COMMAND
REAL I/O	7I-14	LI	345			LEVEL TRANSDUCER	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL	AI	TANK LEVEL
REAL I/O	7I-14	LI	346			LEVEL TRANSDUCER	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL	AI	TANK LEVEL
REAL I/O	7I-14	LI	321			LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL	AO	TANK LEVEL
REAL I/O	7I-14	SI	321			LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL	AO	SPEED INDICATION
REAL I/O	7I-14	XI	321			LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL	AO	GALLONS DISPENSED
REAL I/O	7I-14	LI	322			LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL	AO	TANK LEVEL
REAL I/O	7I-14	SI	322			LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL	AO	SPEED INDICATION
REAL I/O	7I-14	XI	322			LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL	AO	GALLONS DISPENSED
REAL I/O	7I-14	SC	335			LUBE OIL PUMP	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL	AO	SPEED COMMAND
REAL I/O	7I-14	SC	336			LUBE OIL PUMP	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL	AO	SPEED COMMAND
REAL I/O	7I-14	FAH	315			FLOW SWITCH	LUBE OIL DAY TANK	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DI	FLOW ALARM HIGH
REAL I/O	7I-14	FAH	316			FLOW SWITCH	LUBE OIL DAY TANK	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DI	FLOW ALARM HIGH
REAL I/O	7I-14	HS	321	A		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL	DI	OPEN SLOW FILL GRAVITY VALVES
REAL I/O	7I-14	HS	321	C		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL	DI	LUBE OIL SYSTEM SS NATURAL GAS/DIESEL
REAL I/O	7I-14	HS	321	D		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL	DI	PUMP DISCHARGE SS ENGINE/DAY TANK
REAL I/O	7I-14	HS	321	F		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL	DI	GALLONS DISPENSED/ SYSTEM RESET
REAL I/O	7I-14	HS	321	G		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL	DI	RUN LUBE OIL PUMP
REAL I/O	7I-14	HS	322	A		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL	DI	OPEN SLOW FILL GRAVITY VALVES
REAL I/O	7I-14	HS	322	C		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL	DI	LUBE OIL SYSTEM SS NATURAL GAS/DIESEL
REAL I/O	7I-14	HS	322	D		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL	DI	PUMP DISCHARGE SS ENGINE/DAY TANK
REAL I/O	7I-14	HS	322	F		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL	DI	GALLONS DISPENSED/ SYSTEM RESET
REAL I/O	7I-14	HS	322	G		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL	DI	RUN LUBE OIL PUMP
REAL I/O	7I-14	HS	335	A		LUBE OIL PUMP	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL	DI	REMOTE
REAL I/O	7I-14	YS	335			LUBE OIL PUMP	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL	DI	VFD FAIL
REAL I/O	7I-14	HS	336	A		LUBE OIL PUMP	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL	DI	REMOTE
REAL I/O	7I-14	YS	336			LUBE OIL PUMP	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL	DI	VFD FAIL
REAL I/O	7I-14	LAH	345	A		LEVEL SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL	DI	TANK LEVEL HIGH
REAL I/O	7I-14	ZLC	345	A		POSITION SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL	DI	PUMP NOT HIGH PRESS
REAL I/O	7I-14	LAH	345	B		LEVEL SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL	DI	TANK LEAK
REAL I/O	7I-14	ZLC	345	B		POSITION SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL	DI	TANK VALVE CLOSED
REAL I/O	7I-14	LAH	346	A		LEVEL SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL	DI	TANK LEVEL HIGH
REAL I/O	7I-14	ZLC	346	A		POSITION SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL	DI	PUMP NOT HIGH PRESS
REAL I/O	7I-14	LAH	346	B		LEVEL SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL	DI	TANK LEAK
REAL I/O	7I-14	ZLC	346	B		POSITION SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL	DI	TANK VALVE CLOSED

13300 Instrumentation and Control
APPENDIX B - I/O TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION	I/O TYPE	P&ID DESCRIPTION
REAL I/O		7I-14	HS	-315	A	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-315	B	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-315	C	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-315	D	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-315	E	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-315	F	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-315	G	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-315	H	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-315	I	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-315	J	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-315	K	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-315	L	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-316	A	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-316	B	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-316	C	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-316	D	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-316	E	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-316	F	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-316	G	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-316	H	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-316	I	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-316	J	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-316	K	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	OPEN VALVE
REAL I/O		7I-14	HS	-316	L	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL	DO	CLOSE VALVE
REAL I/O		7I-14	HS	-321		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL	DO	SYSTEM ALARM
REAL I/O		7I-14	HS	-322		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL	DO	SYSTEM ALARM
REAL I/O		7I-14	HS	-335		LUBE OIL PUMP	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL	DO	PUMP RUN
REAL I/O		7I-14	HS	-336		LUBE OIL PUMP	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL	DO	PUMP RUN
REAL I/O		7I-15	YA	-002	A	BREAKER TRIPPED	BREAKER M-112	USS-2	480VAC	DI	BREAKER TRIPPED
REAL I/O		7I-15	ZSC	-002	A	BREAKER POSITION	BREAKER M-112	USS-2	480VAC	DI	BREAKER CLOSED
REAL I/O		7I-15	ZSC	-002	A	BREAKER POSITION	BREAKER M-112	USS-2	480VAC	DI	BREAKER OPENED
REAL I/O		7I-15	YA	-002	B	BREAKER TRIPPED	BREAKER M-222	USS-2	480VAC	DI	BREAKER TRIPPED
REAL I/O		7I-15	ZSC	-002	B	BREAKER POSITION	BREAKER M-222	USS-2	480VAC	DI	BREAKER CLOSED
REAL I/O		7I-15	ZSC	-002	B	BREAKER POSITION	BREAKER M-222	USS-2	480VAC	DI	BREAKER OPENED
REAL I/O		7I-15	YA	-002	C	BREAKER TRIPPED	BREAKER M-012	USS-2	480VAC	DI	BREAKER TRIPPED
REAL I/O		7I-15	ZSC	-002	C	BREAKER POSITION	BREAKER M-012	USS-2	480VAC	DI	BREAKER CLOSED
REAL I/O		7I-15	ZSC	-002	C	BREAKER POSITION	BREAKER M-012	USS-2	480VAC	DI	BREAKER OPENED
REAL I/O		7I-15	YA	-002	D	BREAKER TRIPPED	BREAKER M-022	USS-2	480VAC	DI	BREAKER TRIPPED
REAL I/O		7I-15	ZSC	-002	D	BREAKER POSITION	BREAKER M-022	USS-2	480VAC	DI	BREAKER CLOSED
REAL I/O		7I-15	ZSC	-002	D	BREAKER POSITION	BREAKER M-022	USS-2	480VAC	DI	BREAKER OPENED
REAL I/O		7I-15	YA	-002	E	BREAKER TRIPPED	BREAKER M-002	USS-2	480VAC	DI	BREAKER TRIPPED
REAL I/O		7I-15	ZSC	-002	E	BREAKER POSITION	BREAKER M-002	USS-2	480VAC	DI	BREAKER CLOSED
REAL I/O		7I-15	ZSC	-002	E	BREAKER POSITION	BREAKER M-002	USS-2	480VAC	DI	BREAKER OPENED
REAL I/O		7I-15	HS	-002	K	LOCAL CONTROL	BREAKER M-112	USS-2	480VAC	DI	LOCAL CONTROL
REAL I/O		7I-15	HS	-002	L	LOCAL CONTROL	BREAKER M-222	USS-2	480VAC	DI	LOCAL CONTROL
REAL I/O		7I-15	HS	-002	M	LOCAL CONTROL	BREAKER M-012	USS-2	480VAC	DI	LOCAL CONTROL
REAL I/O		7I-15	HS	-002	N	LOCAL CONTROL	BREAKER M-022	USS-2	480VAC	DI	LOCAL CONTROL
REAL I/O		7I-15	HS	-002	O	LOCAL CONTROL	BREAKER M-002	USS-2	480VAC	DI	LOCAL CONTROL
REAL I/O		7I-15	SAH	-071		CARBON MONOXIDE DETECTOR	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY	DI	CARBON MONOXIDE HIGH ALARM
REAL I/O		7I-15	SAH	-072		COMBUSTIBLE GAS DETECTOR	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY	DI	LEL HIGH ALARM
REAL I/O		7I-15	SAH	-073		SMOKE DETECTOR	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY	DI	SMOKE ALARM
REAL I/O		7I-15	SAH	-075		CARBON MONOXIDE DETECTOR	CONTROL ROOM	CONTROL ROOM	LIFE SAFETY	DI	CARBON MONOXIDE HIGH ALARM
REAL I/O		7I-15	SAH	-076		COMBUSTIBLE GAS DETECTOR	CONTROL ROOM	CONTROL ROOM	LIFE SAFETY	DI	LEL HIGH ALARM
REAL I/O		7I-15	SAH	-077		SMOKE DETECTOR	CONTROL ROOM	CONTROL ROOM	LIFE SAFETY	DI	SMOKE ALARM
REAL I/O		7I-15	ZSC	-090	A	LIMIT SWITCH	NORTH BUILDING	NORTH BUILDING	DOOR SWITCHES	DI	DOOR CLOSED
REAL I/O		7I-15	ZSC	-090	B	LIMIT SWITCH	NORTH BUILDING	NORTH BUILDING	DOOR SWITCHES	DI	DOOR CLOSED
REAL I/O		7I-15	ZSC	-090	C	LIMIT SWITCH	NORTH BUILDING	NORTH BUILDING	DOOR SWITCHES	DI	DOOR CLOSED
REAL I/O		7I-15	ZSC	-090	D	LIMIT SWITCH	NORTH BUILDING	NORTH BUILDING	DOOR SWITCHES	DI	DOOR CLOSED
REAL I/O		7I-15	ZSC	-090	E	LIMIT SWITCH	SOUTH BUILDING	SOUTH BUILDING	DOOR SWITCHES	DI	DOOR CLOSED
REAL I/O		7I-15	ZSC	-090	F	LIMIT SWITCH	SOUTH BUILDING	SOUTH BUILDING	DOOR SWITCHES	DI	DOOR CLOSED
REAL I/O		7I-15	ZSC	-090	G	LIMIT SWITCH	SOUTH BUILDING	SOUTH BUILDING	DOOR SWITCHES	DI	DOOR CLOSED
REAL I/O		7I-15	SAH	-171		CARBON MONOXIDE DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY	DI	CARBON MONOXIDE HIGH ALARM
REAL I/O		7I-15	SAH	-172		COMBUSTIBLE GAS DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY	DI	LEL HIGH ALARM
REAL I/O		7I-15	SAH	-173		SMOKE DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY	DI	SMOKE ALARM
REAL I/O		7I-15	SAH	-271		CARBON MONOXIDE DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY	DI	CARBON MONOXIDE HIGH ALARM
REAL I/O		7I-15	SAH	-272		COMBUSTIBLE GAS DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY	DI	LEL HIGH ALARM
REAL I/O		7I-15	SAH	-273		SMOKE DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY	DI	SMOKE ALARM
REAL I/O		7I-15	SAH	-373		SMOKE DETECTOR	FUEL OIL STORAGE	FUEL OIL STORAGE	LIFE SAFETY	DI	SMOKE ALARM

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APPENDIX B - I/O TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION	I/O TYPE	P&ID DESCRIPTION
REAL I/O	71-15	YA	3001	A		52 BREAKER	MAIN TIE	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	71-15	YA	3001	B		FEEDER MANAGEMENT RELAY	MAIN TIE	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	71-15	HS	3001	C		52 BREAKER	MAIN TIE	SWITCHEGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	71-15	HS	3001	D		52 BREAKER	MAIN TIE	SWITCHEGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	71-15	YA	3001			52 BREAKER	MAIN TIE	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	71-15	ZLC	3001			52 BREAKER	MAIN TIE	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	71-15	ZLO	3001			52 BREAKER	MAIN TIE	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	71-15	YA	3100	A		52 BREAKER	NORTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	71-15	YA	3100	B		FEEDER MANAGEMENT RELAY	NORTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	71-15	HS	3100	C		52 BREAKER	NORTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	71-15	HS	3100	D		52 BREAKER	NORTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	71-15	YA	3100			52 BREAKER	NORTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	71-15	ZLC	3100			52 BREAKER	NORTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	71-15	ZLO	3100			52 BREAKER	NORTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	71-15	YA	3101	A		52 BREAKER	NORTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	71-15	YA	3101	B		FEEDER MANAGEMENT RELAY	NORTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	71-15	HS	3101	C		52 BREAKER	NORTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	71-15	HS	3101	D		52 BREAKER	NORTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	71-15	YA	3101			52 BREAKER	NORTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	71-15	ZLC	3101			52 BREAKER	NORTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	71-15	ZLO	3101			52 BREAKER	NORTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	71-15	YA	3112	A		52 BREAKER	SWG-1 SPACE 12 FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	71-15	YA	3112	B		FEEDER MANAGEMENT RELAY	SWG-1 SPACE 12 FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	71-15	HS	3112	C		52 BREAKER	SWG-1 SPACE 12 FEED	SWITCHEGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	71-15	HS	3112	D		52 BREAKER	SWG-1 SPACE 12 FEED	SWITCHEGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	71-15	YA	3112			52 BREAKER	SWG-1 SPACE 12 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	71-15	ZLC	3112			52 BREAKER	SWG-1 SPACE 12 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	71-15	ZLO	3112			52 BREAKER	SWG-1 SPACE 12 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	71-15	YA	3114	A		52 BREAKER	SWG-1 SPACE 14 FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	71-15	YA	3114	B		FEEDER MANAGEMENT RELAY	SWG-2 SPACE 14 FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	71-15	HS	3114	C		52 BREAKER	SWG-1 SPACE 14 FEED	SWITCHEGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	71-15	HS	3114	D		52 BREAKER	SWG-1 SPACE 14 FEED	SWITCHEGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	71-15	YA	3114			52 BREAKER	SWG-1 SPACE 14 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	71-15	ZLC	3114			52 BREAKER	SWG-1 SPACE 14 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	71-15	ZLO	3114			52 BREAKER	SWG-1 SPACE 14 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	71-15	YA	3200	A		52 BREAKER	SOUTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	71-15	YA	3200	B		FEEDER MANAGEMENT RELAY	SOUTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	71-15	HS	3200	C		52 BREAKER	SOUTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	71-15	HS	3200	D		52 BREAKER	SOUTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	71-15	YA	3200			52 BREAKER	SOUTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	71-15	ZLC	3200			52 BREAKER	SOUTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	71-15	ZLO	3200			52 BREAKER	SOUTH TIE	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	71-15	YA	3201	A		52 BREAKER	SOUTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	71-15	YA	3201	B		FEEDER MANAGEMENT RELAY	SOUTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	71-15	HS	3201	C		52 BREAKER	SOUTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	71-15	HS	3201	D		52 BREAKER	SOUTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	71-15	YA	3201			52 BREAKER	SOUTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	71-15	ZLC	3201			52 BREAKER	SOUTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	71-15	ZLO	3201			52 BREAKER	SOUTH SECTION LOAD BANK FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	71-15	YA	3222	A		52 BREAKER	SWG-2 SPACE 22 FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	71-15	YA	3222	B		FEEDER MANAGEMENT RELAY	SWG-2 SPACE 22 FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	71-15	HS	3222	C		52 BREAKER	SWG-2 SPACE 22 FEED	SWITCHEGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	71-15	HS	3222	D		52 BREAKER	SWG-2 SPACE 22 FEED	SWITCHEGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	71-15	YA	3222			52 BREAKER	SWG-2 SPACE 22 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	71-15	ZLC	3222			52 BREAKER	SWG-2 SPACE 22 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	71-15	ZLO	3222			52 BREAKER	SWG-2 SPACE 22 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	71-15	YA	3223	A		52 BREAKER	SWG-2 SPACE 23 FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE ALARM
REAL I/O	71-15	YA	3223	B		FEEDER MANAGEMENT RELAY	SWG-2 SPACE 23 FEED	SWITCHEGEAR NO.3	4160VAC	DI	TROUBLE
REAL I/O	71-15	HS	3223	C		52 BREAKER	SWG-2 SPACE 23 FEED	SWITCHEGEAR NO.3	4160VAC	DI	LOCAL CONTROL
REAL I/O	71-15	HS	3223	D		52 BREAKER	SWG-2 SPACE 23 FEED	SWITCHEGEAR NO.3	4160VAC	DI	DCS CONTROL
REAL I/O	71-15	YA	3223			52 BREAKER	SWG-2 SPACE 23 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER TRIPPED
REAL I/O	71-15	ZLC	3223			52 BREAKER	SWG-2 SPACE 23 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER CLOSED
REAL I/O	71-15	ZLO	3223			52 BREAKER	SWG-2 SPACE 23 FEED	SWITCHEGEAR NO.3	4160VAC	DI	BREAKER OPENED
REAL I/O	71-15	HS	002	A		OPEN BREAKER	BREAKER M-112	USS-2	480VAC	DO	OPEN BREAKER
REAL I/O	71-15	HS	002	B		OPEN BREAKER	BREAKER M-222	USS-2	480VAC	DO	OPEN BREAKER
REAL I/O	71-15	HS	002	C		OPEN BREAKER	BREAKER M-012	USS-2	480VAC	DO	OPEN BREAKER
REAL I/O	71-15	HS	002	D		OPEN BREAKER	BREAKER M-022	USS-2	480VAC	DO	OPEN BREAKER
REAL I/O	71-15	HS	002	E		OPEN BREAKER	BREAKER M-002	USS-2	480VAC	DO	OPEN BREAKER

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APPENDIX B - I/O TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION	I/O TYPE	P&ID DESCRIPTION
REAL I/O	7I-15	HS	-002	F		CLOSE BREAKER	BREAKER M-112	USS-2	480VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-002	G		CLOSE BREAKER	BREAKER M-222	USS-2	480VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-002	H		CLOSE BREAKER	BREAKER M-012	USS-2	480VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-002	I		CLOSE BREAKER	BREAKER M-022	USS-2	480VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-002	J		CLOSE BREAKER	BREAKER M-002	USS-2	480VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-074			AUDIBLE ALARM & STROBE	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY	DO	AUDIBLE & STROBE ALARM
REAL I/O	7I-15	HS	-078			AUDIBLE ALARM & STROBE	CONTROL ROOM	CONTROL ROOM	LIFE SAFETY	DO	AUDIBLE & STROBE ALARM
REAL I/O	7I-15	HS	-174			AUDIBLE ALARM & STROBE	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY	DO	AUDIBLE & STROBE ALARM
REAL I/O	7I-15	HS	-274			AUDIBLE ALARM & STROBE	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY	DO	AUDIBLE & STROBE ALARM
REAL I/O	7I-15	HS	-374			AUDIBLE ALARM & STROBE	FUEL OIL STORAGE	FUEL OIL STORAGE	LIFE SAFETY	DO	AUDIBLE & STROBE ALARM
REAL I/O	7I-15	HS	-3001	A		52 BREAKER	MAIN TIE	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-15	HS	-3001	B		52 BREAKER	MAIN TIE	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-3100	A		52 BREAKER	NORTH TIE	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-15	HS	-3100	B		52 BREAKER	NORTH TIE	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-3101	A		52 BREAKER	NORTH SECTION LOAD BANK FEED	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-15	HS	-3101	B		52 BREAKER	NORTH SECTION LOAD BANK FEED	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-3112	A		52 BREAKER	SWG-1 SPACE 12 FEED	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-15	HS	-3112	B		52 BREAKER	SWG-1 SPACE 12 FEED	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-3114	A		52 BREAKER	SWG-1 SPACE 14 FEED	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-15	HS	-3114	B		52 BREAKER	SWG-1 SPACE 14 FEED	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-3200	A		52 BREAKER	SOUTH TIE	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-15	HS	-3200	B		52 BREAKER	SOUTH TIE	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-3201	A		52 BREAKER	SOUTH SECTION LOAD BANK FEED	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-15	HS	-3201	B		52 BREAKER	SOUTH SECTION LOAD BANK FEED	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-3222	A		52 BREAKER	SWG-2 SPACE 22 FEED	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-15	HS	-3222	B		52 BREAKER	SWG-2 SPACE 22 FEED	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-15	HS	-3223	A		52 BREAKER	SWG-2 SPACE 23 FEED	SWITCHGEAR NO.3	4160VAC	DO	OPEN BREAKER
REAL I/O	7I-15	HS	-3223	B		52 BREAKER	SWG-2 SPACE 23 FEED	SWITCHGEAR NO.3	4160VAC	DO	CLOSE BREAKER
REAL I/O	7I-16	LSH	-050			FLOAT SWITCH	HOLDING TANK	NORTH BUILDING	SUMP PUMPS	DI	HOLDING TANK LEVEL HIGH
REAL I/O	7I-16	LSH	-050			FLOAT SWITCH	HOLDING TANK	NORTH BUILDING	SUMP PUMPS	DI	HOLDING TANK LEVEL HIGH-HIGH
REAL I/O	7I-16	LSH	-051			FLOAT SWITCH	HOLDING TANK	NORTH BUILDING	SUMP PUMPS	DI	NORTH SUMP LEVEL HIGH
REAL I/O	7I-16	LSH	-052			FLOAT SWITCH	HOLDING TANK	SOUTH BUILDING	SUMP PUMPS	DI	SOUTH SUMP LEVEL HIGH
REAL I/O	7I-16	SAH	-061			SMOKE DETECTOR	ELECTRICAL BUILDING AC UNIT	ELECTRICAL BUILDING AC UNIT	LIFE SAFETY	DI	SUPPLY SMOKE ALARM
REAL I/O	7I-16	SAH	-062			SMOKE DETECTOR	ELECTRICAL BUILDING AC UNIT	ELECTRICAL BUILDING AC UNIT	LIFE SAFETY	DI	SUPPLY SMOKE ALARM
REAL I/O	7I-16	EAL	081			UPS	208/120VAC	ELECTRICAL ROOM	UPS	DI	BATTERY LOW
REAL I/O	7I-16	YA	081			UPS	208/120VAC	ELECTRICAL ROOM	UPS	DI	UPS ON BYPASS
REAL I/O	7I-16	YA	081			UPS	208/120VAC	ELECTRICAL ROOM	UPS	DI	UPS TROUBLE
REAL I/O	7I-16	YA	081			UPS	208/120VAC	ELECTRICAL ROOM	UPS	DI	LOSS OF UTILITY POWER
REAL I/O	7I-16	EAL	082			UPS	208/120VAC	ELECTRICAL ROOM	UPS	DI	BATTERY LOW
REAL I/O	7I-16	YA	082			UPS	208/120VAC	ELECTRICAL ROOM	UPS	DI	UPS ON BYPASS
REAL I/O	7I-16	YA	082			UPS	208/120VAC	ELECTRICAL ROOM	UPS	DI	UPS TROUBLE
REAL I/O	7I-16	YA	082			UPS	208/120VAC	ELECTRICAL ROOM	UPS	DI	LOSS OF UTILITY POWER
REAL I/O	7I-16	HS	-170	A		HAND SWITCH	SAFETY EYEWASH SHOWER	NORTH BUILDING	LIFE SAFETY	DI	EYEWASH ALARM-1
REAL I/O	7I-16	FAH	-170			FLOW SWITCH	SAFETY EYEWASH SHOWER	NORTH BUILDING	LIFE SAFETY	DI	EYEWASH ALARM-2
REAL I/O	7I-16	HS	-270	A		HAND SWITCH	SAFETY EYEWASH SHOWER	SOUTH BUILDING	LIFE SAFETY	DI	EYEWASH ALARM-1
REAL I/O	7I-16	FAH	-270			FLOW SWITCH	SAFETY EYEWASH SHOWER	SOUTH BUILDING	LIFE SAFETY	DI	EYEWASH ALARM-2
REAL I/O	7I-16	HS	-370	A		HAND SWITCH	SAFETY EYEWASH SHOWER	FUEL/ OIL STORAGE	LIFE SAFETY	DI	EYEWASH ALARM-1
REAL I/O	7I-16	FAH	-370			FLOW SWITCH	SAFETY EYEWASH SHOWER	FUEL/ OIL STORAGE	LIFE SAFETY	DI	EYEWASH ALARM-2

13300 Instrumentation and Control
APPENDIX C - INSTRUMENTATION TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
INSTRUMENT	1f-1		SE	400		TACHOMETER	MOTOR 400	MOTOR 400	SEWAGE PUMP 400
INSTRUMENT	1f-1		SE	500		TACHOMETER	MOTOR 500	MOTOR 500	SEWAGE PUMP 500
INSTRUMENT	1f-1		TE	400	A	WINDING THERMOCOUPLE	MOTOR 400	MOTOR 400	SEWAGE PUMP 400
INSTRUMENT	1f-1		TE	400	B	WINDING THERMOCOUPLE	MOTOR 400	MOTOR 400	SEWAGE PUMP 400
INSTRUMENT	1f-1		TE	400	C	WINDING THERMOCOUPLE	MOTOR 400	MOTOR 400	SEWAGE PUMP 400
INSTRUMENT	1f-1		TE	400	D	WINDING THERMOCOUPLE	MOTOR 400	MOTOR 400	SEWAGE PUMP 400
INSTRUMENT	1f-1		TE	400	E	WINDING THERMOCOUPLE	MOTOR 400	MOTOR 400	SEWAGE PUMP 400
INSTRUMENT	1f-1		TE	400	F	WINDING THERMOCOUPLE	MOTOR 400	MOTOR 400	SEWAGE PUMP 400
INSTRUMENT	1f-1		TE	400	G	BEARING THERMOCOUPLE	MOTOR 400	MOTOR 400	SEWAGE PUMP 400
INSTRUMENT	1f-1		TE	400	H	BEARING THERMOCOUPLE	MOTOR 400	MOTOR 400	SEWAGE PUMP 400
INSTRUMENT	1f-1		TE	400	I	AMBIENT THERMOCOUPLE	MOTOR 400	MOTOR 400	SEWAGE PUMP 400
INSTRUMENT	1f-1		TE	400	J	MOTOR CASE THERMOCOUPLE	SWITCHGEAR NO.2	MOTOR 400	SEWAGE PUMP 400
INSTRUMENT	1f-1		TE	500	A	WINDING THERMOCOUPLE	MOTOR 500	MOTOR 500	SEWAGE PUMP 500
INSTRUMENT	1f-1		TE	500	B	WINDING THERMOCOUPLE	MOTOR 500	MOTOR 500	SEWAGE PUMP 500
INSTRUMENT	1f-1		TE	500	C	WINDING THERMOCOUPLE	MOTOR 500	MOTOR 500	SEWAGE PUMP 500
INSTRUMENT	1f-1		TE	500	D	WINDING THERMOCOUPLE	MOTOR 500	MOTOR 500	SEWAGE PUMP 500
INSTRUMENT	1f-1		TE	500	E	WINDING THERMOCOUPLE	MOTOR 500	MOTOR 500	SEWAGE PUMP 500
INSTRUMENT	1f-1		TE	500	F	WINDING THERMOCOUPLE	MOTOR 500	MOTOR 500	SEWAGE PUMP 500
INSTRUMENT	1f-1		TE	500	G	BEARING THERMOCOUPLE	MOTOR 500	MOTOR 500	SEWAGE PUMP 500
INSTRUMENT	1f-1		TE	500	H	BEARING THERMOCOUPLE	MOTOR 500	MOTOR 500	SEWAGE PUMP 500
INSTRUMENT	1f-1		TE	500	I	AMBIENT THERMOCOUPLE	MOTOR 500	MOTOR 500	SEWAGE PUMP 500
INSTRUMENT	1f-1		TE	500	J	MOTOR CASE THERMOCOUPLE	SWITCHGEAR NO.1	MOTOR 500	SEWAGE PUMP 500
INSTRUMENT	1f-1		VE	400	A	X-AXIS VIBRATION ELEMENT	MOTOR 400	PUMP MOTOR ROOM	SEWAGE PUMP 400
INSTRUMENT	1f-1		VE	400	B	Y-AXIS VIBRATION ELEMENT	MOTOR 400	PUMP MOTOR ROOM	SEWAGE PUMP 400
INSTRUMENT	1f-1		VE	400	C	Z-AXIS VIBRATION ELEMENT	MOTOR 400	PUMP MOTOR ROOM	SEWAGE PUMP 400
INSTRUMENT	1f-1		VE	500	A	X-AXIS VIBRATION ELEMENT	MOTOR 500	PUMP MOTOR ROOM	SEWAGE PUMP 500
INSTRUMENT	1f-1		VE	500	B	Y-AXIS VIBRATION ELEMENT	MOTOR 500	PUMP MOTOR ROOM	SEWAGE PUMP 500
INSTRUMENT	1f-1		VE	500	C	Z-AXIS VIBRATION ELEMENT	MOTOR 500	PUMP MOTOR ROOM	SEWAGE PUMP 500
INSTRUMENT	4f-1		TTT	970	A	TEMPERATURE INDICATOR TRANSMITTER	WW SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970
INSTRUMENT	4f-1		TTT	970	B	TEMPERATURE INDICATOR TRANSMITTER	WW RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970
INSTRUMENT	4f-1		TTT	970	C	TEMPERATURE INDICATOR TRANSMITTER	LT COOLING SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970
INSTRUMENT	4f-1		TTT	970	D	TEMPERATURE INDICATOR TRANSMITTER	LT COOLING RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970
INSTRUMENT	4f-1		TTT	970	E	TEMPERATURE INDICATOR TRANSMITTER	HT COOLING SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970
INSTRUMENT	4f-1		TTT	970	F	TEMPERATURE INDICATOR TRANSMITTER	HT COOLING RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 970
INSTRUMENT	4f-1		TTT	974	A	TEMPERATURE INDICATOR TRANSMITTER	WW SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974
INSTRUMENT	4f-1		TTT	974	B	TEMPERATURE INDICATOR TRANSMITTER	WW RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974
INSTRUMENT	4f-1		TTT	974	C	TEMPERATURE INDICATOR TRANSMITTER	LT COOLING SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974
INSTRUMENT	4f-1		TTT	974	D	TEMPERATURE INDICATOR TRANSMITTER	LT COOLING RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974
INSTRUMENT	4f-1		TTT	974	E	TEMPERATURE INDICATOR TRANSMITTER	HT COOLING SUPPLY	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974
INSTRUMENT	4f-1		TTT	974	F	TEMPERATURE INDICATOR TRANSMITTER	HT COOLING RETURN	HEAT EXCHANGER PIPING	HEAT EXCHANGER 974
INSTRUMENT	7f-1		SD	175	A	SMOKE DETECTOR	NORTH BUILDING	SUPPLY DUCT	LIFE SAFETY
INSTRUMENT	7f-1		SD	176	A	SMOKE DETECTOR	NORTH BUILDING	EXHAUST DUCT	LIFE SAFETY
INSTRUMENT	7f-1		SD	275	A	SMOKE DETECTOR	NORTH BUILDING	SUPPLY DUCT	LIFE SAFETY
INSTRUMENT	7f-1		SD	276	A	SMOKE DETECTOR	NORTH BUILDING	EXHAUST DUCT	LIFE SAFETY
INSTRUMENT	7f-2		FTT	100	A	TEMP CORRECTED TOTALIZING METER	GEN-110	NORTH BUILDING	NAT GAS
INSTRUMENT	7f-2		FTT	100	B	TEMP CORRECTED TOTALIZING METER	GEN-210	SOUTH BUILDING	NAT GAS
INSTRUMENT	7f-2		PT	100		PRESSURE TRANSMITTER	POWER GENERATION FACILITY	NORTH BUILDING	NAT GAS
INSTRUMENT	7f-3		SD	175	B	SMOKE DETECTOR	NORTH BUILDING	SUPPLY DUCT	LIFE SAFETY
INSTRUMENT	7f-3		SD	176	B	SMOKE DETECTOR	NORTH BUILDING	EXHAUST DUCT	LIFE SAFETY
INSTRUMENT	7f-3		SD	275	B	SMOKE DETECTOR	NORTH BUILDING	SUPPLY DUCT	LIFE SAFETY
INSTRUMENT	7f-3		SD	276	B	SMOKE DETECTOR	NORTH BUILDING	EXHAUST DUCT	LIFE SAFETY
INSTRUMENT	7f-4		LE	310		LEVEL TRANSDUCER	DIESEL FUEL	TNK-310	FUEL/ OIL STORAGE AREA
INSTRUMENT	7f-4		LIT	310		LEVEL INDICATOR & TRANSMITTER	DIESEL FUEL	TNK-310	FUEL/ OIL STORAGE AREA
INSTRUMENT	7f-4		LSH	310	A	LEVEL SWITCH	DIESEL FUEL	TNK-310	FUEL/ OIL STORAGE AREA
INSTRUMENT	7f-4		LSH	310		LEVEL SWITCH	DIESEL FUEL	TNK-310	FUEL/ OIL STORAGE AREA

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APPENDIX C - INSTRUMENTATION TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
INSTRUMENT	7I-4	LSHH	-	300		FLOAT SWITCH	DIESEL FUEL	SUMP	FUEL/ OIL STORAGE AREA
INSTRUMENT	7I-5	LSH	-	312		LEVEL SWITCH	NORTH BUILDING	DIESEL DAY TANK	DIESEL FUEL
INSTRUMENT	7I-5	LSH	-	314		LEVEL SWITCH	SOUTH BUILDING	DIESEL DAY TANK	DIESEL FUEL
INSTRUMENT	7I-5	LT	-	312		LEVEL TRANSMITTER	NORTH BUILDING	DIESEL DAY TANK	DIESEL FUEL
INSTRUMENT	7I-5	LT	-	314		LEVEL TRANSMITTER	SOUTH BUILDING	DIESEL DAY TANK	DIESEL FUEL
INSTRUMENT	7I-6	PI	-	140	A	PRESSURE GAGE	GEN-110	NORTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PI	-	140	B	PRESSURE GAGE	GEN-120	NORTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PI	-	140	C	PRESSURE GAGE	AIR RECEIVER	NORTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PI	-	140		PRESSURE GAGE	COMPRESSED AIR	NORTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PI	-	240	A	PRESSURE GAGE	GEN-210	SOUTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PI	-	240	B	PRESSURE GAGE	GEN-220	SOUTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PI	-	240	C	PRESSURE GAGE	AIR RECEIVER	SOUTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PI	-	240		PRESSURE GAGE	COMPRESSED AIR	SOUTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PSH	-	140		PRESSURE SWITCH	AIR RECEIVER	NORTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PSH	-	240		PRESSURE SWITCH	AIR RECEIVER	SOUTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PSHH	-	140		PRESSURE SWITCH	AIR RECEIVER	NORTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PSHH	-	240		PRESSURE SWITCH	AIR RECEIVER	SOUTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PSL	-	140		PRESSURE SWITCH	AIR RECEIVER	NORTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PSL	-	240		PRESSURE SWITCH	AIR RECEIVER	SOUTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PSLL	-	140	A	PRESSURE SWITCH	AIR RECEIVER	NORTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PSLL	-	140		PRESSURE SWITCH	AIR RECEIVER	NORTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PSLL	-	240	A	PRESSURE SWITCH	AIR RECEIVER	SOUTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	PSLL	-	240		PRESSURE SWITCH	AIR RECEIVER	SOUTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	TSH	-	141		TEMPERATURE SWITCH	AIR COMPRESSOR NO.1	NORTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	TSH	-	142		TEMPERATURE SWITCH	AIR COMPRESSOR NO.2	NORTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	TSH	-	241		TEMPERATURE SWITCH	AIR COMPRESSOR NO.1	SOUTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-6	TSH	-	242		TEMPERATURE SWITCH	AIR COMPRESSOR NO.2	SOUTH BUILDING	COMPRESSED AIR
INSTRUMENT	7I-8	PIT	-	111	A	DIFFERENTIAL PRESSURE TRANSMITTER	NORTH BUILDING	ROOF	NORTH BUILDING
INSTRUMENT	7I-8	PIT	-	111	B	DIFFERENTIAL PRESSURE TRANSMITTER	NORTH BUILDING	FLT-111B	AHU-111
INSTRUMENT	7I-8	PIT	-	111	C	DIFFERENTIAL PRESSURE TRANSMITTER	NORTH BUILDING	FLT-111C	AHU-111
INSTRUMENT	7I-8	PIT	-	121	A	DIFFERENTIAL PRESSURE TRANSMITTER	NORTH BUILDING	ROOF	NORTH BUILDING
INSTRUMENT	7I-8	PIT	-	121	B	DIFFERENTIAL PRESSURE TRANSMITTER	NORTH BUILDING	FLT-121B	AHU-121
INSTRUMENT	7I-8	PIT	-	121	C	DIFFERENTIAL PRESSURE TRANSMITTER	NORTH BUILDING	FLT-121C	AHU-121
INSTRUMENT	7I-8	PIT	-	211	A	DIFFERENTIAL PRESSURE TRANSMITTER	SOUTH BUILDING	ROOF	SOUTH BUILDING
INSTRUMENT	7I-8	PIT	-	211	B	DIFFERENTIAL PRESSURE TRANSMITTER	SOUTH BUILDING	FLT-211B	AHU-211
INSTRUMENT	7I-8	PIT	-	211	C	DIFFERENTIAL PRESSURE TRANSMITTER	SOUTH BUILDING	FLT-211C	AHU-211
INSTRUMENT	7I-8	PIT	-	221	A	DIFFERENTIAL PRESSURE TRANSMITTER	SOUTH BUILDING	ROOF	SOUTH BUILDING
INSTRUMENT	7I-8	PIT	-	221	B	DIFFERENTIAL PRESSURE TRANSMITTER	SOUTH BUILDING	FLT-221B	AHU-221
INSTRUMENT	7I-8	PIT	-	221	C	DIFFERENTIAL PRESSURE TRANSMITTER	SOUTH BUILDING	FLT-221C	AHU-221
INSTRUMENT	7I-8	TT	-	111	A	TEMPERATURE TRANSMITTER	NORTH BUILDING	ROOF	OAT
INSTRUMENT	7I-8	TT	-	111	B	TEMPERATURE TRANSMITTER	NORTH BUILDING	NORTH BUILDING	IAT
INSTRUMENT	7I-8	TT	-	121	B	TEMPERATURE TRANSMITTER	NORTH BUILDING	NORTH BUILDING	IAT
INSTRUMENT	7I-8	TT	-	211	B	TEMPERATURE TRANSMITTER	SOUTH BUILDING	SOUTH BUILDING	IAT
INSTRUMENT	7I-8	TT	-	221	A	TEMPERATURE TRANSMITTER	SOUTH BUILDING	ROOF	OAT
INSTRUMENT	7I-8	TT	-	221	B	TEMPERATURE TRANSMITTER	SOUTH BUILDING	NORTH BUILDING	IAT
INSTRUMENT	7I-9	TIT	-	115	A	TEMPERATURE TRANSMITTER	HEX-115	ROOF	AHU-115
INSTRUMENT	7I-9	TIT	-	115	B	TEMPERATURE TRANSMITTER	HEX-115	ROOF	AHU-115
INSTRUMENT	7I-9	TIT	-	115	C	TEMPERATURE TRANSMITTER	HEX-115A	ROOF	AHU-115
INSTRUMENT	7I-9	TIT	-	115	D	TEMPERATURE TRANSMITTER	HEX-115A	ROOF	AHU-115
INSTRUMENT	7I-9	TIT	-	125	A	TEMPERATURE TRANSMITTER	HEX-125	ROOF	AHU-125
INSTRUMENT	7I-9	TIT	-	125	B	TEMPERATURE TRANSMITTER	HEX-125	ROOF	AHU-125
INSTRUMENT	7I-9	TIT	-	125	C	TEMPERATURE TRANSMITTER	HEX-125A	ROOF	AHU-125
INSTRUMENT	7I-9	TIT	-	125	D	TEMPERATURE TRANSMITTER	HEX-125A	ROOF	AHU-125
INSTRUMENT	7I-9	TIT	-	215	A	TEMPERATURE TRANSMITTER	HEX-215	ROOF	AHU-215
INSTRUMENT	7I-9	TIT	-	215	B	TEMPERATURE TRANSMITTER	HEX-215	ROOF	AHU-215

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APPENDIX C - INSTRUMENTATION TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
INSTRUMENT	7I-9		TIT - 215	215	C	TEMPERATURE TRANSMITTER	HEX-215A	ROOF	AHU-215
INSTRUMENT	7I-9		TIT - 215	215	D	TEMPERATURE TRANSMITTER	HEX-215A	ROOF	AHU-215
INSTRUMENT	7I-9		TIT - 225	225	A	TEMPERATURE TRANSMITTER	HEX-225	ROOF	AHU-225
INSTRUMENT	7I-9		TIT - 225	225	B	TEMPERATURE TRANSMITTER	HEX-225	ROOF	AHU-225
INSTRUMENT	7I-9		TIT - 225	225	C	TEMPERATURE TRANSMITTER	HEX-225A	ROOF	AHU-225
INSTRUMENT	7I-9		TIT - 225	225	D	TEMPERATURE TRANSMITTER	HEX-225A	ROOF	AHU-225
INSTRUMENT	7I-11		PI - 771	771		PRESSURE GAGE	HT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		PI - 772	772		PRESSURE GAGE	LT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		PI - 773	773		PRESSURE GAGE	HT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		PI - 774	774		PRESSURE GAGE	LT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		PI - 781	781		PRESSURE GAGE	HT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		PI - 782	782		PRESSURE GAGE	LT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		PI - 783	783		PRESSURE GAGE	HT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		PI - 784	784		PRESSURE GAGE	LT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		TI - 702	702		TEMPERATURE INDICATOR	HT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		TI - 703	703		TEMPERATURE INDICATOR	HT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		TI - 705	705		TEMPERATURE INDICATOR	HT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		TI - 706	706		TEMPERATURE INDICATOR	HT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		TI - 708	708		TEMPERATURE INDICATOR	LT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		TI - 710	710		TEMPERATURE INDICATOR	LT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		TI - 711	711		TEMPERATURE INDICATOR	LT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		TI - 711	711		TEMPERATURE INDICATOR	LT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		TI - 722	722		TEMPERATURE INDICATOR	HT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		TI - 723	723		TEMPERATURE INDICATOR	HT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		TI - 725	725		TEMPERATURE INDICATOR	HT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		TI - 726	726		TEMPERATURE INDICATOR	HT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		TI - 728	728		TEMPERATURE INDICATOR	LT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		TI - 730	730		TEMPERATURE INDICATOR	LT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		TI - 731	731		TEMPERATURE INDICATOR	LT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		TI - 731	731		TEMPERATURE INDICATOR	LT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		TI - 771	771	A	TEMPERATURE INDICATOR	HT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		TI - 771	771		TEMPERATURE INDICATOR	HT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		TI - 772	772	A	TEMPERATURE INDICATOR	LT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		TI - 772	772		TEMPERATURE INDICATOR	LT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		TI - 773	773	A	TEMPERATURE INDICATOR	HT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		TI - 773	773		TEMPERATURE INDICATOR	HT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		TI - 774	774	A	TEMPERATURE INDICATOR	LT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		TI - 774	774		TEMPERATURE INDICATOR	LT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		TI - 781	781	A	TEMPERATURE INDICATOR	HT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		TI - 781	781		TEMPERATURE INDICATOR	HT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		TI - 782	782	A	TEMPERATURE INDICATOR	LT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		TI - 782	782		TEMPERATURE INDICATOR	LT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		TI - 783	783	A	TEMPERATURE INDICATOR	HT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		TI - 783	783		TEMPERATURE INDICATOR	HT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		TI - 784	784	A	TEMPERATURE INDICATOR	LT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		TI - 784	784		TEMPERATURE INDICATOR	LT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		TIT - 771	771		TEMPERATURE INDICATING TRANSMITTER	HT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		TIT - 772	772		TEMPERATURE INDICATING TRANSMITTER	LT LOOP	NORTH BUILDING	GEN-110
INSTRUMENT	7I-11		TIT - 773	773		TEMPERATURE INDICATING TRANSMITTER	HT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		TIT - 774	774		TEMPERATURE INDICATING TRANSMITTER	LT LOOP	NORTH BUILDING	GEN-120
INSTRUMENT	7I-11		TIT - 781	781		TEMPERATURE INDICATING TRANSMITTER	HT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		TIT - 782	782		TEMPERATURE INDICATING TRANSMITTER	LT LOOP	SOUTH BUILDING	GEN-210
INSTRUMENT	7I-11		TIT - 783	783		TEMPERATURE INDICATING TRANSMITTER	HT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		TIT - 784	784		TEMPERATURE INDICATING TRANSMITTER	LT LOOP	SOUTH BUILDING	GEN-220
INSTRUMENT	7I-11		ZSC - 741	741		LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM

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APPENDIX C - INSTRUMENTATION TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
INSTRUMENT	7I-11	ZSC	-742			LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM
INSTRUMENT	7I-11	ZSC	-743			LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM
INSTRUMENT	7I-11	ZSC	-744			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM
INSTRUMENT	7I-11	ZSC	-745			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM
INSTRUMENT	7I-11	ZSC	-746			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM
INSTRUMENT	7I-11	ZSO	-741			LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM
INSTRUMENT	7I-11	ZSO	-742			LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM
INSTRUMENT	7I-11	ZSO	-743			LIMIT SWITCH	LT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM
INSTRUMENT	7I-11	ZSO	-744			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM
INSTRUMENT	7I-11	ZSO	-745			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM
INSTRUMENT	7I-11	ZSO	-746			LIMIT SWITCH	HT WW HEX BYPASS ISO VLV	VALVE	COOLING SYSTEM
INSTRUMENT	7I-13	LE	-347			LEVEL TRANSDUCER	WASTE LUBE OIL STORAGE TANK	FUEL/OIL STORAGE AREA	WASTE LUBE OIL
INSTRUMENT	7I-13	LSH	-347	A		LEVEL SWITCH	WASTE LUBE OIL STORAGE TANK	FUEL/OIL STORAGE AREA	WASTE LUBE OIL
INSTRUMENT	7I-13	LSH	-347			LEVEL SWITCH	WASTE LUBE OIL STORAGE TANK	FUEL/OIL STORAGE AREA	WASTE LUBE OIL
INSTRUMENT	7I-13	PSH	-331			PRESSURE SWITCH	WASTE LUBE OIL	GEN-110	WASTE LUBE OIL PUMP
INSTRUMENT	7I-13	PSH	-332			PRESSURE SWITCH	WASTE LUBE OIL	GEN-120	WASTE LUBE OIL PUMP
INSTRUMENT	7I-13	PSH	-333			PRESSURE SWITCH	WASTE LUBE OIL	GEN-210	WASTE LUBE OIL PUMP
INSTRUMENT	7I-13	PSH	-334			PRESSURE SWITCH	WASTE LUBE OIL	GEN-220	WASTE LUBE OIL PUMP
INSTRUMENT	7I-13	ZSO	-331			VALVE POSITION	WASTE LUBE OIL	GEN-110	WASTE LUBE OIL PUMP
INSTRUMENT	7I-13	ZSO	-332			VALVE POSITION	WASTE LUBE OIL	GEN-120	WASTE LUBE OIL PUMP
INSTRUMENT	7I-13	ZSO	-333			VALVE POSITION	WASTE LUBE OIL	GEN-210	WASTE LUBE OIL PUMP
INSTRUMENT	7I-13	ZSO	-334			VALVE POSITION	WASTE LUBE OIL	GEN-220	WASTE LUBE OIL PUMP
INSTRUMENT	7I-14	FE	-315			FLOW METER	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	FE	-316			FLOW METER	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	FSH	-315			FLOW SWITCH	LUBE OIL DAY TANK	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	FSH	-316			FLOW SWITCH	LUBE OIL DAY TANK	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	LE	-315			LEVEL TRANSDUCER	LUBE OIL DAY TANK	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	LE	-316			LEVEL TRANSDUCER	LUBE OIL DAY TANK	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	LE	-345			LEVEL TRANSDUCER	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	LE	-346			LEVEL TRANSDUCER	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	LSH	-345	A		LEVEL SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	LSH	-345	B		LEVEL SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	LSH	-346	A		LEVEL SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	LSH	-346	B		LEVEL SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	ZSC	-345	A		POSITION SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	ZSC	-345	B		POSITION SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	ZSC	-346	A		POSITION SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-14	ZSC	-346	B		POSITION SWITCH	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL
INSTRUMENT	7I-15	PNL	-071	A		CARBON MONOXIDE DETECTOR	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-071	B		CARBON MONOXIDE DETECTOR	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-072	A		COMBUSTIBLE GAS DETECTOR	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-072	B		COMBUSTIBLE GAS DETECTOR	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-073	A		SMOKE DETECTOR	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-073	B		SMOKE DETECTOR	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-075	A		CARBON MONOXIDE DETECTOR	CONTROL ROOM	CONTROL ROOM	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-076	A		COMBUSTIBLE GAS DETECTOR	CONTROL ROOM	CONTROL ROOM	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-077	A		SMOKE DETECTOR	CONTROL ROOM	CONTROL ROOM	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-171	A		CARBON MONOXIDE DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-171	B		CARBON MONOXIDE DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-171	C		CARBON MONOXIDE DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-171	D		CARBON MONOXIDE DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-172	A		COMBUSTIBLE GAS DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-172	B		COMBUSTIBLE GAS DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-172	C		COMBUSTIBLE GAS DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	7I-15	PNL	-172	D		COMBUSTIBLE GAS DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY

13300 Instrumentation and Control
APPENDIX C - INSTRUMENTATION TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
INSTRUMENT	71-15	PNL	-173	A		SMOKE DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-173	B		SMOKE DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-173	C		SMOKE DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-173	D		SMOKE DETECTOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-271	A		CARBON MONOXIDE DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-271	B		CARBON MONOXIDE DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-271	C		CARBON MONOXIDE DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-271	D		CARBON MONOXIDE DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-272	A		COMBUSTIBLE GAS DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-272	B		COMBUSTIBLE GAS DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-272	C		COMBUSTIBLE GAS DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-272	D		COMBUSTIBLE GAS DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-273	A		SMOKE DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-273	B		SMOKE DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-273	C		SMOKE DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-273	D		SMOKE DETECTOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	PNL	-373	A		SMOKE DETECTOR	FUEL OIL STORAGE	FUEL OIL STORAGE	LIFE SAFETY
INSTRUMENT	71-15	PNL	-373	B		SMOKE DETECTOR	FUEL OIL STORAGE	FUEL OIL STORAGE	LIFE SAFETY
INSTRUMENT	71-15	PNL	-373	C		SMOKE DETECTOR	FUEL OIL STORAGE	FUEL OIL STORAGE	LIFE SAFETY
INSTRUMENT	71-15	PNL	-373	D		SMOKE DETECTOR	FUEL OIL STORAGE	FUEL OIL STORAGE	LIFE SAFETY
INSTRUMENT	71-15	SE	-072	A		COMBUSTIBLE GAS SENSOR	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY
INSTRUMENT	71-15	SE	-072	B		COMBUSTIBLE GAS SENSOR	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY
INSTRUMENT	71-15	SE	-076	A		COMBUSTIBLE GAS SENSOR	CONTROL ROOM	CONTROL ROOM	LIFE SAFETY
INSTRUMENT	71-15	SE	-172	A		COMBUSTIBLE GAS SENSOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	SE	-172	B		COMBUSTIBLE GAS SENSOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	SE	-172	C		COMBUSTIBLE GAS SENSOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	SE	-172	D		COMBUSTIBLE GAS SENSOR	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	SE	-272	A		COMBUSTIBLE GAS SENSOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	SE	-272	B		COMBUSTIBLE GAS SENSOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	SE	-272	C		COMBUSTIBLE GAS SENSOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-15	SE	-272	D		COMBUSTIBLE GAS SENSOR	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-16	FSH	-170			FLOW SWITCH	SAFETY EYEWASH SHOWER	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	71-16	FSH	-270			FLOW SWITCH	SAFETY EYEWASH SHOWER	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-16	FSH	-370			FLOW SWITCH	SAFETY EYEWASH SHOWER	FUEL/ OIL STORAGE	LIFE SAFETY
INSTRUMENT	71-16	HS	-170	A		HAND SWITCH	SAFETY EYEWASH SHOWER	NORTH BUILDING	LIFE SAFETY
INSTRUMENT	71-16	HS	-270	A		HAND SWITCH	SAFETY EYEWASH SHOWER	SOUTH BUILDING	LIFE SAFETY
INSTRUMENT	71-16	HS	-370	A		HAND SWITCH	SAFETY EYEWASH SHOWER	FUEL/ OIL STORAGE	LIFE SAFETY
INSTRUMENT	71-16	LSH	-050			FLOAT SWITCH	HOLDING TANK	NORTH BUILDING	SUMP PUMPS
INSTRUMENT	71-16	LSH	-051			FLOAT SWITCH	HOLDING TANK	NORTH BUILDING	SUMP PUMPS
INSTRUMENT	71-16	LSH	-052			FLOAT SWITCH	HOLDING TANK	SOUTH BUILDING	SUMP PUMPS
INSTRUMENT	71-16	LSHH	-050			FLOAT SWITCH	HOLDING TANK	NORTH BUILDING	SUMP PUMPS
INSTRUMENT	71-16	PSH	-375			SPRINKLER RISER	FUEL OIL STORAGE	FUEL OIL STORAGE	LIFE SAFETY
INSTRUMENT	71-16	PSL	-375			SPRINKLER RISER	FUEL OIL STORAGE	FUEL OIL STORAGE	LIFE SAFETY
INSTRUMENT	71-16	SD	-061			SMOKE DETECTOR	ELECTRICAL BUILDING AC UNIT	ELECTRICAL BUILDING AC UNIT	LIFE SAFETY
INSTRUMENT	71-16	SD	-062			SMOKE DETECTOR	ELECTRICAL BUILDING AC UNIT	ELECTRICAL BUILDING AC UNIT	LIFE SAFETY

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APPENDIX D - EQUIPEMENT TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
EQUIPMENT	1I-1	1	BKR	1111		52 BREAKER	VFD-500	SWITCHGEAR NO.1	4160VAC
EQUIPMENT	1I-1	1	BKR	2312		52 BREAKER	VFD-400	SWITCHGEAR NO.2	4160VAC
EQUIPMENT	1I-1	1	FMR	400		FEEDER MANAGEMENT RELAY	VFD-400	SWITCHGEAR NO.2	4160VAC
EQUIPMENT	1I-1	1	FMR	500		FEEDER MANAGEMENT RELAY	VFD-500	SWITCHGEAR NO.1	4160VAC
EQUIPMENT	1I-1	1	MMR	400		MOTOR MANAGEMENT RELAY	MOTOR 400	PNL-400	SEWAGE PUMP 400
EQUIPMENT	1I-1	1	MMR	500		MOTOR MANAGEMENT RELAY	MOTOR 500	PNL-500	SEWAGE PUMP 500
EQUIPMENT	1I-1	1	MTR	400		MOTOR	SEWAGE PUMP 400	PUMP MOTOR ROOM	SEWAGE PUMP 400
EQUIPMENT	1I-1	1	MTR	500		MOTOR	SEWAGE PUMP 500	PUMP MOTOR ROOM	SEWAGE PUMP 500
EQUIPMENT	1I-1	1	PNL	400		PUMP CONTROL SYSTEM PANEL	MOTOR 400	(E) ENGINE ROOM	SEWAGE PUMP 400
EQUIPMENT	1I-1	1	PNL	500		PUMP CONTROL SYSTEM PANEL	MOTOR 500	(E) ENGINE ROOM	SEWAGE PUMP 500
EQUIPMENT	1I-1	1	UPS	400		UPS	VFD & VIBRATION CONTROLLER	PNL-400	SEWAGE PUMP 400
EQUIPMENT	1I-1	1	UPS	500		UPS	VFD & VIBRATION CONTROLLER	PNL-500	SEWAGE PUMP 500
EQUIPMENT	1I-1	1	VFD	400		VFD	MOTOR 400	PNL-400	SEWAGE PUMP 400
EQUIPMENT	1I-1	1	VFD	500		VFD	MOTOR 500	PNL-500	SEWAGE PUMP 500
EQUIPMENT	1I-1	1	VT	400		VIBRATION CONTROLLER	MOTOR 400	PUMP MOTOR ROOM	SEWAGE PUMP 400
EQUIPMENT	1I-1	1	VT	500		VIBRATION CONTROLLER	MOTOR 500	PUMP MOTOR ROOM	SEWAGE PUMP 500
EQUIPMENT	2I-1	1	PNL	610		SYNC CHECK/CLOSED TRANSITION PANEL	USS-1	(E) ELECTRICAL ROOM	SYNCH CHECK/ CLOSED TRANSITION PANEL
EQUIPMENT	7I-1	1	BAT	110		GENERATOR INSTRUMENT BATTERY	GEN-110	NORTH BUILDING	GEN-110
EQUIPMENT	7I-1	1	BAT	120		GENERATOR INSTRUMENT BATTERY	GEN-120	NORTH BUILDING	GEN-120
EQUIPMENT	7I-1	1	BKR	3110		52 BREAKER	GEN-110	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-1	1	BKR	3210		52 BREAKER	GEN-210	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-1	1	ENG	120		ENGINE	GEN-120	NORTH BUILDING	GEN-120
EQUIPMENT	7I-1	1	FMR	3110		FEEDER MANAGEMENT RELAY	GEN-110	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-1	1	FMR	3210		FEEDER MANAGEMENT RELAY	GEN-210	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-1	1	GEN	120		GENERATOR	GEN-120	NORTH BUILDING	GEN-120
EQUIPMENT	7I-1	1	GMR	3110		GENERATOR MANAGEMENT RELAY	GEN-110	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-1	1	GMR	3210		GENERATOR MANAGEMENT RELAY	GEN-210	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-1	1	HAS	120		GENERATOR REMOTE CONTROLLER	GEN-120	ELECTRICAL BUILDING	GEN-120
EQUIPMENT	7I-1	1	SV	110		ENGINE START VALVE	GEN-110	NORTH BUILDING	GEN-110
EQUIPMENT	7I-1	1	SV	120		ENGINE START VALVE	GEN-120	NORTH BUILDING	GEN-120
EQUIPMENT	7I-1	1	TEMS	120		GENERATOR LOCAL CONTROLLER	GEN-120	NORTH BUILDING	GEN-120
EQUIPMENT	7I-3	1	BAT	210		GENERATOR INSTRUMENT BATTERY	GEN-210	SOUTH BUILDING	GEN-210
EQUIPMENT	7I-3	1	BAT	220		GENERATOR INSTRUMENT BATTERY	GEN-220	SOUTH BUILDING	GEN-220
EQUIPMENT	7I-3	1	BKR	3120		52 BREAKER	GEN-120	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-3	1	BKR	3220		52 BREAKER	GEN-220	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-3	1	ENG	210		ENGINE	GEN-210	SOUTH BUILDING	GEN-210
EQUIPMENT	7I-3	1	ENG	220		ENGINE	GEN-220	SOUTH BUILDING	GEN-220
EQUIPMENT	7I-3	1	FMR	3120		FEEDER MANAGEMENT RELAY	GEN-120	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-3	1	FMR	3220		FEEDER MANAGEMENT RELAY	GEN-220	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-3	1	GEN	210		GENERATOR	GEN-210	SOUTH BUILDING	GEN-210
EQUIPMENT	7I-3	1	GEN	220		GENERATOR	GEN-220	SOUTH BUILDING	GEN-220
EQUIPMENT	7I-3	1	GMR	3120		GENERATOR MANAGEMENT RELAY	GEN-120	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-3	1	GMR	3220		GENERATOR MANAGEMENT RELAY	GEN-220	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	7I-3	1	HAS	210		GENERATOR REMOTE CONTROLLER	GEN-210	ELECTRICAL BUILDING	GEN-210
EQUIPMENT	7I-3	1	HAS	220		GENERATOR REMOTE CONTROLLER	GEN-220	ELECTRICAL BUILDING	GEN-220
EQUIPMENT	7I-3	1	SV	210		ENGINE START VALVE	GEN-210	SOUTH BUILDING	GEN-110
EQUIPMENT	7I-3	1	SV	210		ENGINE START VALVE	GEN-210	SOUTH BUILDING	GEN-110
EQUIPMENT	7I-3	1	SV	220		ENGINE START VALVE	GEN-220	SOUTH BUILDING	GEN-220
EQUIPMENT	7I-3	1	TEMS	210		GENERATOR LOCAL CONTROLLER	GEN-210	SOUTH BUILDING	GEN-210
EQUIPMENT	7I-3	1	TEMS	220		GENERATOR LOCAL CONTROLLER	GEN-220	SOUTH BUILDING	GEN-220
EQUIPMENT	7I-4	1	PNL	310	A	AUTOMATIC FUEL PORT CONTROL PANEL	DIESEL FUEL	FUEL/ OIL STORAGE AREA	FUEL/ OIL STORAGE AREA
EQUIPMENT	7I-4	1	PNL	310		DIESEL FUEL STORAGE TANK LOCAL CONTROL PANEL	DIESEL FUEL	FUEL/ OIL STORAGE AREA	FUEL/ OIL STORAGE AREA
EQUIPMENT	7I-4	1	PNL	311		FUEL POLISHING SYSTEM	DIESEL FUEL	FUEL/ OIL STORAGE AREA	FUEL/ OIL STORAGE AREA
EQUIPMENT	7I-4	1	PSV	310	A	PRESSURE SAFETY VALVE	DIESEL FUEL	TNK-310	FUEL/ OIL STORAGE AREA
EQUIPMENT	7I-4	1	PSV	310		PRESSURE SAFETY VALVE	DIESEL FUEL	TNK-310	FUEL/ OIL STORAGE AREA

13300 Instrumentation and Control
APPENDIX D - EQUIPEMENT TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
EQUIPMENT	7I-4	SV-	310	A	SOLENOID VALVE	DIESEL FUEL	PNL-310A	FUEL/ OIL STORAGE AREA	
EQUIPMENT	7I-4	TNK-	310		TANK	DIESEL FUEL	FUEL/ OIL STORAGE AREA	FUEL/ OIL STORAGE AREA	
EQUIPMENT	7I-5	PMP-	312		RETURN PUMP	NORTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-5	PMP-	314		RETURN PUMP	SOUTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-5	PNL-	312		DIESEL DAY TANK CONTROL PANEL	NORTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-5	PNL-	314		DIESEL DAY TANK CONTROL PANEL	SOUTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-5	PSV-	312	A	PRESSURE SAFETY VALVE	NORTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-5	PSV-	312	B	PRESSURE SAFETY VALVE	NORTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-5	PSV-	314	A	PRESSURE SAFETY VALVE	SOUTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-5	PSV-	314	B	PRESSURE SAFETY VALVE	SOUTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-5	SV-	312		SOLENOID VALVE	NORTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-5	SV-	314		SOLENOID VALVE	SOUTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-5	TNK-	312		DIESEL DAY TANK	NORTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-5	TNK-	314		DIESEL DAY TANK	SOUTH BUILDING	DIESEL DAY TANK	DIESEL FUEL	
EQUIPMENT	7I-6	ACP-	141		AIR COMPRESSOR	NORTH BUILDING	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	ACP-	142		AIR COMPRESSOR	NORTH BUILDING	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	ACP-	241		AIR COMPRESSOR	SOUTH BUILDING	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	ACP-	242		AIR COMPRESSOR	SOUTH BUILDING	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	FLT-	140		AIR FILTER	PRE-FILTER AIR DRYER	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	FLT-	141		AIR FILTER	AFTER FILTER AIR RECEIVER	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	FLT-	142		AIR FILTER	FINAL FILTER EQUIPMENT	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	FLT-	240		AIR FILTER	PRE-FILTER AIR DRYER	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	FLT-	241		AIR FILTER	AFTER FILTER AIR RECEIVER	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	FLT-	242		AIR FILTER	FINAL FILTER EQUIPMENT	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	PCV-	140	A	PRESSURE CONTROL VALVE	GEN-110	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	PCV-	140	B	PRESSURE CONTROL VALVE	GEN-120	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	PCV-	140	C	PRESSURE CONTROL VALVE	SCR	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	PCV-	240	A	PRESSURE CONTROL VALVE	GEN-210	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	PCV-	240	B	PRESSURE CONTROL VALVE	GEN-220	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	PCV-	240	C	PRESSURE CONTROL VALVE	SCR	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	PNL-	140		AIR COMPRESSOR PANEL	NORTH BUILDING	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	PNL-	240		AIR COMPRESSOR PANEL	SOUTH BUILDING	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	PSV-	140		PRESSURE SAFETY VALVE	EQUIPMENT	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	PSV-	240		PRESSURE SAFETY VALVE	EQUIPMENT	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	RAD-	143		AIR DRYER	AIR RECEIVER	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	RAD-	243		AIR DRYER	AIR RECEIVER	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	TNK-	140		AIR RECEIVER	COMPRESSED AIR	NORTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-6	TNK-	240		AIR RECEIVER	COMPRESSED AIR	SOUTH BUILDING	COMPRESSED AIR	
EQUIPMENT	7I-7	B-	110		BLOWER PACKAGE	GEN-110	NORTH BUILDING	GEN-110	
EQUIPMENT	7I-7	B-	120		BLOWER PACKAGE	GEN-120	NORTH BUILDING	GEN-110	
EQUIPMENT	7I-7	B-	210		BLOWER PACKAGE	GEN-210	SOUTH BUILDING	GEN-110	
EQUIPMENT	7I-7	B-	220		BLOWER PACKAGE	GEN-220	SOUTH BUILDING	GEN-110	
EQUIPMENT	7I-7	CEMS-	110		EMISSIONS CONTROLLER	GEN-110	NORTH BUILDING	GEN-110	
EQUIPMENT	7I-7	CEMS-	120		EMISSIONS CONTROLLER	GEN-120	NORTH BUILDING	GEN-120	
EQUIPMENT	7I-7	CEMS-	210		EMISSIONS CONTROLLER	GEN-210	SOUTH BUILDING	GEN-210	
EQUIPMENT	7I-7	CEMS-	220		EMISSIONS CONTROLLER	GEN-220	SOUTH BUILDING	GEN-220	
EQUIPMENT	7I-7	LT-	160		LEVEL TRANSMITTER	UREA TANK	NORTH BUILDING	UREA	
EQUIPMENT	7I-7	LT-	260		LEVEL TRANSMITTER	UREA TANK	SOUTH BUILDING	UREA	
EQUIPMENT	7I-7	PMP-	110		PUMP	UREA	NORTH BUILDING	GEN-110	
EQUIPMENT	7I-7	PMP-	120		PUMP	UREA	NORTH BUILDING	GEN-120	
EQUIPMENT	7I-7	PMP-	210		PUMP	UREA	SOUTH BUILDING	GEN-210	
EQUIPMENT	7I-7	PMP-	220		PUMP	UREA	SOUTH BUILDING	GEN-220	
EQUIPMENT	7I-7	SCR-	110		SCR CONTROLLER	GEN-110	NORTH BUILDING	GEN-110	
EQUIPMENT	7I-7	SCR-	120		SCR CONTROLLER	GEN-120	NORTH BUILDING	GEN-120	
EQUIPMENT	7I-7	SCR-	210		SCR CONTROLLER	GEN-210	SOUTH BUILDING	GEN-210	

13300 Instrumentation and Control
APPENDIX D - EQUIPEMENT TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
EQUIPMENT		71-7	SCR	-220		SCR CONTROLLER	GEN-220	SOUTH BUILDING	GEN-220
EQUIPMENT		71-7	TNK	-160		TANK	NORTH BUILDING	NORTH BUILDING	UREA
EQUIPMENT		71-7	TNK	-260		TANK	NORTH BUILDING	NORTH BUILDING	UREA
EQUIPMENT		71-8	AHU	-111		PACKAGED EQUIPMENT	NORTH BUILDING	ROOF	AHU-111
EQUIPMENT		71-8	AHU	-121		PACKAGED EQUIPMENT	NORTH BUILDING	ROOF	AHU-121
EQUIPMENT		71-8	AHU	-211		PACKAGED EQUIPMENT	SOUTH BUILDING	ROOF	AHU-211
EQUIPMENT		71-8	AHU	-221		PACKAGED EQUIPMENT	SOUTH BUILDING	ROOF	AHU-221
EQUIPMENT		71-8	DC	-111	A	FIELD DISCONNECT SWITCH	FAN NO.1	AHU-111	SUPPLY FAN NO.1
EQUIPMENT		71-8	DC	-111	C	FIELD DISCONNECT SWITCH	DPR-111	AHU-111	SUPPLY FAN NO.1
EQUIPMENT		71-8	DC	-112	A	FIELD DISCONNECT SWITCH	FAN NO.2	AHU-111	SUPPLY FAN NO.2
EQUIPMENT		71-8	DC	-112	C	FIELD DISCONNECT SWITCH	DPR-112	AHU-111	SUPPLY FAN NO.2
EQUIPMENT		71-8	DC	-113	A	FIELD DISCONNECT SWITCH	FAN NO.3	AHU-111	SUPPLY FAN NO.3
EQUIPMENT		71-8	DC	-113	C	FIELD DISCONNECT SWITCH	DPR-113	AHU-111	SUPPLY FAN NO.3
EQUIPMENT		71-8	DC	-114	A	FIELD DISCONNECT SWITCH	FAN NO.4	AHU-111	SUPPLY FAN NO.4
EQUIPMENT		71-8	DC	-114	C	FIELD DISCONNECT SWITCH	DPR-114	AHU-111	SUPPLY FAN NO.4
EQUIPMENT		71-8	DC	-121	A	FIELD DISCONNECT SWITCH	FAN NO.1	AHU-121	SUPPLY FAN NO.1
EQUIPMENT		71-8	DC	-121	C	FIELD DISCONNECT SWITCH	DPR-121	AHU-121	SUPPLY FAN NO.1
EQUIPMENT		71-8	DC	-122	A	FIELD DISCONNECT SWITCH	FAN NO.2	AHU-121	SUPPLY FAN NO.2
EQUIPMENT		71-8	DC	-122	C	FIELD DISCONNECT SWITCH	DPR-122	AHU-121	SUPPLY FAN NO.2
EQUIPMENT		71-8	DC	-123	A	FIELD DISCONNECT SWITCH	FAN NO.3	AHU-121	SUPPLY FAN NO.3
EQUIPMENT		71-8	DC	-123	C	FIELD DISCONNECT SWITCH	DPR-123	AHU-121	SUPPLY FAN NO.3
EQUIPMENT		71-8	DC	-211	A	FIELD DISCONNECT SWITCH	FAN NO.1	AHU-211	SUPPLY FAN NO.1
EQUIPMENT		71-8	DC	-211	C	FIELD DISCONNECT SWITCH	DPR-211	AHU-211	SUPPLY FAN NO.1
EQUIPMENT		71-8	DC	-212	A	FIELD DISCONNECT SWITCH	FAN NO.2	AHU-211	SUPPLY FAN NO.2
EQUIPMENT		71-8	DC	-212	C	FIELD DISCONNECT SWITCH	DPR-212	AHU-211	SUPPLY FAN NO.2
EQUIPMENT		71-8	DC	-213	A	FIELD DISCONNECT SWITCH	FAN NO.3	AHU-211	SUPPLY FAN NO.3
EQUIPMENT		71-8	DC	-213	C	FIELD DISCONNECT SWITCH	DPR-213	AHU-211	SUPPLY FAN NO.3
EQUIPMENT		71-8	DC	-214	A	FIELD DISCONNECT SWITCH	FAN NO.4	AHU-211	SUPPLY FAN NO.4
EQUIPMENT		71-8	DC	-214	C	FIELD DISCONNECT SWITCH	DPR-214	AHU-211	SUPPLY FAN NO.4
EQUIPMENT		71-8	DC	-221	A	FIELD DISCONNECT SWITCH	FAN NO.1	AHU-221	SUPPLY FAN NO.1
EQUIPMENT		71-8	DC	-221	C	FIELD DISCONNECT SWITCH	DPR-221	AHU-221	SUPPLY FAN NO.1
EQUIPMENT		71-8	DC	-222	A	FIELD DISCONNECT SWITCH	FAN NO.2	AHU-221	SUPPLY FAN NO.2
EQUIPMENT		71-8	DC	-222	C	FIELD DISCONNECT SWITCH	DPR-222	AHU-221	SUPPLY FAN NO.2
EQUIPMENT		71-8	DC	-223	A	FIELD DISCONNECT SWITCH	FAN NO.3	AHU-221	SUPPLY FAN NO.3
EQUIPMENT		71-8	DC	-223	C	FIELD DISCONNECT SWITCH	DPR-223	AHU-221	SUPPLY FAN NO.3
EQUIPMENT		71-8	DPR	-111		DAMPER	FAN NO.1	AHU-111	SUPPLY FAN NO.1
EQUIPMENT		71-8	DPR	-112		DAMPER	FAN NO.2	AHU-111	SUPPLY FAN NO.2
EQUIPMENT		71-8	DPR	-113		DAMPER	FAN NO.3	AHU-111	SUPPLY FAN NO.3
EQUIPMENT		71-8	DPR	-114		DAMPER	FAN NO.4	AHU-111	SUPPLY FAN NO.4
EQUIPMENT		71-8	DPR	-121		DAMPER	FAN NO.1	AHU-121	SUPPLY FAN NO.1
EQUIPMENT		71-8	DPR	-122		DAMPER	FAN NO.2	AHU-121	SUPPLY FAN NO.2
EQUIPMENT		71-8	DPR	-123		DAMPER	FAN NO.3	AHU-121	SUPPLY FAN NO.3
EQUIPMENT		71-8	DPR	-211		DAMPER	FAN NO.1	AHU-211	SUPPLY FAN NO.1
EQUIPMENT		71-8	DPR	-212		DAMPER	FAN NO.2	AHU-211	SUPPLY FAN NO.2
EQUIPMENT		71-8	DPR	-213		DAMPER	FAN NO.3	AHU-211	SUPPLY FAN NO.3
EQUIPMENT		71-8	DPR	-214		DAMPER	FAN NO.4	AHU-211	SUPPLY FAN NO.4
EQUIPMENT		71-8	DPR	-221		DAMPER	FAN NO.1	AHU-221	SUPPLY FAN NO.1
EQUIPMENT		71-8	DPR	-222		DAMPER	FAN NO.2	AHU-221	SUPPLY FAN NO.2
EQUIPMENT		71-8	DPR	-223		DAMPER	FAN NO.3	AHU-221	SUPPLY FAN NO.3
EQUIPMENT		71-8	FAN	-111		FAN	NORTH BUILDING	AHU-111	SUPPLY FAN NO.1
EQUIPMENT		71-8	FAN	-112		FAN	NORTH BUILDING	AHU-111	SUPPLY FAN NO.2
EQUIPMENT		71-8	FAN	-113		FAN	NORTH BUILDING	AHU-111	SUPPLY FAN NO.3
EQUIPMENT		71-8	FAN	-114		FAN	NORTH BUILDING	AHU-111	SUPPLY FAN NO.4
EQUIPMENT		71-8	FAN	-121		FAN	NORTH BUILDING	AHU-121	SUPPLY FAN NO.1
EQUIPMENT		71-8	FAN	-122		FAN	NORTH BUILDING	AHU-121	SUPPLY FAN NO.2

13300 Instrumentation and Control
APPENDIX D - EQUIPEMENT TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
EQUIPMENT	7I-8	FAN	-	123		FAN	NORTH BUILDING	AHU-121	SUPPLY FAN NO.3
EQUIPMENT	7I-8	FAN	-	211		FAN	SOUTH BUILDING	AHU-211	SUPPLY FAN NO.1
EQUIPMENT	7I-8	FAN	-	212		FAN	SOUTH BUILDING	AHU-211	SUPPLY FAN NO.2
EQUIPMENT	7I-8	FAN	-	213		FAN	SOUTH BUILDING	AHU-211	SUPPLY FAN NO.3
EQUIPMENT	7I-8	FAN	-	214		FAN	SOUTH BUILDING	AHU-211	SUPPLY FAN NO.4
EQUIPMENT	7I-8	FAN	-	221		FAN	SOUTH BUILDING	AHU-221	SUPPLY FAN NO.1
EQUIPMENT	7I-8	FAN	-	222		FAN	SOUTH BUILDING	AHU-221	SUPPLY FAN NO.2
EQUIPMENT	7I-8	FAN	-	223		FAN	SOUTH BUILDING	AHU-221	SUPPLY FAN NO.3
EQUIPMENT	7I-8	FLT	-	111	B	FILTER	NORTH BUILDING	ROOF	AHU-111
EQUIPMENT	7I-8	FLT	-	111	C	FILTER	NORTH BUILDING	ROOF	AHU-111
EQUIPMENT	7I-8	FLT	-	121	B	FILTER	NORTH BUILDING	ROOF	AHU-121
EQUIPMENT	7I-8	FLT	-	121	C	FILTER	NORTH BUILDING	ROOF	AHU-121
EQUIPMENT	7I-8	FLT	-	211	B	FILTER	SOUTH BUILDING	ROOF	AHU-211
EQUIPMENT	7I-8	FLT	-	211	C	FILTER	SOUTH BUILDING	ROOF	AHU-211
EQUIPMENT	7I-8	FLT	-	221	B	FILTER	SOUTH BUILDING	ROOF	AHU-221
EQUIPMENT	7I-8	FLT	-	221	C	FILTER	SOUTH BUILDING	ROOF	AHU-221
EQUIPMENT	7I-8	LVR	-	111		LOUVER	NORTH BUILDING	ROOF	AHU-111
EQUIPMENT	7I-8	LVR	-	121		LOUVER	NORTH BUILDING	ROOF	AHU-121
EQUIPMENT	7I-8	LVR	-	211		LOUVER	SOUTH BUILDING	ROOF	AHU-211
EQUIPMENT	7I-8	LVR	-	221		LOUVER	SOUTH BUILDING	ROOF	AHU-221
EQUIPMENT	7I-8	VFD	-	111		VFD	AHU-111	ELECTRICAL BUILDING	SUPPLY FAN NO.1
EQUIPMENT	7I-8	VFD	-	112		VFD	AHU-111	ELECTRICAL BUILDING	SUPPLY FAN NO.2
EQUIPMENT	7I-8	VFD	-	113		VFD	AHU-111	ELECTRICAL BUILDING	SUPPLY FAN NO.3
EQUIPMENT	7I-8	VFD	-	114		VFD	AHU-111	ELECTRICAL BUILDING	SUPPLY FAN NO.4
EQUIPMENT	7I-8	VFD	-	121		VFD	AHU-121	ELECTRICAL BUILDING	SUPPLY FAN NO.1
EQUIPMENT	7I-8	VFD	-	122		VFD	AHU-121	ELECTRICAL BUILDING	SUPPLY FAN NO.2
EQUIPMENT	7I-8	VFD	-	123		VFD	AHU-121	ELECTRICAL BUILDING	SUPPLY FAN NO.3
EQUIPMENT	7I-8	VFD	-	211		VFD	AHU-211	ELECTRICAL BUILDING	SUPPLY FAN NO.1
EQUIPMENT	7I-8	VFD	-	212		VFD	AHU-211	ELECTRICAL BUILDING	SUPPLY FAN NO.2
EQUIPMENT	7I-8	VFD	-	213		VFD	AHU-211	ELECTRICAL BUILDING	SUPPLY FAN NO.3
EQUIPMENT	7I-8	VFD	-	214		VFD	AHU-211	ELECTRICAL BUILDING	SUPPLY FAN NO.4
EQUIPMENT	7I-8	VFD	-	221		VFD	AHU-221	ELECTRICAL BUILDING	SUPPLY FAN NO.1
EQUIPMENT	7I-8	VFD	-	222		VFD	AHU-221	ELECTRICAL BUILDING	SUPPLY FAN NO.2
EQUIPMENT	7I-8	VFD	-	223		VFD	AHU-221	ELECTRICAL BUILDING	SUPPLY FAN NO.3
EQUIPMENT	7I-9	AHU	-	115		PACKAGED EQUIPMENT	NORTH BUILDING	ROOF	AHU-115
EQUIPMENT	7I-9	AHU	-	125		PACKAGED EQUIPMENT	NORTH BUILDING	ROOF	AHU-125
EQUIPMENT	7I-9	AHU	-	215		PACKAGED EQUIPMENT	SOUTH BUILDING	ROOF	AHU-215
EQUIPMENT	7I-9	AHU	-	225		PACKAGED EQUIPMENT	SOUTH BUILDING	ROOF	AHU-225
EQUIPMENT	7I-9	DC	-	115	A	FIELD DISCONNECT SWITCH	FAN NO.5	AHU-111	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DC	-	115	C	FIELD DISCONNECT SWITCH	DPR-115	AHU-111	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DC	-	116	A	FIELD DISCONNECT SWITCH	FAN NO.6	AHU-111	EXHAUST FAN NO.6
EQUIPMENT	7I-9	DC	-	116	C	FIELD DISCONNECT SWITCH	DPR-116	AHU-111	EXHAUST FAN NO.6
EQUIPMENT	7I-9	DC	-	117	A	FIELD DISCONNECT SWITCH	FAN NO.7	AHU-111	EXHAUST FAN NO.7
EQUIPMENT	7I-9	DC	-	117	C	FIELD DISCONNECT SWITCH	DPR-117	AHU-111	EXHAUST FAN NO.7
EQUIPMENT	7I-9	DC	-	118	A	FIELD DISCONNECT SWITCH	FAN NO.8	AHU-111	EXHAUST FAN NO.8
EQUIPMENT	7I-9	DC	-	118	C	FIELD DISCONNECT SWITCH	DPR-118	AHU-111	EXHAUST FAN NO.8
EQUIPMENT	7I-9	DC	-	125	A	FIELD DISCONNECT SWITCH	FAN NO.5	AHU-121	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DC	-	125	C	FIELD DISCONNECT SWITCH	DPR-125	AHU-121	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DC	-	126	A	FIELD DISCONNECT SWITCH	FAN NO.6	AHU-121	EXHAUST FAN NO.6
EQUIPMENT	7I-9	DC	-	126	C	FIELD DISCONNECT SWITCH	DPR-126	AHU-121	EXHAUST FAN NO.6
EQUIPMENT	7I-9	DC	-	127	A	FIELD DISCONNECT SWITCH	FAN NO.6	AHU-121	EXHAUST FAN NO.7
EQUIPMENT	7I-9	DC	-	127	C	FIELD DISCONNECT SWITCH	DPR-126	AHU-121	EXHAUST FAN NO.7
EQUIPMENT	7I-9	DC	-	215	A	FIELD DISCONNECT SWITCH	FAN NO.5	AHU-211	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DC	-	215	C	FIELD DISCONNECT SWITCH	DPR-215	AHU-211	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DC	-	216	A	FIELD DISCONNECT SWITCH	FAN NO.6	AHU-211	EXHAUST FAN NO.6

13300 Instrumentation and Control
APPENDIX D - EQUIPEMENT TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
EQUIPMENT	7I-9	DC	-	216	C	FIELD DISCONNECT SWITCH	DPR-216	AHU-211	EXHAUST FAN NO.6
EQUIPMENT	7I-9	DC	-	217	A	FIELD DISCONNECT SWITCH	FAN NO.7	AHU-211	EXHAUST FAN NO.7
EQUIPMENT	7I-9	DC	-	217	C	FIELD DISCONNECT SWITCH	DPR-217	AHU-211	EXHAUST FAN NO.7
EQUIPMENT	7I-9	DC	-	218	A	FIELD DISCONNECT SWITCH	FAN NO.8	AHU-211	EXHAUST FAN NO.8
EQUIPMENT	7I-9	DC	-	218	C	FIELD DISCONNECT SWITCH	DPR-218	AHU-211	EXHAUST FAN NO.8
EQUIPMENT	7I-9	DC	-	225	A	FIELD DISCONNECT SWITCH	FAN NO.5	AHU-221	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DC	-	225	C	FIELD DISCONNECT SWITCH	DPR-225	AHU-221	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DC	-	226	A	FIELD DISCONNECT SWITCH	FAN NO.6	AHU-221	EXHAUST FAN NO.6
EQUIPMENT	7I-9	DC	-	226	C	FIELD DISCONNECT SWITCH	DPR-226	AHU-221	EXHAUST FAN NO.6
EQUIPMENT	7I-9	DC	-	227	A	FIELD DISCONNECT SWITCH	FAN NO.7	AHU-221	EXHAUST FAN NO.7
EQUIPMENT	7I-9	DC	-	227	C	FIELD DISCONNECT SWITCH	DPR-227	AHU-221	EXHAUST FAN NO.7
EQUIPMENT	7I-9	DPR	-	115		DAMPER	FAN NO.5	AHU-111	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DPR	-	116		DAMPER	FAN NO.6	AHU-111	EXHAUST FAN NO.6
EQUIPMENT	7I-9	DPR	-	117		DAMPER	FAN NO.7	AHU-111	EXHAUST FAN NO.7
EQUIPMENT	7I-9	DPR	-	118		DAMPER	FAN NO.8	AHU-111	EXHAUST FAN NO.8
EQUIPMENT	7I-9	DPR	-	125		DAMPER	FAN NO.5	AHU-121	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DPR	-	126		DAMPER	FAN NO.6	AHU-121	EXHAUST FAN NO.6
EQUIPMENT	7I-9	DPR	-	127		DAMPER	FAN NO.6	AHU-121	EXHAUST FAN NO.7
EQUIPMENT	7I-9	DPR	-	215		DAMPER	FAN NO.5	AHU-211	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DPR	-	216		DAMPER	FAN NO.6	AHU-211	EXHAUST FAN NO.6
EQUIPMENT	7I-9	DPR	-	217		DAMPER	FAN NO.7	AHU-211	EXHAUST FAN NO.7
EQUIPMENT	7I-9	DPR	-	218		DAMPER	FAN NO.8	AHU-211	EXHAUST FAN NO.8
EQUIPMENT	7I-9	DPR	-	225		DAMPER	FAN NO.5	AHU-221	EXHAUST FAN NO.5
EQUIPMENT	7I-9	DPR	-	226		DAMPER	FAN NO.6	AHU-221	EXHAUST FAN NO.6
EQUIPMENT	7I-9	DPR	-	227		DAMPER	FAN NO.7	AHU-221	EXHAUST FAN NO.7
EQUIPMENT	7I-9	FAN	-	115		FAN	NORTH BUILDING	AHU-111	EXHAUST FAN NO.5
EQUIPMENT	7I-9	FAN	-	116		FAN	NORTH BUILDING	AHU-111	EXHAUST FAN NO.6
EQUIPMENT	7I-9	FAN	-	117		FAN	NORTH BUILDING	AHU-111	EXHAUST FAN NO.7
EQUIPMENT	7I-9	FAN	-	118		FAN	NORTH BUILDING	AHU-111	EXHAUST FAN NO.8
EQUIPMENT	7I-9	FAN	-	125		FAN	NORTH BUILDING	AHU-121	EXHAUST FAN NO.5
EQUIPMENT	7I-9	FAN	-	126		FAN	NORTH BUILDING	AHU-121	EXHAUST FAN NO.6
EQUIPMENT	7I-9	FAN	-	127		FAN	NORTH BUILDING	AHU-121	EXHAUST FAN NO.7
EQUIPMENT	7I-9	FAN	-	215		FAN	SOUTH BUILDING	AHU-211	EXHAUST FAN NO.5
EQUIPMENT	7I-9	FAN	-	216		FAN	SOUTH BUILDING	AHU-211	EXHAUST FAN NO.6
EQUIPMENT	7I-9	FAN	-	217		FAN	SOUTH BUILDING	AHU-211	EXHAUST FAN NO.7
EQUIPMENT	7I-9	FAN	-	218		FAN	SOUTH BUILDING	AHU-211	EXHAUST FAN NO.8
EQUIPMENT	7I-9	FAN	-	225		FAN	NORTH BUILDING	AHU-221	EXHAUST FAN NO.5
EQUIPMENT	7I-9	FAN	-	226		FAN	SOUTH BUILDING	AHU-221	EXHAUST FAN NO.6
EQUIPMENT	7I-9	FAN	-	227		FAN	SOUTH BUILDING	AHU-221	EXHAUST FAN NO.7
EQUIPMENT	7I-9	FLT	-	115	B	FILTER	NORTH BUILDING	ROOF	AHU-115
EQUIPMENT	7I-9	FLT	-	115	C	FILTER	NORTH BUILDING	ROOF	AHU-115
EQUIPMENT	7I-9	FLT	-	125	B	FILTER	NORTH BUILDING	ROOF	AHU-125
EQUIPMENT	7I-9	FLT	-	125	C	FILTER	NORTH BUILDING	ROOF	AHU-125
EQUIPMENT	7I-9	FLT	-	215	B	FILTER	SOUTH BUILDING	ROOF	AHU-215
EQUIPMENT	7I-9	FLT	-	215	C	FILTER	SOUTH BUILDING	ROOF	AHU-215
EQUIPMENT	7I-9	FLT	-	225	B	FILTER	SOUTH BUILDING	ROOF	AHU-225
EQUIPMENT	7I-9	FLT	-	225	C	FILTER	SOUTH BUILDING	ROOF	AHU-225
EQUIPMENT	7I-9	HEX	-	115	A	HEAT EXCHANGER	LT COOLING	ROOF	AHU-115
EQUIPMENT	7I-9	HEX	-	115		HEAT EXCHANGER	HT COOLING	ROOF	AHU-115
EQUIPMENT	7I-9	HEX	-	125	A	HEAT EXCHANGER	LT COOLING	ROOF	AHU-125
EQUIPMENT	7I-9	HEX	-	125		HEAT EXCHANGER	HT COOLING	ROOF	AHU-125
EQUIPMENT	7I-9	HEX	-	215	A	HEAT EXCHANGER	LT COOLING	ROOF	AHU-215
EQUIPMENT	7I-9	HEX	-	215		HEAT EXCHANGER	HT COOLING	ROOF	AHU-215
EQUIPMENT	7I-9	HEX	-	225	A	HEAT EXCHANGER	LT COOLING	ROOF	AHU-225
EQUIPMENT	7I-9	HEX	-	225		HEAT EXCHANGER	HT COOLING	ROOF	AHU-225

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APPENDIX D - EQUIPEMENT TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
EQUIPMENT	7I-9	LVR	-	115		LOUVER	NORTH BUILDING	ROOF	AHU-115
EQUIPMENT	7I-9	LVR	-	125		LOUVER	NORTH BUILDING	ROOF	AHU-125
EQUIPMENT	7I-9	LVR	-	215		LOUVER	SOUTH BUILDING	ROOF	AHU-215
EQUIPMENT	7I-9	LVR	-	225		LOUVER	SOUTH BUILDING	ROOF	AHU-225
EQUIPMENT	7I-9	VFD	-	115		VFD	AHU-115	ELECTRICAL BUILDING	EXHAUST FAN NO.5
EQUIPMENT	7I-9	VFD	-	116		VFD	AHU-115	ELECTRICAL BUILDING	EXHAUST FAN NO.6
EQUIPMENT	7I-9	VFD	-	117		VFD	AHU-115	ELECTRICAL BUILDING	EXHAUST FAN NO.7
EQUIPMENT	7I-9	VFD	-	118		VFD	AHU-115	ELECTRICAL BUILDING	EXHAUST FAN NO.8
EQUIPMENT	7I-9	VFD	-	125		VFD	AHU-125	ELECTRICAL BUILDING	EXHAUST FAN NO.5
EQUIPMENT	7I-9	VFD	-	126		VFD	AHU-125	ELECTRICAL BUILDING	EXHAUST FAN NO.6
EQUIPMENT	7I-9	VFD	-	127		VFD	AHU-125	ELECTRICAL BUILDING	EXHAUST FAN NO.7
EQUIPMENT	7I-9	VFD	-	215		VFD	AHU-215	ELECTRICAL BUILDING	EXHAUST FAN NO.5
EQUIPMENT	7I-9	VFD	-	216		VFD	AHU-215	ELECTRICAL BUILDING	EXHAUST FAN NO.6
EQUIPMENT	7I-9	VFD	-	217		VFD	AHU-215	ELECTRICAL BUILDING	EXHAUST FAN NO.7
EQUIPMENT	7I-9	VFD	-	218		VFD	AHU-215	ELECTRICAL BUILDING	EXHAUST FAN NO.8
EQUIPMENT	7I-9	VFD	-	225		VFD	AHU-225	ELECTRICAL BUILDING	EXHAUST FAN NO.5
EQUIPMENT	7I-9	VFD	-	226		VFD	AHU-225	ELECTRICAL BUILDING	EXHAUST FAN NO.6
EQUIPMENT	7I-9	VFD	-	227		VFD	AHU-225	ELECTRICAL BUILDING	EXHAUST FAN NO.7
EQUIPMENT	7I-10	ARV	-	761		AIR RELEASE VALVE	LT COOLING WATER	ROOF	LT COOLING WATER
EQUIPMENT	7I-10	ARV	-	763		AIR RELEASE VALVE	HT COOLING WATER	ROOF	HT COOLING WATER
EQUIPMENT	7I-10	HEX	-	970		HEAT EXCHANGER	WATER COOLING SYSTEM	(E) LOCATION	WATER COOLING SYSTEM
EQUIPMENT	7I-10	HEX	-	974		HEAT EXCHANGER	WATER COOLING SYSTEM	(E) LOCATION	WATER COOLING SYSTEM
EQUIPMENT	7I-10	PI	-	761		PRESSURE GAGE	LT COOLING WATER	ROOF	LT COOLING WATER
EQUIPMENT	7I-10	PI	-	763		PRESSURE GAGE	HT COOLING WATER	ROOF	HT COOLING WATER
EQUIPMENT	7I-10	PRV	-	762		PRESSURE RELIEF VALVE	LT COOLING WATER	ROOF	LT COOLING WATER
EQUIPMENT	7I-10	PRV	-	764		PRESSURE RELIEF VALVE	HT COOLING WATER	ROOF	HT COOLING WATER
EQUIPMENT	7I-10	TNK	-	761		EXPANSION TANK	LT COOLING WATER	ROOF	LT COOLING WATER
EQUIPMENT	7I-10	TNK	-	762		AIR SEPARATOR	LT COOLING WATER	ROOF	LT COOLING WATER
EQUIPMENT	7I-10	TNK	-	763		EXPANSION TANK	HT COOLING WATER	ROOF	HT COOLING WATER
EQUIPMENT	7I-10	TNK	-	764		AIR SEPARATOR	HT COOLING WATER	ROOF	HT COOLING WATER
EQUIPMENT	7I-10	WS	-	762		WATER SOFTENER	LT COOLING WATER	POWER GENERATION BUILDING	LT COOLING WATER
EQUIPMENT	7I-10	WS	-	764		WATER SOFTENER	HT COOLING WATER	POWER GENERATION BUILDING	HT COOLING WATER
EQUIPMENT	7I-11	ENG	-	110		ENGINE	GEN-110	NORTH BUILDING	GEN-110
EQUIPMENT	7I-11	FV	-	771		3-WAY MOTORIZED VALVE	HT LOOP	NORTH BUILDING	GEN-110
EQUIPMENT	7I-11	FV	-	772		3-WAY MOTORIZED VALVE	LT LOOP	NORTH BUILDING	GEN-110
EQUIPMENT	7I-11	FV	-	773		3-WAY MOTORIZED VALVE	HT LOOP	NORTH BUILDING	GEN-120
EQUIPMENT	7I-11	FV	-	774		3-WAY MOTORIZED VALVE	LT LOOP	NORTH BUILDING	GEN-120
EQUIPMENT	7I-11	FV	-	781		3-WAY MOTORIZED VALVE	HT LOOP	SOUTH BUILDING	GEN-210
EQUIPMENT	7I-11	FV	-	782		3-WAY MOTORIZED VALVE	LT LOOP	SOUTH BUILDING	GEN-210
EQUIPMENT	7I-11	FV	-	783		3-WAY MOTORIZED VALVE	HT LOOP	SOUTH BUILDING	GEN-220
EQUIPMENT	7I-11	FV	-	784		3-WAY MOTORIZED VALVE	LT LOOP	SOUTH BUILDING	GEN-220
EQUIPMENT	7I-11	GEN	-	110		GENERATOR	GEN-110	NORTH BUILDING	GEN-110
EQUIPMENT	7I-11	HAS	-	110		GENERATOR REMOTE CONTROLLER	GEN-110	ELECTRICAL BUILDING	GEN-110
EQUIPMENT	7I-11	HTP	-	110		PUMP	JW PUMP (GEN-110)	NORTH BUILDING	JW PUMP (GEN-110)
EQUIPMENT	7I-11	HTP	-	120		PUMP	JW PUMP (GEN-120)	NORTH BUILDING	JW PUMP (GEN-120)
EQUIPMENT	7I-11	HTP	-	201		PUMP	JW PUMP (GEN-210)	SOUTH BUILDING	JW PUMP (GEN-210)
EQUIPMENT	7I-11	HTP	-	203		PUMP	JW PUMP (GEN-220)	SOUTH BUILDING	JW PUMP (GEN-220)
EQUIPMENT	7I-11	HTX	-	110		DECOUPLING HEAT HEX	HT LOOP	NORTH BUILDING	GEN-110
EQUIPMENT	7I-11	HTX	-	120		DECOUPLING HEAT HEX	HT LOOP	NORTH BUILDING	GEN-120
EQUIPMENT	7I-11	HTX	-	210		DECOUPLING HEAT HEX	HT LOOP	SOUTH BUILDING	GEN-210
EQUIPMENT	7I-11	HTX	-	220		DECOUPLING HEAT HEX	HT LOOP	SOUTH BUILDING	GEN-220
EQUIPMENT	7I-11	LOX	-	110		LUBE OIL HEAT EXCHANGER	ENG-110	NORTH BUILDING	GEN-110
EQUIPMENT	7I-11	LOX	-	210		LUBE OIL HEAT EXCHANGER	ENG-210	SOUTH BUILDING	GEN-210
EQUIPMENT	7I-11	LTP	-	110		PUMP	AC WATER PUMP (GEN-110)	NORTH BUILDING	AC WATER PUMP (GEN-110)
EQUIPMENT	7I-11	LTP	-	120		PUMP	AC WATER PUMP (GEN-120)	NORTH BUILDING	AC WATER PUMP (GEN-120)

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APPENDIX D - EQUIPEMENT TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
EQUIPMENT	7I-11	LTP	-	202		PUMP	AC WATER PUMP (GEN-210)	SOUTH BUILDING	AC WATER PUMP (GEN-210)
EQUIPMENT	7I-11	LTP	-	204		PUMP	AC WATER PUMP (GEN-220)	SOUTH BUILDING	AC WATER PUMP (GEN-220)
EQUIPMENT	7I-11	LTX	-	110		DECOUPLING HEAT HEX	LT LOOP	NORTH BUILDING	GEN-110
EQUIPMENT	7I-11	LTX	-	120		DECOUPLING HEAT HEX	LT LOOP	NORTH BUILDING	GEN-120
EQUIPMENT	7I-11	LTX	-	210		DECOUPLING HEAT HEX	LT LOOP	SOUTH BUILDING	GEN-210
EQUIPMENT	7I-11	LTX	-	220		DECOUPLING HEAT HEX	LT LOOP	SOUTH BUILDING	GEN-220
EQUIPMENT	7I-11	TEMS	-	110		GENERATOR LOCAL CONTROLLER	GEN-110	NORTH BUILDING	GEN-110
EQUIPMENT	7I-11	TNK	-	110	A	EXPANSION TANK	HT ENGINE LOOP	NORTH BUILDING	GEN-110
EQUIPMENT	7I-11	TNK	-	110	B	EXPANSION TANK	LT ENGINE LOOP	NORTH BUILDING	GEN-110
EQUIPMENT	7I-11	TNK	-	120	A	EXPANSION TANK	HT ENGINE LOOP	NORTH BUILDING	GEN-120
EQUIPMENT	7I-11	TNK	-	120	B	EXPANSION TANK	LT ENGINE LOOP	NORTH BUILDING	GEN-120
EQUIPMENT	7I-11	TNK	-	210	A	EXPANSION TANK	HT ENGINE LOOP	SOUTH BUILDING	GEN-210
EQUIPMENT	7I-11	TNK	-	210	B	EXPANSION TANK	LT ENGINE LOOP	SOUTH BUILDING	GEN-210
EQUIPMENT	7I-11	TNK	-	220	A	EXPANSION TANK	HT ENGINE LOOP	SOUTH BUILDING	GEN-220
EQUIPMENT	7I-11	TNK	-	220	B	EXPANSION TANK	LT ENGINE LOOP	SOUTH BUILDING	GEN-220
EQUIPMENT	7I-12	FIT	-	791		FLOW METER	LT COOLING CIRCULATION	TBD	COOLING SYSTEM
EQUIPMENT	7I-12	FIT	-	795		FLOW METER	HT COOLING CIRCULATION	TBD	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	701		MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	702		MOTORIZED VALVE	HT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	703		MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	704		MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	705		MOTORIZED VALVE	HT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	706		MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	707		MOTORIZED VALVE	LT SUPPLY MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	708		MOTORIZED VALVE	LT AIR HEX BYPASS VLV	NORTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	709		MOTORIZED VALVE	LT NAT GAS ENG DECOUPLING FEED VLV	NORTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	710		MOTORIZED VALVE	LT DIESEL ENG DECOUPLING FEED VLV	NORTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	711		MOTORIZED VALVE	LT RETURN MANIFOLD ISO VLV	NORTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	721		MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	722		MOTORIZED VALVE	HT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	723		MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	724		MOTORIZED VALVE	HT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	725		MOTORIZED VALVE	HT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	726		MOTORIZED VALVE	HT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	727		MOTORIZED VALVE	LT SUPPLY MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	728		MOTORIZED VALVE	LT AIR HEX BYPASS VLV	SOUTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	729		MOTORIZED VALVE	LT NAT GAS ENG DECOUPLING FEED VLV	SOUTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	730		MOTORIZED VALVE	LT DIESEL ENG DECOUPLING FEED VLV	SOUTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	FV	-	731		MOTORIZED VALVE	LT RETURN MANIFOLD ISO VLV	SOUTH SIDE	COOLING SYSTEM
EQUIPMENT	7I-12	PMP	-	791		JOCKEY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	PMP	-	792		DUTY PUMP	LT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	PMP	-	793		DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	PMP	-	794		DUTY PUMP	LT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	PMP	-	795		DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	PMP	-	796		DUTY PUMP	HT COOLING CIRCULATION	NORTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	PMP	-	797		EMERGENCY PUMP	HT COOLING CIRCULATION	SOUTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	VFD	-	791		VFD	JOCKEY PUMP	NORTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	VFD	-	792		VFD	DUTY PUMP	NORTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	VFD	-	793		VFD	DUTY PUMP	SOUTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	VFD	-	794		VFD	DUTY PUMP	SOUTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	VFD	-	795		VFD	DUTY PUMP	NORTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	VFD	-	796		VFD	DUTY PUMP	NORTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-12	VFD	-	797		VFD	EMERGENCY PUMP	SOUTH BUILDING	COOLING SYSTEM
EQUIPMENT	7I-13	PMP	-	331		PUMP	WASTE LUBE OIL	GEN-110	WASTE LUBE OIL PUMP
EQUIPMENT	7I-13	PMP	-	332		PUMP	WASTE LUBE OIL	GEN-120	WASTE LUBE OIL PUMP

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APPENDIX D - EQUIPEMENT TAGGING LIST

DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
EQUIPMENT	71-13	PMP	-	333		PUMP	WASTE LUBE OIL	GEN-210	WASTE LUBE OIL PUMP
EQUIPMENT	71-13	PMP	-	334		PUMP	WASTE LUBE OIL	GEN-220	WASTE LUBE OIL PUMP
EQUIPMENT	71-13	PNL	-	331		GEN-110 WASTE PUMP CONTROL PANEL	WASTE LUBE OIL	GEN-110	WASTE LUBE OIL PUMP
EQUIPMENT	71-13	PNL	-	332		GEN-120 WASTE PUMP CONTROL PANEL	WASTE LUBE OIL	GEN-120	WASTE LUBE OIL PUMP
EQUIPMENT	71-13	PNL	-	333		GEN-210 WASTE PUMP CONTROL PANEL	WASTE LUBE OIL	GEN-210	WASTE LUBE OIL PUMP
EQUIPMENT	71-13	PNL	-	334		GEN-220 WASTE PUMP CONTROL PANEL	WASTE LUBE OIL	GEN-220	WASTE LUBE OIL PUMP
EQUIPMENT	71-13	TNK	-	347		WASTE LUBE OIL STORAGE TANK	WASTE LUBE OIL	FUEL/OIL STORAGE AREA	WASTE LUBE OIL
EQUIPMENT	71-14	FV	-	315	A	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	FV	-	315	C	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	FV	-	315	E	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	FV	-	315	G	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	FV	-	315	I	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	FV	-	315	K	MOTORIZED VALVE	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	FV	-	316	A	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	FV	-	316	C	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	FV	-	316	E	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	FV	-	316	G	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	FV	-	316	I	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	FV	-	316	K	MOTORIZED VALVE	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	PMP	-	335		NAT GAS ENGINE SUPPLY LUBE OIL PUMP	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	PMP	-	336		DIESEL ENGINE SUPPLY LUBE OIL PUMP	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	PNL	-	321	A	PORTABLE CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL
EQUIPMENT	71-14	PNL	-	321		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	NORTH BUILDING	SUPPLY LUBE OIL
EQUIPMENT	71-14	PNL	-	322	A	PORTABLE CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL
EQUIPMENT	71-14	PNL	-	322		LUBE OIL SYSTEM CONTROL PANEL	LUBE OIL	SOUTH BUILDING	SUPPLY LUBE OIL
EQUIPMENT	71-14	PRV	-	345	A	PRESSURE RELIEF VALVE	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	PRV	-	346	A	PRESSURE RELIEF VALVE	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	TNK	-	315		LUBE OIL DAY TANK	LUBE OIL	NORTH BUILDING	NAT GAS ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	TNK	-	316		LUBE OIL DAY TANK	LUBE OIL	SOUTH BUILDING	DIESEL ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	TNK	-	345		NAT GAS ENGINE LUBE OIL STORAGE TANK	LUBE OIL	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	TNK	-	346		DIESEL ENGINE LUBE OIL STORAGE TANK	LUBE OIL	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	VFD	-	335		VFD	LUBE OIL PUMP	FUEL/OIL STORAGE AREA	NAT GAS ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-14	VFD	-	336		VFD	LUBE OIL PUMP	FUEL/OIL STORAGE AREA	DIESEL ENGINE SUPPLY LUBE OIL
EQUIPMENT	71-15	BKR	-	3001		52 BREAKER	MAIN TIE	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	BKR	-	3100		52 BREAKER	NORTH TIE	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	BKR	-	3101		52 BREAKER	NORTH SECTION LOAD BANK FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	BKR	-	3112		52 BREAKER	SWG-1 SPACE 12 FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	BKR	-	3114		52 BREAKER	SWG-1 SPACE 14 FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	BKR	-	3200		52 BREAKER	SOUTH TIE	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	BKR	-	3201		52 BREAKER	SOUTH SECTION LOAD BANK FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	BKR	-	3222		52 BREAKER	SWG-2 SPACE 22 FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	BKR	-	3223		52 BREAKER	SWG-2 SPACE 23 FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	FMR	-	3001		FEEDER MANAGEMENT RELAY	MAIN TIE	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	FMR	-	3100		FEEDER MANAGEMENT RELAY	NORTH TIE	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	FMR	-	3101		FEEDER MANAGEMENT RELAY	NORTH SECTION LOAD BANK FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	FMR	-	3112		FEEDER MANAGEMENT RELAY	SWG-1 SPACE 12 FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	FMR	-	3114		FEEDER MANAGEMENT RELAY	SWG-1 SPACE 14 FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	FMR	-	3200		FEEDER MANAGEMENT RELAY	SOUTH TIE	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	FMR	-	3201		FEEDER MANAGEMENT RELAY	SOUTH SECTION LOAD BANK FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	FMR	-	3222		FEEDER MANAGEMENT RELAY	SWG-2 SPACE 22 FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	FMR	-	3223		FEEDER MANAGEMENT RELAY	SWG-2 SPACE 23 FEED	SWITCHGEAR NO.3	4160VAC
EQUIPMENT	71-15	PNL	-	074	A	AUDIBLE ALARM & STROBE	ELECTRICAL BUILDING	ELECTRICAL BUILDING	LIFE SAFETY
EQUIPMENT	71-15	PNL	-	078	A	AUDIBLE ALARM & STROBE	CONTROL ROOM	CONTROL ROOM	LIFE SAFETY
EQUIPMENT	71-15	PNL	-	174	A	AUDIBLE ALARM & STROBE	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
EQUIPMENT	71-15	PNL	-	274	A	AUDIBLE ALARM & STROBE	SOUTH BUILDING	SOUTH BUILDING	LIFE SAFETY

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DEVICE TYPE	P&ID	NO.	TAG	NO.	SUF	DEVICE DESCRIPTION	PRIMARY SERVICE	MAIN DEVICE LOCATION	MAIN SYSTEM ASSOCIATION
EQUIPMENT	7I-15	PNL	-	374	A	AUDIBLE ALARM & STROBE	FUEL OIL STORAGE	FUEL OIL STORAGE	LIFE SAFETY
EQUIPMENT	7I-15	ZAS	-	005		MASTER GENERATOR CONTROLLER	POWER GENERATION FACILITY	ELECTRICAL BUILDING	MASTER GENERATOR CONTROLLER
EQUIPMENT	7I-15	ZSC	-	090	A	LIMIT SWITCH	NORTH BUILDING	NORTH BUILDING	DOOR SWITCHES
EQUIPMENT	7I-15	ZSC	-	090	B	LIMIT SWITCH	NORTH BUILDING	NORTH BUILDING	DOOR SWITCHES
EQUIPMENT	7I-15	ZSC	-	090	C	LIMIT SWITCH	NORTH BUILDING	NORTH BUILDING	DOOR SWITCHES
EQUIPMENT	7I-15	ZSC	-	090	D	LIMIT SWITCH	NORTH BUILDING	NORTH BUILDING	DOOR SWITCHES
EQUIPMENT	7I-15	ZSC	-	090	E	LIMIT SWITCH	SOUTH BUILDING	SOUTH BUILDING	DOOR SWITCHES
EQUIPMENT	7I-15	ZSC	-	090	F	LIMIT SWITCH	SOUTH BUILDING	SOUTH BUILDING	DOOR SWITCHES
EQUIPMENT	7I-15	ZSC	-	090	G	LIMIT SWITCH	SOUTH BUILDING	SOUTH BUILDING	DOOR SWITCHES
EQUIPMENT	7I-16	BNK	-	3000		LOAD BANK	SWITCHEGEAR NO.3	OUTSIDE	4160VAC
EQUIPMENT	7I-16	CMP	-	375		AIR COMPRESSOR	FUEL OIL STORAGE	FUEL OIL STORAGE	LIFE SAFETY
EQUIPMENT	7I-16	PMP	-	051		SUMP PUMP	NORTH BUILDING SUMP	NORTH BUILDING	SUMP PUMPS
EQUIPMENT	7I-16	PMP	-	052		SUMP PUMP	SOUTH BUILDING SUMP	SOUTH BUILDING	SUMP PUMPS
EQUIPMENT	7I-16	SES	-	170		SAFETY EYEWASH SHOWER	NORTH BUILDING	NORTH BUILDING	LIFE SAFETY
EQUIPMENT	7I-16	SES	-	270		SAFETY EYEWASH SHOWER	SOUTH BUILDING	NORTH BUILDING	LIFE SAFETY
EQUIPMENT	7I-16	SES	-	370		SAFETY EYEWASH SHOWER	FUEL/ OIL STORAGE	NORTH BUILDING	LIFE SAFETY
EQUIPMENT	7I-16	SWI	-	081		UPS EXTERNAL BYPASS SWITCH	208/120VAC	ELECTRICAL ROOM	UPS
EQUIPMENT	7I-16	SWI	-	082		UPS EXTERNAL BYPASS SWITCH	125VDC	ELECTRICAL ROOM	UPS
EQUIPMENT	7I-16	TNK	-	050		HOLDING TANK	POWER GENERATION FACILITY	NORTH BUILDING	SUMP PUMPS
EQUIPMENT	7I-16	UPS	-	081		UPS	208/120VAC	ELECTRICAL ROOM	UPS
EQUIPMENT	7I-16	UPS	-	082		UPS	125VDC	ELECTRICAL ROOM	UPS
EQUIPMENT	N/A	AC	-	060		AIR CONDITIONER	CONTROL ROOM	ROOF	AC SYSTEM NO.1
EQUIPMENT	N/A	AC	-	061		AIR CONDITIONER	ELECTRICAL BUILDING	ROOF	AC SYSTEM NO.2
EQUIPMENT	N/A	AC	-	062		AIR CONDITIONER	ELECTRICAL BUILDING	ROOF	AC SYSTEM NO.3
EQUIPMENT	N/A	C	-	150		BRIDGE CRANE	NORTH BUILDING	NORTH BUILDING	BRIDGE CRANE
EQUIPMENT	N/A	C	-	250		BRIDGE CRANE	SOUTH BUILDING	SOUTH BUILDING	BRIDGE CRANE
EQUIPMENT	N/A	G	-	004		ENTRANCE GATE	PS2	NORTH WEST CORNER OF PS2	PS2
EQUIPMENT	N/A	HRG	-	110		HIGH RESISTANCE GROUNDING UNIT	GEN-110	NORTH BUILDING	GENERATOR SOURCE
EQUIPMENT	N/A	HRG	-	120		HIGH RESISTANCE GROUNDING UNIT	GEN-120	NORTH BUILDING	GENERATOR SOURCE
EQUIPMENT	N/A	HRG	-	210		HIGH RESISTANCE GROUNDING UNIT	GEN-210	NORTH BUILDING	GENERATOR SOURCE
EQUIPMENT	N/A	HRG	-	220		HIGH RESISTANCE GROUNDING UNIT	GEN-220	NORTH BUILDING	GENERATOR SOURCE
EQUIPMENT	N/A	MTS	-	010		MANUAL TRANSFER SWITCH	MCC-8 AND MCC-9	ELECTRICAL BUILDING	480VAC MCC MTS
EQUIPMENT	N/A	REC	-	082		RECTIFIER	DC-3	ELECTRICAL BUILDING	125VDC SOURCE
EQUIPMENT	N/A	USS	-	002		UNIT SUBSTATION	POWER GENERATION FACILITY	ELECTRICAL BUILDING	480VAC
EQUIPMENT	N/A	XFMR	-	010		TRANSFORMER	POWER GENERATION FACILITY	ELECTRICAL BUILDING	480VAC-208/120VAC
EQUIPMENT	VARIABLES	AC	-	003		AC UPS POWER PANEL	POWER GENERATION FACILITY	ELECTRICAL BUILDING	208/120VAC
EQUIPMENT	VARIABLES	DC	-	003		DC UPS POWER PANEL	POWER GENERATION FACILITY	ELECTRICAL BUILDING	125VDC
EQUIPMENT	VARIABLES	LP	-	008		LIGHTING PANEL	POWER GENERATION FACILITY	ELECTRICAL BUILDING	208/120VAC
EQUIPMENT	VARIABLES	MCC	-	008		MCC	NORTH BUILDING	ELECTRICAL BUILDING	MCC-8
EQUIPMENT	VARIABLES	MCC	-	009		MCC	SOUTH BUILDING	ELECTRICAL BUILDING	MCC-9
EQUIPMENT	VARIABLES	PP	-	008		POWER PANEL	POWER GENERATION FACILITY	ELECTRICAL BUILDING	208/120VAC
EQUIPMENT	VARIABLES	SWB	-	008		VALVE SWITCH BOARD	POWER GENERATION FACILITY	ELECTRICAL BUILDING	480VAC
EQUIPMENT	VARIABLES	SWG	-	003		SWITCHEGEAR NO.3	POWER GENERATION FACILITY	ELECTRICAL BUILDING	4160VAC

SECTION 13350 - COMMISSIONING

PART 1 -- GENERAL

1.1. THE REQUIREMENT

- A. This Specification discusses pre-commissioning and commissioning activities. Pre-commissioning activities include all the activities associated with the first time startup of all equipment, instruments, electrical gear and/or process equipment. This includes all checks and tests prior to running equipment and any laboratory tests that may be required to verify proper operation of processes. Commissioning is requisite to satisfactory completion of the contract and, therefore, shall be completed within the contract time.

- 1.2. Only throughout this section herein, the CITY may refer to any City employee, consultants directly hired by the CITY, or the Engineer of Record who is a consultant for the CITY. CITY employees shall not make any engineering decisions without the Engineer of Record's consultation and approval. Only authorized and appointed CITY personnel shall direct the CONTRACTOR.

1.3. RELATED WORK SPECIFIED ELSEWHERE

- A. The requirements of the following sections and divisions apply to the work of this section. Other sections and divisions, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01014 Work Sequence
 - 2. Section 13300 Instrumentation and Control
 - 3. Divisions 2 thru 16

1.4. COMMISSIONING TEAM

The Commissioning Team shall be made up of personnel from the CONTRACTOR, CITY, Engineer of Record, and equipment manufacturer's representatives. The Commissioning Coordinator shall be duly authorized to commit the CONTRACTOR's personnel and resources during commissioning.

- A. Commissioning Coordinator: The Commissioning Coordinator shall utilize representatives of the CONTRACTOR's mechanical, electrical and instrumentation Subcontractors, and others as appropriate for Pre-commissioning and Commissioning activities and testing. This team shall be available at the Work site during construction working hours and shall be available within 2 hours notice at all other times upon notice by telephone. This team shall at all times be equipped and ready to provide emergency repairs, adjustments and corrections to the equipment and systems installed and modified as a part of this Contract.
 - 1. Qualifications: The CONTRACTOR shall hire an independent company that shall staff a qualified Commissioning Coordinator. The Commissioning Coordinator shall be engaged by the CONTRACTOR upon approval by the CITY. The CONTRACTOR shall provide the Commissioning Coordinator's qualifications within 30 days from the Notice

to Proceed. CITY reserves the right to interview Commissioning Coordinator and assistant team members and during the interview test them on knowledge of the Contract Documents to assess their suitability to being qualified. The Commissioning Coordinator shall be knowledgeable in all activities related to pre-commissioning and commissioning activities. The Commissioning Coordinator shall have a minimum working knowledge in commissioning of 2 facilities of similar type, size, and capacity. The Commissioning Coordinator shall be knowledgeable in all aspects of commissioning and testing or as may be supplemented by similarly knowledgeable assistants. The Commissioning Coordinator may be a team of staff, but shall have a single person assigned as the official Commissioning Coordinator. Assistant Commissioning Coordinators who's knowledge and technical expertise is critical to filling any gaps of knowledge of the Commissioning Coordinator shall also have their qualifications provided at the same time; shall be reviewed and approved by the CITY; these assistants do not need to be an independent firm as is required for the Commissioning Coordinator. The Commissioning Coordinator shall be responsible of charge for any required Assistant Commissioning Coordinators.

The Commissioning Coordinator may be an employee of the chosen natural gas engine-generator manufacturer or other qualified firm not owned by the CONTRACTOR. The Commissioning Coordinator's Team shall have direct knowledge with commissioning of:

- a. prime natural gas engine generators of similar size to this project,
 - b. knowledge with breaker protective device settings,
 - c. knowledge and understanding of electrical paralleling of sources,
 - d. knowledge with communications protocols such as MODBUS over Ethernet IP,
 - e. knowledge with emission controls in Southern California,
 - f. and have thorough controls knowledge and electrical knowledge.
2. Commissioning Coordinator Responsibilities: The Commissioning Coordinator shall direct and be responsible for all pre-commissioning, commissioning tests, and related documentation. He shall also provide technical instruction for pre-commissioning and commissioning and shall direct the facility operation during equipment testing and facility testing. All facility operation and tests shall be performed in the presence of CITY personnel unless such presence is expressly waived in writing. The Commissioning Coordinator shall be responsible for the Commissioning Plan and pre-commissioning and commissioning submittals. CONTRACTOR, Subcontractors and equipment suppliers shall provide technical labor support staff during pre-commissioning and commissioning. Commissioning Coordinator responsibilities include:
- a. Prepare the submittals required for the WORK of this section.
 - b. Develop and implement test procedures.
 - c. Develop and implement the Commissioning Plan.

- d. Develop a detailed Pre-commissioning and Commissioning Schedule.
- e. Develop a standard testing log to be used as a record of testing of each equipment item. This log shall:
 - (1) Be acceptable to and approved by the CITY.
 - (2) Include equipment name.
 - (3) Have provisions for recording dates of completion for checking, inspection by manufacturer, verification of instrumentation and controls, and completion of tests; and
 - (4) Provide space for problems remaining with equipment and for signature of CITY and manufacturer's representatives indicating acceptance.
- f. Develop Commissioning Forms to be used to record testing of each equipment item.
- g. Notify the CITY and all respective equipment manufacturers at least 21 days prior to the date when each equipment system is scheduled to be initially started; also submit testing plan stating schedule and quantity and source of utilities and other materials needed.
- h. Be responsible for the preparation and updating of the test schedule and incorporate testing activities in the progress schedule, in accordance with General Requirements.
- i. Provide all documentation that equipment is ready for testing.
- j. Provide all test reports after each test. The report shall include all data collected during the test.
- k. Perform the actual pre-commissioning tests and/or supervise the performance of pre-commissioning tests by manufacturer's field service representatives for various pieces of equipment.
- l. Perform the Operational Readiness Tests (ORT).
- m. Perform the Functional Acceptance Test (FAT).
- n. Perform the Reliability Acceptance Test (RAT).
- o. Operate the facility during RAT with the support of CITY Operators. At the discretion of the CITY, the CITY may choose to intervene and direct operations during RAT in order to protect public health and safety.
- p. Prepare all test reports including the Final Commissioning Report.
- q. Formally request training facilities for the classroom portion of the operator and maintenance training 30 days prior to use.

3. CONTRACTOR Responsibilities include:

- a. Furnish labor, materials, consumables, tools, instruments, oils, fluids, test water and services for checking and testing all equipment during pre-commissioning and commissioning. This includes services from manufacturers' representatives, subcontractors, electricians, instrumentation technicians, and pipe-fitters that may be required during pre-commissioning and commissioning.
- b. Obtain and furnish qualified manufacturer's representative to assist the testing of each equipment type and system in accordance with Manufacturer's Field Services.
- c. Be responsible for all maintenance and servicing of all equipment, generators, electrical gear, and instrumentation during pre-commissioning and commissioning.
- d. Provide NETA acceptance testing during the Pre-commissioning phase in accordance with Division 16. Tests on newly-installed power systems and apparatus will be conducted before energizing, to ensure that the installation and equipment comply with Specifications and intended use as well as with regulatory and safety requirements.
- e. Provide Operator and Maintenance training to the CITY staff in accordance with Contract Documents.
- f. Provide Operations and Maintenance Manuals in accordance with the Contract Documents.

B. CITY RESPONSIBILITIES

1. Will provide DCS programming.
2. Will provide classroom facilities for equipment manufacturer's Operator and Maintenance Staff training.
3. Will operate existing equipment not modified by this project during Function Acceptance Test (FAT).
4. Shall utilize fully trained Operators and shall operate the equipment during the Reliability Acceptance Test (RAT).

1.5. WORK PRIOR TO COMMISSIONING

- A. Pre-commissioning: Pre-commissioning is made up of all the activities that must be completed before the CONTRACTOR is permitted to begin actual field Commissioning. The primary activities for this are construction, factory testing, documentation, component testing and stand-alone equipment testing. This includes but not limited to pipe pressure testing and electrical continuity testing. The intent is to test isolated equipment and components. Pre-commissioning testing shall conclude with CITY's acceptance of Operational Readiness Tests.

Once all components have been tested individually and all required deliverables have been accepted by CITY, the CONTRACTOR may request to proceed to Commissioning. If the CITY agrees that the CONTRACTOR has successfully performed all tests and provided all required documentation, the CITY will notify the CONTRACTOR in writing that they may begin Commissioning.

1.6. MANUFACTURER'S FIELD SERVICES

It is the CONTRACTOR's responsibility to provide and procure the services of the manufacturer's representatives that apply during equipment installation, facilities testing, pre-commissioning, commissioning, and training of CITY personnel.

- A. Definitions: For purposes of furnishing manufacturers' services, the following definitions shall apply:
 - 1. Manufacturer's Representatives: Employee of manufacturer who is factory trained and knowledgeable in technical aspects of their products and systems.
- B. Submittals: CONTRACTOR shall submit the following under this section and as specified in the General Requirements:
 - 1. Qualifications and knowledge records of proposed manufacturers' representatives who will assist installation and testing of equipment and conduct training sessions.
 - 2. After installation, each manufacturer's representative shall submit to the CITY a written report (Certificate of Proper Installation) certifying that the all equipment is installed properly in accordance with the manufacturer's installation instructions.
 - 3. After the RAT, each manufacturer's representative shall submit to the CITY a written report (Certificate of Proper Operation) certifying that the all 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 under full load conditions and that it operated per Specifications.
- C. Scheduling of Manufacturer's Field Services: The manufacturer's representative shall be a knowledgeable, competent, and authorized representative of the manufacturer of each item of equipment for which field services are indicated in the individual sections of the Contract Specifications. He shall visit the site of the Work to inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is being tested and placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected.

The scheduling of all visits to the site by the manufacturer's field services representative shall be determined by the CONTRACTOR and accepted by the CITY. It is intended that the manufacturers' representatives' visits are for the purpose of making equipment inspections and normal adjustments, and not for the purpose of remedying defective work.

Manufacturers' representatives shall resolve assembly or installation problems attributable to or associated with, their products and equipment. During the testing, the manufacturer's representative shall assist, as applicable, the initial equipment and system adjustments and calibrations. After all acceptance tests have been completed, but prior to Substantial

Completion, the CONTRACTOR shall recheck all equipment for proper alignment and adjustment, check oil levels, re-lubricate all bearing and wearing points, and, in general, assure that all equipment is in proper condition for regular continuous operation.

1.7. PRE-COMMISSIONING AND COMMISSIONING TESTS

The following tests are coordinated and led by the Commissioning Coordinator during Pre-commissioning and Commissioning:

- A. Pre-commissioning: The CONTRACTOR must successfully complete each test and receive written confirmation prior to starting any Commissioning Tests.
 - 1. FDT - Factory Demonstration Test: The purpose of this test is for the CONTRACTOR and CITY to inspect and witness the testing of the Contract equipment at the manufacture's facility including hardware and control software components. The Hardware component will demonstrate the functionality of the DCS equipment, including the Network Switching equipment, and all Third-Party Interface equipment. The Control Software component will demonstrate the ability of the control software and graphics to meet the intended DCS Control Strategies through simulation. The CONTRACTOR will be responsible for the Hardware FDT, and the CITY will be responsible for the Control Software FDT.
 - 2. ORT - Operational Readiness Test: This test is performed after installation and calibration of instruments is complete. The test purpose is for the CONTRACTOR to check and document the complete control system, including I/O to/from DCS register but excluding the application software is ready for operation. In addition, the equipment shall be tested in local/manual mode for operation and functionality.
- B. Commissioning
 - 1. FAT – Functional Acceptance Test: The FAT is a combined effort between the CITY and the CONTRACTOR. The combined software/hardware system is tested from this point forward. The purpose for the test is to insure that the DCS, Operator Graphics software configuration, and integration of the manufacture's supplied PLC and/or controllers, and mechanical/electrical systems are working together as intended per the control philosophies.
 - 2. RAT – Reliability Acceptance Test: The Purpose for this test is for the CONTRACTOR to demonstrate that all systems are capable of operating continuously in the intended manner for an extended period without failing. During the RAT, the system under test will be operated within design parameters reflecting the day-to-day operation of the facilities for an uninterrupted period of 7 days unless noted otherwise herein.

PART 2 -- PRODUCTS

CONTRACTOR shall provide all required equipment and personal necessary to perform WORK specified herein. Any approved deviations from WORK herein shall be borne in full by the CONTRACTOR at no additional cost to the CITY. In addition to any required hard copies specified herein, all corresponding hardcopies shall also be submitted with electric copies in their native formats if available otherwise in a pdf format.

2.1. COMMISSIONING PLAN

The Commissioning Coordinator shall be responsible for preparing the detailed Commissioning Plan. As a condition precedent to the CONTRACTOR receiving progress payments in excess of 75 percent of the Contract amount the Commissioning Coordinator shall submit and received the CITY's acceptance for the commissioning plan. The CITY shall require fifteen (15) copies to review the submitted commissioning plan. Once the CITY has accepted the Commissioning Plan, the Commissioning Coordinator shall reproduce the plans in sufficient number for the Commissioning Coordinator's purposes and an additional ten (10) copies for delivery to the CITY. No test work shall begin until the Commissioning Coordinator has delivered the specified number of final commissioning plans to the CITY.

A. Testing

1. The Commissioning Coordinator shall develop test plans detailing the coordinated sequential testing of each item of equipment and system installed under this Contract. Each test plan shall be specific to the item of equipment or system to be tested. Test plans shall identify by specific equipment or tag number each device or control station to be manipulated or observed during the test procedure. The specific results to be observed or obtained shall be identified in the plan. Test plans shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, subcontractors' and manufacturers' representatives to be present and expected test duration. As a minimum, the test plans shall include the following features:
 - a. FDT / ORT checkout procedures reviewed and accepted by the respective equipment manufacturers.
 - b. Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by the CONTRACTOR for the systematic testing of all equipment and systems installed under this Contract.
 - c. Procedures shall include statement indicating test objectives, test descriptions, forms, and checklists to be used to control and document the required tests.
 - d. Step-by-step proving procedure for all control and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device.
 - e. Calibration of all analysis instruments and control sensors.

- f. Performance testing of each individual item of mechanical, electrical, and instrumentation equipment. Performance tests shall be selected to duplicate the operating conditions described in the Contract Documents.
 - g. System tests designed to duplicate, as closely as possible, operating conditions described in the Contract Documents as well as simulating equipment failure and emergency scenarios.
2. The Commissioning Coordinator shall prepare written test procedures for submittal to the CITY, for acceptance. For each test, the procedure form should clearly define the following:
- a. Test Number.
 - b. Purpose of the test: Describe what is being verified by this particular test.
 - c. Test Method: Describe the setup for the test and the steps required to complete the test.
 - d. Criteria: Describe the criteria for passing or failing the test.
 - e. Provide space on the form for the CITY's comments and for individual sign-off.
 - f. Test on a loop-by-loop basis. Every loop shall be signed off individually.
 - g. Provide a test schedule.
 - h. Provide a list of all test equipment to be available for the tests.
 - i. Provide a block diagram showing the test setup arrangement. The diagram shall illustrate the equipment under test, any special test equipment and indicate equipment interconnections.
3. Staffing for each test identifying roles and responsibilities:
- a. Organization chart for conducting Pre-commissioning and Commissioning
 - b. Description of previous knowledge on similar projects of both personnel and testing companies to be employed in pre-commissioning and commissioning, include list of references complete with phone numbers
4. Instrumentation list with calibration methods and calibration dates.
5. Acceptance criteria required to release equipment and systems for commissioning.
6. Statement of successful test.
7. Forms for each test.
- B. Schedule: The Commissioning Coordinator shall produce a testing schedule setting forth the sequence contemplated for performing the test work.

1. The schedule shall detail the equipment and systems to be tested, and shall be part of the CONTRACTOR's Baseline Construction Schedule.
2. The schedule shall show the start date, duration of the test and completion of each pre-commissioning and commissioning activity.
3. The test schedule shall be submitted, reviewed, and accepted by the CITY with the Baseline Construction Schedule.
4. The test schedule shall be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of the Contract Documents.
5. Daily Schedule for Testing
 - a. The Commissioning Coordinator shall begin each day of witnessed testing by meeting with the CITY.
 - b. The meeting purpose is to review the test schedule, the test results from the previous day, and where applicable, to coordinate the testing schedule with Plant Operations.
 - c. The Commissioning Coordinator will need to schedule some testing outside normal working hours because of plant operational requirements. The Commissioning Coordinator may be required to rearrange portions of the testing schedule at short notice to accommodate unanticipated plant conditions such as equipment failure or unusually high sewage flows caused by wet weather.
6. Show all tests with beginning and ending dates. At a minimum the Test Engineer will show all NETA testing, FDTs, ORTs, FAT and RAT schedule.
7. Show all operations and maintenance training classes.
8. Show all document submittal dates.

2.2. DOCUMENTATION

- A. During all phases of commissioning, the Commissioning Coordinator shall have on site a failure log. The failure log shall consist of any equipment failures that have occurred, the condition of the failure, and the time of failure. The purpose of the failure log is to troubleshoot equipment and systems that may fail under complex conditions or when the Commissioning Coordinator is not on site. The CONTRACTOR and Commissioning Coordinator shall use the failure log in addition to the punch list items during Commissioning. Reason(s) for the failure and suggested corrective action(s) shall be the responsibility of the Commissioning Coordinator.
- B. Pre-commissioning: The following documentation must be up to date and accepted by the CITY prior to starting any Commissioning activities. The CITY will give written notice to the CONTRACTOR when all the documents are accepted.
 1. Equipment Submittal Process Complete

2. RFIs and Responses up to Date
 3. All Electrical Equipment Tests
 4. All Process and Instrumentation Equipment Tests
 5. All Mechanical Equipment Tests
 6. Loop Drawings
 7. P&ID Drawings
 8. CONTRACTOR Lock-out Tag-out Procedures
 9. All Vendor and Manufacturer Certificates of Correct Installation
 10. All Pressure Test Reports
 11. All Loop Test Reports
 12. All Conductivity Test Reports
 13. All Instrument Calibration Reports
 14. All Electrical Breaker Setting Reports
 15. All Mechanical Alignment Reports
 16. Local/Manual Test Reports
 17. Draft Operations and Maintenance Manual
 18. Any and All Operating Permits
 19. Commissioning Plan: Due 90 days prior to the start of ORT
 20. Operator Training Plan
 21. Pre-commissioning Report
- C. Commissioning
1. Updated As-Built Drawings
 2. Final Maintenance Manuals
 3. Final Punch List
 4. Redline Drawings
 5. Commissioning Report

D. Documentation

1. The Commissioning Coordinator shall develop a record keeping system to document compliance with the requirements of this Section. Calibration documentation shall include identification (by make, manufacturer, model, and serial number) of all test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory.
2. Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test instruments employed for the test and signature spaces for the CITY's witness (ORT, FAT, RAT) and the CONTRACTOR's Quality Control Manager (FDT through RAT). A separate file shall be established for each system and item of equipment. These files shall include the following information as a minimum:
 - a. Metallurgical tests
 - b. Factory performance tests
 - c. Accelerometer recordings made during shipment
 - d. Field calibration tests¹
 - e. Field pressure tests¹
 - f. Field performance tests¹
 - g. Field operational tests¹

¹ Each of these tests is required even though not specifically listed in the detailed Specification section.

3. The Commissioning Coordinator shall develop test documentation forms specific to each item of equipment and system installed under this Contract.
4. Once the CITY has reviewed and taken no exception to the forms proposed by the Commissioning Coordinator, the Commissioning Coordinator shall produce sufficient forms, at his expense, to provide documentation of all testing work to be conducted as a part of this Contract.
5. Reference Documentation: The Commissioning Coordinator shall make two sets of the following documentation available to the CITY or its representatives, at the test site:
 - a. Copy of the accepted test procedure for the specific equipment being tested; and
 - b. Copy of Drawings and hardware submittals for equipment being tested

E. REPORTS

The CONTRACTOR shall submit several Reports to the CITY for acceptance in order to continue with the Commissioning process. The reports are described below.

1. Pre-commissioning Report: The Pre-commissioning Report is a collection of all test reports, test data, certificates and commissioning forms that are produced during the Pre-commissioning Stage. The first section of this document will be a summary of the contents certifying that all prescribed tests and procedures have been successfully completed. The Commissioning Coordinator is responsible for producing this document.
2. Commissioning Report: The Report is a collection of all test reports, test data, certificates and commissioning forms that are produced. The first section of this document will be a summary of the contents certifying that all prescribed tests and procedures have been successfully completed. The Commissioning Coordinator is responsible for producing this document. Manufacturer's equipment data:
 - a. Field recorded dimensional measurements and clearances.
 - b. Pressure, pressure differential, level, flow and other field settings.
 - c. All electrical devices field settings.
 - d. Operational pressure tests, control system timing tests and settings and other test data specified.
 - e. Field wiring changes made, including marked up drawings.

2.3. SUBMITTALS

- A. CONTRACTOR shall submit the following information in addition to specific equipment where specified in individual sections and paragraphs:
 1. Manufacturer's Certification of Proper Installation of all equipment before Commissioning begins.
 2. A complete description of the CONTRACTOR's plan for documenting the results of all testing, including:
 - a. Proposed plan for documenting the calibration of all test instruments.
 - b. Proposed plan for calibration of all instrument systems, including flow meters and all temperature, pressure, weight, and analysis systems.
 - c. Sample forms for documenting the results of field pressure and performance tests.
 3. The credentials and certification of the testing laboratory proposed by the CONTRACTOR for calibration of all test equipment.
 4. Detailed commissioning plan with schedule, prepared by the Commissioning Coordinator, for each equipment item and system. Submit schedule updates showing testing work not less than 90 days in advance of first scheduled tests. Schedules shall list each piece of equipment or component to be tested, as specified in this Section or by the

various sections of the Specifications. Schedules shall include sequence and duration for all testing required including Pre-commissioning Testing and Commissioning Testing.

5. Manufacturer's Certificates of Proper Operation for each equipment prior to the Notice of Substantial Completion.
 6. O&M manuals per Contact Documents. The CITY reserves the right to delay Commissioning if the manuals submitted are incomplete, inaccurate or otherwise unsuitable for use by the CITY. No contract extension or extra cost will be allowed for the delays in Commissioning due to O&M Manual submittal delay.
 7. Lock-out and Tag-out Procedures and Policies that will be used by the CONTRACTOR during pre-commissioning and commissioning.
- B. Submit design and details of temporary test facility (if required).
- C. Submit Test Reports in Conformance with Requirements Specified herein.
1. Preliminary copies of test data in field report form will be made available to the CITY with in two days after completion of each test. This information will remain available to the CITY for the duration of the Project.
 2. Submit five (5) bound copies and one (1) electronic copy of field test reports of checkout and testing of all equipment within thirty (30) days after completion of testing
- D. Formal Reports: Submit ten (10) bound copies and one (1) electronic copy of Reports within thirty days after completion of last test.

PART 3 – EXECUTION

3.1 PRE-COMMISSIONING MEETINGS

The main purpose of the commissioning meetings is to get all the relevant parties working cooperatively together for a complete and successful project. These meetings will help shape the final details for the Commissioning Plan that the Commissioning Coordinator shall write. The requirement of commissioning shall be successfully implementing and reliably demonstrating all the various control philosophies described in Section 13300, Instrumentation and Control, and more specifically, Appendix A2, Process and Control Strategies and Design Philosophy.

These meetings are not for CONTRACTORS technical submittals on specific equipment that is still deficient; those shall be considered separate meetings from the WORK required of this Section. The meeting requirements listed herein are for discussing submittals that have been checked by the CITY as, "No Exceptions Taken", or discuss the commissioning impact of any agreed contract deviations.

The Commissioning Coordinator shall be responsible for producing each meeting's agenda sufficiently in advance so the team members can sufficiently prepare and add additional discussion items to the agenda. The Commissioning Coordinator shall provide detailed meetings minutes and distribute electrically a draft to the participating team members. Team

members shall review the minutes and provide comments as necessary. The Commissioning Coordinator shall incorporate comments appropriately and re-issue electronically the final minutes to the participating team members.

The Commissioning Coordinator shall conduct the meetings, keep to the agenda as much as practical, and keep the meeting discussion focused on the tasks required.

Meetings shall be attended in person by all parties, no remote conferencing shall be allowed. The CITY shall furnish a meeting place within the limits of the City of San Diego.

A. Pre-Commissioning Progress Meetings: The purpose of these meetings is to keep track of the team's ongoing and future work, keep the team generally informed, and track and update the schedule. The CONTRACTOR, Commissioning Coordinator, CITY, and the Engineer of Record are required to attend these meetings.

1. Monthly Progress Meetings: After the contract notice to proceed, there shall be regularly scheduled monthly progress meeting for the first 6 months.
2. Weekly Progress Meetings: 6 months after the Contract notice to proceed and until all phases of pre-commissioning and commissioning (included RAT and FAT) are complete, there shall be regularly scheduled weekly occurring meetings. These meetings shall be up to 2 hours in length only.

B. Technical Pre-Commissioning Meeting:

The purpose of these meetings are for technical discussion and coordination between the commissioning team and the manufactures. Some of the required technical meetings listed below may be the same manufacturer, but meeting requirements shall be treated separately.

The duration between meetings shall be based on the project's needs, agreed to by CITY staff, and coordinated by the Commissioning Coordinator. The meetings listed are the assumed minimum number of meetings required; if additional meetings are deemed necessary by the CITY or the Commissioning Coordinator, then the CONTRACTOR shall have manufacturers' representatives attend the additionally required meetings at no additional cost to the CITY.

Meetings do not count for actual field testing or manufactures field work requirements during ORT, RAT, or FAT phases. Manufacturer's representative(s) shall come fully prepared based on the meeting's agenda.

Typical discussion items will be highly technical and may include discussion items such as: setpoints, ramp rates, alarms, values, calibration, specific lines of programming code, specific HMI screens, MODBUS IP communication "word messages", proportional integral derivative (PID) control, PID constants, system response, operator training, control philosophy logic, hard I/O, soft I/O, review of documentation, scheduling, electrical paralleling of sources, FMR setpoints, MMR setpoints, GMR setpoints, breaker trip settings, SDG&E interconnection, emissions controls, and etc.

The following meetings shall be attended by the commissioning team and the manufacturer representative(s):

1. 4160VAC Natural Gas Engine Generator Manufacturer, including **Master Generator Controller** integration of all 4 engine-generators in the power generation facility: The manufacturer of the natural gas engine-generator is responsible for **integration** of the master generator controller and integrating of the diesel engine-generators manufacturer per the control philosophies in Section 13300. The natural gas engine manufacturer shall attend 12 separate meetings at 4 hours each; in addition, they shall **also attend** and participate in at least one meeting per each manufacturer listed below, manufacturers listed in paragraphs a thru e (sub paragraphed manufacturer i and ii **not required**), as directed by the Commissioning Coordinator.
 - a. 4160VAC Diesel Engine Generator Manufacturer: 6 meetings at 4 hours each. In addition, they shall also attend and participate in at least one meeting per each manufacturer listed below (manufactures listed in paragraphs i and ii), as directed by the Commissioning Coordinator.
 - i. Diesel Engine Emissions Controls Manufacturer: 3 meetings at 4 hours each.
 - ii. Diesel Day Tank Packaged System Manufacturer: 2 meetings at 4 hours each.
 - b. Natural Gas Engine Emissions Controls Manufacturer: 3 meetings at 4 hours each.
 - c. 4160VAC Switchgear No.3 Manufacturer: 1 meeting at 4 hours each.
 - d. FMR Manufacturer: 6 meetings at 4 hours each.
 - e. GMR Manufacturer: 3 meetings at 4 hours each.
2. 4160VAC Breaker Manufacturer, Switchgear No.1 and No.2: 1 meeting at 4 hours each.
3. 4160VAC Breaker Manufacturer, Switchgear No.3: 1 meeting at 4 hours each.
4. 4160VAC Main Sewage Pump Motor Manufacturer: 3 meetings at 4 hours each. In addition, they shall also attend and participate in at least one meeting per each manufacturer listed below (manufacturers listed in paragraphs a and b), as directed by the Commissioning Coordinator.
 - a. MMR Manufacturer: 3 meetings at 4 hours each.
 - b. 4160VAC Main Sewage Pump VFD Manufacturer: 3 meetings at 4 hours each.
5. Synch Check / Closed Transition Panel Manufacture: 3 meetings at 4 hours each.
6. Existing 500KW Emergency Diesel Engine, Caterpillar representative shall attend: 1 meetings at 2 hours each.
7. DCS Equipment, Emerson representative shall attend: 3 meetings at 4 hours each.
8. AHU Packaged System Manufacturer: 3 meetings at 4 hours each.
9. Diesel Fuel Storage Tank Manufacturer and associated Local Control Panel Manufacturers: 2 meetings at 4 hours each.

10. 4160VAC Load Bank Manufacturer: 2 meetings at 4 hours each.

3.2 DCS TECHNICAL PROGRAMMING MEETINGS:

Six months after the CONTRACTOR receives a notice to proceed, the CITY will provide weekly status updates to the team with regards to DCS programming.

DCS technical meetings purpose is to review detailed programming logic based on the Control Strategy, the Commissioning Plan, and the Pre-commissioning meetings. The Engineer of Record shall be involved, CITY Operations staff, and the Commissioning Coordinator may attend at their discretion or when specifically required for their direct input. It is anticipated that this weekly meeting will be 4-hours in duration every week.

3.3 FAT COMMISSIONING MEETINGS:

Purpose of FAT commissioning meetings is to discuss last minute issues, go over test results, determine if the FAT test was successful, discuss equipment deficiencies discovered during the FAT test and solutions before retesting, and etc.

The duration between meetings shall be based on the project's needs, agreed to by CITY staff, and coordinated by the Commissioning Coordinator. The meetings listed are the assumed minimum number of meetings required; if additional meetings are deemed necessary by the CITY or the Commissioning Coordinator, then the CONTRACTOR shall have manufacturers' representatives attend the additionally required meetings at no additional cost to the CITY. The following manufacturers shall attend the required meetings during their respective FAT test.

- A. 4160VAC Natural Gas Engine Generator Manufacturer, including Master Generator Controller: 20 meetings at 2 hours each.
- B. 4160VAC Diesel Engine Generator Manufacturer: 10 meetings at 2 hours each.
- C. Diesel Engine Emissions Controls Manufacturer: 4 meetings at 2 hours each.
- D. Diesel Day Tank Packaged System Manufacturer: 2 meetings at 2 hours each.
- E. Natural Gas Engine Emissions Controls Manufacturer: 4 meetings at 2 hours each.
- F. 4160VAC Switchgear No.3 Manufacturer: 2 meetings at 2 hours each.
- G. FMR Manufacturer: 6 meetings at 2 hours each.
- H. GMR Manufacturer: 2 meetings at 2 hours each.
- I. 4160VAC Breaker Manufacturer, Switchgear No.1 and No.2: 2 meetings at 2 hours each.
- J. 4160VAC Breaker Manufacturer, Switchgear No.3: 2 meetings at 2 hours each.
- K. 4160VAC Main Sewage Pump Motor Manufacturer: 2 meetings at 2 hours each.

- L. MMR Manufacturer: 2 meetings at 2 hours each.
- M. 4160VAC Main Sewage Pump VFD Manufacturer: 2 meetings at 2 hours each.
- N. Synch Check / Closed Transition Panel Manufacture: 2 meetings at 2 hours each.
- O. Existing 500KW Emergency Diesel Engine, Caterpillar representative shall attend: 2 meetings at 2 hours each.
- P. DCS Equipment, Emerson: 2 meetings at 2 hours each.
- Q. AHU Packaged System Manufacturer: 4 meetings at 2 hours each.
- R. Diesel Fuel Storage Tank Manufacturer and associated Local Control Panel Manufacturers: 2 meetings at 2 hours each.
- S. 4160VAC Load Bank Manufacturer: 1 meeting at 2 hours each.

3.4 COMMISSIONING PHASES (See related Section 01014, Work Sequence):

Commissioning includes FAT and RAT testing. The WORK requires four separate and independent commissioning phases for a safe and successful project. The primary reason for the 4 commissioning phases is to maintain safe and reliable sewer force main surge protection at all times. Until new and modified equipment (4160VAC power sources and ancillary equipment) successfully complete RAT testing, such equipment shall not be consider a valid second independent source when it comes to actual hydraulic surge protection of the sewage forcemains. During commissioning of Phase 1, and when the system configuration requires a second power source, the existing natural gas engine-driven pump shall run to guarantee no single source of failure during commissioning causes a damaging hydraulic surge event. The Commissioning Coordinators commissioning plan shall still include actual operation of equipment testing as if it were the second source, (even though the existing natural gas engine-driven pump is also running for assurance).

- A. FAT-RAT Commissioning Phase 1: Shall partially commission the new power generation facility and interim engine cooling water systems and fully commission the fuel/ oil storage area systems. At this time, it is not possible to fully test the system since the cooling system is only partially complete since half of the existing systems are utilized to cool the existing natural gas engine direct-drive main sewage pumps, and at this time, the new main sewage motors and VFDs are not installed.
 - 1. Duration: The total duration of FAT and RAT testing shall not be less than 6 months. The RAT test shall be a minimum of 2 months.
- B. FAT-RAT Commissioning Phase 2: Phase 1 RAT testing shall be complete before this phase may begin. Phase 2 includes commissioning of VFD-400, Motor-400, and testing systems integrations with the power generation facility with then new motor load.
 - 1. Duration: The total duration of FAT and RAT testing shall not be less than 3 months. The RAT test shall be a minimum of 1 month.

C. FAT-RAT Commissioning Phase 3: Phase 2 RAT testing shall be complete before this phase may begin. Phase 2 includes commissioning of VFD-500, Motor-500, and testing systems integrations with the power generation facility with then new motor load.

1. Duration: The total duration of FAT and RAT testing shall not be less than 1 month. The RAT test shall be a minimum of 7 days.

D. FAT-RAT Commissioning Phase 4: Phase 3 RAT testing shall be complete before this phase may begin. Phase 3 includes commissioning of the final cooling system configuration and testing systems integrations with the power generation facility

1. Duration: The total duration of FAT and RAT testing shall not be less than 1 month. The RAT test shall be a minimum of 7 days.

3.5 FUNCTIONAL ACCEPTANCE TEST (FAT)

A. During FAT testing, the CITY shall provide natural gas for the natural gas engine-generator.

B. During FAT testing, the CONTRACTOR shall provide diesel fuel for the two 4MW diesel engine generators as well as the 500KW emergency diesel generator.

C. The FAT is a combined effort between the CONTRACTOR, the CITY, and the Engineer of Record. The combined software/hardware system is tested from this point forward. The purpose of the test is to ensure that the DCS and Operator Graphics software configuration is working in conjunction with the hardware as intended per the control philosophies. This test is accomplished with the system on-line under operating conditions. Application software problems encountered during the test will be investigated and corrected by the CONTRACTOR. Problems with DCS software programming done by the CITY will be corrected by the CITY. Prior to the test the Commissioning Coordinator shall submit a written FAT procedure to the CITY for acceptance. The CITY acceptance of the procedure prior to the start of the FAT is required. CONTRACTOR shall include in the schedule at least half the time as allocated for troubleshooting the DCS system.

D. The Commissioning Coordinator shall design testing scenarios to simulate as close as possible real conditions that the equipment will see throughout the lifetime of the facility, including simulating all emergency scenarios. The Commissioning Coordinator shall provide a detailed list of every scenario to be tested and accepted by the CITY.

E. Not all the equipment and systems integration can be fully FAT testing during the same period since the WORK requires specific Work Sequence per Section 01014 and the Contract Documents.

3.6 RELIABILITY ACCEPTANCE TEST (RAT)

A. During RAT testing, the CITY shall provide natural gas for the natural gas engine-generator.

B. During RAT testing, the CITY shall provide diesel fuel for the two 4MW diesel engine generators as well as the 500KW emergency diesel generator unless the emergency was caused by a failure of CONTRACTORS equipment during RAT, then the CONTRACTOR shall refuel the diesel tank(s) at no additional cost to the CITY.

- C. Reliability Acceptance Test: Subject to CITY acceptance, the Reliability Acceptance Test shall begin as soon as possible after completion of the Functional Acceptance Test. This test shall be directed by the Commissioning Coordinator.
- D. "Significant interruption" during the Reliability Acceptance Test may include any of the following events:
1. Failure of a system (process, control, etc.) that is not permanently corrected within six (6) hours after such failure occurs.
 2. Failure of a process equipment unit (mechanical, electrical, instruments, etc.) that is not permanently corrected within eight (8) hours after such failure occurs.
 3. "Permanently corrected" means without a repeat failure during the remaining duration of the test and shall consist of all of the following:
 - a. Work repaired and replaced to conform with specified requirements.
 - b. Parts and components replaced as recommended by original manufacturer without impacting on warranty, and conforming with reviewed submittals.
 - c. Piping and valves properly installed and connected.
 - d. Wiring properly terminated.
 - e. The facility is back on line and operating within normal operating parameters.
 4. Occurrence of a significant interruption shall require the time restarted at time equals zero (begin at Day 1 again) after permanent corrections are made.
- E. Retesting of Equipment: When testing or operation of the equipment demonstrates that the equipment does not meet the specified requirements, the CONTRACTOR shall repeat or perform all additional tests as necessary and required by the CITY. When the re-testing is caused by failure of CONTRACTOR to perform the Work satisfactorily, as a required procedure, or for minor changes to the equipment, the CONTRACTOR will not be granted an increase in the Contract Price, nor an extension of Contract Time.
- F. Continuous Operation: After successful Reliability Acceptance Test of a particular equipment type or system, the CITY may elect to operate a portion of the equipment or system for continuous operation. Such operation will not interfere with testing of other equipment and systems that may still be underway, and shall not preclude the need to start up the portion operated in combination with the rest of the facility when all testing is completed.

****END OF SECTION ****

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SECTION 13400 - DISTRIBUTED CONTROL SYSTEM (DCS)

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CITY will program all the process equipment controlled by the DCS per Section 13300 Instrumentation and Control Appendix A2 - Control Strategy. The CITY will provide the graphics for the DCS Workstations; the CONTRACTOR shall provide all the graphic screens for any of the local Operator Interface Terminal (OIT) or Human Machine Interface (HMI) Screens required for process equipment per the Contract Documents. The Contract Drawings shall take precedence over this Section. Section 13350 – Commissioning shall take precedence over this Section. The remaining of Section 13400 Distributed Control System (DCS) below is the CITY's current standard Specification, and not all items below may apply based on the hierarchy just described.
- B. The CONTRACTOR shall furnish all equipment and provide all needed engineering to accomplish the functional and technical requirements of these Contract Documents including, but not limited to, project management, design assistance, coordination with Operations staff, detailed system design and integration, conducting graphic development meetings (for local OIT and HMI screens), equipment supply, shipment, storage, job site delivery, programming communication configuration, installation oversight, training, calibration, testing, startup, and maintenance. The DISTRIBUTED CONTROL SYSTEM (DCS) hardware required for this project shall be obtained from Emerson Process Management Power and Water solutions (Emerson) to match existing. Equivalent products will not be accepted.
- C. It is the intent of these specifications to have the Contractor singularly responsible for the procurement, supply, delivery, implementation and future support of all DCS equipment (i.e., hardware and associated software). In order to preserve this focused responsibility, the Contractor shall procure the services of Emerson to ensure the following:
1. Be the manufacturer of the DCS hardware being proposed for this project or offer the hardware in their standard product line.
 2. Be the originator of all data acquisition and control software.
 3. Be the source of all DCS remote equipment documentation.
- D. The Contractor shall be responsible for providing all equipment, labor, engineering, and services associated with integrating all of the instrumentation and Control devices, and

special systems (Fire Detection, Energy Management, and control valve data links), into the DCS hardware in a transparent and seamless manner.

- E. As a minimum, the Contractor shall assume full responsibility for the following:
 - 1. Furnishing and installation of the DCS equipment:
 - a. Provide all engineering, resources, equipment, and labor required to:
 - 1) Design and submit DCS hardware, associated software, and spare part submittals.
 - 2) RESERVED
 - 3) RESERVED
 - 4) RESERVED
 - 5) Procure all hardware and associated software required to conform to these specifications.
 - 6) RESERVED
 - 7) RESERVED
 - 8) Coordinate and participate in an Operational Readiness Test (ORT) near the City's Headquarters or the project site to verify conformance of the DCS equipment to these specifications.
 - 2. Integration of the DCS with the facility:
 - a. Provide all engineering, resources, equipment and labor required to:
 - 1) Reserved
 - 2) Review all loop drawings generated for all control and instrumentation devices associated with each facility and verify system compatibilities.
 - 3) Install DCS equipment, data communications devices, fiber optic and other communications cables and other equipment as specified in these Contract Documents.

- 4) Coordinate with suppliers for data link information and configure DCS data links to communicate equipment furnished by others.
- 5) Oversee the performance of on-site loop and commissioning tests by others.
- 6) RESERVED
- 7) Update and submit all documentation and previous submittals to reflect "as-built" or record conditions.

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 01640 Seismic Design of Equipment and Anchorage
 2. Section 09800 Protective Coating
 3. Section 13300 Instrumentation and Control
 4. Section 13350 Commissioning

1.3 CODES

- A. The 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
 3. Underwriters Laboratory (UL) (or third-party certification that work meets UL requirements)
- B. 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.
- C. 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 CONSTRUCTION MANAGER for approval.

- D. 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 CONTRACTOR at no additional expense to the OWNER.

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1.	ISA-S5.1	Instrument Symbols and Identification
2.	ISA-S5.4	Instrument Loop Diagrams
3.	ISA-S12.4	Instrument Purging for Reduction of Hazardous Area Classification
4.	ISO 9001	Quality systems - Model for Quality Assurance in Design/Development, Production, Installation and Servicing
5.	SAMA	Scientific Apparatus Makers Association (SAMA) SAMA-PMC-33.1
6.	IEEE 812	Standard Definitions of Terms Relating to Fiber Optics
7.	EIA/TIA-568	Commercial Building Telecommunications Wiring Standard

1.5 ELECTRONIC DOCUMENT SUBMITTALS

- A. All final submittals are required in both paper and electronic format. One copy of each final submittal shall be provided on DVD.
- B. Where preliminary submittals are required in electronic format, one copy of the preliminary submittal shall be provided on DVD for the City' s review.
- C. File Requirements:

1. Documents shall be in Adobe Acrobat PDF format, version as specified by the Contract Manager. Vendor and CONTRACTOR shop drawings developed under the Contract shall be in Bentley Microstation (.DGN) format. Documents in electronic format (, Microsoft Word, Excel, etc.) shall be converted to standard PDF format using the Acrobat printer driver.
2. Deviation from this standard will be accepted only if advance approval is given by the City's Project Manager.
3. Documents not available in electronic format shall be scanned at 300 dpi, bitonal (black and white) and converted into Adobe Acrobat (PDF). Scanned image enhancement software shall be used. PDF sub-format shall be full Image + Hidden Text PDF file format.
4. All PDF documents shall be reviewed, and corrected if necessary, for orientation and legibility.
5. Individual document files shall not exceed 3 megabytes in size.

D. Document Organization and Indexing:

1. Submittals shall be logically organized. File names shall be in UPPERCASE only, a maximum of 64 characters, contain no spaces, and clearly indicate the file contents.
2. Supplier's submittals that include O&M documentation for more than one equipment item shall be divided into separate documents for each equipment item.
3. Each section identified by the bookmarks will be separated by index tabs in all paper copies of the submittal.
4. A master PDF index file shall be generated, with a master Table of Contents, and links to individual document files. External PDF link file names shall be in uppercase only.
5. A table shall be provided and submitted in spreadsheet format which includes the information about each document file. The contents of the table shall be submitted and approved by the City's Project Manager. An example of information to be provided is as follows: (This is an example only)
 - a. Document file name

- b. Document title and description
- c. Hard Copy Catalog No. (used by facility document coordinator)
- d. Document Type:
 - 1) Design
 - a) Design Specifications
 - b) Design Drawings
 - 2) Operations
 - a) Facility design O&M manuals
 - b) Facility manufacturer O&M manuals
 - c) Standard Operations Procedures
 - d) Record Drawings
 - 3) Maintenance
 - a) Maintenance Management System
 - b) Facility Loop and Wiring Diagrams
 - 4) Training
 - 5) Student study guide
 - 6) User guides
 - 7) User manuals
- e. Environmental
- f. Engineering
- g. Research & Development
- h. Division Processes and Procedures

- i. Facility Name
- j. Specification Number
- k. Process Name
- l. Unit Process Number
- m. Manufacturer' s Name (if applicable)
- n. Supplier' s Name (if applicable)
- o. EMPAC asset number (if applicable)
- p. Asset Description (if applicable)
 - 1) Keyword
 - 2) Qualifier

1.6 SHOP DRAWINGS AND SAMPLES

- A. The CONTRACTOR 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 hard and electronic copy. All drawing shall be developed in Bentley Systems MICROSTATION CAD software.
- B. The CONTRACTOR shall provide a project loop drawing submittal (PLDS) to verify the DCS interfaces with all instrumentation and devices being provided. For each DCS input/output, the DBC shall note on the PLDS the following information:
 - 1. PCM number and physical location.
 - 2. Type of input.
 - 3. Tag number
 - 4. I/O card location and address.
 - 5. All DCS-dependent displayed functions using ISA symbology.
 - 6. Drawing reference for DCS software content.

- C. 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 Instrument Society of America Standard 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.
- D. All shop drawings shall include the letter head and/or title block of the CONTRACTOR. The title block shall include, as a minimum, the CONTRACTOR's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing. The quantity of submittal sets required shall be as specified in Section 2.5.3.3, "Contractor Submittals".
- E. The DCS hardware submittal (DCSHS) shall be a singular all inclusive submittal which shall include, but not be limited to:
1. A complete set of system diagrams which depict:
 - a. All Process Control Modules (PCMs), communication devices, network equipment and communication links.
 - b. All conduit and wire required to support the power, ground, Input/Output, and communication requirements of the system. A separate diagram shall be submitted for each DCS component fully annotated with conduit size, number, associated with the power source. All conduit and wire numbers shall be consistent with the numbering system shown in these Contract Documents.
 - c. All separation requirements between signal, power and communication conductors shall be clearly shown.
 2. Comprehensive power diagrams which shall show and identify each component of each system and shall show which components require a nominal 110 volt, 60 Hz power source. Where a voltage regulator is required, it shall be included.
 3. Technical data sheets for each component together with a technical projects brochure or bulletin which show:
 - a. The component name as used on project drawings and in these specifications.
 - b. Manufacturer's model number or other identifying product designation.

- c. The project tag number.
 - d. The project system of which it is a part of.
 - e. The project site to which it applies.
 - f. Input and output characteristics.
 - g. Requirements for electric power.
 - h. Specifications for ambient operating condition.
 - i. Details on materials of construction for those components to be field mounted.
4. Site-specific arrangement and construction drawings for all DCS equipment cabinets, including dimensions, identification of all components, preparation and finish data, nameplates, and the like. All drawings shall be accurately scaled and show the position of the equipment in its intended installation location. All drawings must show 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 manufacturer's recommendation, NEC and other applicable codes. All drawings must be drawn to a 1/2-inch = 1 foot scale.
 5. Installation, mounting and anchoring details for all components and assemblies to be field mounted, including access requirements, conduit connections or entry details. All details must be site specific. Provide calculation per Section 01640 Seismic Design of Equipment and Anchorage.
 6. Calibration, adjustment and test details for all components and systems.
 7. Complete and detailed bill of material.
 8. Calculations shall be submitted to verify each network's optical power budget. Calculations shall include the PMD being used, transmitter output power level (dbm), receiver input power level (dbm), losses generated by splices, connectors, and repeaters. The resulting calculations shall represent the allowable end-to-end optical link budgets for use in designing the network.

9. The hardware submittal copies shall be numbered, with controlled distribution. Updates for the DCS Hardware submittal shall be issued whenever the hardware configuration or equipment supplied changes as a result of change orders, requests for substitution or any other procedure. Updates shall be clearly marked as to the pages to be removed and replaced. Updates shall be issued to all holders of controlled distribution copies.
- F. The DCS Software Submittal (DCSSS) shall be included in a singular **all inclusive** submittal which shall include but not be limited to:
1. A complete set of all available software algorithms.
 2. A complete set of control strategies which depict all monitoring and control functions on a loop by loop basis, in a modified SAMA-type **format**.
 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 annotated module configuration sheets depicting each loop linkage.
 5. A complete listing of the DCS data base listing for each data **points** relevant parameters such as range, contact orientation, limits, **incremental** limits, I/O card type, I/O hardware address and assignment.
 6. Detailed descriptions of procedures used to implement and **modify** control strategies and data base construction.
 7. The software submittal copies shall be numbered, with controlled distribution. Updates for the DCS Software submittal shall be issued **periodically** or upon major software configuration changes occur as a result of change orders, requests for substitution or any other procedure. Updates shall be clearly marked as to the pages to be removed and replaced. Updates shall be issued to all holders of controlled distribution copies.
- G. The DCS graphics will be generated on the CITY PCTS Development System and will be available for live, real-time view during development. Graphic submittals will not be distributed.
- H. The CONTRACTOR shall submit the procedures proposed to be followed during the tests required under this project. Procedures shall include statement **indicating** test

objectives, test descriptions, forms, and checklists to be used to control and document the required tests. Prior to the preparation of the detailed test procedures, the CONTRACTOR shall submit outlines of the specific proposed tests. Submittal shall include examples of the proposed forms and checklists. Once the Preliminary Test Procedure Submittal have been reviewed by the CONSTRUCTION MANAGER and returned stamped either "no exceptions noted" or "make corrections noted", the CONTRACTOR shall submit the proposed detailed test procedures, forms, and checklists. Once the detailed Test Procedures Submittal have been reviewed by the CONSTRUCTION MANAGER and returned stamped either "no exceptions noted" or "make corrections noted", the tests may be scheduled. Upon completion of each required test, document the test by submitting a copy of the signed-off test procedures shall be submitted as test documentation. These requirements shall apply to the factory testing of all panels, and all on-site tests. The CONTRACTOR shall submit a detailed ORT specification to the CONSTRUCTION MANAGER at least 6 weeks in advance of commencement of the ORT.

I. RESERVE

1. RESERVE
2. RESERVE
3. RESERVE

1.7 OWNERS MANUAL

- A. The organization of the preceding shop drawing submittal shall be compatible to eventual inclusion with the Operations & Maintenance Manual submittals for this facility and shall include final alterations reflecting "record" conditions. Submittal not organized as described herein and incomplete submittals for a given Loop shall not be accepted. Accordingly, the initial multiple-copy shop drawing submittal shall be separately bound in a standard size, 3-ring, loose-leaf, vinyl plastic, hard cover, binder suitable for bookshelf storage. Binder ring size shall not exceed 3-inches. Five (5) final sets of technical manuals shall be supplied for the OWNER in accordance with Section 2.5.3.5, "Contractor Submittal", and one final set shall be supplied for the CONSTRUCTION MANAGER, as a condition of acceptance of the project.
1. Initially, 2 sets of these manuals shall be submitted to the CONSTRUCTION MANAGER for review after return of favorably reviewed shop drawings and data required herein. Following the CONSTRUCTION MANAGER's review, one set will be returned to the CONTRACTOR with comments. The sets shall be revised and/or amended as required and the requisite final sets shall be

submitted to the CONSTRUCTION MANAGER 15 days prior to start-up of systems. The CONSTRUCTION MANAGER will distribute the copies.

2. In addition to updated shop drawing information reflecting actual existing conditions, each set of technical manuals shall include installation, connection, operation, troubleshooting, maintenance and overhaul instructions in complete detail. This shall provide the OWNER with comprehensive information on all systems and all components to enable operation, service, maintenance and repair. Exploded or other detailed views of instruments, assemblies and accessory components shall be included together with complete parts lists and ordering instructions.
3. Repair parts list for each item (as applicable); such lists shall contain the name of each item, purchase order number, model/serial number, and the recommended repair parts to stock, along with the catalog, part, or piece number of each such repair part.
4. Outline dimensional drawings and assembly drawings and the names of the parts.
5. Copies of maintenance specifications, schedules, and instructions.
6. Copies of operation and adjustment instructions for all equipment and components.
7. Processor, peripheral, and data communications equipment instruction, reference, wiring, and option manuals.
8. Software manuals and program source and object listings, annotated in clear English, technically correct flow charts, narrative descriptions, diagnostics, and user's guides. Permanent copies of all programs on DVD shall be provided for the OWNER's use. Software documentation shall include full instructions on how a program is used, including execution procedures and system software dependency.
9. System test plans and procedures.
10. The Control Strategy Narrative is provided by the CITY for incorporation into the DCS Owner's Manual by the CONTRACTOR.
11. All Emerson drawings and documentation related to the Ovation DCS Hardware and Configuration shall be provided in electronic format such as pdf. All DCS drawings related to the COMNET design and installation shall be provided in

electronic format to include both pdf and the native software package format utilized to create the documentation, such as Microstation, MS Word, MS Excel, or approved format.

12. Provide configuration files for all switches, field LAN routers, Ethernet link controllers, SNMP, and all related accessory equipment. Provide all administrative passwords for setup on workstations, switches, field LAN routers, controllers, and including all related accessory equipment.

1.8 AS-BUILT DRAWINGS

- A. As-built drawings shall be prepared in accordance with Section 2.5.3.5 with the following exceptions and changes:
 1. The CONTRACTOR shall keep current an approved set of complete DCS loop drawings, PIDs, control descriptions, Input/Output termination lists, control schematics, DCS installation drawings, UPS installation drawings, network conduit and cable routing drawings, and test reports. These drawings shall include all devices furnished under this specification and interfaces with all other devices furnished under this specification and interfaces with all other devices which communicate with the DCS.
 2. One set of original drawings and two copies of each as-built drawing under this Section shall be submitted to the CONSTRUCTION MANAGER after completion of field checkout, but before placing the systems in service for the OWNER'S use.

1.9 SERVICES OF MANUFACTURER

- A. The CONTRACTOR shall provide job site visits and services of manufacturer's technical field representatives for all equipment which is furnished by others. Job site visits shall occur during the calibration, testing and start-up phase of the project.
 1. The CONTRACTOR shall provide the services of competent field technicians to oversee the installation, testing, calibration, start-up, operation and maintenance of the equipment provided under this Section.
 2. Provide all necessary assistance to instruct the OWNER's representative in regard to the operation of the equipment supplied. This assistance shall be provided during the start-up phase of the project and the first year of the facility operation following project completion and OWNER acceptance.

1.10 GUARANTEE

- A. The CONTRACTOR shall guarantee the WORK of this section.

1.11 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. After the successful completion the Operational Readiness Testing, and subsequent to the site construction progressing to a point where the intended locations for DCS equipment are complete and free from exposure to on-going construction, all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site. Special instructions for proper field handling, storage, and installation required by the manufacturer for proper protection, shall be securely attached to each piece of equipment prior to packaging and shipment.
- B. Each component shall be tagged to identify its location, tag number, and function in the system. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment under this Section. Identification shall be prominently displayed on the outside of the package.
 - 1. Equipment shall not be stored outdoors. Equipment shall be stored in dry shelters, including in-line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR at their own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such test such as directed by the CONSTRUCTION MANAGER. This shall be at the cost and expense of the CONTRACTOR, or the apparatus shall be replaced by the CONTRACTOR at their own expense.

1.12 QUALITY ASSURANCE

- A. The CONTRACTOR shall have instituted a quality assurance program which utilizes organized methodologies and industry standards. All manufacturing, design, development, production, installation, and field service resources of the CONTRACTOR shall be certified as conforming with all of the requirements of international quality standard ISO 9001. The certification shall be submitted to the CONSTRUCTION MANAGER. This certification shall be a "Certification of Quality", from an

internationally recognized certification agency. The program shall include the following aspects at a minimum:

1. System of traceability of manufactured unit and system software throughout development, production and testing.
2. System of "burn-in" for all components and available supportive documents.
3. Demonstrated record of prompt positive response to field failures.
4. Record of prompt shipments in accordance with contract obligations.
5. Documented program of failure analysis.
6. Quality assurance organization which complies with ISO 9001 guidelines.
7. Documented product safety policy relevant to all products intended to be furnished under this Contract.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Current Technology:** All hardware and software shall be the most recent field-proven models and revision levels marketed by their manufacturers at the time of proposal submission. It is the intent of the City to obtain a DCS which utilizes state-of-the-art products in the DCS manufacturer's product line. Products within the DCS manufacturer's product line which have been superseded by newer, more advanced devices shall be acceptable. Successful operation and calculation shall be demonstrated during startup and testing.
- B. **Hardware and Software Commonality:** Where there is more than one item of similar equipment, being furnished under this contract, all such equipment shall be the product of a single manufacturer and feature the interchangeability of parts. Minor deviations from this requirement are acceptable when specific technical requirements impose a deviation in the specifications. In case of a discontinued or upgraded product, or other cases where changing technology requires changes in equipment, the CONTRACTOR shall submit a Substitute Item Request Form. 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
- C. **Fault Tolerant:** Where a system processor is indicated to be redundant, that unit shall function as a fault tolerant device. 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. A fault tolerant configuration shall provide synchronous read/execute/compare capabilities with no database transfer. 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 without affecting normal system operation. Upon replacement of the defective processor, the operator shall initiate the processor and initiate a command from the workstation to download the database and control logic from the active processor. The operator shall then choose to initiate a transfer to the replaced processor. Alternatively, the download may occur automatically on processor replacement. The use of backup, "hot standby", or "automatic 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.
- D. **Environmental Suitability:** 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. The system design shall be adequate to provide proper protection against interferences from all such possible situations. 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.
1. **Field-Situated Equipment:** DCS equipment being furnished under this contract shall be suitable for use in wastewater treatment facilities, some of which are in an environment of salt-sea laden air with traces of methane and hydrogen sulfide. The system design shall be adequate to provide proper protection against such an environment. All field-situated equipment including PCMs shall be UL-listed or certified by a qualified third-party as meeting UL requirements. All DCS devices shall be housed in an enclosure suitable for its intended service

and installation location. All DCS devices to be installed in MCC or other protected areas shall be furnished in NEMA 1 rated enclosures. All DCS devices to be installed in indoor unprotected areas shall be furnished in NEMA 12 rated enclosures. All DCS devices to be installed in indoor areas subject to hose-down conditions, or outdoor areas, shall be furnished in NEMA 4X rated stainless steel enclosures. All DCS devices to be installed in areas where corrosive agents are present in quantities which exceed the warranty limits of the equipment (Headworks, Digesters, Solids Handling, etc) shall be furnished in purged, refrigerated/ air scrubbed NEMA 4X rated stainless steel enclosures. As 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)

2. **Control Room-Situated Equipment:** Each Area control room or central control room will be normally air conditioned to maintain environmental conditions defined herein. No positive control of relative humidity is provided or contemplated. DCS equipment shall meet the following environmental requirements:

- a. PCMs:
 - 1) Temperature Range: Storage: -40 to 70 degrees C; Operating: 0 to 50 degrees C.
 - 2) Thermal Shock: 6 degrees C maximum rate of change in 30 minutes.
 - 3) Relative Humidity: Storage: 0 to 100% non-condensing
 - 4) Operating: 5 to 95% non-condensing
- b. WS
 - 1) Temperature Range: Storage: -40 to 70 degrees C
 - 2) Operating: 0 to 40 degrees C.
 - 3) Thermal Shock: 6 degrees C maximum rate of change in 30 minutes.

- 4) Relative Humidity: Storage: 5 to 95% non-condensing
- 5) Operating: 5 to 95% non-condensing
3. **Noise Tolerance:** The CONTRACTOR shall furnish and install sound adsorption materials within/over (i.e., printer covers) DCS equipment enclosures to be installed in those area control centers where DCS devices share work space with personnel to ensure that, with only the DCS equipment operating, the ambient dB level is 55 dB or less when monitored three (3) feet from the operating DCS equipment.
4. **Environmental Operating Range:** All indoor and outdoor enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Control Documents. Heating, cooling, and dehumidifying devices shall be incorporated in order to maintain all devices 20% below their rated environmental operating ranges. The CONTRACTOR shall furnish all internal power wiring for these devices (i.e., heaters, fans, etc.). Enclosures suitable for the environment shall be furnished. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous/classified location in which it is to be installed, and be in conformance with the National Electrical Code (NEC).
5. **Surge and Radio Interference:** All DCS devices shall be IEEE surge withstand qualified. Radio Frequency Protection (RFI) shall conform to SAMA-PMC-33.1.
6. Each PCM shall be provided with an RTD which reports the control room temperature excursions associated with PCM enclosures. For those PCM enclosures which utilize purging, sensors shall be provided which report to the control room to high temperature, low pressure, and "door ajar" conditions. All I/O and sensors associated with enclosure monitoring are to be furnished by the CONTRACTOR.

E. **Equipment Locations:** The DCS configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the OWNER exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the CONTRACTOR shall make such changes without extra cost to the OWNER.

F. **Alternative Equipment and Methods:** Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the CONSTRUCTION MANAGER. Any changes inherent to a proposed alternative, including design modifications, shall be at no additional cost to the OWNER or CONSTRUCTION MANAGER. The required approval shall be obtained by the CONTRACTOR prior to submittal of shop drawings and data. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method specified, or shall include evidence that a specified component is not available.

G. **RESERVED**

H. **RESERVED**

I. **RESERVED**

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5. RESERVED

6. RESERVED

J. **PRIMARY SYSTEM COMPONENTS:** The DCS shall consist of the following primary components;

1. **Process Control Modules (PCMs):** PCMs shall be directly hardwired to process I/O, intelligent transmitters, and Programmable Logic Controllers (PLCs). All PCMs shall be fault tolerant. PCMs shall receive power from dedicated UPS or, in the event of a failure to the UPS, from the supply power to the UPS. Each PCM shall contain all of the required data acquisition, alarming and control strategies required to monitor and control its associated process. PCMs shall be configured by operator interface devices called Workstations (WS) which utilize object-oriented interactive editors to download database and control configurations over the Process Information Network (PIN). The failure of any other DCS device shall not affect the monitoring and control capabilities of the PCMs. PCMs shall dual ported to communicate with other DCS devices over

the Process Information Network (PIN). For additional PCM requirements, see paragraph 2.2.

2. Process Inputs/ Outputs (I/O): All process I/O shall be terminated in an enclosure which is proximal or integral with the PCM that is associated with the I/O. All I/O modules shall be IEEE surge withstand qualified with individual A/D and D/A converters on a per-point basis.
 - a. If the DCS manufacturer's analog input/analog output I/O boards do not provide A/D and D/A conversion on a per-point basis, or adequate signal isolation, the CONTRACTOR shall:
 - 1) Furnish spare analog input/analog output or AD/DA boards to conform to the per-point requirement (i.e. if a board has 8 inputs which share an A/D, seven spare analog input boards or seven spare A/D converter boards shall be furnished.
 - 2) Partition I/O so that the failure of an I/O board will not disable a control strategy. If the implementation of this partitioning results in the need to provide additional analog input/analog output boards, they shall be furnished by the CONTRACTOR at no additional cost to the Owner.
 - 3) Furnish and install signal isolators on the field side termination assembly of the PCM on a per-point basis.
 - b. For additional requirements, see paragraph 2.3.
 - c. All I/O shall be optically isolated. Process I/O shall accept the following variations:
 - 1) Analog Inputs To DCS
 - a) Four (4) wire transmitters shall provide an isolated 4 to 20 mA signal.
 - b) Two (2) wire transmitters shall provide an isolated 4 to 20 mA signal powered from dc power supplies internal to the DCS.
 - c) The DCS shall have a fixed 4-20 ma analog input load of 250 ohms. Provision shall be made to ensure continuity of the loop independent of the DCS equipment status.

- 2) Analog Outputs From DCS
 - a) Outputs shall be isolated 4 to 20 mA dc signals powered from the DCS
 - b) Signal shall be capable of driving a loop impedance of 0 to 600 ohms or greater.
- 3) Discrete Inputs To DCS
 - a) Inputs shall be unpowered, isolated contact closures rated at 1A at 24 V dc. Contacts shall be of noble metal or hermetically sealed.
 - b) The DCS shall monitor the inputs using internal 24V dc power supplies.
 - c) Field contacts for alarms will be wired to discrete inputs in a "fail-safe" mode; i.e. an open wire will result in an alarm.
- 4) Discrete Outputs From DCS
 - a) Outputs shall be unpowered, isolated contacts rated at 5 amps, 120V ac.
 - b) 120V ac power for sensing all discrete outputs shall be provided external to the DCS.
- 5) Intelligent Transmitter Interface To DCS
 - a) Intelligent transmitters shall communicate with the DCS using a bi-directional communication interface.
 - b) The DCS interface shall enable remote transmitter configuration and simultaneous DCS database updating from a DCS workstation (WS).

d. Programmable Logic Controller (PLC) Interface With DCS

- 1) The instrumentation panels to be provided under Section 13300 Instrumentation and Control shall be provided with PLC controllers and membrane LED displays in lieu of the specified relays and window-box annunciators.

- 2) Unless shown otherwise in the Contract Drawings, PLCs shall communicate with the DCS using Ethernet cables furnished and installed by others. Protocol shall be one of the following:
 - a) Modbus RTU via TCP, with the PLC acting as the slave.
 - b) Allen-Bradley CSP, Allen-Bradley EIP, or other native PLC protocol that is currently supported by Ovation
3. **RESERVED**
 - a. RESERVED
 - b. RESERVED.
4. **Process Information Network (PIN):** The PIN shall consist of communications processors and fiber optic cables all of shall be dual ported into all connected DCS devices. The PIN, in its installed configuration shall be fault tolerant. 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. For additional PIN requirements, see paragraph 2.4.
5. **RESERVED**
6. **Facility Information Network (FIN):** The FIN shall provide connectivity between the DCS and plant facility management systems. The FIN shall specifically have connectivity to WS and HS devices using Remote Desktop. For additional FIN requirements, see paragraph 2.4.
7. **Department Information Network (DIN):** The DIN shall provide connectivity between all City's facilities and resources by virtue of a network which incorporates high-speed fiber, and telephone data links and radio technology. For additional DIN requirements, see paragraph 2.4.

2.2 PROCESS CONTROL MODULES

- A. **General:** The PCM shall be a 32 bit microprocessor with on-board random access memory (RAM) for read/write functions. The PCM, in conjunction with field Input/Output (I/O) modules shall perform all system data acquisition, alarm detection, regulatory, logic, timing and sequential process control. PCMs shall perform continuous control, sequential control, and data acquisition concurrently in the same microprocessor. PCMs shall communicate with the Historian System (HS), Workstations (WS) over the

Process Information Network (PIN). All PCM's shall be fault tolerant and be provided with the implemented built-in capability to provide continued correct execution in the presence of the failure of a common logic board or software faults. Failover from one processor to another shall occur within 1000 ms. Each PCM shall be supplied to provide complete redundancy (excluding I/O) configured for fault tolerant processing via standard system configuration procedures. Fault tolerant features shall each include, but not be limited to, control processors, power supplies, wiring and buses. PCM's shall be remotely configurable from WSs over the PIN. Each PCM shall have the capacity to accommodate a minimum of 2000 field-originated I/O points, without requiring additional memory or processors, assuming a mix of 25% analog I/O and 75% discrete, with 50% of memory reserved for control logic

- B. **Communications:** PCM's shall communicate with each other directly in a peer-to-peer manner using peer protocol or logical link protocol in which the sequence of message exchanges between two entities in the same layer is facilitated by utilizing the services of underlying layers to effect the successful transfer of data/control information from one location to another location.
- C. **PCM Functionality:** Independent of the operation or failure of any other DCS device, the PCM shall perform the following core or essential functions;
1. Real-time data acquisition at scan rates specified at the WSs.
 2. Perform input signal smoothing, averaging, or totalization, as required.
 3. Alarm limit checking for absolute limits, deviation rates, or warning limits on designated variables.
 4. Real-time process control based on logic and control strategies downloaded from the WSs to the PCM's over the PIN.
 5. Communicate variable data information (i.e., current value, alarm status, set point, output control constants, etc.) to the HS and WSs.
 6. Communicate with all other system processors regardless of their function without the need for hardware or software gateways. Respond to interrogations for data and receive downloaded operating system, processing records, point data base information and updated parameters for application programs operating in the PCM.
 7. Perform regulatory, logic and sequential control based on configuration data written in a high level process oriented control language, compiled, and downloaded to the PCM.

8. Have an extensive array of self-diagnostics which test and report on the integrity of each printed circuit board in the common logic file in addition to I/O failures. Errors and/or failures shall be indicated locally by Light Emitting Diode (LED) and reported at the WSs.
 9. The PCM shall function as a stand-alone unit which performs all of the functions described herein completely independent from the functioning of the HS device, WSs, the PIN, bridges, routers or other PCMs, i.e., a failure. Any device furnished under this section or other PCM(s) shall not impact data acquisition, control, scaling, alarm checking, or communication functions of a given PCM.
- D. **PCM Hardware Component Platform:** Each PCMs hardware platform shall use fully redundant Intel or Intel-compatible microprocessors, each with its own bus connection. No hard disks or other moving parts shall be used. The PCM shall consist of the following components:
1. **Microprocessor Unit:** The microprocessor CPU shall be a CISC- complex Instruction Set Computer or a RISC-Reduced Instruction Set Computer. The CPU shall conform to the following:
 - a. Intel-compatible 32 BIT processor, 400 MHz or faster
 - b. Floating point processor.
 - c. Crystal controlled real time clock.
 - d. Power fail/auto restart.
 - e. Watch dog timer protection (hardware or API).
 - f. Redundant isolated power supplies (may be shared with I/O)
 - g. Serial interface to process I/O.
 - h. Priority interrupt driven.
 2. **Memory:** CPU memory shall be on-board and shall conform to the following:
 - a. CMOS shared RAM memory with battery backup. After the configuration of all database and control strategies which incorporate the current I/O quantities plus the 20 percent growth required under 2.1 G, each PCM shall have 25 percent of its memory which is dedicated to (1) the storage of

database and control strategies and (2) field I/O termination points unused with both resources available for future expansion. Requirements for spare memory capacity may be, on approval by the OWNER or CONSTRUCTION MANAGER, applied on a Facility basis.

- b. Cache memory which is positioned between the CPU and the bus which maintains a copy of referenced data from the shared memory.
 - c. CMOS-ROM or EPROM in which firmware and the operating system resides.
3. An itemization of PCMs required for the Facility is located in the Appendix and defines the current I/O allocations associated with each device. These totals do not include spare I/O points and spare resources as defined in paragraph 2.1 of this section.

2.3 PROCESS INPUTS/OUTPUTS (I/O)

- A. General: Process I/O modules shall be rack mounted or DIN rail-mounted in an enclosure which is proximal or integral to/with the associated PCM. All process I/O boards shall be slot independent i.e. any I/O card can occupy any card slot. The backplane of the I/O nest shall permit the removal of I/O cards without the need to remove power from the I/O card being removed. All process I/O channels shall be electrically isolated (input isolated, output isolated, and power isolated) from field terminations and adjacent channels as defined in ISA-S50.1.
- B. All I/O boards shall conform to ANSI/IEEE C37.90-1989 for surge withstand capability and EN50082-2 for electromagnetic compatibility immunity.
- C. Analog input boards shall provide 120 dB at 50 or 60 Hz and 60 dB common mode and normal mode noise rejection respectively. Analog Input boards shall have an on-board isolation of 500 DCV pr peak ac between channels or channel to ground.
- D. Analog input boards or modules shall be provided to interface with process I/O and intelligent transmitters as follows;
 1. Analog input boards shall be provided to accept 4-20 mA, pulse frequency, and thermocouple (Type K,T,J,R,S) inputs. Through board level jumper selection on a point-by-point basis, the analog input channel can act as either source for two wire transmitters) or sink (four wire transmitters). Each analog input shall have a minimum of 12-bit resolution, minimum accuracy of plus or minus 0.1 percent, maximum long-term drift of 0.02 percent, and a dedicated A/D converter.

2. Intelligent transmitter modules (ITMs) which allow receiving continuous self-diagnostic data shall be provided. The reading of transmitter data or value shall not disturb or interfere with the reading of the measurement signal.
 - a. Intelligent process instrumentation shall be directly connected to the DCS through a bi-directional digital communication interface at the PCM. Analog transmission of variables from intelligent transmitters shall not be acceptable.
 - b. Each ITM shall contain a minimum of six (6) individual channels, each of which provides isolated power and communication to the intelligent device. 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 (10) times per second. Each message shall contain the following:
 - 1) Primary measurement information such as flow, pressure, level, etc.
 - 2) Transmitter temperature readings in a 32 bit floating point format which complies with IEEE.
 - 3) Data security information
 - 4) Diagnostic information
 - 5) Message checking
 - c. Information (when available from the field instrument), which shall be displayable at any DCS WS, shall include:
 - 1) The assignment of configurable parameters such as tag number, location, address, tag name, designation of digital or 4 to 20 mA output, upper and lower range values, zero elevation or suppression, linear or square root output for d/p cells, and damping time.
 - 2) Perform a loop integrity check.
 - 3) Rearrange without using calibrating input pressure.
 - 4) Display the 4 to 20 mA signal in terms of percent of span, or engineering units.
 - 5) Last calibration date.

- 6) Fail-safe direction.
 - 7) Read process variables in user selected engineering units.
 - 8) Diagnose problems and determine fault between processor or transmitter.
- d. All ITMs shall be slot independent. ITM operation shall **not** be impacted in the event that one of a pair of fault tolerant PCM processor fails.
 - e. The transmitter bus provided shall where indicated provide ISA SP50, or ISP (InterOperable Systems Project) connectivity.
 - f. In addition to ISA SP 50 and ISP conformity, all ITM devices shall be furnished to communicate with devices which use the HART protocol.
- E. Analog output boards shall be provided to output 4-20 mA commands. Each analog output shall have a minimum of 12-bit resolution, accuracy of 0.1 percent of full scale, and a dedicated D/A converter.
 - F. Discrete input boards shall be of the voltage monitoring type and shall be powered by the PCM. The discrete input board shall accept 24 V dc.
 - G. Discrete output boards shall be unpowered isolated contacts rated for 5 amps at 120 V ac.
 - H. Field PLCs shall interface to the DCS through CITY pre-approved Ethernet capable PLCs such as an Allen-Bradley 5/05 or CompactLogix or ControlLogix.

2.4 COMMUNICATION SYSTEMS

- A. **General:** Data communication subsystems shall be comprised of industrial grade redundant communication buses that provide high speed data transmission between all distributed processors and I/O modules. Each communication network shall be designed around the International Standards Organization's Open System Interconnection (OSI) model, IEEE 802 or ANSI X3T12 industry standards and support a hierarchical communications network. Communications shall be masterless with communications residing in each distributed processor. All communication cables shall be installed in conduits. The CONTRACTOR shall review the contract drawings to review the current communications system design. The CONTRACTOR shall furnish all cable required to accommodate the communications system being provided. The PIN and the FIN may be integrated into a single network, provided that the PIN real-time data uses synchronous mode transmission.

- B. **Low-Level Protocols:** Physical and data link layer protocols shall support local area networks (LANs), metropolitan area networks or wide area networks (WANs). Information shall be conveyed in packets with a sustained signaling rate of at least 2 million bits per second.
- C. **Mid-Level Protocols:** Network and transport layer protocols shall provide addressing and routing facilities to enable a host on one network to send a block of information to host located on another network thereby expanding a host's communication environment from a single network to a network of networks, or an ethernet, joining addressable hosts. Mid-level protocols shall support the implementation of half-gateways i.e., LAN - backbone coupling and full gateways i.e., LAN-LAN couplings. Node-node gateways shall perform protocol translation and if necessary implement virtual circuits where required. For those applications which access the network layer directly, a programming interface shall be implemented in the packet network to facilitate the use of datagrams i.e., blocks of information embedded within single packets which can be sent to individual hosts without using additional protocol software.
- D. **High-Level Protocols:** The Session, Presentation, and Application Layers shall use the transport mechanism provided by the Mid-Level Protocols to implement a distributed computational environment. Session Layer services shall augment the virtual circuit facilities present at the Transport Layer. The Presentation Layer shall regulate the representation of data items conveyed across the network. Support for the ONC (Open Network Computing) product suite (i.e. XDR, RPC, NIS, NIS+), BSD sockets, SYS V streams shall be provided.
- E. **Process Information Network (PIN):** The CONTRACTOR shall furnish and oversee the installation of a Process Information Network (PIN) which shall connect all DCS and information system devices in a manner which creates an environment in which applications on distinct devices shall accomplish work cooperatively by sharing information as well as synchronizing the operation of the two applications of a common task. The PIN shall be the DCS manufacturer's standard and most secure offering for a process control network, and shall use a physical star and/or and ring topology. The PIN shall conform to the following;
1. Each DCS and information system device shall be furnished with a PIN communication device, complete with detailed device command algorithms encoded as processor instructions, to manage the device/controller interface.
 2. The PIN shall be able to support the system response times stated in paragraph 2.5 with a database sized in conformance with 2.1 H (i.e. 220% of the current database).

3. The PIN shall utilize redundant fiber optic cables between structures. Within structures, Category 5 unshielded twisted pair cable (UTP) may be used, provided that levels of induced electrical noise do not interfere with data transmission. The cables shall be furnished and installed by the CONTRACTOR.
4. The CONTRACTOR shall review the Contract Documents to determine if the conduit system meets the DCS manufacturer's requirements, determine the exact length requirements and to compare the tensile strength associated with the cable to be provided with the hand hole/pull box spacing indicated in the contract documents. If additional hand holes/pull boxes are needed to accommodate the characteristics of the CONTRACTOR'S cable, they shall be furnished by the CONTRACTOR at no expense to the OWNER. The PIN shall utilize a medium which as a minimum conforms to the following:
 - a. Industrial grade, water resistant optic fiber, coated with a suitable material to preserve the intrinsic strength of the glass, suitable for installation in conduits which are encased/directly buried/ cable trays.
 - b. Cable of all dielectric construction.
 - c. Multi-mode, graded index, solid glass waveguides with the following characteristics:
 - Nominal core diameter 62.5 microns
 - Minimum ellipticity 2.0 percent
 - Outside clad diameter 125.0 microns
 - Maximum Numerical Aperture (NA) 0.275
 - Maximum attenuation (850) 3.75 dB/Km
 - Maximum attenuation (1,300) 1.5 dB/Km
 - d. Each fiber continuous with no factory splices.
 - e. Tight buffer.
 - f. RESERVED
 - g. Drop cables shall be of variable lengths of flexible fiber optic cable, typically not to exceed 400 feet so that loss in the drop cable is less than 1 dB. This length of drop cable shall permit relative freedom in routing the trunk cable and locating the station.

F. **Facility Information Network (FIN):** The intent of these Contract Documents is to conceptually describe the desired level of functionality and key criteria associated with the FIN.

1. **FIN CONCEPTS:** The FIN shall connect all WSs associated with the facility with multiple file servers which will run various future applications. The FIN shall provide connectivity between the DCS and plant facility management systems. The FIN shall specifically have connectivity to WS and HS devices. Each WS shall interact with (i.e. monitor and manipulate data) resources associated with the FIN. The HS shall provide a DCS historical resource for the FIN connected devices to support FIN applications. All FIN resources and applications, including those implemented under this contract and future applications, shall all be accessible and manipulatable from the WS in a manner that is identical to any terminal directly connected to the FIN while the WS is using Remote Desktop utilities. The FIN shall have access to the current DCS database, all WS display graphics, and the DCS historical database. Any PCWS device connected to the FIN shall have monitoring and display capabilities equivalent to that of the WSs.
2. **FIN Design Criteria:** The FIN shall enable plant staff to select different third-party applications which run on varying hardware and software platforms. The FIN shall comply with IEEE 802.3 for 10 BASE-T Ethernet, or IEEE 802.3u Fast Ethernet (100BASE-T). Within a building, the FIN configuration shall provide a dedicated 10 Mbps Ethernet 10BaseT port to each device on the FIN, using switched Ethernet. Switching shall use the fragment-free or store-and-forward method. Stackable switching hubs, provided with UPS power, shall provide support for SNMP management, and for multiple MAC addresses. External to a building, backbone connections to the switching hubs shall be 100 Mbps or Fast Ethernet. All FIN WSs and PCWSs shall be provided with 10/100 network interface cards. The FIN to be designed and furnished by the CONTRACTOR shall conform to the following;
 - a. Machine Independent
 - b. Operating system independent
 - c. Network independent
 - d. Transport protocol independent
 - e. Accommodate multiple servers
 - f. Accommodate 75 nodes

3. **FIN Cable Installation:** The CONTRACTOR shall furnish all FIN cable. FIN cable shall conform to the cable specified for the PIN, and when routed through the process areas, shall be installed in the same conduits as the PIN. In the operations building, the FIN cable shall be routed to a patch panel which shall be provided under this contract. The patch panel shall be located as shown on the contract drawings. From the patch panel, the FIN shall be extended to the various office sites as indicated on the electrical drawings. From the patch panel, the FIN shall be extended to the various office sites (as shown on the contract electrical drawings of the Reference Documents) using **two** 4-pair solid conductor #24 AWG cable wired in conformance with the EIA/TIA-568a cabling specifications and recommendations. The untwisted pair (UTP) cable shall not be run in conduits that carry electrical cable and shall not be run near fluorescent lights or large electromagnetic machinery. Teflon sheaths shall be used for plenum installations. All closet connections and wall plates shall be clearly labeled for easy identification of origin and end node. UTP shall be AT&T DIW 24/4 EIA/TIA 568 Category 5, or equal.
4. For connections between buildings, multi-mode fiber shall be used. The PIN and FIN may be different strands within the same bundle of fiber. The CONTRACTOR shall allocate one spare strand for every strand used for PIN and FIN application.
5. Fiber optic cable terminations: All fiber optic cables shall be terminated in a fiber optic patch panel, Siecor model WCC or equal, with epoxy- type ST connectors. One fiber optic jumper cable shall be provided for each fiber.
6. **FIN Testing:** The capability of FIN devices to extract data from the PIN and compile this data into Excel spreadsheets shall be tested. The capability of WSS and other FIN devices to use the Microsoft Office and Microsoft Windows resources shall be tested.

G. **Department Information Network (DIN):** The intent of these Contract Documents is to conceptually describe the desired level of functionality and key criteria associated with the DIN.

1. **DIN CONCEPTS:** The DIN shall interconnect with the FINs and PINs associated with North City Water Reclamation Plant (NCWRP), Fiesta Island Replacement Project/Northern Sludge Processing facility (MBC/NSPF) and the Point Loma Wastewater Treatment Plant (PLWTP). This interconnection shall utilize a multistranded single-mode fiber optic data communication link between all facilities.

2. A WS at any facility shall be identical to and have the same access to all process displays and FIN data via a Remote Desktop session. Serial data transport within the DIN to the existing Ovation system at COMC shall be configured for selected real-time and calculated process data to be placed onto the COMC PIN for display and control.
3. **DIN Design Criteria:** The DIN shall provide a service backbone network for the City. At the COMC control room at MOC 2, the WSs located in the City's Headquarters shall have the capability of the following;
 - a. Dynamically view any WS process display screen associated with the selected facility connected to the DIN.
 - b. View all displays associated every facilities' FIN resources. This shall include dynamically linking into MMS, MIS, LIMS, etc data associated with the selected facility.
 - c. View current and historical associated with both the PIN and FIN resources at any facility.
 - d. Receive, in a dynamic manner, all high priority alarms associated with any facility.
 - e. Generate overview process reports based on data extracted from each plants historical database. The CONTRACTOR shall provide for the quantity of reports listed in the Appendix. Reports shall be generated on a daily, weekly, monthly and annual basis.
 - f. Generate overview reports based on data extracted from each plant' s FIN database, such as management / maintenance / laboratory / process data. Reports shall be generated on a daily, weekly, monthly and annual basis.
 - g. Receive a selected set of real-time process data at COMC and alarms for display on an inter-facility overview graphic.

2.5 RESERVED

- A. **RESERVED**
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- F. **WS Operating System (OS) Software:** The OS shall comply with the requirements of paragraph 2.14.
- G. **WS database Management System (DBMS):** Each WS shall have its own Real-Time Data Base (RTDB) that reflects the current state of all process variables. All real time process data shall be available to any WS connected to the PIN.

H. **WS Tools Platforms (TP):** The TP shall extend the functionality of the multitasking OS by providing application tools or extensions of the OSS platform. The TP shall provide, through a procedural call interface, software to support:

1. User-operating system interface (shells) to allow the user to manipulate files and run application programs in a concurrent manner.
2. Database management systems (DBMS) which employ Structured Query Language (SQL) interface to a relational database. Shell environment variables to support SQL shall be configured for Oracle.
3. 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.

I. **WS Standards Compliance:** 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:

1. Floating point processor shall comply with IEEE-754.
2. Network communications shall comply with IEEE-802.3/802.4.
3. Peripheral interface shall comply with Ultra-SCSI
4. Compatible with network protocols TCP/IP.
5. User interface based on X Windows, X11.

2.6 RESERVE

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2.7 RESERVED

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2.8 RESERVED

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2.9 RESERVED

A. RESERVED

2.10 EQUIPMENT ENCLOSURES AND CONSOLES

A. **General:** The DCS equipment furnished under this contract shall be housed in enclosures designed to provide physical and environmental protection for the interior modules, busses and terminations. All PCM enclosures shall be provided with dual feed, fully redundant power modules utilizing power auctioning to provide intermediate power to all enclosure components. Input power source shall be 120 Vac 60 Hz and 125 or 24 V dc. Enclosures shall contain racks which allow easy removal of all modules, i.e., processors, I/O boards, power supplies, etc. without removal of wiring or power. All modules shall be restrained to prevent accidental disconnection. Each enclosure shall be designed to pass through a 36 x 90 inch doorway opening. All equipment enclosures shall be UL-listed or certified by a qualified third party as meeting UL requirements.

B. **Field Enclosures:** Field enclosures shall provide moisture and contaminant protection and meet the electrical classification specified. Enclosures shall as a minimum provide NEMA 1 protection. Internal air circulation fans to aid in convection cooling or other means of temperature conditioning shall be provided as needed. Power and signal wiring shall enter the enclosures from its top or bottom section and terminate at termination assemblies residing in the bottom or side sections of the enclosure. Terminal connections shall support a single 12 AWG or two 14 AWG wires. A terminal shall be provided for each conductor of external circuits plus one ground for each internally powered analog signal shield. Each analog loop shall be individually fused with all fuses or circuit breakers clearly labeled and located for each maintenance if individual isolation is not provided at the board level.

C. RESERVED

2.11 NITROGEN GAS PURGE SYSTEMS FOR PCMs

A. If explicitly shown to be required on the Contract Drawings, the CONTRACTOR shall furnish a nitrogen gas purge system which continuously purges PCM enclosures with nitrogen gas at the rate of one (1) complete volume change per day.

1. The nitrogen gas system shall consist of nitrogen cylinders piped to a common manifold with individual branch circuits extending to each enclosure to be purged.
 2. The manifold system shall include;
 3. A discharge pressure regulator on the manifold
 4. An isolation valve for each cylinder
 5. A check valve for each cylinder
 6. An isolation valve on each branch circuit
 7. A check valve on each circuit
 8. All ancillary piping, fittings, and accessories
- B. Suitable couplings and flexible pipe sections shall be provided on each branch to permit the quick removal and installation of cylinders on a routine basis.
1. All valves, fittings, and accessories shall be 316 stainless steel.
 2. All components, including but not limited to, piping, enclosures, liquid nitrogen cylinders, gauges, fittings and other accessories shall be purchased. Temporary rental or leasing arrangements shall be acceptable.
- C. A minimum of two (2) liquid nitrogen cylinders, each containing the equivalent of three thousand six hundred (3600) cubic feet of nitrogen gas at atmospheric pressure will be provided for each system.
- D. Each cylinder shall deliver gas reliably and continuously without pressure fall-off. The pressure building regulator shall maintain minimum operating pressure while the economizer regulator shall reduce excess pressure during non-use periods.
- E. Each liquid nitrogen storage cylinder shall have the following features;
1. Allow direct gas flow without auxiliary equipment.
 2. Sustain discharge at required pressures.
 3. Be capable of providing gas at a maximum continuous rate of twenty five (25) cubic feet per hour

4. Be capable of providing gas at a maximum intermittent rate of one hundred (100) cubic feet per hour
5. Both of the flow rates noted in preceding items 3 and 4 shall be delivered with only regulator and piping attachments required. An external heat exchanger shall not be utilized.
6. Have a built-in shock absorbing system to resist rough handling during transport.
7. Have self-contained controls and piping which is protected by a stainless steel ring which is welded to the top of the cylinder.
8. All valve handles shall have a low thermal conductivity to permit comfortable operation without the need for gloves.
9. A strong internal support system to provide added stability and added protection under all working conditions.
10. Fully insulated cylinder walls to reduce evaporative losses through the pressure relief valve.
11. A built-in automatic pressure building system to allow immediate operation after filling or pressure transfer.
12. A built-in evaporizer to provide direct gas flow without auxiliary equipment. A built-in economizer circuit shall be provided to reduce evaporative pressure build up during idle time and provide virtual no-loss operation. Evaporative losses during periods of non-use (zero-gas withdrawal) shall not exceed two and one-half (2.5) percent of the stored volume per day
13. Designed for unattended service or operation subsequent to initial set up without the need to make repetitive pressure adjustments.
14. The following devices shall be provided for each cylinder in conformance with the technical requirements which regulate the quality of such devices as defined in the contract documents;
 - a. gas pressure gauges
 - b. Container bursting disc
 - c. safety relief valve

- d. manual gas vent valve
 - e. economizer regulator
 - f. pressure building regulator
 - g. manual pressure building valve
 - h. liquid level gauge
 - i. casting bursting disc
 - j. manual liquid fill and withdrawal valve
 - k. pressure building coil
 - l. vaporizer
 - m. . gas withdrawal check valve.
- F. Each cylinder safety relief valve shall be set at 235 psig with a normal container gas operating pressure of one hundred twenty five (125) psig. A single pressure regulator, adjustable between 0 and 3.0 psig shall be provided on the manifold gas line to maintain a desired positive pressure in each enclosure being purged.
- G. Unless otherwise specified or shown, all piping, fittings, valves, and other accessories shall be 1/4 inch diameter.
- H. All cylinders shall be secured by retainers to prevent tipping over.
- I. All PCMs which are purged shall be provided with sensors which detect and transmit to the DCS the following conditions:
- a. A low pressure condition internal to the enclosure.
 - b. A high temperature condition internal to the enclosure.
 - c. An enclosure-door-open condition.
- J. The complete nitrogen purge system shall be checked-out and in operation prior to the installation of related PCMs. All costs associated with nitrogen deliveries and refills prior to system acceptance shall be the responsibility of the CONTRACTOR.

- K. All cylinders, valves, piping, enclosures, and other equipment comprising the nitrogen gas purge system shall become the property of the City upon system acceptance.

2.12 OPERATING SYSTEM SOFTWARE

- A. **Operating System Software (OSS):** The OSS shall be a multiprogramming network operating system in that it shall support multiple processes by sharing computer resources with processes intercommunicating with various forms of resource sharing occurring via a network. The OSS shall be a multitasking (i.e., supports multiple processes per user). A process shall be defined as units of activity characterized by a single sequential thread of execution, a current state, and an associated set of resources. The OSS shall be open (i.e., have a publicly specified interface, be non-proprietary, and be based on a public domain specification). The OSS shall be a Windows Server 2008 and Windows 7 or approved equal. The OSS shall provide the following functionality:

1. Multi-tasking to provide task suspension and priority scheduling of task execution.
2. Hardware interrupt priority handling.
3. Network communications to accommodate program downloading from the host and to respond with data transfers as required by the host or interactive shared display system.
4. Support for multiple processors.
5. TCP/IP shall be implemented on this project. All OSS's shall be Windows Server 2008 and Windows 7 and be provided with SMP. OSS's which feature SMP and TCP/IP but which do not implement it are not acceptable.

2.13 SYSTEM CONFIGURATOR

- A. **General:** The following software components shall be furnished to structure and customize process operations and information management tasks. The ability to modify the structure at a later date shall also be provided.
 1. **Display Building, Configuring and Editing Tools:** Software tools shall be provided for developing, editing, using and managing displays. Sophisticated display structures shall be configured as defined by the CONTRACTOR subsequent to the finalization of user meetings and graphic submittals. Displays shall be constructed from a combination of pre-defined graphic objects that shall be developed, maintained, and manipulated. The Display Builder shall contain libraries of grouped objects and separate libraries of user- and system suppliers-

defined marker tables. Addition to the libraries shall be provided by incorporating user-defined objects named and created with the Display Builder. Addition to the marker tables shall be provided by using the Marker Editor in the Graphics Utilities.

2. **Display Builder:** The Display Builder shall use pull-down menus and a high resolution pointing/input device, such as a mouse or trackball, for function selection. It shall also create overlays as unique files. It shall be possible to configure any number of overlays to exist on the screen at any one time. Overlays or "windows" shall contain any information that must be invoked quickly from a "base" display (typically for gaining more detail). The builder shall be a general purpose, object-oriented editor for the construction and editing of detailed, interactive displays. It shall produce an object-oriented data base that is used during the building process. The software shall enable the operator to build displays representing any type of application.
 - a. The following types of objects shall be furnished as a minimum:
 - 1) Geometric Shapes -- Lines, rectangles, polygons, arcs, and ellipses.
 - 2) Text -- Alphanumeric characters in a variety of fonts and sizes.
 - 3) Markers -- Small, single-color shapes such as pumps, valves, and icons that are used repeatedly.
 - 4) Groups -- Object(s) composed of other objects.
 - 5) Library Group -- Standard and user-defined objects for inclusion in user-built displays.
 - b. There shall be no inherent limit on the complexity of objects or the number of objects contained in another object. Display objects shall be connected to control algorithm parameters and system variables. Configured displays shall remain editable by the Display Builder. Display objects shall have the following editing features as a minimum:
 - 1) Move -- Change the location of an object within a display.
 - 2) Stretch/Shrink -- Alter the dimensions of an object.
 - 3) Cut/Copy/Paste -- Delete, duplicate, and add objects.

- c. Drawing functions shall be organized as a set of tools and resources, selectable from the menu bar, that are used to construct and edit objects. Resources shall be used to aid in the construction. These major functions shall include as a minimum:
 - 1) Filing
 - 2) Library functions
 - 3) Drawing
 - 4) Editing
 - 5) Resources
 - 6) Grid
- 3. **Display Configurator:** A Display Configurator shall be furnished to convert static displays into dynamic displays that interact with the process, and provide a logical hierarchy of control capability. Connection of display objects, trend objects, or X/Y plot objects to shared system variables to reflect the current value of the variable, or to connect to control variables to allow the operator to view and change the value of the variable shall be provided.
 - a. Selectability configuration of a given display object shall be provided to perform one or more of the following functions when the operator picks that display object:
 - 1) Run/execute a program
 - 2) Call up a display or overlay
 - 3) Close the current display or overlay
 - 4) Write text to a file
 - 5) Set a relative pick
 - 6) Ramp
 - 7) Momentary contact (Hold-down Pulse or Timed-Pulse)
 - 8) Trends, X/Y profile plots

4. **User Interface:** Associated variables (process or shared) with display objects shall use both graphical and hierarchical methods to move about and within the display object data base. Pull-down menus accessible from the display field shall select objects in the display hierarchy and specify connection attributes.
 - a. **Display Object Data Base:** The Display Object data base shall be composed of all the display objects that are all part of the hierarchy of object groups. The root group shall contain all display object groups. At each level in the hierarchy, the associated display menu shall indicate the position of the currently selected object in the hierarchy as well as of the connectable attributes of that object.
 - b. **System Data Base:** The System data base shall be any system variable or value in the system that is accessible through the Object Manager. This shall include all shared program variables and all control variables. The system data base shall be accessed by typing the qualified path name of the system variable to be read or written in the appropriate connection dialogue box.
5. **Display File Manipulation:** The Display Configurator shall accept Display Builder files to configure as well as installed files to re-configure. Direct access to Display Builder software for necessary object changes shall be furnished. Once a display is configured, it shall be installed automatically for use by Display Manager in an interactive mode.
6. **Connection Types:** Any connection between an external variable and a display attribute shall be active or passive, and continuous or discrete. Active connections shall alter process or system variables in response to operator manipulation of the display. Passive connections shall alter attributes of display objects in response to changes in process or system variables. Also, attributes shall be active and passive and the system shall be able to configure both an active and a passive connection for them. The active connection shall determine the behavior of the object (position, shape, text contents, etc.) as long as the object is selected for user manipulation. The passive connection shall determine the behavior at all other times. Continuous connections shall vary continuously over a given range, such as flow. Discrete connections shall exhibit a finite number of states, such as pump status or steps in a sequence.
7. **Connection Configuration:** Selecting an object and the desired object attribute for connection shall present an appropriate configuration dialogue box. The dialogue box shall allow the operator to enter a connectable variable and related configuration information (e.g., state table, type of pulse, change delta).

If the object selectability attribute is to be configured, the function menu shall become selectable. Selecting the desired function accesses the appropriate dialogue box for configuration. Selecting a trend or plot shall provide access to configuration dialogue boxes specific to trends or plots. Changes to or deletion of configured connections shall be by the connect menu.

8. **Display Conventions Configurator:** The configuration shall be a menu driven subsystem that allows the operator to build and edit named conventions used to connect display object attributes, such as color and text contents, to individual bits in control strategy: algorithm parameters and global variables. Bit assignments for algorithm parameters, connections to any data type: long integer, floating point, byte, and character shall be possible. Objects shall be bitmapped: rectangle, polygon, arc, text, and marker. Their attributes include visibility, color, fill color, line style, marker number, text contents, and background color. Display Builder and Display Configurator shall be used in conjunction with Display Conventions Configurator. Conventions shall be stored in a file that is read by the Display Configurator.
9. **Graphics Status Attributes Configurator:** This software shall be furnished to edit a configuration file used by the Display Manager to show out-of-service (OOS) and bad input/out (BADIO) status of control algorithms in Detail displays, faceplates, and user displays. Display objects that are connected to a point that reports one of these states shall change the graphic attributes of the object. Display actions for BADIO and OOS shall be separately configurable. The configuration file shall be global and shall govern the graphic behavior of all workstations. The configurator shall provide a brief description of the command options, show the selected configuration, and prompt for any changes. Also, a file with default values shall be supplied for the system. Display objects to display the connection status are: Rectangle, Normal Text, Overstrike Text, Polygon, Circle, Arc, Line, Polyline, Mark. As a minimum, their attributes shall include visibility, color, fill color, line style, marker number, foreground and background color.
10. **Graphics Utilities:** A collection of general purpose graphics editors and utility files for the construction of new fonts and markers, or for editing system supplied fonts and markers shall be furnished. In addition, a color palette shall be available with both the system supplied colors and colors that are customizable.
 - a. The editors shall be used to modify both the standard system graphic utility files which store system markers, fonts and colors, and user graphic utility

files for user markers. These files shall be referenced by all displays upon display call up.

- b. The fonts, markers, and colors shall be accessible in the Display Builder and Display Configurator software for use in building and configuring displays.
 - c. Font Editor software shall allow the operator to edit a font set or create a variety of fonts for use on displays. When accessed within the Display Builder, the selected character font set shall be made available in one of four sizes: single-width, single-height; single-width, double-height; double width, single-height; double-width, double-height.
 - d. Marker Editor software shall allow the operator to create graphics symbols that are used repeatedly. Symbols shall appear as industry-standard shapes, and shall be included in a marker table.
 - e. The Color Palette Editor shall allow the operator to edit colors in the system palette file or create palette work files. The user shall be able to change the foreground and background colors available from the color palette to create more than 16 million colors. At least 233 colors shall be available for use in process diagrams. The first sixteen background colors are standard colors related to system displays. Blink colors shall also be settable.
11. **Workstation/Mode Configuration:** The User's view of the system and the process to which it is connected shall be provided. A specific mode shall be associated with a user, a group of users, or fixed for a given workstation.
- a. This shall be the first level of security for accessing and manipulating system information. The second level of security shall be provided by restricting the selection of individual fields within displays. Different modes shall have different groups of selectable fields for the utmost security. Workstation configuration shall be enabled by the Password Mode Configurator. It shall allow the flexibility to set up security schemes to match plant operation setup.
 - b. The configurator shall be a collection of mode editing functions and tools that maintain a set of configuration data files that allow the following functions:
 - 1) Provide access security for the different operation modes of the system.

- 2) Allow an authorized user to modify mode menus (menu bar entries), and to associate specific displays with the invocation of any given mode.
 - 3) The configurator shall be able to run in any workstation as a transient application task, and shall operate primarily with simple menu selections and dialogue box prompts. An alphanumeric keyboard and a high resolution input device, such as a mouse or trackball, shall be required for configurator operation. Any input device can be used to access menus subsequently built.
- c. There shall be six default modes, in order of increasing capabilities and access:
- 1) View Only
 - 2) Senior Operator
 - 3) Operator
 - 4) I & C
 - 5) Programmer
 - 6) Administration
- d. The content of all modes and menu bars shall be able to be configured to suit the user. Additional modes shall be assigned by using the configurator.

2.14 WORKSTATION (WS) APPLICATIONS

- A. **General:** Window systems shall manage the user-OSS interface that deals with multiple processes and the display of those processes from virtual displays via space multiplexed physical displays. Each WS shall employ a base window system designed for use in a networked, bitmapped workstation mode. The operations for placing information on the screen include graphic oriented and character oriented commands for monochrome and color displays. The windowed implementation shall divide an implementation into a client and a server with a specialized interface between them. The protocol between the client and server shall be of a sufficiently high level (and general) that the client and server can be implemented on distinct machines interconnected by the network although the usual workstation configuration is to implement the two parts on a single machine. The user interface shall provide the fundamental facilities required to support a desktop management implementation which explicitly addresses space multiplexing for

representing virtual terminals-across multiple physical screens that operate with a single physical keyboard and mouse, each with its own application process.

- B. 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 workstation shall be changeable on-line and shall be pre-configured by using a Password Mode Configurator.
- C. 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 workstation functions. Multiple windows with icons shall also be available. Content of the menus shall form the display hierarchy.
- D. The Real-Time Display Software shall support either single-screen or dual-screen operation. Single-screen operation shall allow workstations to operate independently of one another; e.g., duplicate workstations can have duplicate or independent responsibilities. As a minimum, dual-screen real-time software shall provide the following:
 - 1. Ability to direct input devices such as a mouse, trackball, or keyboard, to multiple screens.
 - 2. Ability to enable/disable keyboard and cursor device on-line.
 - 3. Ability to redirect displays from one screen to another and to support up to four process diagram windows on each screen.
 - 4. Ability to call up multiple displays simultaneously with a single request.
 - 5. All process diagrams shall be available for dual-screen use.
- E. Windows and menus shall be used by the OPEN LOOK Graphical User Interface to provide an intuitive windows mode. Windowing shall take advantage of the multi-tasking operating system capability. It shall allow beginning a task in one window while continuing work in another. It shall also allow a single CRT interface within the system using Remote Desktop for interfaces with the DIN and FIN (information networks). As a minimum, the following applications that concurrently appear in its own window shall be:
 - 1. Network Manager
 - 2. Display Manager

3. Data Acquisition and Control Configurator
4. Report Configurator
5. Historian Configurator
6. Operator Message Interface
7. Spreadsheet
8. Virtual Terminal Mode
9. Electronic Documentation Print Routine
10. Loadable Documentation
11. Help Functions
12. X Window from FIN and DIN

2.15 NETWORK MANAGEMENT SOFTWARE (NOT USED)

2.16 DISPLAY MANAGER (NOT USED)

2.17 DATABASE CONFIGURATOR (NOT USED)

2.18 DATA ACQUISITION AND CONTROL CONFIGURATOR (NOT USED)

2.19 ALARM CONFIGURATOR (NOT USED)

2.20 REPORT CONFIGURATOR (NOT USED)

2.21 HISTORIAN CONFIGURATOR (NOT USED)

2.22 STATION (WS) CUSTOM GRAPHIC SCREENS (NOT USED)

2.23 WORKSTATION (WS)-TREND SUBSYSTEM (NOT USED)

2.24 WORKSTATION (WS)-X/Y PLOTS AND PROFILE PLOTS (NOT USED)

2.25 AUTOMATICALLY GENERATED DISPLAYS (NOT USED)

2.26 PREFORMATTED GROUP DISPLAYS

- A. **General:** Preformatted displays provided shall be modified or new ones created through a menu-driven configuration and editing process. Link preformatted displays shall be linked to each other and to graphics to form a user-defined display hierarchy.
- B. 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. The display shall contain faceplates, trends, or X/Y plots or a combination of all three. Display Builder and Display Configurator shall be used to edit displays.
- C. Sequence algorithms shall be intermingled with Continuous algorithms and PLB algorithms in 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

2.27 INVOKING DEFAULT DISPLAYS

- A. Default displays, preformatted displays, and user-defined displays must all be invoked in an identical manner. 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.

2.28 ELECTRONIC DOCUMENTATION

- A. **General:** Systems documentation shall be provided on the system itself in electronic format. It shall be available as DVDs to be run as a separate entity, and as on-line help that is associated with the software functions themselves. DVDs shall be used as they are needed or be loaded onto the hard drive for easy access.
- B. Documentation shall be broken down by function and user. Information required by process operators shall be included in a Process Operator's Guide; information required to configure process control algorithms shall be included in Integrated Control documents and shall be geared toward the process engineer.
 1. **Loadable Documentation:** Loadable documentation shall provide comprehensive information about hardware and software. It shall consist of text and graphics displayed on the workstation screen. Documentation shall be able to run in its own window concurrently with other applications. Documents shall be accessed via the menu bar pick, with further selections made from another menu and table of contents. Documents shall be picked from an alphabetical list or from functionally organized subgroups. Once a document is selected, choice of reading the entire document, a specific area of interest or list of figures, or an index that shows the document selections that discuss the subject area desired will be made available. Various screen control functions shall be provided as selectable icons displayed at the bottom right of each screen of text. These shall include Next Screen, Previous Screen, Next Section, Table of Contents, Exit, and Return. A distinction shall be made between active and inactive selections using different icons.
 2. **Printing Loadable Documentation:** Loadable documentation shall be printed by a special utility that prints all text sections in the document. Each printed page shall contain up to two screens of text.

3. **Embedded Help:** Embedded help shall provide information and assistance for software program/functions. The information shall relate to the current display, current program operation or selection. It shall change as the operator proceeds through the program to provide appropriate information. Help shall be requested by selecting HELP from the menu bar. A menu of topics relating to the current display or selection shall appear on the screen. Selection of a topic from a menu displays the Help text in a partial screen overlay. Screen control functions shall be displayed as selectable icons below each help overlay. They shall be Return, Next Screen, Previous Screen, and Exit Help. For operator guidance, embedded help shall also be user-created to be associated with operational displays.

PART 3 -- EXECUTION

3.1 EQUIPMENT, MATERIALS AND WORKMANSHIP

- A. **General:** It is the intent of these Contract Documents to secure high quality in all equipment and materials, and to require first-class workmanship, in order to assure long, trouble-free operation and minimum maintenance of the DCS.
- B. Equipment and materials shall be the products of reputable, knowledgeable manufacturers with a verifiable history of manufacturing similar equipment. Similar items in the project shall be the products of the same manufacturer. All equipment shall be of industrial grade and standard construction, shall be of sturdy design and manufacture, and shall be capable of long, reliable, trouble-free service.
- C. All work, including calibration, testing, adjustment, start-up and maintenance, shall be done by qualified knowledgeable personnel who are technically skilled in their trade, are thoroughly instructed, and are competently supervised. The resulting completed installation shall reflect professional quality work, employing the highest industrial standards and methods.

3.2 OPERATIONAL READINESS TESTING (ORT)

- A. **General:** The complete system, including all, DCS equipment, peripheral devices and interconnecting cables shall be assembled on the DCS manufacturer's test floor, 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. All hardware test procedures shall strictly conform to the following sections of ISA-RP55.1 - 1975 (R 1983):

1. Section 3: in its entirety
 2. Section 4: applicable portions
 3. Section 5: in its entirety
 4. Section 6: in its entirety
 5. Section 7: in its entirety
 6. Section 8: in its entirety
 7. Glossary - CMR test configuration
 8. Glossary - NMR test configuration
 9. Glossary - Noise measurement configuration
 10. Appendix A - Analog Input Subsystem Accuracy
- C. Four certified copies of all test data and results shall be submitted to the CONSTRUCTION MANAGER. All test documentation and results shall comply with ISA-RP55.1-1975 (R1983) Type 2 and type 3 documentation as described in section 10.2 of the referenced standard.
- D. The equipment shall be operationally tested for compliance with the conditions of these Specifications. ORT operational readiness test 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.
- E. The CONTRACTOR shall submit a detailed ORT specification to the CONSTRUCTION MANAGER at least 6 weeks in advance of commencement of the ORT. The CONSTRUCTION MANAGER shall be notified at least 30 days in advance of the ORT and reserves the right to have his representatives in attendance.
- F. 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 CONSTRUCTION MANAGER.
- G. 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 CONTRACTOR 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.

- H. After successful completion of the factory test, 4 certified copies of all test results shall be furnished to the CONSTRUCTION MANAGER together with a clear and unequivocal statement that all ORT requirements have been met. The CONSTRUCTION MANAGER will give written notice of the acceptability of the ORT within 30 days of receipt of the ORT results.
- I. Three CONSTRUCTION MANAGER/OWNER Representatives shall witness the ORT and at least 30 working days written notice shall be given prior to date of starting tests. One copy of each acceptance test procedure shall be submitted to the OWNER 30 days prior to the start of the acceptance test.
- J. In the event that the system does not function as specified, it shall be modified at the factory 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 CONTRACTOR.

All of the CONSTRUCTION MANAGERS/OWNER's travel and per diem costs associated with all ORT testing and retesting shall be borne by the CONTRACTOR.

- K. Prior to installation, all PIN, FIN, and DIN cable shall be ORT by the CONTRACTOR 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 CONTRACTOR 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 datalinks, which shall be the final hardware, application software, and Modbus addresses installed in the field shall be tested during the operational readiness test.

3.3 INSTALLATION SUPERVISION

- A. **General:** The CONTRACTOR shall provide personnel to properly oversee the installation of all DCS equipment performed by others. Subsequent to the installation of all DCS equipment, the CONTRACTOR shall certify to the OWNER that the DCS has been properly installed.
- B. The CONTRACTOR 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. There shall also be furnished complete installation drawings and instructions in accordance with these Specifications.

3.4 CALIBRATION

- A. **General:** The CONTRACTOR shall calibrate the complete system after installation. This shall ensure that those components 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. Defective elements which cannot achieve proper calibration or accuracy, either individually or within the system, or subsystem, shall be replaced.
 - 1. Analog input channels shall be verified at 25 percent, 50 percent and 75 percent of span by applying simulated analog test signals. 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 CRT display. At least one simulated analog signal shall be routed through each analog-to-digital converter. The accuracy of the analog-to-digital converters and data processing activities shall be verified at each calibration step for each channel being simulated by comparing the known input against the Root Mean Square Summation tolerances calculated for each engineering unit data value noted.
 - 2. The accuracy of all digital-to-analog converters shall be verified by manually entering engineering unit data values at the WS and then reading and recording the resulting analog output data. All analog output data shall be compared against calculated Root Mean Square Summation tolerance requirements.

3.5 TESTING OF FIBER OPTIC CABLE INSTALLATION

- A. **Acceptance Testing:** The CONTRACTOR shall perform pre-installation and post-installation fiber optic cable acceptance tests of cable installed by others. The CONSTRUCTION MANAGER shall be notified a minimum of 5 days in advance so

they may have the opportunity to witness the tests. Each of these tests is described as follows;

1. **Pre-installation tests:** Prior to the installation of cable, the CONTRACTOR shall perform the following test;
 - a. The purposes of these tests is to perform acceptance tests on the shipped cable prior to installation in order to validate that the cable conforms to the manufacturers specifications, and is free of defects, breaks, and damages caused by transportation and manufacturing processes. The CONTRACTOR shall perform all tests on all reels of cable. These tests shall be documented and submitted to the CONSTRUCTION MANAGER for review. Subsequent to the receipt of the CONSTRUCTION MANAGERS approval, the cable shall be available for installation.
 - b. The tests shall measure a total attenuation or loss for each fiber on each cable reel and document results of physical inspections to identify any cable and reel damage conditions, less or more than the specified fibers in the cable, and any deviations from the manufacturer's specifications.
2. **Post-Installation Tests:** The CONTRACTOR, upon completion by others of the fiber optic cable installation and splicing, shall perform the following tests;
 - a. Double-ended loss test per EIA/TIA 568 Appendix H: OFSTP-14 (Optical Fiber Test Procedure 14.) Method B
 - b. Measurements for each fiber shall be documented and provided to the CONSTRUCTION MANAGER
 - c. Any fiber, connectors or other components which do not meet the requirements of EIA/TIA 568 B3 (including standards incorporated by reference) shall be removed and replaced at the expense of the CONTRACTOR. Fusion splices shall not have a loss of more than 0.3 dB. Multimode splices must have a return loss of better than 20 dB. Single mode splices must be better than 26 dB ORL. Requirements for loss are:

Fiber Type	Wavelength (nm)	Max Attenuation Coefficient (dB/km)	Bandwidth (MHz-km with overfilled launch)
50/125	850	3.5	500
	1300	1.5	500
62.5/125	850	3.5	160
	1300	1.5	500
Single mode(Premises)	1310	1.0	NA
	1550	1.0	NA
Single mode(Outside Plant)	1310	0.5	NA
	1550	0.5	NA

- d. Upon completion of the previous tests, all fiber optic cable coils shall be secured with ends capped to prevent intrusion of dirt and water.

3.6 INSTALLATION TEST

- A. **General:** The CONTRACTOR shall be responsible for the oversight of installation of all DCS equipment being furnished under this project. If a DCS device (including network cables) has been installed in a faulty manner, the CONTRACTOR shall notify the CONSTRUCTION MANAGER. Systems shall be exercised through operational tests in the presence of the CONSTRUCTION MANAGER in order to demonstrate achievement of the specified performance.
- B. A complete integrated distributed control system test shall be performed. All modes of operation and man/machine interactions shall be exercised. Compliance to specified system failure detection and failover requirements shall be verified by selectively disabling individual CRT's, common logic files, data communication equipment and data links. Compliance to signal failure detection and response requirements shall be verified by employing analog test equipment to apply excessive signal amplitude and rate-of-change values. All data communication equipment shall be thoroughly tested for function and accuracy.
- C. The results of all distributed control system installation test activities shall be documented. All analog-to-digital converter and digital-to-analog converter accuracy tests shall be documented on test forms, approved by the CONSTRUCTION

MANAGER, which include calculated Root Mean Square tolerance limits for each calibration step.

- D. Upon the satisfactory completion of all distributed control system installation tests, a certified report, including all test documentation, shall be furnished to the CONSTRUCTION MANAGER together with a clear and unequivocal statement that the installed system has been successfully calibrated, inspected and tested. The CONSTRUCTION MANAGER will give his acceptance of the installation tests within 10 days of his personal receipt of the test report if the results of the computer installation tests are acceptable.

3.7 SYSTEM COMMISSIONING AND PERFORMANCE TESTING

- A. **General:** System commissioning and performance testing shall comply with the provisions specified herein and the contract drawings and specifications. Further, system commissioning and performance testing shall commence after all installation tests 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 reviewed by the CONSTRUCTION MANAGER. All tests data shall be acquired using equipment as specified and recorded on test forms, previously reviewed by the CONSTRUCTION MANAGER, which includes calculated tolerance limits for each calibration step. 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 CONSTRUCTION MANAGER with a clear and unequivocal statement that all system commissioning and test requirements have been satisfied. The CONSTRUCTION MANAGER will give his acceptance of the system commissioning and test activities within ten days of his personal receipt of the report if the report is accepted.
- 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 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 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. The stable steady-state operation of final control elements running under the control of field mounted automatic analog 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 field mounted 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.

- 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. 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.
- E. Subsequent to the performance testing of process/process equipment furnished by others, the CONTRACTOR shall conduct a successful 90 day performance test for the distributed control systems 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 system failures. If a system failure occurs, the 90 day test shall be considered a failure and not acceptable. The CONTRACTOR shall reinitiate the 90 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.
- F. The system availability shall be calculated based on the following equation:

$$A = (\text{MTBF} \times 100\%) / (\text{MTBF} + \text{MTTR})$$

where, A = system availability in percent

MTBF = average time interval between consecutive system failures

MTTR = average time required to repair system failure

- G. Downtime resulting from the following shall be considered system failures:

1. Downtime of any system component which is automatically "backed-up" and the back-up unit fails to automatically assume control within the specified time or if a component failure cannot be repaired/replaced within 2 hours.
 2. Downtime of any component (exclusive of I/O) whose failure results in the inability of the Operator to monitor and manipulate control loops from the associated EC/OC using standard man-machine interface procedures.
 3. Downtime resulting from the concurrent failure of any two (2) workstations, or any two (2) operator workstation input devices associated with the same workstation.
 4. Downtime in excess of 2 hours resulting from any I/O component failure.
 5. Downtime resulting from concurrent failure of two or more I/O components in a single PCM.
 6. Downtime of any component/peripheral associated with the Historian if the failed component (1) results in a disabling of the historical functions and (2) the failed component is not repaired or replaced within 8 hours.
- H. The CONTRACTOR 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. Final acceptance, in writing, of the DCS will be provided by the CONSTRUCTION MANAGER if the results of all of the performance tests are acceptable.
- I. The CONTRACTOR shall guarantee the required availability of the entire distributed control system for a period of one (1) year after acceptance of all required performance tests. The CONTRACTOR shall be responsible for furnishing and maintaining the spare parts/tools on-site at an inventory level it determines is sufficient to achieve the system availability requirements specified herein. All spare parts/tools stored on-site shall become the property of the OWNER upon completion of the guarantee period. If the DCS does not comply with the availability requirements stated herein within the first year of system operation, the CONTRACTOR shall forfeit that amount of the performance bond equal to the replacement cost of the entire DCS bid under this contract. The CONTRACTOR shall guarantee the following:
1. The completed system shall perform all of the data acquisition, control, and reporting functions as shown and specified.

2. The availability of the entire distributed control system shall not be less than 99.98 percent with a mean time to repair (MTTR) of 2.0 hours for any consecutive period of 6 months during the guarantee period. Availability, MTTR and other supporting terminology shall be as defined in SAMA Standard PMC 32.1-1976.

3.8 RESERVED

- A. **RESERVED**
- B. RESERVED
- C. RESERVED
- D. RESERVED
- E. RESERVED

1. RESERVED

- a. RESERVED
- b. RESERVED
- c. RESERVED
- d. RESERVED
 - 1) RESERVED
 - 2) RESERVED
 - 3) RESERVED
 - 4) RESERVED
 - 5) RESERVED
 - 6) RESERVED
 - 7) RESERVED
 - 8) RESERVED

e. RESERVED

2. RESERVED

a. RESERVED

b. RESERVED

c. RESERVED

1) RESERVED

2) RESERVED

3) RESERVED

4) RESERVED

5) RESERVED

6) RESERVED

F. RESERVED

3.9 RESERVED

A. **RESERVED**

B. RESERVED

C. RESERVED

D. RESERVED

E. RESERVED

F. RESERVED

G. RESERVED

1. RESERVED

2. RESERVED

3. RESERVED

3.10 RESERVED

A. **RESERVED**

B. RESERVED

C. RESERVED

1. RESERVED

2. RESERVED

3. RESERVED

4. RESERVED

3.11 SOFTWARE DOCUMENTATION

A. Software documentation shall be delivered to the OWNER prior to the **final acceptance** at which time all programs shall have been tested, delivered, and fully **operational**. The Owner retains all rights to programming and software configurations **developed**, performed, and implemented under this project. The CONTRACTOR **must** obtain the Owner's consent prior to reuse of project software. Each set of documentation shall include, but not be limited to, the following:

1. General description of the overall purpose of each program **with any** assumptions or restrictions fully explained. Format for any **input and/or output** messages shall be included.
2. Abstracts describing the operational objectives of each major **program** section together with an explanation of its relationship to other major **program** sections.
3. A complete listing all of hardware devices which comprise the **DCS**. The listing shall include manufacturer, model number, physical **location** and hardware address.
4. A complete listing of all of the tag numbers in the **DCS** along **with** associated description information and hardware addresses.
5. A complete listing of all specialized interface functions that are **associated** with each system function, tag, or operator function.

6. Complete documentation on all system and process displays including a graphical depiction of the hierarchy with linkages shown, definition of security levels associated with each display, a listing and hard copy of all displays and formats.
7. Complete copy of system data base organized by PCM.
8. Complete set of all software configurations implemented for data acquisition, control, and alarming purposes. Data shall include both text and graphic depictions. All software listings shall be fully annotated with as-built data.

** END OF SECTION **

**SECTION 13935 -
DRY-PIPE FIRE SPRINKLER SYSTEM**

PART 1 - GENERAL

1.1 APPLICATION

- A. The dry-pipe sprinkler system shall be designed, furnished, and commissioned by a qualified System Supplier who has a minimum of 2 years of knowledge in designing and furnishing dry-pipe sprinkler systems.

1.2 DEFINITIONS

- A. System Supplier: Where "System Supplier" is referred to in this section, it shall mean the party under contract with the Contractor for design, furnishing, and commissioning the dry-pipe sprinkler system. At the Contractor's option, the System Supplier may also install the system.

1.3 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.
2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.

B. American Society of Mechanical Engineers (ASME)

1. ASME B1.20.1, Pipe Threads, General Purpose (Inch)
2. ASME B16.3, Malleable Iron Threaded Fittings Classes 150 and 300
3. ASME B16.4, Cast Iron Threaded Fittings Classes 125 and 250
4. ASME B16.5, Pipe Flanges and Flanged Fittings

C. American Society for Testing and Materials (ASTM):

1. ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
3. ASTM A536, Standard Specification for Ductile Iron Castings
4. ASTM B584, Standard Specifications for Copper Alloy Sand Castings for General Applications

D. American Water Works Association (AWWA)

1. AWWA C606, Grooved and Shouldered Joints
2. AWWA M20, Water Chlorination Principles and Practices

E. Factory Mutual (FM)

1. Approval Guide

F. National Electrical Manufacturers Association (NEMA)

1. NEMA ICS 6, Industrial Control and Systems Enclosure

G. National Fire Protection Association (NFPA)

1. NFPA 13, Installation of Sprinkler Systems
 2. NFPA 24, Private Fire Service Mains and Their Appurtenances
 3. NFPA 291, Fire Flow Testing and Marking of Hydrants
 4. NFPA 1963, Standard for Fire Hose Connections
- H. Underwriters Laboratories, Inc. (UL)
1. UL 45, Portable Electric Tools
 2. UL 193, Alarm Valves for Fire Protection Service
 3. UL 199, Automatic Sprinklers for Fire Protection Service
 4. UL 213, Rubber Gasketed Fittings for Fire Protection Service
 5. UL 262, Gate Valves for Fire Protection Service
 6. UL 312, Check Valves for Fire Protection Service
 7. UL 346, Safety Waterflow Indicators for Fire Protective Signaling Systems
 8. UL 393, Safety Indicating Pressure Gauges for Fire-Protection Service
 9. UL 405, Fire Department Connections
 10. UL 753, Alarm Accessories for Automatic Water-Supply Control Valves for Fire-Protection Services
 11. UL 1726, Safety Automatic Drain Valve for Standpipe System

1.4 SYSTEM DESCRIPTION

- A. A dry-pipe fire sprinkler system shall provide coverage in all the areas shown on the drawings. The sprinkler heads shall be the heat activated standard type. All components shall be designed to withstand 175 psig minimum working pressure. The system shall be pressured at a minimum of 10 psi of air when in normal standby operation. The hydraulic calculations shall include a 10 percent margin of safety for the available water flow and pressure. Gridded dry-pipe system is not allowed.
- B. Design Requirements
1. The dry-pipe fire sprinkler system shall be designed in accordance with the requirements of the City of San Diego Fire Department.
 2. Provide all flow switches, supervisory switches, and pressure switches, etc. as required for a properly installed dry-pipe fire sprinkler system that interfaces with the fire alarm control panel.
 3. Provide system in conformance with NFPA 13 for all portions of the building. The maximum area per sprinkler is 130 square feet. A hose stream requirement of 250 gpm is to be included in the system demand.
 4. All exposed sprinkler piping shall be painted red.
 5. All piping shall be provided with identification at 15-foot intervals and on both sides of any walls or floors the pipe may pass through.
 6. Provide earthquake bracing in accordance with NFPA 13 for Seismic Zone 4.
 7. Vertical supports for other than earthquake shall be installed in accordance with NFPA 13.
 8. Provide fire department connections at location directed by the OCFA.
 9. All drains and inspectors test connections shall terminate outside the building, in a safe location.
 10. Underground firewater laterals shall comply with NFPA 24.

1.5 SUBMITTALS

A. General

1. The shop drawings, product data, calculations, and evidence that the designers and installers qualifications shall be submitted as one package for review /approval prior to purchase and installation. Failure to submit this information as a package shall result in a rejection of the submittal.
2. The Contractor shall submit all necessary submittals to the City of San Diego Fire Department and receive all necessary approvals. The Contractor shall pay all fees related to submittals, approvals, and inspections.

B. Material and Equipment Information

1. Material and equipment information shall include manufacturer's catalog cuts, descriptive data, and technical data for each component or device used in the system to enable the exact function of each device to be determined and shall indicate UL Listing or FM Approval. The model shall be clearly indicated. Failure to do so indicate the model will result in the rejection of the material. The material to be submitted shall include, but not be limited to the following:
 - a. Alarm Valve
 - b. Isolation Valve
 - c. Pressure Switches
 - d. Tamper Switches
 - e. Fittings
 - f. Sprinkler Heads
 - g. Spare Sprinkler Box/Cabinet
 - h. Fire Department Connection
 - i. Pipe supports
 - j. Identification Signs
 - k. Gauges

C. Drawings

1. Plan and isometric drawings shall be submitted to the Engineer for review. Drawings shall be in accordance with NFPA 13 and shall indicate, as a minimum, the quantities of devices, their locations, installation details of all piping, instrumentation, and equipment associated with the dry-pipe fire sprinkler system. Drawings shall be to an indicated scale of not less than 1/4 inch to the foot. All drawings shall be reviewed by and stamped by a C-16 Contractor, regularly employed by the Contractor, licensed to perform such work by the State of California, fully experienced and qualified in the design of dry-pipe fire sprinkler systems.

D. Calculations

1. Hydraulic Calculations: Submit hydraulic calculations stamped by a California State Registered Fire Protection Engineer in accordance with NFPA 13 for approval. The calculations shall include a 10 percent margin of safety for the available water flow and pressure.
2. Seismic Calculations: Submit seismic calculations in accordance with NFPA 13.

E. Operations and Maintenance Manuals

1. The Operations and Maintenance Manuals shall be submitted. The Contractor shall provide complete bound operation and maintenance instruction manuals to the Engineer.
2. The manuals shall include catalog cuts indicating the manufacturer's name, model number, parts list, a brief description of equipment and their basic operating features.
3. Manufacturer's descriptive literature, with information for each piece of equipment shall be included.

F. Test Procedures

1. The test plan shall describe how the systems will be tested. This shall include a step-by-step description of all tests and shall indicate type and location of test apparatus to be employed. This test is intended to demonstrate that the operating and installation requirements of this specification have been met. All tests shall be conducted in the presence of the Engineer.

G. Test Reports

1. The test reports shall show all field tests performed to adjust each component and all field tests performed to prove compliance with the this specification and NFPA 13. Each test report shall indicate the operating position of controls.

H. Certificates

1. Certificates of compliance for the system shall be submitted in accordance with NFPA 13.

I. As-Builts

1. Upon completion of each system, the Contractor shall provide as-built drawings showing actual installation details. All piping routing shall be indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. All equipment delivered and placed in storage shall be stored with protection from weather, humidity and temperature variations, dirt and dust and other contaminants.
- B. Equipment and materials shall be delivered and stored in their original containers. Labels and containers shall indicate clearly the manufacturer's name, brand name and identifying part number.
- C. The Contractor shall provide adequate means for and shall fully protect finish pieces of the equipment and materials against damage during installation through final completion.
- D. In the event that damage has incurred during any phase of storage, handling or installation, the Contractor shall replace the equipment at his cost without delay to the original schedule.

1.7 QUALITY ASSURANCE

A. Qualifications of the Contractor

1. The system shall be designed, installed, and tested by an experienced firm regularly engaged in the designing, installation, and testing of automatic dry-pipe fire sprinkler systems of this type. The Contractor shall employ engineering and field employees with a minimum of 2 years of knowledge in design, installation, testing and service of dry-pipe fire sprinkler systems.
 - a. The Contractor shall maintain a current State of California C-16 Fire Protection Contractors License. This will be required to accompany the bid for information purposes. Failure to supply this information will result in the bidder being considered non-responsive.
2. The Contractor shall provide a list of a least 2 references for the design and installation of systems of similar nature and size. This will be required to accompany the bid for information purposes. Failure to supply this information will result in the bidder being considered non-responsive.
3. All major components of the system shall be produced by one manufacturer whose established reputation and experience in the industry is not less than 2 years.

1.8 WARRANTY

- A. All dry-pipe fire sprinkler system components furnished as specified herein shall be guaranteed against defect in design, material and workmanship for the full warranty period which is standard with the manufacturer and/or supplier, but in no case will less than two years from the date of system acceptance. In addition, the Contractor shall guarantee the system against false actuation or leakage or malfunction due to faulty equipment, design or workmanship for a period of 2 years from final acceptance. In the event of a fire sprinkler leakage or malfunction from any of the above conditions, the Contractor shall correct any or all of the above conditions which caused the leakage or malfunction at no cost to the City.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Materials and equipment shall be standard products of a single manufacturer's latest design and suitable to perform the functions intended. The name of the manufacturer and the serial numbers shall appear on all major components.
- B. All devices and equipment shall be new, UL-listed and FM-approved for their intended use and shall conform to the types and sizes in accordance with NFPA 13. Each item shall be capable of performing its function over an extended period of time with a minimum of attention and maintenance.
- C. Each item of equipment, including parts and accessories, shall be constructed, in a workmanlike manner, using new materials of the best quality obtainable for the purposes intended. The materials, piping, pipe supports, and equipment shall be designed, built and tested in accordance with applicable codes and this specification.
- D. Quality of Materials Used
 1. All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. Equivalent products may be considered if equal.

2.2 DRY-PIPE VALVE ASSEMBLY

- A. The dry-pipe valve shall be a latching differential type listed in UL Fire Prot Dir or FM P7825a and FM P7825b, and shall be complete with trim piping, valves, fittings, pressure gauges, priming water fill cup, velocity drip check, drip cup, and other ancillary components as required for proper operation. The assembly shall include a quick-opening device by the same manufacturer as the dry-pipe valve for systems over 1890 liters (500 gallons) in capacity.

2.3 AIR SUPPLY SYSTEM

- A. Air supply system shall be in accordance with NFPA 13. The connection pipe from the air compressor shall not be less than ½ inch in diameter and shall enter the system above the priming water level of the dry-pipe valve. The check valve shall be installed in the air line piping and a shutoff valve of the renewable disc type shall be installed on the supply side of this check valve. The air supply system shall be sized to pressurize the sprinkler system to 10 psi within 20 minutes.
- B. The air compressor shall be single stage oil-less type, air-cooled, electric-motor driven, equipped with a check valve, shutoff valve and pressure switch for automatic starting and stopping. Pressure switch shall be factory set. A safety relief valve shall be provided.
- C. The air pressure maintenance device shall be a pressure regulator which automatically reduces supply air pressure to pressure required to be maintained in the piping system. The device shall have a cast bronze body and valve housing complete with diaphragm assembly, spring, filter, ball check to prevent backflow, 1.6 mm (1/16 inch) restriction to prevent rapid pressurization of the

system, and adjustment screw. The device shall be capable of reducing an inlet pressure of up to 680 kPa, 100 psig to a fixed outlet pressure adjustable to 70 kPa, 10 psig.

- D. The air supply system shall be configured so that each dry-pipe system is equipped with a separate pressure maintenance device, air compressor, shutoff valve, bypass valve, and pressure gauge. Piping shall be galvanized steel in accordance with ASTM A795 or ASTM A53.

2.4 LOW AIR PRESSURE ALARM DEVICE

- A. Each dry-pipe valve trim shall be provided with a local alarm device consisting of a metal enclosure containing an alarm horn or bell, silence switch, green power-on light, red low-air alarm light and amber trouble light. The alarm device shall be activated by the low air pressure switch. Upon reduction of sprinkler system pressure to approximately 70 kPa 10 psig above the dry-valve trip point pressure, the low air pressure switch shall actuate the audible alarm device and a red low-air alarm light. Restoration of system pressure shall cause the low-air alarm light to be extinguished and the audible alarm to be silenced. An alarm silence switch shall be provided to silence the audible alarm. An amber trouble light shall be provided which will illuminate upon operation of the silence switch and shall be extinguished upon return to its normal position.

2.5 WATER MOTOR ALARM ASSEMBLY

- A. Assembly shall include a body housing, impeller wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum 20 mm (3/4 inch) galvanized piping shall be provided between the housing and the alarm check valve. Drain piping from the body housing shall be minimum 25 mm (1 inch) galvanized steel and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and on the outside surfaces.

2.6 PIPING AND FITTINGS

A. Underground Pipe

- 1. Carbon steel pipe shall conform to ASTM A53, with cement-mortar lining and Type D or E coating, as specified in Section 15065.

B. Aboveground Pipe

- 1. Black steel pipe shall conform to ASTM A53, Schedule 40 in pipe sizes 6 inches and smaller, and Schedule 80 in pipe sizes 8 inches and larger.

2.7 PIPE FITTINGS

A. Below Grade Fittings

- 1. Carbon steel fittings shall conform to ASTM A 234, as specified in Section 15065.

B. Above Grade Fittings

- 1. Steel Fittings: ASME B16.5, threaded fittings.
- 2. Cast Iron Fittings: ASME B16.4, threaded fittings.
- 3. Malleable Iron Fittings: ASME B16.3, threaded type.
- 4. Mechanical Grooved Couplings: Steel housing, 175 psig pressure rating; with butylene O-rings, and pipe stop; for use with Schedule 40, plane-end, steel pipe meeting UL 213 or FM Approved. Include fittings manufacturer's pressure-sealing tools meeting UL 45. All mechanical grooved couplings gaskets shall be manufactured by the same manufacturer as the grooved couplings. Couplings used shall be suitable for their application, Victaulic, or equal.
- 5. Grooveless clamp or saddle fittings are not acceptable.

2.8 JOINT MATERIALS

- A. Threaded Joint Compound: "Thread-Tight" or "Key-Paste" or Teflon tape.
- B. Couplings: Steel couplings having steel-pipe dimensions, conforming to UL 213 and AWWA C606. Include ASTM A536, ductile-iron housing, rubber gaskets, and steel bolts and nuts.
- C. Unions: 150-psig malleable iron for threaded ferrous piping.
- D. Flanges: Aboveground, 150-psig forged steel slip-on flanges for ferrous piping.
- E. All similar unions, flanges, and couplings shall be by the same manufacturer.

2.9 VALVES

- A. Gate Valves (2-1/2 inches and larger): UL 262, and FM-approved, Iron body, bronze trim, rising stem, flanged ends, 175 psig nonshock working pressure rating, OS&Y, solid wedge. The gate valves shall be Stockham, "G-634" or equal.
- B. Check Valves shall conform to UL 312 and shall be FM-approved, iron body, bronze trim, swing disc, renewable disc and seat, flanged ends. The check valves shall be Stockham "G-940" or equal.
- C. Ball valves and butterfly valves shall not be used.
- D. Drain Valves: 2 inches and smaller, bronze body, solid bronze wedge, non-rising stem, Class 150. The drain valves shall be Nibco "T-133" or equal.
- E. Valves: Shall bear label or marking of the listing or approving agency with manufacturer's name and pressure rating marked on valve body.
- F. Automatic Drain Valve: 175 psig working pressure, spring loaded type, body constructed of bronze per ASTM B584, and ball and-spring constructed of corrosion resistant material. The automatic drain valve shall be Grinnell "F789" or equal.
- G. All similar valves shall be manufactured by the same manufacturer.

2.10 PIPING SPECIALTIES

- A. Alarm Valve (4, 6, and 8 inches): UL 193 and FM-approved; cast iron body, 175 psig working pressure, flanged inlet and outlet, bronze seat ring, rubber faced clapper, retard, handhole cover, retard chamber, with all required appurtenances for an closed drain basic trim. The alarm valve shall be Grinnell "F200" or equal.
- B. Pressure Switch: UL 753 and FM-approved; water-flow switch with retard feature, cover of die-cast aluminum with textured red powdercoat finish, steel plate base, NEMA ICS 6 Type 4, tamper resistant screws for securing the cover, one SPDT contact, 24 Vdc. The pressure switch shall be Potter Electric "PS10-1A" or equal.
- C. Supervisory Switches for Gate Valves: UL 346 and FM-approved; cover of die-cast aluminum with textured red powdercoat finish, base die-cast zinc, NEMA ICS 6 Type 4, tamper resistant screws for securing the cover, one SPDT contact, 24 Vdc. The supervisory switch shall be Potter Electric "OSYSU" or equal. Plug and loop type tamper switches shall not be used.
- D. Fire Department Connection: UL 405 and FM-approved; straightway pattern, rough brass body with brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections, 2-1/2" x 2-1/2" x 4" siamese type connection, 175 psig working pressure, single clapper, identification "AUTO SPKR" with 1-inch letters, 2-1/2" connections to be National Fire Hose Threads conforming to NFPA 1963; 4" connection to be NPT conforming to ASME B1.20.1. The fire department connection shall be Grinnell "F715" or equal.
- E. Automatic Drain Valve: UL 1726 and FM-approved, 175 psig working pressure, spring loaded type, body constructed of bronze per ASTM B584, and ball-and-spring constructed of corrosion resistant material. The automatic drain valve shall be Grinnell "F789" or equal.

- F. Pressure Gauge shall conform to UL 393 and shall be FM approved, 3-1/2-inch diameter dial, liquid filled type, moisture proof and weather resistant with dial range of 0 to 250 psig in five (5) psi increments, Ashcroft "B95" or equal. Each pressure gauge shall be fitted with a three-way valve and 1/4-inch threaded test gauge connection.
- G. Water Motor Alarm: UL 753 and FM-approved, 175 psig working pressure, hydraulically operated impeller outdoor alarm design, shaft and sleeve of suitable length for the wall construction, with 3/4-inch inlet and y-strainer, 1-inch drain connection, housing constructed of aluminum alloys, self lubricating bearings, aluminum alloy gong with red-enamel factory finish. The water motor alarm shall be Grinnell "F360" or equal.
- H. Identification Signs: Valve identification signs shall be minimum 6 inches wide x 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on a red background. Wording of signs shall include, but not be limited to "main drain", "auxiliary drain," "inspector's test", "alarm test," "alarm line," and similar wording as required to identify operational components.
- I. Pipe Hangers and Supports: Shall be in accordance with Division 15.
- J. All similar piping specialties shall be manufactured by the same manufacturer.

2.11 SPRINKLER HEADS

- A. Exposed Area Type: UL 199 and FM-approved; typical standard response, 5 mm bulb, upright or pendent heads and shall have an ordinary temperature rating of 155° F, natural brass finish, 1/2-inch orifice, 1/2-inch NPT. The sprinkler head shall be Grinnell "A" or equal.
- B. Finished Area Type: UL 199 and FM-approved; typical standard response, 5 mm bulb, concealed heads are to have an ordinary temperature rating of 155° F, white escutcheon, brass sprinkler head, 1/2-inch orifice, 1/2-inch NPT. The sprinkler head shall be Grinnell "F976" or equal.
- C. Guards: Furnish shall match sprinkler head where there is a likelihood of mechanical damage. Guards shall be painted red.
- D. Escutcheons: Split ring type, chrome plated, with spring or screw for securing to piping, Pegasus "Plate No. 20" or equal
- E. All sprinklers shall be manufactured by the same manufacturer.
- F. Spare sprinkler heads, in accordance with NFPA 13, shall be delivered in original container to the Engineer for inclusion in the spare sprinkler cabinet.

2.12 SLEEVE MATERIAL

- A. In concrete slabs and walls shall be Schedule 40 black steel pipe.
- B. Sleeves through waterproof membranes shall be either cast iron or steel and shall be provided with a flashing clamp device and corrosion-resistant clamping holes.

2.13 SPARE PARTS

- A. A spare sprinkler cabinet shall be provided and installed by the Engineer.

PART 3 - EXECUTION

3.1 COORDINATE WITH OTHER TRADES

- A. Coordinate work of this section with other affected trades.
- B. Place pipe runs to minimize obstruction with other trades.

3.2 PREPARATION

- A. Ream pipe and tube ends to full inside diameter.

- B. Remove burrs.
- C. Remove scale and foreign material, inside and outside, before assembly. Provide caps on ends of cleaned piping.
- D. Use full pipe lengths; random lengths joined by couplings will not be accepted.
- E. Perform fire hydrant flow test in accordance with NFPA 13 and NFPA 291.

3.3 INSTALLATION - PIPING

- A. Piping between the fire department connections and the check valves shall be galvanized, standard weight steel pipe with grooved ends.
- B. Underground Service Entrance Piping
 - 1. Provide a 6-inch bed of sand below pipe and 12-inch cover of sand above piping with locator tape on top of the sand.
 - 2. Tracer wire shall be wrapped and taped to non-metallic piping at maximum 20-foot intervals.
 - 3. When the system riser is close to a foundation or footing, underground fittings of proper length shall be used to avoid pipe joints located in or under the wall or footing. When the connection passes through a foundation or footing below grade, a one to three inch clearance shall be provided around the pipe, and the clear space filled with asphalt mastic or similar flexible waterproofing material.
- C. Screw-joint steel piping up to and including 2 inches in diameter. Mechanically couple piping 2-1/2 inches in diameter and larger, including branch connections.
- D. Die-cut screw joints with full-cut, standard-taper pipe threads with non-toxic joint compound applied to male threads only.
- E. Coat male threaded ends with pipe-lubricant compound.
- F. Install piping in accordance with NFPA 13.
- G. Install earthquake bracing. The installation of all required supplemental steel, whether or not indicated in the drawings shall be the responsibility of the Contractor. The spacing of the earthquake bracing shall be in accordance with NFPA 13.
- H. Pipe supports shall be in accordance with Division 15.
- I. Do not penetrate building structural members.
- J. Sleeves and Packing
 - 1. Provide sleeves for all pipes passing through slabs, concrete walls, and lath and plaster ceilings (except drop nipples for heads) and partitions. Sleeves shall extend 3 inches above floors and be flush with walls, ceilings, and partitions. In concrete construction, sleeves shall be set in forms prior to pour.
 - 2. For sleeves set in fire walls and floors, caulk space between pipe and sleeve with flexible fire-resistive packing compound to achieve rating at least equal to that of the wall or floor penetrated. Annular space between sleeves and piping shall be sealed with UL-listed, through-penetration systems #49 (concrete) or #147 (gypsum/stud). Sleeves in floors on grade or exterior walls below grade shall be packed with oakum between pipe and sleeve flush with top of sleeve for floors and with outer surface for walls. Sleeves at seismic joints shall not be packed unless associated with a fire rated wall, partition, floor or floor ceiling assembly.
- K. Place piping in concealed spaces above finished ceilings.
- L. Escutcheons shall be provided on all exposed pipes passing through walls, floors, ceilings, (except for sprinkler heads) and partitions.

- M. All dry-pipe fire sprinkler system piping exposed to view in or on the building shall be painted red, after completion of hydrostatic tests, per applicable systems under Section 09800.
- N. Install the inspectors test connection, complete with shutoff valve, sized and located in accordance with NFPA 13.
- O. The inspectors test connection shall terminate outside the building in a safe manner.
- P. Install sprinkler piping and drains such that all portions of the system is drainable.
- Q. All drain lines are to terminate outside the building in a safe manner.
- R. Provide dielectric fittings where dissimilar piping materials are joined.
- S. Provide for expansion and contraction of all pipe and for seismic movement.
- T. Provide reducing fittings for all changes in pipe size; provide fittings for all changes in pipe direction. Riser piping shall be installed plumb with offset fittings used where alignment adjustment is necessary.
- U. Pipe Hangers and Supports
 - 1. Provide in accordance with referenced standards. Do not mix piping material and hanger material of dissimilar metals. All beam clamps shall be fitted with steel retainer straps. Hanger rods of less than 3/8-inch diameter are not permitted.
 - 2. Piping shall be hung with hangers and supports independent of any other hangers, support systems, or devices. Non-related materials may not be suspended from or attached to sprinkler piping or components.
- V. Identification signs shall be provided in accordance with NFPA 13.
- W. The fire bell shall be located on the face of the protected building adjacent to the fire department connection with a mounting height of eight to ten feet above finished grade.

3.4 INSTALLATION - VALVES

- A. Install valves with stems upright or horizontal, not inverted.
- B. The center of the alarm valve shall be at 5 feet above finished floor.
- C. Provide gate valves for shutoff or isolating service.
- D. Provide drain valves at main shutoff valves and at low points of piping.
- E. The center of the inspectors test valve and the drain valves shall be at 5 feet above finished floor.
- F. Provide mechanical identification.
- G. All valve handwheels shall be painted with red enamel.
- H. Install unions adjacent to each valve in pipes 2 inches and smaller.

3.5 INSTALLATION - FIRE DEPARTMENT CONNECTION

- A. Fire department connections shall be located as indicated on the drawings.
- B. Fire department connection inlets shall be located 30 to 36 inches above grade on street front and, as measured at all inlets, within a 36-inch radius.
- C. Where subject to mechanical damage, protection shall be provided. The means of protection shall be as approved and shall be arranged in a manner which shall not interfere with the connection to inlets.

D. Maintain a 36-inch clear radius around the fire department connection. Grade variation within this radius shall not exceed 1:12. The fire department connection shall be arranged so that hose lines can be readily and conveniently attached to inlets without interference from any nearby objects including buildings, fences, posts, or other fire department connections.

E. The fire department connection shall be clearly visible from the street.

3.6 INSTALLATION - SPRINKLER HEADS

A. Recessed sprinklers shall be used in all areas that have a drop or finished ceiling.

B. Center sprinklers in both directions in ceiling tile and align with adjacent light fixture axis.

C. Spare Sprinkler Cabinet shall be installed as indicated by the Engineer.

3.7 SYSTEM ACTIVATION

A. Activate automatic fire sprinkler systems in a timely manner. Activate in a timely manner all electrical devices associated with the fire sprinkler systems including enunciation of the central alarm system upon activation of the fire sprinkler system.

3.8 CLEANING

A. Flush entire piping system of foreign matter.

B. The dry-pipe systems shall be disinfected in accordance with AWWA M20.

C. Fire department connections and piping shall be flushed.

D. Underground mains and supply connections to sprinkler risers shall be flushed thoroughly before connections to sprinkler systems.

3.9 SYSTEM INSPECTION AND TESTING

A. All material and equipment furnished and work done will be continuously inspected by the Engineer. Any material, equipment, or work approved and later found to be defective shall be replaced by the Contractor at his own expense. The Contractor shall ask for approval only after his own inspection and after he is satisfied that he has met all requirements of these specifications only after his own inspection and after he is satisfied that he has met all requirements of these specifications.

B. The Contractor shall coordinate all necessary inspections and obtain all approvals required by the City of San Diego Fire Department.

C. The Contractor shall perform all required acceptance tests and complete the Contractor's Material and Test Certificates in accordance with NFPA 13. All tests shall be performed by the Contractor in the presence of the Engineer. The Contractor shall submit to the Engineer detailed test procedures at least 10 working days before the scheduled test date. All test procedures shall be reviewed and approved by the Engineer before any tests are conducted. The scheduled test dates shall be given to the Engineer at least 72 hours in advance.

D. All necessary equipment, material, and labor for the tests shall be provided by the Contractor. If any test or portion thereof should fail, the Contractor shall undertake repairs immediately and retest to the satisfaction of the Engineer.

E. Verify that valves, trim, fittings, controls, and accessories are installed and operate correctly.

F. Verify that any damaged sprinklers and sprinklers with paint or coatings not specified are replaced with a new, correct type.

G. Verify that the sprinklers are correct types, have the correct finishes and temperature ratings, and have guards as required for each application.

H. Fire department connections and piping shall be included in hydrostatic testing.

- I. Verify that the fire department connection have threads that are compatible with the local fire department equipment.
- J. Hydrostatically test entire system in accordance with NFPA 13.
- K. Coordinate with fire alarm tests. Operate electrical devices as required.
- L. All water pressure sensors and alarm and supervisory signals shall be performance tested.
- M. Test may be witnessed by the Engineer.
- N. A completed Contractor's material and test certificate shall be submitted to the Engineer as required by NFPA 13 prior to requesting approval of the installation.

** END OF SECTION **

SECTION 14600 - HOISTS AND CANTILEVER JIB CRANES, GENERAL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing general requirements for hoists and cantilever jib cranes.
- B. The WORK also includes coordination of design, assembly, testing and installation.

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 11000 Equipment General Provisions

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. AISC Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings
 - 2. AGMA American Gear Manufacturers Association
 - 3. ANSI B30.11 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoists)
 - 4. ANSI B30.16 Portal, Tower, and Pillar Cranes
 - 5. ANSI MH 27.1 Specifications for Underhung Crane and Monorail Systems
 - 6. ASTM A 36 Specification for Structural Steel
 - 7. CMA Crane Manufacturer's Association of America
 - 8. NEMA National Electrical Manufacturers Association

1.4 SHOP DRAWINGS AND SAMPLES

- A. In addition to the requirements of Section 11000, the following shall be submitted:
 - 1. Shop drawings indicating weights, loads, dimensions and clearances.

1.5 OWNER'S MANUAL

- A. In addition to the requirements of Section 11000, the following shall be submitted:
 - 1. Certification by CONTRACTOR and manufacturer that equipment complies with the indicated requirements: Articulated (360 degrees rotation) floor mounted jib crane, all

stainless steel construction, designed to lift the combined weight minimum 1700 pounds with the boom horizontal and 2200 pounds with the boom at 45 degree from vertical; Type 316 stainless steel wire rope assemblies complete and locking mechanism when not in use.

1.6 SERVICES OF MANUFACTURER

- A. Services of manufacturer shall be provided in accordance with Section 11000 when listed in specific hoists and cranes sections.

PART 2 -- PRODUCTS

2.1 PRODUCTS

- A. All items shall be new, of current design, from reputable manufacturers specializing in such products.

2.2 MANUFACTURERS

- A. Equipment shall be manufactured by one of the following (or equal). See Contract Drawings for additional requirements.

David Round
Crane Authority

PART 3 -- EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Hoists and cranes shall be installed in accordance with the manufacturer's installation instructions, Section 11000, this Section, and the requirements shown on the plans.

3.2 FIELD TESTING

- A. The CONTRACTOR shall field test all hoists and cranes to verify their rated load-carrying capacity.

**** END OF SECTION ****

SECTION 14630 - BRIDGE CRANES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing electrically operated bridge cranes of the low headroom type, designed for travel in both directions and mounted on structural sections.

1.2 RELATED SECTIONS

- A. The WORK of the following Section 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 05120 Structural Steel
 2. Section 09800 Protective Coating
 3. Section 11000 Equipment General Provisions
 4. Section 14600 Hoists and Cranes, General
 5. Section 16050 Basic Electrical Materials and Methods

1.3 SERVICES OF MANUFACTURER

- A. Services of manufacturer shall comply with Section 14600. The authorized manufacturer's representative shall visit the site for not less than two (2) days.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. **Requirement:** The bridge crane system shall be controlled from a pendant pushbutton station and shall include safety devices and overload protection. The power supply shall be from enclosed, UL-approved conductor bar systems. The rails shall be standard I-beams, or fabricated steel sections anchored to the structure as indicated and as required by the CBC for seismic loads. The track deflection shall not exceed 1/800 of the span, or 1-1/4 inches, whichever is less. The crane system, except the tracks, shall be the product of a crane manufacturer regularly engaged in the manufacture of such equipment.
- B. **Site Conditions:** The bridge crane shall comply with the

Site Conditions:			
1	Equipment No.	C-150	C-250
2	Location	North Generator Building	South Generator Building
3	Atmosphere	Indoor	Indoor

C. **Design Criteria:** The bridge crane system shall comply with the following:

Design Criteria:			
1	Equipment No.	C-150	C-250
2	Type of Crane	Top Running	Top Running
3	Type of Bridge	Single Girder	Single Girder
4	Capacity (Tons)	10.0	10.0
5	Maximum Lift (Feet)	25'-3"	25'-3"
6	Length of Track (Feet)	45'-10" (Max.)	37'-6" (Max.)
7	Length of Bridge (Feet)	40'-4" +	40'-4" +
8	Span between tracks (feet)	41'-4"	41'-4"
9	Speed Control	Variable Speed	Variable Speed
10	Lifting Speed (fpm)	20/3.3 (2 speed)	20/3.3 (2 speed)
11	Trolley Speed (fpm)	100 VFC (2 step Variable)	100 VFC (2 step Variable)
12	Bridge Speed (fpm)	160 VFC (2 step Variable)	160 VFC (2 step Variable)
13	Hoist Motor (hp)	14.4	14.4
14	Trolley Motor (hp)	1.2	1.2
15	Bridge Motor (hp)	Two Each 2.6HP	Two Each 2.6HP
16	Power Supply (V-ph-Hz)	460-3-60	460-3-60

2.2 FABRICATION

- A. **Hook and Wire Rope:** The lifting hook shall be fabricated of drop-forged, heat-treated steel and shall include 360-degree swivel on a shielded roller thrust bearing with safety spring latch. The wire ropes shall be fabricated of plow steel with steel center complete and shall include swaged fittings.
- B. **Hoist and Drive:** The hoisting drum shall be deep grooved flanged drum with at least 2 full turns of rope remaining on the drum at the lowest hook position and shall include heavy-duty pre-lubricated sealed bearings. The drum shall be driven by a helical gear reducer with external spur drum gear enclosed in an oil-tight housing. The housing motor shall be a standard, 30-minute duty-motor, 1750 rpm, with NEMA-type shaft extension. The hoisting mechanism shall include dc magnet-actuated disc motor brake with hook drift. The motor shall be rated at minimum of 150 percent of full load torque, with gravity type upper and lower hook limit switch, and an overload cut-off switch designed to interrupt the raising circuit.
- C. **Trolley Assembly:** The trolley assembly shall be a underhung type. The trolley assembly shall be supported by trolley wheels with tapered tread surfaces hardened to 375 to 425 Brinell. Each wheel shall be supported on tapered roller bearings suitable to take radial and thrust loads. The wheel mounting shall be designed so that axles and wheels can be removed without affecting alignment. The wheel tread shall be smooth, true, and uniform within 0.010-inch tread diameter on all wheels.

- D. **Trolley Drive:** The trolley shall be driven by a 30-minute-duty-cycle rated motor with oil-tight gear reducer conforming to NEMA Specifications. The motor shall include cushion start and controller designed for smooth travel and load control. The driver shall provide synchronous drive from gear reducer to both drive wheels. The trolley drive shall include integrally mounted spring set and an electrically-released drag brake.
- E. **Crane Bridge Assembly:** The crane bridge assembly shall be a single beam over-riding or top-running double beam center-drive type. The bridge beam shall be designed in accordance with the specifications of the Crane Manufacturers Association of America. It shall be fabricated of standard structural shapes complying with AISC Specifications. At full load, the beam shall be designed to limit the deflection to 1/600 of the span, but not to exceed 1-1/4-inch maximum deflection. An ASCE rail shall be provided on top of the beam securely fastened in place to maintain center distance. Provision shall be made to prevent creeping of bridge rails by means of positive stops at the ends of the rails. Crane shall be reinforced with outrigger to provide squareness with end truck, adequate lateral stiffness with a minimum lateral moment of inertia of 1/20 that of the vertical beam. Outrigger shall be designed to support squaring shaft and the crane drive motor and gear reducer assembly.
- F. **End Trucks:** The end trucks shall be traversed by stable assembly of structural shapes welded together to provide proper wheel and bearing alignment. The end truck wheel base shall be minimum of 1/7 of the crane span. One wheel of each end truck shall be geared and meshed with the pinion mounted on the crane squaring shaft. The crane and trucks shall contain diaphragm members welded to truck frames to maintain alignment and distribute truck loads on inner and outer truck members. The truck shall be designed so that, in case of a wheel axle or wheel failure, the drop of the load will be limited to one inch. The end trucks shall be fastened to the bridge beams with bolts to ensure alignment.
- G. **Crane Wheels:** Crane wheels shall have tread surfaces hardened to 375 to 425 Brinell. Treads shall be tapered to provide proper running alignment. Each wheel shall be supported on tapered roller bearings mounted on stationary axles, designed for radial and thrust loads. The wheels shall be lubricated at the factory with a sodium base grease, and shall include adequate reservoir of lubricant to eliminate the need for field lubrication. Wheel axles must have mounting nuts for bearing adjustment. Wheel mounting shall be designed so that axles and wheels can be removed without disturbing alignment. Wheel treads shall be smooth, true, and uniform within 0.01-inch tread diameter on all wheels.
- H. **Crane Drive:** The crane drive motor shall be totally enclosed, 30-minute cycle rated. The motor shall be integral with a fully enclosed oil splash lubricated gear reduction. The motor, the drive shaft, and the gear reduction shafts shall be supported by permanently lubricated precision ball or roller bearings. The drive shaft shall provide synchronous drive from the gear reduction to both end trucks. The crane drive shall include integrally-mounted spring set electrically released dc rectified disc brake.
- I. **Drive Shaft:** The drive shaft of the crane shall be supported on lubricated, precision, ball-bearing pillow blocks on 10-ft maximum centers. Pillow blocks shall be lubricated through pressure grease fittings. The crane drive shaft shall be steel and designed to limit torsional shaft stress to 6,000 psi. Maximum torsional twist angle in the drive shaft shall not exceed one degree of the wheel rotation under maximum rated load.

- J. **Bearing Life:** Bearings in crane wheels and bearings supporting the drive and gear reduction shafts shall be designed for 5,000 hrs L-10 bearing life minimum.
- K. **Gearing:** Gears shall be cut from solid blanks with 20-degree pressure angle involute shape for high strength and shall comply with AGMA specifications for load ratings. Gears operating at higher than 20 fpm pitch line speed shall be fully enclosed in oil-tight housings and lubricated by splash principle. Gear teeth shall have ductile cores and be surface hardened to RC40 minimum. The gear shall provide for a minimum service of 4,000 hr.
- L. **Bridge Stops:** The bridge shall be provided with bumpers capable of stopping the crane (not including the lifted load) at a rate of deceleration not to exceed 3 fps^2 when traveling in either direction at 20 percent of rated speed. The bumpers shall have sufficient energy absorbing capacity to stop the crane when traveling at a speed of at least 40 percent of the rated load speed. Bridge trucks shall be equipped with sweeps which extend below the top of the rail and project in front of the crane wheel.
- M. **Runway Beams and Rails:** The runway beams and rails shall comply with the indicated requirements. The rails shall be an ASCE type securely fastened into the runway beams. The runway beams shall be designed from an ASTM A36 structural steel shape and shall have a maximum deflection not to exceed $1/800$ of the span. The beams shall be equipped with stops on both ends capable of withstanding the impact of the fully loaded crane at 50 percent of rated speed, and shall be field-adjustable. Necessary column supports or clamps, hanger rods, bolts, and fittings shall be provided.
- N. **Electrical Controls:** Electrical controls shall be single-speed or multiple-speed as recommended by the manufacturer. Bridge control shall include a mainline magnetic contactor, manually-operated fused mainline disconnect with lock-out provisions, branch circuit fuses, reversing bridge control, and transformer with fused secondary. Bridge control shall be mounted on bridge in an enclosure, NEMA rated in accordance with the area designations of Section 16050, actuated from a pendant pushbutton station suspended from movable trolley, by means of a retractable cable to permit operation at 4 feet above all floor levels. Motors shall include cushion start.
- O. **Conductor and Wirings:** The runway shall be provided with enclosed conductor base electrification. The bridge shall have a rigid truck festoon type electrification. Other wiring of the crane shall be in rigid or flexible conduit and in accordance with National Electrical Code and complying with Fire Underwriters specifications. When a crane is shipped knocked down, the wiring shall terminate in terminal boxes and the wire end shall be provided with permanent marking tags.
- P. **Corrosion Protection:** All components of the bridge crane and crane rail shall be epoxy primed and finish painted in the manufacturer's shop in accordance with Section 09800. Color shall be as selected by Owner. Ferrous bearing and contact surfaces shall receive a shop grease coating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Bridge cranes shall be installed in accordance with the manufacturer's installation instructions, Section 11000 Equipment General Provisions, this Section, and the requirements shown on the plans.

**** END OF SECTION ****

SECTION 15000 - PIPING COMPONENTS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing fittings, hangers, supports, anchors, expansion joints, flexible connectors, insulation, lining and coating, testing, disinfection, and accessories.

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 05500 Miscellaneous Metalwork
 2. Section 09800 Protective Coating
 3. Section 11000 Equipment General Provisions
 4. Section 15010 Mill Piping - Exposed and Buried
 5. Section 15020 Pipe Supports

1.3 CODES

- A. The WORK of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:
1. Uniform Mechanical Code
 2. Uniform Plumbing Code
 3. Uniform Fire Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following applies to the WORK of this Section:

ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch)
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
ANSI/ASME B31.1	Power Piping
ANSI/AWWA C111	Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
ANSI/AWWA C150	Thickness Design for Ductile Iron Pipe
ANSI/AWWA C153	Ductile Iron Compact Fittings, 3 In through 24 In and 54 In Through 64 In for Water Service
ANSI/AWWA C207	Steel Pipe Flanges for Water Works Service, Sizes 4 in. Through 144 in.
ANSI/AWWA C213	Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
ANSI/AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 In Through 12 In for Water Distribution
ANSI/AWWA C905	Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In through 36 In

ANSI/AWS D10.9	Specifications for Qualifications of Welding Procedures and Welders for Piping and Tubing
ASTM A 123	Specification for Zinc Coatings on Iron and Steel Products
ASTM A 536	Ductile Iron Castings
ASTM D 792	Test Methods for Specific Gravity and Density of Plastics by Displacement
ASTM D 2000	Classification System for Rubber Products in Automotive Applications

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Shop drawings showing dimensions and details of pipe joints, fittings, fitting specials, valves and appurtenances.
2. Detailed layout, spool, or fabrication drawings showing pipe spools, spacers, adapters, connectors, fittings, and pipe supports.
 - A. Pipe layout drawings shall show all pipe supports with a legend, label, or other marking to clearly indicate what support type is being used at each support location in conformance with specification 15020.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. Manufacturer's product data.
2. Manufacturer's installation instructions.
3. Manufacturer's certification of compliance.
4. Statement from the pipe fabricator certifying that all pipe will be fabricated subject to a Quality Control Program.
5. Outline of Quality Control Program.

1.7 INSPECTION, TESTING AND WELDING

- A. **Inspection:** Products shall be inspected at the manufacturer's plant.
- B. **Tests:** Materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards.
- C. **Welding Requirements:** Welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D10.9. Welding procedures shall be required for longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- D. **Welder Qualifications:** Welding shall be performed by skilled operators who have had adequate knowledge in the methods and materials to be used and have been qualified under the provisions of ANSI/AWS D10.9 by an independent approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests.

1.8 FACTORY TESTING

- A. **Product Testing:** Products shall be tested at the factory for compliance with the indicated requirements.
- B. **Witnesses:** The OWNER and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness factory tests.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Products 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.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Miscellaneous Small Pipes:** Miscellaneous small pipes and fittings shall comply with Section 15010.
- B. **Pipe Supports:** Pipes shall be properly supported in accordance with Section 15020.
- C. **Coating:** Pipes above ground or in structures shall be field-painted in accordance with Section 09800.
- D. **Pressure Rating:** Except as otherwise indicated, piping systems shall be designed for 150 percent of the maximum indicated pressure.
- E. **Grooved Piping Systems:** Grooved couplings on buried piping must be bonded. Grooved fittings, couplings, and valves shall be from the same manufacturer.

2.2 PIPE FLANGES

- A. **Flanges:** Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D or ANSI B16.5 150-lb class. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to either ANSI/AWWA C207 Class E, Class F, or ANSI B16.5 150-lb class. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ANSI B16.5 300-lb class. Flanges shall be attached to the pipe in accordance with ANSI/AWWA C207.
- B. **Blind Flanges:** Blind flanges shall comply with ANSI/AWWA C207. Blind flanges for pipe sizes 12 inches and larger shall include lifting eyes in form of welded or screwed eye bolts.
- C. **Flange Coating:** Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- D. **Flange Bolts:** Bolts and nuts shall comply with Section 05500. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs may be used only on valve flange connections where space restrictions preclude the use of regular bolts.

- E. **Insulating Flanges:** Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter. Existing flanges where new insulating gaskets are required for the project may require boring the holes greater or replacement of the flanges at no additional cost to the CITY.
- F. **Insulating Flange Sets:** Insulating flange sets shall be provided where indicated and shall consist of insulating gaskets (retainer), insulating bolt sleeves, and double insulating washers. All insulating components shall be NEMA G-10 epoxy glass. Insulating gaskets (retainers) shall be full face, Type E and shall have a Buna-N (nitrile) O-ring type sealing element such as PSI Linebacker or equal.

Insulating flange kits shall be tested and inspected by the City's Corrosion Engineer. The City's Corrosion Engineer shall be contacted at (858) 614-5560 a minimum of 48 hours prior to the assembly of any insulating flange kits. Insulating flange kits shall be installed and tested in accordance with NACE SP0286-07. Insulating flange kits shall be tested using a minimum of two test methods. The first test method shall utilize a Gas Electronics Model 601 Insulator Checker specifically designed for testing insulating flanges. Additionally, insulating flanges shall be tested by measuring pipe-to-soil potentials on either side of the insulating joint per industry standards.

The installation of the insulating flange kit shall be considered complete when the testing above indicates that no shorts or partial shorts are present. Any insulating flange kit that is determined to be ineffective shall be repaired or replaced at the CONTRACTOR'S expense.

- G. **Flange Gaskets:** Gaskets for flanged joints shall be full-face, 1/8-inch thick sheets of neoprene, suitable for temperatures to 550 degrees F, a pH of 0 to 14, and pressures to 1400 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted.

2.3 THREADED INSULATING CONNECTIONS

- A. **General:** Threaded insulating bushings, unions, and couplings shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are indicated.
- B. **Materials:** Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties suitable for the service and loading conditions indicated.

2.4 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

- A. **General:** Cast mechanical-type couplings shall be provided where shown. Bolts and nuts shall conform to Section 05500. Gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized in accordance with the coupling manufacturer's recommendations. The wall thickness of all grooved piping shall conform with the coupling manufacturer's recommendations suitable for the highest pressure indicated.

2.5 SLEEVE-TYPE COUPLINGS

- A. **Construction:** Sleeve-type couplings shall be installed where indicated and shall include steel bolts, without pipe stop, and shall be sized to fit the pipe and fittings indicated. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 or 7 inches long for standard steel couplings, and 16 inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be

of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to Section 05500. Buried sleeve-type couplings shall be epoxy-coated at the factory.

- B. Pipe Preparation:** The ends of the pipe, where indicated, shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12 inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.
- C. Gaskets:** Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," grade 60, or equivalent suitable elastomer. The rubber in the gasket shall comply with the following:
1. Color - Jet Black
 2. Surface - Non-blooming
 3. Durometer Hardness - 74 ∇ 5
 4. Tensile Strength - 1000 psi Minimum
 5. Elongation - 175 percent Minimum

The gaskets shall resist deterioration caused by impurities normally found in water or wastewater. Gaskets shall comply with ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as otherwise indicated. Gaskets shall be compatible with the piping service and fluid utilized.

- D. Insulating Couplings:** Where insulating couplings are indicated, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to insulate coupling metal parts from the pipe.

E. Restrained Joints:

1. Harnesses for flexible sleeve type couplings shall be in accordance with the requirements of the appropriate reference standards and standard practices.
2. Mechanical and Push-On Joints: Restraints shall be provided where shown and may be provided in lieu of concrete thrust blocks.
 - a. Mechanical joint restraint mechanisms shall consist of individually activated multiple gripping devices which incorporate breakoff actuating units and permanent nuts for future disassembly. Pressure ratings shall be:
 - (1) Ductile Iron Pipe
 - (a) 3 to 6 inch diameter: 350 psi (2:1 safety factor)
 - (b) 18 to 48 inch diameter: 250 psi (2:1 safety factor)
 - (2) PVC Pipe
 - (a) 3 to 36 inch diameter: full pressure rating or pressure class of pipe (2.5:1 safety factor)

- b. Push-on joints for steel pipes shall be in accordance with the appropriate reference standards and standard practice.
- c. Restrained push-on joints for all other pipe materials shall be comprised of two rings with connecting rods. The restraint ring shall be on the spigot, and a plain or slit bell ring shall be on the bell. Pressure ratings shall be:
 - (1) Ductile Iron Pipe
 - (a) 3 to 16 inch diameter: 350 psi (2:1 safety factor)
 - (b) 18 to 48 inch diameter: 250 psi (2:1 safety factor)
 - (2) PVC Pipe
 - (a) 3 to 10 inch diameter: 200 psi (4:1 safety factor)
 - (b) 12 inch diameter: 150 psi (4:1 safety factor)
 - (c) 14 to 16 inch diameter: 235 psi (2:1 safety factor)
 - (d) 18 to 30 inch diameter: 165 psi (2:1 safety factor)
 - (e) 36 inch diameter: 125 psi (2:1 safety factor)
 - (3) Dimensions of push-on bell restraints shall be compatible with ANSI/AWWA C150 and C900 or C905 for ductile iron or PVC pipe, respectively.
- d. Restraint glands shall be of ductile iron conforming to ASTM A 536. Dimensions of the glands shall be compatible with standard mechanical joint bell and tee head bolts conforming to ANSI/AWWA C111 and C153, respectively.
- e. Bolts and nuts shall conform to Section 05500.

2.6 FLEXIBLE CONNECTORS

- A. Flexible connectors shall be provided in all piping connections to engines, pumps, blowers, compressors, vibrating equipment, and where indicated. Flexible connectors for service temperatures up to 180 degrees F shall be flanged reinforced neoprene or butyl rubber spools, rated for working pressures of 40 to 150 psi or reinforced flanged rubberized duck, as best suited for the application. For temperatures above 180 degrees F, flexible connectors shall be flanged braided Type 316 stainless steel spools with inner corrugated stainless steel hose rated for minimum 150 psi working pressure unless indicated otherwise. Connectors shall be minimum of 9 inches face to face between flanges. Material selection shall be proposed by the manufacturer based on the application.

2.7 EXPANSION JOINTS

- A. **Linear Expansion Only:** Use expansion loops, bellows-type expansion joints, or sliding type expansion joints of ductile iron, stainless steel, monel, or rubber.
- B. **Linear, Angular, and Lateral Movement:** Use flexible expansion joints consisting of expansion sleeve and ball-and-socket joints in a single unit. Each unit shall be capable of minimum 15 degrees angular motion in any direction, and the expansion sleeve shall be capable of minimum 4 inches of linear travel. Joints shall be suitable for the pressure and temperature application and be ductile iron conforming to ANSI/AWWA C153. All surfaces containing pressure and sealing surfaces shall be coated with minimum 15 mils of fusion bonded epoxy conforming to ANSI/AWWA C213.

2.8 PIPE THREADS

- A. Pipe threads shall comply with ANSI/ASME B1.20.

2.9 PIPE INSULATION

- A. All cooling loop piping (AWS, AWR, JWS, JWR) shall be insulated. Insulation shall be in accordance with specification 15250.

2.10 AIR AND GAS TRAPS (NOT USED)

2.11 STEAM TRAPS (NOT USED)

2.12 GLASS LINING (NOT USED)

2.13 MANUFACTURERS

- A. **Manufacturers:** Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):

1. **Insulating Flanges:**

JM Red Devil, Type E
Maloney Pipeline Products Co.
PSI Products, Inc.

2. **Flange Gaskets:**

John Crane, Style 2160
Garlock, BLUE-GARD® Style 3000

3. **Steel Pipe Couplings:**

Gustin-Bacon (banded or grooved)
Victaulic Vic-Ring® Style 41 or 44 (banded)
Victaulic Style 77 or Zero-Flex® Style 07 (grooved)

4. **Ductile Iron Pipe Couplings:**

Gustin-Bacon
Victaulic Style 31

5. **Couplings for PVC Pipe:**

Gustin-Bacon
Victaulic Style 775

6. **Sleeve-Type Couplings:**

Dresser, style 38
Ford Meter Box Co., Inc., Style FC1 or FC3
Smith-Blair, Style 411

7. Dismantling Joints:

Romac Industries, Inc DJ400
Smith-Blair, Inc 970 Series

PART 3 -- EXECUTION

3.1 GENERAL

- A. Pipes, fittings, and appurtenances shall be installed in accordance with the manufacturer's installation instructions.

**** END OF SECTION ****

SECTION 15010 - MILL PIPING - EXPOSED AND BURIED

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing small steel pipe, stainless steel pipe and tubing, red brass pipe, copper pipe and tubing, solvent-welded PVC pipe, CPVC pipe, fiber glass reinforced plastic pipe, process glass pipe, cast iron soil pipe, and corrosion-resistant cast iron pipe with fittings, gaskets, bolts, insulating connections, pipe insulation, and other specialties required for an operable piping system.

1.2 RELATED SECTIONS

- A. The WORK of the following Section 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 09800 Protective Coating
 2. Section 15000 Piping Components

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
1. ANSI/ASME B16.3 Malleable Iron Threaded Fittings, Classes 150 and 300
 2. ANSI/ASME B16.4 Cast Iron Threaded Fittings, Class 125 and 250
 3. ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
 4. ANSI B16.11 Forged Steel Fittings, Socket-Welding and Threaded
 5. ANSI B16.12 Cast-Iron Threaded Drainage Fittings
 6. ANSI/ASME B16.15 Cast Bronze Threaded Fittings, Classes 125 and 250
 7. ANSI B16.21 Nonmetallic Flat Gaskets for Pipe Flanges
 8. ANSI B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 9. ANSI/ASME B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings
 10. ASTM A 53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 11. ASTM A 74 Specification for Cast Iron Soil Pipe and Fittings
 12. ASTM A 105 Specification for Forgings for Piping Components
 13. ASTM A 106 Specification for Seamless Carbon Steel Pipe for High Temperature Service

14.	ASTM A 269	Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
15.	ASTM A 312	Specification for Seamless and Welded Austenitic Stainless Steel Pipe
16.	ASTM A 518	Specification for Corrosion-Resistant High-Silicon Iron Castings
17.	ASTM B 42	Specification for Seamless Copper Pipe, Standard Sizes
18.	ASTM B 43	Specification for Seamless Red Brass Pipe, Standard Sizes
19.	ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings
20.	ASTM B 88	Specifications for Seamless Copper Water Tube
21.	ASTM C 599	Specification for Process Glass Pipe and Fittings
22.	ASTM D 1785	Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
23.	ASTM D 2996	Specification for Filament-Wound Reinforced Thermosetting Resin Pipe
24.	ASTM D 4101	Specification for Propylene Plastic Injection and Extrusion Materials
25.	ASTM F 441	Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

1.4 SHOP DRAWINGS AND SAMPLES

- A. Manufacturer's written certification that all products comply with the contract requirements.
- B. Manufacturer's product specifications and performance information.
- C. Shop drawings showing fabrication details, dimensions, fittings, coatings, and all information pertaining to the fabrication or installation of provided pipe.

PART 2 -- PRODUCTS

2.1 STEEL PIPE

- A. Unless otherwise indicated, galvanized steel pipe and black steel pipe in all sizes shall conform to the requirements of ASTM A 53 and shall be Schedule 40, Grade A unless noted otherwise. Fittings for galvanized steel pipe shall be of galvanized malleable iron, with NPT or grooved ends as indicated. Black pipe may have welded joints, with standard or extra strong welded fittings unless noted or shown otherwise..

2.2 STAINLESS STEEL PIPE

- A. Unless otherwise indicated, stainless steel pipe shall be Type 316 Schedule 40 threaded pipe conforming to ASTM A 312 with stainless steel threaded fittings, or with stainless steel welded fittings, where indicated. Lightweight stainless steel pipe shall be Type 316 Schedule 10 pipe conforming to ASTM A 312, with stainless steel welding fittings. All threaded piping shall include 316 stainless steel unions located, at a minimum, at all pieces of equipment, valves, or other areas where maintenance occurs.
 - a. Where the compressed air piping system requires flanged connections 300lb flanges shall be used.

2.3 STAINLESS STEEL TUBING

- A. Stainless steel tubing shall be made of Type 316 L stainless steel to the requirements of ASTM A 269, of minimum 1/4-inch inside diameter, or as indicated, for the test pressure required. The fittings shall be swage ferrule design of Type 316 L stainless steel, of the double acting ferrule design, providing both a primary seal and a secondary bearing force. Flare bite or compression type fittings are not acceptable.

2.4 RED BRASS PIPE

- A. Brass pipe shall conform to the requirements of ASTM B 43. Fittings shall be of bronze conforming to the requirements of ASTM B 62 with threaded ends, conforming to ANSI/ASME B16.15.

2.5 COPPER PIPE

- A. Copper pipe shall be hard drawn, to the requirements of ASTM B 42, with regular or extra strong wall thickness, as required for the test pressure. Copper pipe shall have screwed ends for NPT fittings, or brazed joints. The fittings shall be threaded cast bronze fittings to the requirements of ANSI/ASME B16.15, class 125 or 250, as required, or flanged cast copper alloy fittings to the requirements of ANSI/ASME B16.24, with 150 lbs rating, or as required.

2.6 COPPER TUBING

- A. Copper tubing shall conform to the requirements of ASTM B 88 and shall be Type K, soft temper for buried tubing and hard drawn for above-ground application. Fittings shall be soldered or sweated on and shall be of wrought copper conforming to ANSI B16.22. Soldered joints shall contain 95-percent tin and 5-percent antimony. For oxygen service, joints shall be made with silver solder. No solders or fluxes containing more than 0.2 percent of lead shall be used.

2.7 POLYVINYL CHLORIDE PRESSURE PIPE, SOLVENT-WELDED

- A. Polyvinyl chloride pressure pipe shall be made from all new rigid unplasticized polyvinyl chloride and shall be Normal Impact Class 12454-B, Schedule 80, conforming to ASTM D 1785, unless otherwise indicated. Elbows and tees shall be of the same material as the pipe. Joint design shall be for solvent-welded construction.

2.8 CHLORINATED POLYVINYL CHLORIDE PRESSURE PIPE, SOLVENT-WELDED

- A. Chlorinated polyvinyl chloride pressure pipe, for hot, corrosive solutions and where indicated, shall be made from all new rigid unplasticized chlorinated polyvinyl chloride, Class 23447-B, and shall be Schedule 80 conforming to ASTM F 441, with solvent-welded fittings of the same material as the pipe.

2.9 POLYPROPYLENE PIPE

- A. Polypropylene pipe, for chemical drains and where indicated, shall be **Type 1**, Schedule 80 pipe conforming to ASTM D 4101, with drainage pattern fittings made of the **same material** and shall be joined by the thermo-seal fusion process, or by threading, or flanging.

2.10 PROCESS GLASS PIPE

- A. Process glass pipe, for chemical drains and where indicated, shall be **made** of chemically resistant, low-expansion Type 1 borosilicate glass with conical ends and **drainage** fittings of the same material as the pipe, with compression couplings and Teflon joints, **conforming** to ASTM C 599. Where concealed or buried, process glass pipe shall be armored **with a factory-applied** protective jacket of polystyrene, or similar material.

2.11 FIBERGLASS REINFORCED PLASTIC PIPE

- A. Fiberglass reinforced plastic pipe shall be machine-made reinforced **thermosetting** resin pressure pipe, manufactured by the filament winding process conforming to ASTM D 2996, suitable for exposed or buried service. Unless otherwise indicated, it shall be made **of epoxy resins** and continuous glass filaments, wound together over a resin-rich reinforced **liner**, with fittings made of the same material. The pipes shall have adhesive-bonded bell and **spigot joints** or flanged connections, and shall be suitable for operating pressures of 175 psig at **temperatures** up to 200 degrees F, or for temperatures up to 300 degrees F at derated pressures.

2.12 CAST IRON SOIL PIPE

- A. Cast iron soil pipe and fittings shall be made of gray cast iron, **service weight**, conforming to ASTM A 74, suitable for service in drainage, waste, vent, and sewer lines. **The pipes and fittings** shall have caulked lead bell and spigot joints, or hubless joints with **stainless steel** couplings over suitable elastomer sleeves.

2.13 CORROSION-RESISTANT CAST IRON SOIL PIPE

- A. Corrosion-resistant cast iron soil pipe and fittings shall be made of **high-silicon** cast iron conforming to ASTM A 518, **service weight**, suitable for chemical drains and vents. The pipes and fittings shall have caulked lead bell and spigot joints, or hubless joints with **stainless steel** couplings over suitable elastomer sleeves.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** Mill piping shall be installed in accordance with the manufacturer's installation instructions.
- B. **Small Steel Pipe:** Buried galvanized or black steel pipe shall be coated **in accordance** with Section 09800 Protective Coating or with an extruded high density polyethylene coating with minimum thickness of 35 mils.
- C. **Plastic Pipe:** PVC, CPVC, and FRP pipe joints shall be solvent-welded **in accordance** with the manufacturer's instructions. Expansion joints or pipe bends shall be installed to absorb pipe expansion over a temperature range of 100 degrees F, unless otherwise **indicated**. Care shall be taken to provide sufficient supports, anchors, and guides, to eliminate stress **on the piping**.

3.2 CONTINUITY BONDS

- A. Where indicated, metallic pipe joints, except field-welded joints and insulating joints, shall be continuity bonded or as indicated on the drawings.

**** END OF SECTION****

SECTION 15015 - PVC PRESSURE PIPE

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing solvent-welded, polyvinyl chloride (PVC) piping as indicated, including fittings and accessories as required for a complete and operable piping system, up to and including 4-inch diameter pipe.

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 02200 Earthwork
 - 2. Section 09800 Protective Coating
 - 3. Section 15000 Piping Components
 - 4. Section 15020 Pipe Supports
 - 5. Section 15030 Piping Identification Systems

1.3 CODES

- A. The 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 Plumbing Code

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 D 1599 Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.
 - 2. ASTM D 1785 Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - 3. ASTM D 2467 Specification for Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.

1.5 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).

1.6 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:

1. Shop drawings showing dimensions and details of pipe joints, fittings, fitting specials, valves and appurtenances.
2. Detailed layout, spool or fabrication drawings showing pipe spools, spacers, adaptors, connectors, fittings and pipe supports not indicated in the Contract Documents.
3. Manufacturer's product data.

1.7 OWNER'S MANUAL

A. The following shall be submitted:

1. Manufacturer's installation instructions.
2. Manufacturer's certification of compliance with these specifications.

1.8 PROJECT RECORD DRAWINGS

A. For concealed field-routed piping, the following shall be included in the PROJECT RECORD DRAWINGS:

1. Complete layout drawings indicating the pipeline as installed; fully dimensioned including location, length and depth of all piperuns, offsets, bends, fittings and specials and appurtenances.

1.9 FACTORY TESTING

A. **Product Testing:** PVC pipe shall be tested at the factory for compliance with the minimum burst pressure requirements as specified in ASTM D 1785, using the test method specified in ASTM D 1599.

B. **Witnesses:** The OWNER and the CONSTRUCTION MANAGER (at the option of either or both) reserve the right to witness factory tests.

1.10 FIELD TESTING

A. Piping shall be pressure tested at the pressure indicated in the Piping Schedule for not less than one hour without exceeding the leakage tolerances in the Piping Schedule. Where pressures are not indicated the piping shall be subjected to 1½ times the maximum working pressure.

1. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. All fixtures, devices, or other accessories connected to the line which would be damaged by the test pressure shall be disconnected. Ends of branch lines disconnect points shall be plugged or capped as appropriate during the test procedure.

2. Leaks shall be repaired to the satisfaction of the CONSTRUCTIONMANAGER and the piping shall be re-tested until no leaks are found.

1.11 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Piping materials shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. **Storage:** Piping materials shall be carefully stored in a manner that will prevent damage and in an area that is protected from sunlight and other harmful elements.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **General:** Pipe and fittings for welded joints shall comply with the requirements of Subsections 212-2.1.3 of SSPWC, and as indicated herein.

2.2 PIPE

- A. Polyvinyl chloride (PVC) pipe shall conform to ASTM D 1785 - Schedule 80, suitable for solvent weld joints.

2.3 FITTINGS

- A. Fittings shall be socket fittings conforming to ASTM D 2467 - Schedule 80.

2.4 PIPE SUPPORTS

- A. Pipe supports shall conform to the requirements of Section 15020 and shall also be in compliance with manufacturer's recommendations.

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPING

- A. **General:** PVC pipe shall be installed in accordance with Subsection 801-5.3.3 of SSPWC and the manufacturer's instructions, using solvent weld joints.
- B. For exposed piping, pipe supports shall be provided in compliance with Section 15020 and as recommended by the manufacturer of the pipe.
- C. For buried piping, trenching configuration pipe zone material, backfill and compaction shall be performed in accordance with the manufacturer's instructions, and in compliance with Section 02200.

3.2 PROTECTIVE COATING

- A. Unless otherwise indicated, PVC piping exposed to sunlight shall be painted with a coating system as specified in Section 09800.

3.3 PIPE IDENTIFICATION

- A. Piping identification shall be in compliance with Section 15030.

** END OF SECTION **

SECTION 15020 - PIPE SUPPORTS

PART 1-- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing pipe supports, hangers, guides, and anchors.

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 01640 Seismic Design of Equipment and Equipment Anchorage
 - 2. Section 05500 Miscellaneous Metalwork
 - 3. Section 15000 Piping Components

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

ANSI/ASME B31.1	Power Piping
ANSI/MSS SP-58	Standard Pipe Support Components

1.4 SHOP DRAWINGS AND SAMPLES

- A. Submittals shall comply with Section 15000 and shall include:
 - 1. Shop drawings of pipe supports including details of concrete inserts.
 - 2. Manufacturer's catalogue information demonstrating compliance with the specifications.
 - 3. Hanger and support location drawings with a legend that lists at a minimum, support identification number, support type, seismic restraint locations, anchor locations, pipe size, service and weight.
 - 4. Seismic restraint calculations signed by an engineer registered in California.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. **General:** Piping systems including connections to equipment shall be properly supported to prevent deflection and stresses. Supports shall comply with ANSI/ASME B31.1, except as otherwise indicated.
- B. **ANSI/MSS Types:** Except as otherwise indicated, pipe support components shall comply with the types in ANSI/MSS SP-58.

- C. **Support Spacing:** Supports for horizontal piping shall be properly spaced. Except as otherwise indicated, pipe support spacing shall comply with the following:

1. **Support Spacing for Schedule 40 & 80 Steel Pipe:**

Pipe Size (inches)	Max. Span (feet)
1/2	6
3/4 & 1	8
1-1/4 to 2	10
3	12
4	14
6	17
8 & 10	19
12 & 14	23
16 & 18	25
20 & Above	30

2. **Support Spacing for Copper Tubing:**

Tube Size (inches)	Max. Span (feet)
1/2 to 1-1/2	6
2 to 4	10
6 & Above	12

3. **Support Spacing for Schedule 80 PVC Pipe:**

Pipe size (inches)	Max Span (@100 degrees F) (feet)
1/2	4
3/4	4
1	5
1-1/4	5
1-1/2	5
2	6
3	7
4	8
6	10
8	11
10	12
12	13

4. **Support Spacing for Welded, Fabricated Steel Pipe:**

Practical Safe Spans for Simply Supported Pipe in
120-deg Contact Saddles

Nominal Size in.	Wall Thickness-in									
	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
24	33	37	40	43	45	47				
26	33	37	41	43	45	47				
28	33	38	41	44	46	48				
30	34	38	41	44	47	49				
32	34	38	42	45	47	50				
34	34	38	42	45	48	50				
36	34	39	42	45	48	50	54			
38	34	39	43	46	48	51	55			
40	34	39	42	46	49	51	55			
42	35	39	43	46	49	52	56			
45		39	43	47	50	52	56			
48		40	44	47	50	53	57	61		
51		40	44	47	50	53	58	61		
54		40	44	47	51	53	58	62		
57		40	44	48	51	54	58	62		
60		40	44	48	51	54	59	63	66	69
63		40	44	48	51	54	59	63	67	70
66		40	45	48	52	54	59	64	67	71
72		41	45	49	52	55	60	64	68	72
78		41	45	49	52	55	61	65	69	72
84		41	45	49	53	56	61	66	70	73
90		41	45	49	53	56	61	66	70	74
96		41	46	50	53	56	62	67	71	75

For steel pipe sizes not indicated, the support spacing shall be designed to ensure that the stress on the pipe does not exceed 5,000 psi calculated from the following formula:

$$L = \frac{7500tD}{32t+D}$$

t = thickness, in.
 D = Diameter, in.
 L = Safe span, ft.

Maximum deflection of pipe shall be limited to 1/360th of the span.

5. **Support Spacing for Ductile Iron Pipe:**

<u>Pipe Size</u>	<u>Max. Span</u>
All Sizes	2 Supports per length or 10 feet (One of the 2 supports located at joint)

6. **Variations:** For temperatures other than ambient temperatures and for other piping materials or wall thicknesses, the above spacings shall be modified in accordance with the pipe manufacturer's recommendations.

7. **Additional Supports:** Additional supports complying with ANSI B31.1 shall be provided at critical elbows, valves, gauges, and meters.
- D. **Pipe Hangers:** Pipe hangers shall be capable of supporting the pipe, shall allow for free expansion and contraction of the piping, and shall prevent excessive stress on equipment. Hangers shall have a means of vertical adjustment after erection. Hangers shall be designed so that they cannot become disengaged by any movement of the pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile loading, only.
- E. **Hangers Subject to Horizontal Movements:** At hanger locations where lateral or axial movement is indicated, suitable linkage shall be provided to permit movement. Where horizontal pipe movement is greater than 1/2-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from minimum to maximum temperature, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.
- F. **Spring-Type Hangers:** Spring-type pipe hangers shall be provided for piping where vibration or vertical expansion and contraction is indicated, (engine exhausts and similar piping). Spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions indicated. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. Supports shall be designed for a maximum variation of 25 percent for the total travel resulting from thermal movement.
- G. **Thermal Expansion:** Wherever expansion and contraction of piping is indicated, a sufficient number of expansion loops or joints shall be provided, with rolling or sliding supports, anchors, guides, pivots, and restraints. They shall permit the piping to expand and contract freely in directions away from the anchored points and shall be structurally suitable to withstand all loads imposed.
- H. **Heat Transmission:** Supports, hangers, anchors, and guides shall be designed and insulated so that excessive heat shall not be transmitted to the structure or to other equipment.
- I. **Riser Supports:** Risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.
- J. **Freestanding Piping:** Free-standing pipe connections to equipment, including chemical feeders and pumps, shall be firmly attached to fabricated steel frames made of angles, channels, or I-beams anchored to the structure. Exterior, free-standing overhead piping shall be supported on fabricated pipe stands, consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps installed to secure piping.
- K. **Point Loads:** Meters, valves, heavy equipment, and other point loads on PVC, and other plastic pipes, shall be supported on both sides according to manufacturer's recommendations to avoid pipe stresses. Supports on plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields.

- L. **Noise Reduction:** To reduce transmission of noise in piping systems, copper tubes shall be wrapped with a 2-inch wide strip of rubber fabric at each pipe support, bracket, clip, and hanger.
- M. **Structural Design:** Pipe supports, anchors, and restrainers shall be designed for static, dynamic, wind, and seismic loads. The horizontal seismic design force shall be the greater of that indicated in the project Geotechnical Report or the requirement of the CBC for Seismic Zone 4.

2.2 COATING

- A. **Galvanizing:** Fabricated pipe products, except stainless steel or non-ferrous supports, shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM 123.
- B. **Other Coatings:** Other than stainless steel or non-ferrous supports, supports shall be coated in accordance with Section 09800.

2.3 MANUFACTURERS

- A. Pipe supports shall be manufactured by one of the following (or equal):

- Basic Engineers
- Bergen-Paterson Corp.
- ITT-Grinnell Corp.
- NPS Industries, Inc.
- Powerstrut
- Unistrut

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** Pipe supports, hangers, brackets, anchors, guides, and inserts shall be installed in accordance with the manufacturer's installation instructions and ANSI/ASME B31.1.
- B. **Appearance:** Supports and hangers shall be installed to produce an orderly, neat piping system. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings as possible and without interference with other work.

** END OF SECTION **

SECTION 15030 - PIPING IDENTIFICATION SYSTEMS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing identification devices for all piping and valves using color bands, lettering, flow direction arrows, and related permanent identification devices, and all appurtenant works. The WORK of this Section also includes providing identification devices for all hazardous materials storage and conveyance facilities.

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 09800 Protective Coating
 2. Divisions 11, 13, 15 Piping, Valves, and Appurtenances, as applicable

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

ANSI A13.1	Scheme for the Identification of Piping Systems
ANSI Z535.1	Safety Color Code
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
NFPA	Guide to Hazardous Materials
NFPA 704	Hazard Identification System
UFC 79-3	Identification of the Health, Flammability and Reactivity of Hazardous Materials
29CFR 1910.106	Flammable and Combustible Liquids (OSHA)
29CFR 1910.145	Specification for Accident Prevention Signs and Tags (OSHA)
29CFR 1910.1200	Hazard Communication (OSHA)

1.4 CODES

- A. The WORK of this Section shall comply with the following codes in the California Code of Regulations (CCR):

CCR, Title 8,	Piping Systems Valving and Labeling (Cal-OSHA)
CCR, Title 8,	Identification of Piping (Cal-OSHA)
CCR, Title 8,	Hazard Communication (Cal-OSHA)

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Samples of all types of identification devices to be used in the WORK.
 - 2. A list of suggested wording for all valve tags.

PART 2 -- PRODUCTS

2.1 IDENTIFICATION OF EXPOSED PIPING

- A. Identification of all exposed interior and exterior pipe, including pipe in accessible ceiling spaces, pipe trenches, pipe chases, vaults and valve boxes, shall be accomplished by complete color coded painting of all visible pipe and its insulation in accordance with Section 09800 and providing marker lettering and color banding as indicated. Stainless steel pipe shall be color coded utilizing bands at 20 feet intervals as specified for identification of hazardous substance conveyance facilities in CCR, Title 8, Section 3321. Certain pipe indicated in paragraph 3.4 also shall be color coded utilizing bands at 20 feet intervals as specified for identification of hazardous substance conveyance facilities in CCR, Title 8, Section 3321.
- B. Each pipe identification shall consist of a printed pipe marker identifying the name of the pipe and a flow arrow to indicate direction(s) of flow in the pipe. All markers shall be preprinted. Markers shall be the mechanically attached types that are easily removable; they shall not be the adhesive applied type. Markers shall consist of pressure sensitive legends applied to plastic backing which is strapped or otherwise mechanically attached to the pipe. Fasteners shall be non-metallic. Legend and backing shall be resistant to petroleum based oils and grease and shall meet criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL-STD-810C. Markers shall withstand a continuous operating temperature range of minus 40 degrees F to 200 degrees F. Plastic coding markers shall not be the individual letter type, but shall be manufactured and applied in one continuous length of plastic.
- C. Marker and letter sizes shall conform to ANSI A13.1 except as otherwise indicated for hazardous materials identification. Directional arrows shall be the same size as the lettering.
- D. Except as otherwise indicated for hazardous materials identification, markers shall be white with black letters and directional arrows, except for pipes painted white, on which markers shall be blue with white letters.
- E. Pipelines which convey hazardous materials and hazardous materials storage facilities shall be labeled in full conformance with the Cal-OSHA and Federal OSHA regulatory standards, and the guidelines provided in UFC 79-3 and NFPA 704. As a minimum, pipeline identification shall include the chemical name and an appropriate hazard warning using words, pictures, symbols, or a combination thereof to identify flammability, health and reactivity. Placards may be used for hazard warnings, if affixed to the pipes.

2.2 IDENTIFICATION OF EXPOSED VALVES AND SHORT PIPE LENGTHS

- A. Identifying devices for valves, and the sections of pipe that are too short to be identified with engraved markers, and arrows.
- B. All tags shall be 316 stainless steel and engraved. The minimum tag thickness shall be 1/6-inch; the minimum size of 2-1/2-inch by 2-1/2-inch with 5/32-inch diameter top holes. Minimum lettering height shall be 1/4-inch. All tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to such valves or short pipes.

2.3 LOCATION MARKING OF BURIED PIPES

- A. Identification of buried electrical conduits shall be in accordance with Section 16050 and as indicated.

2.4 EXISTING IDENTIFICATION SYSTEMS

- A. In installations where existing piping identification systems have been established, the CONTRACTOR shall continue to use the existing system for pipes which convey non-hazardous materials. Where existing identification systems are incomplete, utilize the existing system as far as practical and supplement with the indicated system. The objective is to fully identify all new piping, valves, and appurtenances to the level indicated herein.

2.5 MANUFACTURERS

- A. Products of the type indicated shall be manufactured by the following (or equal):
 1. W.H. Brady Co.
 2. Seton Nameplate Corp.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All markers and identification tags shall be installed in accordance with the manufacturer's printed instructions, and shall be neat and uniform in appearance. All such tags or markers shall be readily visible from all normal working locations.

3.2 VALVE TAGS

- A. Valve tags shall be attached to the valve or structure by means of self-locking plastic or nylon ties.
- B. Wording on the valve tags shall include both the valve number and a description of the exact function of each valve, e.g., "DHW-R-BALANCING," "CLS THROTTLING", "RAS-PUMP SHUT-OFF," etc.

3.3 EXPOSED PIPE IDENTIFICATION

- A. Each exposed pipe shall be identified at intervals of 20 feet, and at least one time in each room. Piping shall also be identified at a point approximately within 2 feet of all turns, ells,

valves, and on the upstream side of all distribution fittings or branches. Sections of pipe that are too short to be identified with lettered markers, and directional arrows shall be tagged and identified similar to valves.

- B. Pipe identification shall consist of two to four elements: color coating and/ or banding of the pipe, a lettered marker with a directional arrow; and a hazard warning for pipelines which convey hazardous materials.

3.4 EXPOSED PIPE IDENTIFICATION SCHEDULE

- A. Application of the pipe identification systems shall conform to the following color codes. Marker lettering shall conform to that listed under "Function and Identification."

<u>Fluid Abbreviation</u>	<u>Function and Identification</u>	<u>Identification Color</u>	<u>Remarks Suggested Tnemec Color or Equal</u>
AA	Actuator Air	Off-White	Barbados PA24
AWR	Auxiliary Water Return	Light Blue	Clear Sky EN17 (add red band to light blue piping)
AWS	Auxiliary Water Supply	Light Blue	Clear Sky EN17
CA	Compressed Air	Off-White	Barbados PA24
D	Drain	See Remarks	Same color corresponding to service fluid
DDR	Diesel Day Tank Return	Green	Safety Green
DDS	Diesel Day Tank Supply	Green	Safety Green
DER	Diesel Engine Return	Green	Safety Green
DES	Diesel Engine Supply	Green	Safety Green
DF	Diesel Fill	Green	Safety Green
DFP	Diesel Fuel Polishing	Green	Safety Green
EE	Engine Exhaust	Yellow	Safety Yellow
EQ	Equalization	See Remarks	Same color corresponding to service fluid
F	Fill	See Remarks	Same color corresponding to service fluid
FPW	Fire Protection	Red	Safety Red
IA	Instrument Air	Off-White	Barbados PA24
IW	Industrial Water	Light Blue	Clear Sky EN17
JWR	Jacket Water Return	Light Blue	Clear Sky EN17 (add red band to light blue piping)
JWS	Jacket Water Supply	Light Blue	Clear Sky EN17
LOR	Lube Oil Return	Green	Safety Green
LOS	Lube Oil Supply	Green	Safety Green

<u>Fluid Abbreviation</u>	<u>Function and Identification</u>	<u>Identification Color</u>	<u>Remarks Suggested Tnemec Color or Equal</u>
LOW	Lube Oil Waste	Green	Safety Green
NG	Natural Gas	Yellow	Safety Yellow
SA	Sample	See Remarks	Same color corresponding to service fluid
URI	Urea Injection	Yellow	Safety Yellow
URS	Urea Supply	Yellow	Safety Yellow
URT	Urea Return	Yellow	Safety Yellow
V	Vent	See Remarks	Same color corresponding to fluid from which overflow comes
W1	Potable Water	White	White WH01
WW	Waste Water (Cooling Water)	Light Blue	Clear Sky EN17 (add brown band to light blue piping)

**** END OF SECTION ****

SECTION 15034 - GAUGES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing pressure and vacuum gauges, including fittings, snubbers, connections, gaskets, supports, and accessories.

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 11000 Equipment General Provisions
 - 2. Section 15100 Valves, General

1.3 CODES

- A. The 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 Plumbing Code

PART 2 -- PRODUCTS

2.1 PRESSURE AND VACUUM GAUGES

- A. **General:** Pressure gauges shall be installed on suction and discharge connections to pumps; on discharge connections from blowers and compressors; at each side of pressure reducing valves; and where otherwise indicated. Vacuum gauges and compound gauges, where indicated, shall be installed on vacuum pumps.
- B. **Gauge Construction:** Gauges shall have Type 316 stainless steel movement and stainless steel or alloy case. Except as otherwise indicated, gauges shall have a 3-1/2-inch dial, 1/4-inch threaded connection, a Type 316 stainless steel snubber adapter, and a shut-off valve. Gauges shall be calibrated to read with an accuracy of 1 percent to 150 percent of the indicated pressure. Gauges shall be vibration and shock resistant. Gauges on liquid service should have cases filled with a suitable liquid.
- C. **Diaphragm Seal:** Gauges attached to systems containing chemical solutions, corrosive fluids, sludge, sewage, or other liquids containing solids, shall be equipped with diaphragm seals, or equal protective pressure or vacuum sensing devices, and comply with the following:
 - 1. For: sewage, sludge, liquids containing solids, pulsating flow
Seals shall be fabricated with Type 316 stainless steel, with stainless steel diaphragm for pressures over 15 psi, and elastomer diaphragm for pressures of 15 psi and below with Type 316 stainless steel nuts and bolts, fill connection and valved flush port size 1/4-inch NPT, capable of disassembly without loss of filler fluid.

2. For: chemical solutions, low pressure sewage and chemical sludge except as otherwise indicated
- Seals shall be fabricated with PVC body for removable mounting and rated at 200 psi, with Type 316 stainless steel bolts and nuts, 1/2-inch inlet, 1/4-inch outlet, liquid-filled with Teflon diaphragm for pressure service and proper elastomer diaphragm for vacuum service.

2.2 SLEEVE PRESSURE GAUGES

- A. **General:** Sleeved pressure gauges shall be provided where indicated.
- B. Sensors shall be in-line ring-type, bolted directly between 600 lb R.F. flanges. The sensors shall have through-holes for positive alignment with pipeline flanges. Inside diameters of the sensors shall be the same at the mating pipes. Pressure sensing rings shall measure pressure for 360 degrees around the inside circumference of the pipe. Pressure shall be transmitted to the gauge by a locked-in, sealed ethylene glycol or silicone oil. The pressure indicators shall be local to the sensors. Pressure transmitters shall be connected by capillary tubing to the sensors.

2.3 MANUFACTURERS

A. Pressure and Vacuum Gauges

1. **Pressure and vacuum gauges shall be manufactured by one of the following (or equal):**

Ashcroft Industrial Instruments (Dresser)
Foxboro/Jordan, Inc.
Marsh Instrument Company
Marshalltown Instruments, Inc.
U.S. Gauge Div. of Ametek

2. **Diaphragm seals shall be of the following manufacture and model (or equal):**

- a. Stainless steel diaphragm seals and elastomer diaphragm seals for sewage, sludge and liquids containing solids.

Ashcroft®, model 101
Marshalltown, Series 225-01
U.S. Gauge (Ametek), SG

- b. Teflon diaphragm and elastomer diaphragm seals for chemical solutions, low pressure sewage, and chemical sludge.

Harrington Ind. Plastics, Inc.
Plast-O-Matic Valves, Inc.
Utilities Supply

B. Sleeve Pressure Gauges:

1. **Sleeve pressure gauges shall be manufactured by one of the following (or equal):**

Red Valve Company, Inc.
Ronningen-Petter

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Gauges shall be installed in accordance with the manufacturer's installation instructions.
- B. Gauges shall be installed with the face in the vertical position at the indicated locations. Gauges shall be installed to minimize the effect of water hammer and vibrations, and, where indicated, gauges shall be mounted independently, with flexible connectors.

**** END OF SECTION ****

SECTION 15050 - VIBRATION ISOLATION

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing vibration isolation systems for mechanical equipment. Additional vibration isolation system requirements may be included in individual equipment sections.
- B. The WORK also includes coordination of design, assembly, testing and installation.

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 11000 Equipment General Provisions

1.3 CODES

- A. The 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 Mechanical Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. ANSIA58.1 Minimum Design Loads for Buildings and Other Structures
 - 2. ASHRAE CH 8 Handbook, Fundamentals, Sound and Vibration Control

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Static and dynamic deflections, weights, drawings that show isolator locations and flexible connector design information.
 - 2. Information on spring deflections and diameters, compressed spring heights and solid spring heights.
 - 3. Curb mounted base seal and wind resistance details.

4. Seismic restraint load deflection curves.
5. Qualifications of the engineer who will perform the vibration isolation design.

1.6 OWNER'S MANUAL

- A. The following shall be submitted:
1. Certified seismic restraint dynamic analysis report stamped by an engineer licensed in the state of California.
 2. Manufacturer's final inspection report and certification.

PART 2 - PRODUCTS

2.1 GENERAL

- A. **Mounting Requirements:** Unless the equipment incorporates unit construction using an integral rigid frame or is indicated otherwise, each item of mechanical equipment, along with its drive unit, shall be mounted on a rigid steel and concrete base. Cast iron bases are not permitted when equipment is furnished with a vibration isolation system. Where indicated, the equipment, including the base, shall be mounted on or suspended from vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the supporting structure. Vibration isolation available internally in the equipment will not be considered equivalent and shall not be provided in lieu of the vibration isolation indicated. Normally provided internal vibration isolators shall be replaced with rigid supports in such cases. Vibration isolators shall be selected in accordance with unit weight distribution to produce reasonably uniform deflections at each support. Unless otherwise indicated, bases, isolators, and deflections shall be as indicated in ASHRAE CH 8.
- B. **Design Requirements:** The CONTRACTOR shall cause all vibration isolation systems, including the isolators, seismic restraints, and flexible connectors between the isolated equipment and associated piping, ducting and/or electrical work, to be designed by an engineer qualified in this type of work and having no less than 3 years of knowledge in it. This provision, however, shall not be construed as relieving the CONTRACTOR of his overall responsibility for the work. The CONTRACTOR shall submit the engineer's qualifications prior to starting the vibration isolation design. Flexible connectors shall be provided by the manufacturer of the mechanical equipment item in accordance with the recommendations of the vibration isolation system engineer.
- C. **Seismic Restraints:**
1. **General:** Restraint devices shall resist the forces indicated and shall be designed in accordance with UBC for seismic zone 4. Design lateral forces shall be distributed in proportion to the mass distribution of the equipment.
 2. **Floor Mounted Equipment:** Equipment and appurtenances floor mounted on spring or pad type vibration isolators, except for curb mounted equipment, shall be provided with seismic snubbers. Equipment shall receive four all-directional restraint snubbers. The capacity of snubbers, at 3/8-inch deflection, shall be 3 to 4 times the load at the adjacent equipment mount.

3. Restraint assembly for floor mounted equipment shall consist of welded steel interlocking assemblies welded or bolted securely to the equipment or the equipment bases and the supporting structure. Restraint assembly surfaces which engage under seismic motion shall be lined with a resilient elastomer, 3/4 inches thick. Restraints shall be field adjustable and be positioned for 1/4-inch clearance both vertically and horizontally or clearance as required to prevent interference during normal operation, stopping, or starting. Restraint assembly shall have a minimum rating of 0.44 g based on independent test data.
4. **Curb Mounted Equipment:** Seismic restraints for equipment mounted on vibration isolation curbs shall consist of slack stainless steel cables designed to provide 0.44 g restraint in the four primary horizontal directions based on independent test data.
5. **Suspended Equipment:** Restraint assembly for suspended equipment, piping, or ductwork shall consist of plow steel cable attached to steel thimbles with neoprene sleeve all specifically designed for cable service and securely fastened to the equipment or the equipment base and the building structure. Cables shall be sized for a force of 0.44 g with a minimum safety factor of 2 based upon independent test data. Cables shall be installed to prevent excessive seismic motion but not engage during normal operation, starting or stopping.
6. **Testing:** Seismic restraint dynamic tests shall be conducted in an independent laboratory or under the supervision of an independent registered engineer. The snubber assemblies shall be bolted to the test machine as the snubber is normally installed. Test reports shall certify that neither the elastomeric nor the snubber body sustained any obvious deformation after release of load.

2.2 BASES

- A. **Curb Mounted Bases:** Curb mounted equipment where vibration isolation is required, principally roof top heating, ventilating, and air conditioning equipment, shall be mounted on vibration isolation bases that fit over the curb and under the isolated equipment. The extruded aluminum top and bottom members shall contain cadmium-plated springs having a 1-inch minimum deflection with 50 percent additional travel to solid. Spring diameters shall be no less than 0.8 times the spring height at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a minimum clearance of 1/4 inch so as not to interfere with spring action except in high winds. The weather seal shall consist of continuous closed cell sponge materials both above and below the base and a waterproof flexible neoprene connection duct joining the outside perimeter of the aluminum members. Foam or other contact seals are unacceptable at the spring cavity closure. Caulking shall be kept to a minimum.
- B. **Type I Bases:** Type I bases shall be structural steel bases. The bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases, which may be "T" or "L" shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10 of the longest dimension of the base. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 inch.
- C. **Type II Bases:** Type II bases shall be steel members used to cradle machines having legs or bases that do not require a complete supplementary base. All members shall be sufficiently rigid to prevent strains in the equipment. Height saving brackets shall be employed in all mounting locations

to provide a clearance of 1 inch below the base.

- D. **Type III Bases:** Type III bases shall be rectangular foundations consisting of concrete filled structural steel beam or channel forms. Bases for split case pumps shall be of sufficient size to provide support for suction and discharge base ells. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer or required for mass or rigidity. In general, base depth shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. Forms shall include, as a minimum, concrete reinforcement consisting of 1/2-inch bars or angles welded in place or additional steel as required by structural conditions. Forms shall be provided with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts where the anchor bolts fail in concrete locations. Height saving brackets shall be employed in all mounting locations to maintain a 1-inch clearance below the base.

2.3 VIBRATION ISOLATION MOUNTINGS

- A. **Type A Mountings:** Type A mountings shall be double deflection neoprene mountings having a minimum static deflection of 0.35 inches. All metal surfaces shall be neoprene covered to avoid corrosion and shall have friction pads both top and bottom so that they need not be bolted to the floor. Bolt holes and anchor bolts shall be provided where required to resist lateral migration. Resilient washers and bushings shall be provided to prevent contact between the bolts and the equipment support bases. On equipment such as small vent sets, steel rails shall be used above the mountings to compensate for the overhang.
- B. **Type B Mountings:** Type B mountings shall be free-standing spring type isolators laterally stable without any housing and complete with 1/4-inch neoprene acoustical friction pads between the base and the support. Mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 times the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection. Mountings shall be hot-dip galvanized steel.
- C. **Type C Mountings:** Type C mountings shall be Type B mountings with a housing having vertical limit stops to prevent spring extension when weight is removed. Type C mountings shall be provided for equipment with operating weight different from the installed weight, such as chillers and boilers, and equipment exposed to the wind, such as cooling towers. The housing shall serve as blocking during erection and shall be located between the supporting steel and roof or the grillage and dunnage as indicated. The installed and operating heights shall be the same. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring to prevent interference with the spring action. Limit stops shall be out of contact during normal operations. Mountings shall be hot-dip galvanized steel.
- D. **Type D Mountings:** Type D mountings shall be steel hangers which contain a steel spring and a 0.3-inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing which passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be of sufficient size to permit the hanger rod to swing through a 30 degree arc before contacting the hole. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection.
- E. **Type E Mountings:** Type E mountings shall be double deflection cork and rubber sandwich pads consisting of a high-density cork layer permanently bonded to top and bottom layers of corrugated oil-resistant synthetic rubber. The corrugated design shall allow deflection to increase with load

and shall form a nonskid surface to resist lateral migration of the equipment. Bolt holes and anchor bolts shall be provided where required to resist migration. Resilient washers and bushings shall be provided to prevent contact between the bolts and the equipment support bases.

2.4 MANUFACTURERS

- A. Products of the type indicated shall be manufactured by one of the following (or equal):
 - 1. Consolidated Kinetics Corporation
 - 2. Korfund Dynamics
 - 3. Mason Industries, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. **General:** Vibration isolators and equipment shall be installed in accordance with the manufacturer's written instructions.
- B. Flexible connectors shall be provided by the manufacturer of the mechanical equipment item in accordance with the recommendations of the vibration isolation system engineer.

3.2 FIELD INSPECTION

- A. The vibration isolation manufacturer, or his qualified representative, shall provide such supervision as is necessary to assure correct installation and adjustment of the isolators and seismic restraints. Upon completion of the installation and after the system is put into operation, the manufacturer or his representative shall make a final inspection and submit his report in writing certifying the correctness of installation and compliance with shop drawings.

**** END OF SECTION****

SECTION 15100 - VALVES, GENERAL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing general requirements for valves including epoxy coating, installing, adjusting, and testing of valves and where buried valves are indicated, valve boxes to grade, with covers, stem extensions, and position indicators.

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 11000 Equipment General Provisions
2. Section 15000 Piping Components
3. Section 15101 Valve and Gate Operators
4. Section 15103 Globe Valves
5. Section 15104 Butterfly Valves
6. Section 15105 Check Valves
7. Section 15106 Ball Valves
8. Section 15109 Gate Valves
9. Section 15110 Plug Valves
10. Section 15113 Air Release and Vacuum Valves
11. Section 15114 Pressure Regulating Valves

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following standards apply to the WORK of this Section:

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inch)
ANSI/ASME B31.1	Power Piping
ASTM A 36	Specification for Structural Steel
ASTM A 48	Specification for Gray Iron Castings
ASTM A 126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 536	Specification for Ductile Iron Castings
ASTM B 61	Specification for Steam or Valve Bronze Castings
ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings
ASTM B 148	Specification for Aluminum-Bronze Castings
ASTM B 584	Specification for Copper Alloy Sand Castings for General Applications
ANSI/AWWA C500	Gate Valves for Water and Sewerage Systems
ANSI/AWWA C502	Dry-Barrel Fire Hydrants
ANSI/AWWA C503	Wet-Barrel Fire Hydrants
ANSI/AWWA C504	Rubber-Seated Butterfly Valves

ANSI/AWWA C506	Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types
ANSI/AWWA C507	Ball Valves 6 Inches through 48 Inches
AWWA C508	Swing-Check Valves for Waterworks Service, 2 Inches Through 24 Inches NPS
ANSI/AWWA C509	Resilient-Seated Gate Valves for Water and Sewage Systems
AWWA C550	Protective Interior Coatings for Valves and Hydrants
SSPC-SP-2	Hand Tool Cleaning
SSPC-SP-5	White Metal Blast Cleaning

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Manufacturer's product data including catalogue cuts.
2. Manufacturer's installation instructions.
3. Shop drawings showing details and dimensions.
4. Manufacturer's certification that products comply with the indicated requirements.
5. Schedule of valves indicating valve identification and location.
6. Manufacturer's certification that epoxy coatings have been factory tested and comply with the indicated requirements.

1.5 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. Manufacturer's installation and operating instructions.
2. Manufacturer's maintenance procedures.
3. List of special tools.
4. Schedule of valves indicating valve identification and location.
5. Manufacturer's instructions for short term and long term storage.

1.6 FACTORY TESTING

- A. **General:** Valves shall be tested in compliance with the AWWA Standards as indicated. Except as otherwise indicated, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- B. **Proof-of-Design Tests:** The CONTRACTOR shall furnish the CONSTRUCTION MANAGER three (3) certified copies of a report from an independent testing laboratory certifying successful completion of proof-of-design testing for all valves of sizes 10-inch and larger unless indicated otherwise in the specific valve Section. In lieu of testing the valves at an independent testing laboratory, proof-of-design testing may be performed at the valve manufacturer's laboratory, but must be witnessed by a representative of a qualified independent testing laboratory representative. Proof-of-design testing shall have been performed on not less than three valves, with all three units demonstrating full compliance with the test standards. Failure to satisfactorily complete the test shall be deemed sufficient evidence to reject all valves of the proposed make or manufacturer's model number.

1.7 FIELD TESTING

A. **Testing:** Valves shall be field-tested for compliance with the indicated requirements.

PART 2 -- PRODUCTS

2.1 VALVES

- A. **General:** Shut-off valves, 6-inch and larger, shall have operators with position indicators. Where buried, these valves shall be provided with valve boxes and covers containing position indicators, and valve extensions. Valves mounted higher than 7 feet above working level shall be provided with chain operators.
- B. **Valve Flanges:** The flanges of valves shall comply with Section 15000.
- C. **Protective Coating:** Except where otherwise indicated, ferrous surfaces, exclusive of stainless steel surfaces, in the water passages of all valves 4-inch and larger, and exterior surfaces of submerged valves, shall be epoxy coated conforming to Section 09800. Flange faces of valves shall not be epoxy coated.
- D. **Valve Operators:** Where indicated, valves shall include electric operators recommended by the manufacturer. Operators of the same type shall be furnished by the same manufacturer. Valve operators, regardless of type, shall be installed, adjusted, and tested by the valve manufacturer at the manufacturing plant. Except as otherwise indicated, electric, pneumatic, and hydraulic valve operators shall comply with Section 15101.
- E. **Nuts and Bolts:** Nuts and bolts on valve flanges, bodies and supports shall comply with Section 05500.

2.2 NAMEPLATES, TOOLS AND SPARE PARTS

- A. **Nameplates:** Except as otherwise indicated, a label shall be provided on all valves exclusive of hose bibbs. The label shall be 1/16-inch plastic or stainless steel, minimum 2 inches by 4 inches in size, and shall be permanently attached to the valve. Tag shall match valve identification schedule.
- B. **Spare Parts:** Two sets of packings, O-rings, gaskets, discs, seats, and bushings shall be furnished with each valve, as applicable.

PART 3 -- EXECUTION

3.1 VALVE INSTALLATION

- A. **General:** Valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's installation instructions. Valves shall be independently supported to prevent stresses on the pipe.
- B. **Access:** Valves shall be installed to provide easy access for operation, removal, and maintenance and to prevent interferences between valve operators and structural members or handrails.
- C. **Valve Accessories:** Where combinations of valves, sensors, switches, and controls are indicated, the combinations shall be properly assembled and installed to ensure that systems are accessible for maintenance, are compatible with one another and are operating properly.

** END OF SECTION **

SECTION 15101 - VALVE AND GATE OPERATORS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all shut off and throttling valves with manual and power operators as indicated. The CONTRACTOR shall provide the valve and gate operators, complete and operable, including all controls, motors, gears, enclosures and other necessary appurtenances as indicated.
- B. The WORK also requires that the valve or gate manufacturer accept responsibility for furnishing the WORK in this Section but without altering or modifying the CONTRACTOR'S responsibilities under the Contract Documents.
- C. The WORK additionally requires that the one manufacturer who accepts the indicated responsibilities shall manufacture the valve or gate, as a minimum.
- D. The WORK also includes coordination of design, assembly, testing and installation.

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 15100 Valves, General
 - 2. Section 16050 Basic Electrical Materials and Methods
 - 3. Section 16460 Electric Motors

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. JIC P-1 Pneumatic Standards for Industrial Equipment and General Purpose Machine Tools
 - 2. NEMA ICS-2 Industrial Control Devices, Controllers and Assemblies

1.4 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 15100, Section 16050, and Section 16460:
 - 1. Electrical wiring and control diagrams.

1.5 SERVICES OF MANUFACTURER

- A. **Inspection, Startup, and Field Adjustment:** An authorized representative of the manufacturer shall visit the site for not less than 2 days to furnish the indicated services.

- B. **Instruction of OWNER'S Personnel:** The authorized service representative shall also furnish the indicated services for instruction of OWNER'S personnel for not less than 2 days.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **General:** Unless otherwise indicated, all shut-off and throttling valves, and externally-actuated valves and gates, shall be provided with manual or power operators. The CONTRACTOR shall furnish all operators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, handwheels, levers, chains, and extensions, as applicable. All operators shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. All wires of motor-driven operators shall be identified by unique numbers.
- B. **Manufacturers:** Where indicated, certain valves and gates may be provided with operators manufactured by the valve or gate Manufacturer. Where operators are furnished by different manufacturers, the CONTRACTOR shall coordinate selection to have the fewest number of manufacturers possible.
- C. **Materials:** All operators shall be current models of the best commercial quality materials and liberally-sized for the maximum expected torque. All materials shall be suitable for the environment in which the valve or gate is to be installed.
- D. **Mounting:** All operators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. The word "open" shall be cast on each valve or operator with an arrow indicating the direction to open in the counter-clockwise direction. All gear and power operators shall be equipped with position indicators. Where possible, manual operators shall be located between 48 and 60 inches above the floor or a permanent work platform.
- E. **Standard:** Unless otherwise indicated and where applicable, all operators shall be in accordance with ANSI/AWWA C 540 - AWWA Standard for Power-Actuating Devices for Valves and Sluice Gates.
- F. **Functionality:** Electric, pneumatic, and hydraulic operators shall be coordinated with power and instrumentation equipment indicated elsewhere in the Contract Documents.

2.2 MANUAL OPERATORS

- A. **General:** Unless otherwise indicated, all valves and gates shall be furnished with manual operators. Valves in sizes up to and including 32 inches shall have direct acting lever or handwheel operators of the Manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual operators, with an operating pull of maximum 60 pounds on the rim of the handwheel. All buried and submerged gear-assisted valves, all gates, all gear-assisted valves for pressures higher than 250 psi, all valves 30 inches in diameter and larger, and where so indicated, shall have worm-gear operators, hermetically-sealed and grease-packed, where buried or submerged. All other valves 4 inches to 24 inches in diameter may have traveling-nut operators, or worm-gear operators as indicated.
- B. **Buried Valves:** Unless otherwise indicated, all buried valves shall have extension stems to grade, with wrench nuts located within 6 inches of the valve box cover, position indicators, and cast-iron or steel pipe extensions with heavy valve boxes with stay-put, hot-dip galvanized

covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve operators. Covers of valve boxes shall be permanently labeled as requested by the local Utility Company or the ENGINEER. Wrench-nuts shall comply with AWWA C 500 -Metal - Seated Gate Valves for Water Supply Service, and a minimum of 2 operating keys, or one key per 10 valves, whichever is greater, shall be furnished.

- C. **Chain Operator:** Manually-operated valves with the stem located more than 7 feet 6 inches above the floor or operating level shall be furnished with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains, and be provided by the valve Manufacturer. The wheel and guide shall be of ductile-iron or cast-iron, and the chain shall be hot-dip galvanized steel or stainless steel, extending to 5 feet 6 inches above the operating floor level. The valve stem of chain-operated valves shall be extra strong to allow for the extra weight and chain pull. For plug valves 8 inches and larger, the actuator shall be provided with a hammer blow wheel. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.
- D. **Floor Boxes:** Hot-dip galvanized cast-iron or steel floor boxes and covers to fit the slab thickness shall be provided for all operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.
- E. **Adjustable Shaft Valve Boxes:** Adjustable shaft valve boxes shall be concrete or cast iron valve extension boxes. Box covers on water lines shall be impressed with the letter "W". Gas line covers shall be impressed with the letter "G".
- F. **Manual Worm-Gear Operator:** The operator shall consist of a single or double reduction gear unit contained in a weather-proof cast-iron or steel body with cover and minimum 12-inch diameter handwheel. The operator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The operator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm-gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Operator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the operator. All gearing shall be designed for a 100 percent overload.
- G. **Traveling-Nut Operator:** The operator shall consist of a traveling-nut with screw (Scotch yoke) contained in a weather-proof cast-iron or steel housing with spur gear and minimum 12-inch diameter handwheel. The screw shall run in 2 end bearings, and the operator shall be self-locking to maintain the valve position under any flow condition. The screw and gear shall be of hardened alloy steel or stainless steel, and the nut and bushings shall be of alloy bronze. The bearings and gear shall be grease-lubricated by means of grease nipples. All gearing shall be designed for a 100 percent overload.

2.3 ELECTRIC MOTOR OPERATORS

A. General

1. **Equipment Requirements:** Where electric motor operators are indicated, an electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adaptor piece.
2. **Gearing:** The motor operator shall include the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weather-proof NEMA 4x assembly. The

operator shall be a single or double reduction unit consisting of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. All gearing shall be accurately cut with hobbing machines. All power gearing shall be grease- or oil-lubricated in a sealed housing. Ball or roller bearings shall be used throughout. Operator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gearset ratio without further disassembly of the electric operator.

3. **Starting Device:** Except for modulating valves, the unit shall be so designed that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve. The device should allow free movement at the stem nut before imparting the hammer blow. The operator motor must attain full speed before stem load is encountered.
4. **Switches and Wiring:** Travel in the opening and closing directions shall be governed by a switch responsive to mechanical torque developed in seating the valve, or by an obstruction met in opening or closing the valve, or by an on-board microprocessor. The torque switch shall be adjustable and shall function without auxiliary relays or devices, or it shall be adjustable in one-percent increments, sensed by a pulse-counter which receives 15 pulses per rotation of the unit. The geared limit switches shall be of the open type and shall be actuated by a rotor cam with 4 contacts to each cam or gear train. The operator shall have a number of gear trains as required to produce the operation indicated. The operator shall be wired in accordance with the schematic diagram. All wiring for external connections shall be connected to marked terminals. One 1-inch and one 1-1/4-inch conduit connection shall be provided in the enclosing case. A calibration tag shall be mounted near each switch correlating the dial setting to the unit output torque. Position limit switches and associated gearing shall be an integral part of the valve operator. To provide the best possible accuracy and repeatability, limit-switch gearing shall be of the "counting" intermittent type, made of stainless steel, grease-lubricated, and enclosed in its own gearcase to prevent dirt and foreign matter from entering the gear train. Switches shall not be subject to breakage or slippage due to over-travel. Traveling-nuts, cams, or microswitch tripping mechanisms shall not be used. Limit-switches shall be of the heavy-duty open contact type with rotary wiping action.
5. **Handwheel:** A permanently-attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation. The maximum torque required on the handwheel under the most adverse conditions shall not exceed 60 lb-ft, and the maximum force required on the rim of the handwheel shall not exceed 60 lb. An arrow and either the word "open" or "close" shall be cast or permanently affixed on the handwheel to indicate the appropriate direction to turn the handwheel.
6. **Motor:** The motor shall be of the totally-enclosed, non-ventilated, high-starting torque, low-starting current type for full voltage starting. It shall be suitable for operation on 480-volt, 3-phase, 60-Hz current, and have Class F insulation and a motor frame with all dimensions in accordance with the latest revised NEMA MG Standards. The observed temperature rise by thermometer shall not exceed 55 degrees C above an ambient temperature of 40 degrees C when operating continuously for 15 minutes under full rated load. With a line voltage ranging between 10 percent above to 10 percent below the rated voltage, the motor shall develop full rated torque continuously for 15 minutes without causing the thermal contact protective devices imbedded in the motor windings to trip or the starter overloads to drop-out. All bearings shall be of the ball type and thrust bearings shall be provided where necessary. All bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Motor conduit

connections shall be watertight. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require operator disassembly or gearing replacement. The motor shall be furnished with a space heater suitable for operation on 120-volt, single-phase, 60-Hz circuit unless the entire operator is an hermetically-sealed, non-breathing design with a separately sealed terminal compartment which prevents moisture intrusion.

B. Electric Motor Operators (AC Reversing Control Type)

1. **General:** Where indicated, electric motor operators shall be the AC reversing type complete with local control station with open/close and local/remote selector switches.
2. **Operator Appurtenances:** The operator for each valve shall be supplied with open and close status lights; open, close and lock-out-stop push-buttons, and all other devices indicated.
3. **Starter:** The starter shall be suitably sized amperage rated reversing starter with its coils rated for operation on 120-volt, 1-phase, 60-Hz current. A control power transformer shall be included to provide a 120-volt source, unless otherwise indicated. The starter shall be equipped with 3 overload relays of the automatic reset type. Its control circuit shall be wired as indicated. The integral weatherproof compartment shall contain a suitably sized 120-volt ac, single-phase, 60-Hz space heater to prevent moisture condensation on electrical components.

C. Electric Motor Operators (AC Modulating Control Type)

1. **General:** Where indicated, modulating electric motor operators shall be the ac modulating type complete with a local control station with open/close/auto/hold functions.
2. **Control Module:** The control module shall be of the electronic solid-state ac type with proportional pulse output to control the speed of the motor.
3. **Starter:** The operator shall control a solid-state reversing starter designed for minimum susceptibility to power line surges and spikes. The solid-state starter and control module shall be rated for continuous modulating applications. Power supply shall be 480-volt, 3-phase, 60-Hz.
4. **Construction:** The control unit shall be microprocessor-based and shall contain an analog/digital converter, separate input-output switches, non-volatile random access memory for storage of calibration parameters and push-button calibration elements for field-setup. Potentiometer adjustments shall contain a PID control function internally. In addition, the controller shall contain as standard feature a loss of command signal protection selectable to lock in last or lock in pre-set valve position and a valve position output signal in 4-20 mA. As an alternative to the construction requirement, the motor shall be capable of modulating at a rate of 600 starts per hour at the 50 percent to 85 percent travel range of the valve.

2.4 PNEUMATIC OPERATORS

A. **General:**

1. **Controls:** Pneumatic cylinder operators shall be provided complete with all necessary pneumatic or electro-pneumatic controls for the intended actuation of the valve or gate.

2. **Lubricators:** Where required by the service and type of operator, oil-lubricators shall be provided in the air supply to the operator, according to the Manufacturer's instructions.
3. **Air Supply:** All pneumatic operators shall be sized for the available air pressure as indicated and shall be furnished with isolating valves, adjustable filter-regulators, pressure gauges, and condensate drains. The filter elements shall be replaceable 40 micron units.

B. Diaphragm Operators

1. **Construction:** The operator shall consist of a ductile-iron, aluminum, or carbon steel diaphragm housing and stainless steel or carbon steel stem; a ductile-iron or cast-iron yoke and spring barrel with carbon steel spring, and Nitrile-covered fabric diaphragm of sufficient strength for the maximum expected torque or force.
2. **Manual Override:** Each operator shall be provided with a manual handwheel override, top-mounted for linear actuation, and worm-gear mounted with declutchable handwheel for rotary actuation. The worm-gear construction shall be as indicated for manual operators.

C. Double-Piston Operators

1. **Construction:** The operators shall be of the double-acting cylinder type with provision for later field conversion to spring-return action. A rack-and-pinion drive shall provide a 90-degree rotation of the output shaft, which shall be extended to receive a manual override. The operator shall be totally enclosed in a hard-anodized aluminum, ductile-iron, cast-iron, or steel housing. The cylinders and pistons shall be of hard-anodized aluminum or ductile-iron or steel, honed, and nickel or chrome-plated, or coated with a permanent dry-film lubricant and corrosion inhibitor. The rack, pinion, end caps, and tie-rods shall be of hardened carbon steel. The seals and O-rings shall be Buna N.
2. **Manual Override:** Each operator shall be provided with a manual worm-gear override with declutchable handwheel. The worm-gear construction shall be as indicated for manual operators.

D. Scotch-Yoke Piston Operators

1. **Construction:** The operator shall be of the double-acting cylinder type with provision for later field conversion to spring-return action. The operator may be of the single- or double-cylinder design. A scotch-yoke drive shall provide a 90-degree rotation of the output shaft, which shall be extended to receive a manual override. The unit shall be totally enclosed in a hard-anodized aluminum, ductile-iron, cast-iron, or steel housing. The cylinders and pistons shall be of hard-anodized aluminum, cast-iron, ductile-iron, or steel, honed and nickel- or chrome-plated, or coated with a permanent dry-film lubricant and corrosion inhibitor. The piston rod shall be of hard chrome- or nickel-plated steel. The tie-rods shall be of hardened carbon steel, and the seals and O-rings of Buna N.
2. **Manual Override:** Each operator shall be provided with a manual worm-gear operator override with declutchable handwheel. The worm-gear construction shall be as indicated for manual operators.

2.5 (NOT USED)

2.6 MANUFACTURERS

A. Products shall be from the following manufacturers, or equal.

1. Valve Boxes

Brooks 3RT
Christie G5
Empire 72

2. AC Reversing Control Type Operators

EIM
Keystone
Limitorque
Rotork

3. AC Modulating Control Type Operators

EIM
Limitorque Corporation
Rotork

4. DC Modulating Control Type Operators

EIM "Futronic - III"
Limitorque Corporation, "Modutronic - 10"

5. Pneumatic Cylinder Controls

G.H. Bettis
Fisher Controls
Keystone Controls, Inc.
Miller Fluid Power
Neles-Jamesbury, Inc.

Rexroth Corporation

6. Air Supply Lubricators

Fisher Controls, Series 67

7. Diaphragm Operators

Fisher Corporation
ITT Engineered Valves
Neles-Jamesbury, Inc.

8. Manual Worm-Gear Override

G.H. Bettis
Keystone Controls, Inc.
Neles-Jamesbury, Inc.

9. Scotch-Yoke Piston Operators

G.H. Bettis
Keystone Controls, Inc.
Neles-Jamesbury, Inc.
Rotork Controls, Inc.

10. Hydraulic Cylinder Operators

G.H. Bettis
Miller Fluid Power
Rexroth Corporation

11. Power and Control Systems

G.H. Bettis
Miller Fluid Power
Rexroth Corporation

12. Fluid Power Systems

R.W. Atkinson Co., Inc.
Miller Fluid Power
Parker Hannifin Corporation
Rexroth Corporation

PART 3 -- EXECUTION

3.1 GENERAL

Installation shall be as specified herein. Valve operators shall be located so that they are readily accessible for operation and maintenance. Valve operators shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Valve operators shall not be mounted where shock or vibration will impair their operation. Support systems shall not be attached to handrails, process piping, or mechanical equipment.

3.2 SERVICES OF MANUFACTURER

A. Field Adjustments

1. Field representatives of manufacturers of valves or gates with pneumatic, hydraulic, or electric operators shall adjust operator controls and limit-switches in the field for the required function.

3.3 INSTALLATION

A All valve and gate operators and accessories shall be installed in accordance with Section 15100 - Valves, General.

- END OF SECTION -

SECTION 15103 - GLOBE VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing globe valves.

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 15100 Valves, General

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 A197 Specification for Cupola Malleable Iron
 - 2. ATSM A307 Specification for Carbon Steel Bolts and Studs 60,000 psi Tensile
 - 3. ASTM A 563 Specification for Carbon and Alloy Steel Nuts
 - 4. ASTM B371 Specification for Copper-Zinc-Silicon Alloy Rods

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Globe valves for isolating and throttling service shall have screwed ends for sizes up to and including 2 inches, and 125 lb flanged ends for larger sizes. Unless otherwise indicated, all globe valves shall have manual hand wheel actuators.

2.2 GLOBE VALVES 2 INCHES AND SMALLER

- A. Globe valves with threaded ends shall have bronze bodies with union bonnets for class 150 rating, to the following material specifications or equal:
 - 1. Body and bonnet - Bronze, ASTM B62
 - 2. Disc - Teflon
 - 3. Disc holder and nut - Brass, or bronze ASTM B62

- 4. Handwheel - Malleable iron
- 5. Packing - Nonasbestos fiber with Teflon
- 6. Packing nut - Bronze, ASTM B584
- 7. Stem - Copper-silicon bronze, ASTM B371

2.3 GLOBE VALVES LARGER THAN 2 INCHES

A. Globe valves with flanged ends shall have cast iron bodies with flanged bonnet for class 125 rating to the following material specifications or equal:

- 1. Body - Cast iron, ASTM A126, Class B
- 2. Bonnet studs and nuts - Steel, ASTM A307 and A563, respectively
- 3. Disc - Teflon
- 4. Disc holder - Bronze, ASTM B62
- 5. Disc nut - Bronze, ASTM B584
- 6. Handwheel - Malleable iron; cast iron above 4 inches
- 7. Packing - Nonasbestos fiber with Teflon
- 8. Packing gland - Bronze, ASTM B584
- 9. Packing gland flange - Malleable iron, ASTM A197
- 10. Seat ring - Bronze, ASTM B62
- 11. Stem - Copper-silicon bronze, ASTM B584
- 12. Yoke bonnet - Cast iron, ASTM A126, Class B
- 13. Yoke bushing - Bronze, ASTM B584

2.4 MANUFACTURERS

A. Products of the type indicated shall be manufactured by the following (or equal):

- 1. Valves 2 inches and smaller
 - Jenkins, Figure 106B
 - Stockham, Figure B-22-T
 - Walworth, Figure 3095
- 2. Valves larger than 2 inches

Jenkins, Figure 142C
Stockham, Figure G-514-T
Walworth, Figure 8914 F

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Globe valves shall be installed in accordance with Section 15100 and with the manufacturer's written instructions.

**** END OF SECTION ****

SECTION 15104 - BUTTERFLY VALVES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing butterfly valves with epoxy coating, operators, and accessories.

1.2 RELATED SECTIONS

- A. The WORK of the following Section 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 09800 Protective Coating
 - 2. Section 15100 Valves, General

1.3 FACTORY TESTING

- A. Valves shall be tested in compliance with AWWA C 504 and Section 15100.
- B. Proof-of-design tests reports shall be submitted in compliance with Section 15100 and AWWA C504.

PART 2 - PRODUCTS

2.1 BUTTERFLY VALVES (AWWA)

- A. **General:** Butterfly valves shall conform to ANSI/AWWA C504 class 150B and shall be flanged, of the size and class indicated. Flanged valves shall have 125-lb flanges complying with ANSI B.16.5, or 250-lb where so indicated, and shall be short-bodied except as otherwise indicated. Valves shall have independently adjustable open and closed position stops that are adjustable under full line pressure.
 - 1. On valves 30 inches and larger Class 150, the valve port diameter shall not be reduced more than 1-1/2 inches of the nominal pipe diameter.
- B. **Body:** Valve bodies shall be of cast iron per ASTM A126 Class B unless noted otherwise.
- C. **Disc:** Discs shall be cast iron per ASTM A48, Class 40C unless noted otherwise.
- D. **Seat:** The seat shall be of Buna-N and shall be retained within the valve body. Cartridge-type valve seats, or valves employing snap rings to retain the rubber seats, will not be acceptable.
- E. **Shaft:** Shaft material shall be of Type 316 stainless steel. Shaft seals shall be designed for use with standard split-V type packing or other approved seals, and the interior passage shall not have any excessive obstructions or stops.
- F. **Bearings:** Valve shaft bearings shall be non-metallic and permanently lubricated (for valves 20" and smaller) and Teflon lined with a non-metallic fiberglass composite backing and shall be

permanently lubricated (for valves 24' and larger).

G. **Coating:** Corrosive ferrous surfaces of valves, 4-inch and larger, which will be in contact with water (exclusive of flange faces) shall be epoxy-coated complying with Section 09800. Exterior surfaces shall be coated complying with Section 09800

H. **Manual Operators:**

1. Operators shall conform to ANSI/AWWA C504. Except as otherwise indicated, manually-operated butterfly valves shall be equipped with a hand wheel and 2-inch square operating nut and position indicator.

2. Valves 30 inches and larger and submerged or buried valves, shall be equipped with worm-gear operators, lubricated and sealed to prevent entry of dirt or water into the operator at a water pressure of 20 feet of head. Screw-type operators shall not be installed for valves 30 inches in diameter and larger. Operators shall require a minimum of 40 turns to rotate the disc from fully open to fully closed position.

I. **Electric Operators:** Electric operators shall comply with Section 15100.

2.2 BUTTERFLY VALVES FOR AIR AND GAS SERVICE

A. **General:** Butterfly valves for air and gas systems shall be designed for this service and meet or exceed the design, strength, performance, and testing standards of ANSI/AWWA C 504. Butterfly valves shall be designed for pressures from vacuum to 125 psi, and temperatures from minus 40 degrees F to 250 degrees F.

B. **Body:** Valve bodies shall be fabricated with cast iron conforming to ASTM A126, class B, with either wafer, lug, or flanged design, where indicated, and drilled to comply with ANSI B 16.1, class 125.

C. **Disc:** The disc shall be fabricated with ductile iron conforming ASTM A536 with an edge of monel, Type 316 stainless steel, or nickel; it shall be designed with the air-profile or other proper shape. Sprayed or plated disc edges are not acceptable.

D. **Seat:** The elastomer seat shall be mounted in the valve body. The seat shall be field-replaceable without special tools. Except for use with petroleum-based fluids, the seat material shall be Ethylene-Propylene- Diene Monomer (EPDM), or other suitable material, to provide a tight shut-off at the indicated temperatures. The elastomer thickness shall be minimum 1/2-inch, exclusive of backing rings, or stiffeners.

E. **Shaft:** The valve shaft shall be fabricated with stainless steel, Type 316.

F. **Bearings:** Shaft bearings shall be of the self-lubricating corrosion resistant sleeve type.

G. **Packing:** Packing shall be of the adjustable or self-adjustable type, suitable for the temperature and service conditions.

H. **Operators:** Valve operators shall be in accordance with Section 15101 and shall be sized for air service applications and designed for 3 years of service. Manual actuators shall allow for positive throttling and locking in any position from open to close.

2.4 MANUFACTURERS

A. Butterfly valves shall be manufactured by one of the following (or equal):

1. AWWA butterfly valves:

De Zurik
Corporation
Henry Pratt
Company

2. Butterfly valves designed for air and gas service: the following (or equal):

De Zurik Corporation
Keystone Valve -
USA

PART 3 - EXECUTION

3.1 INSTALLATION

A. Exposed butterfly valves shall be installed to permit removal of valve assembly without dismantling the valve or operator.

B. Installation shall be in accordance with Section 15100.

**** END OF SECTION ****

SECTION 15105 - CHECK VALVES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing check valves of the types and sizes indicated with epoxy coating, appurtenances, and accessories.

1.2 RELATED SECTIONS

- A. The WORK of the following Section 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 15100 – Valves, General
2. Section 09800 – Protective Coating

1.3 FACTORY TESTING

- A. Valves shall be tested in compliance with AWWA C506, AWWA C508, and Section 15100.
- B. Proof-of-design tests shall be submitted in compliance with Section 15100 for all check valves size 10-inch and larger.

PART 2 - PRODUCTS

2.1 SWING CHECK VALVES (3-INCH AND LARGER)

- A. **General:** Except as otherwise indicated, swing check valves designed for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, complying with AWWA C 508, and full-opening; valves shall be designed for a water-working pressure of 150 psi and shall have a flanged cover piece designed to provide access to the disc. Corrosive surfaces of valves, 4-inch and larger, intended to be in contact with water, shall be epoxy-coated complying with Section 09800.
- B. **Body:** The valve body and cover shall be fabricated with cast iron conforming to ASTM A126, with flanged ends conforming to ANSI B 16.1, or mechanical joint ends, as indicated.
- C. **Disc:** The valve disc shall be fabricated of cast iron or ductile iron conforming to ASTM B 62, except as otherwise noted.
- D. **Seat and Rings:** The valve seat and rings shall be fabricated of 316 stainless steel or bronze.
- E. **Hinge Pin:** The hinge pin shall be fabricated of bronze or 316 stainless steel.

2.2 SWING CHECK VALVES (2-1/2-INCH AND SMALLER)

- A. **General:** Swing check valves intended for steam, water, oil, or gas in sizes 2-1/2-inch and smaller

shall be designed for a steam pressure of 150 psi and a cold water pressure of 300 psi. They shall have threaded ends and caps.

- B. **Body:** The valve body and cap shall be fabricated of bronze conforming to ASTM B 61 and with threaded ends complying with ANSI/ASME B1.20.1.
- C. **Disc:** Valves designed for steam service shall have bronze discs, and valves designed for cold water, oil, and gas service shall have replaceable composition discs.
- D. **Hinge Pin:** The hinge pins shall be fabricated with bronze or 316 stainless steel.

2.3 INTERNAL SPRING-LOADED CHECK VALVES (GLOBE STYLE)

- A. **General:** Internal spring-loaded check valves designed for water pumps, compressors, gas, air, and steam shall be of the full-flow internal spring-loaded poppet type. The valves shall be designed for a water-working pressure of not less than 150 psi unless otherwise indicated. Corrosive ferrous surfaces of valves 4-inch and larger shall be epoxy-coated complying with Section 09800.
- B. **Body:** Bodies of valves in sizes 3-inch and larger shall be fabricated of cast iron with 125-lb flanged ends conforming to ANSI B 16.1 unless otherwise indicated. Valves shall include positive, watertight seal between the removable seat and valve body and the stem guide shall be integrally cast with the body or screwed into the body.
- C. **Body:** Valves smaller than 3 inches shall have bronze bodies suitable for the intended use with threaded ends conforming to ANSI/ASME B 1.20.1, suitable for a minimum working pressure of 200 psi, and temperature of 250 degrees F, unless otherwise indicated.
- D. **Disc and Stem:** The disc and stem of valves in sizes 3-inch and larger shall be fabricated with bronze or stainless steel. The stem shall have two-point bearings with the downstream bearing fabricated of bronze or other suitable bushings designed to provide smooth operation.
- E. **Disc and Stem:** Valves smaller than 3 inches shall have discs and retaining rings of Teflon, Nylon, or other suitable material, and stems of bronze, brass, or 316 stainless steel suitable for the intended service.
- F. **Seat:** Valves for general service at temperatures up to 250 degrees F shall have bubble-tight shut-off with resilient seats of Buna-N, Teflon, or other suitable material. Valves for steam service and temperatures over 250 degrees F shall have metal-to-metal seating of bronze or stainless steel, as recommended by the manufacturer for the specific service condition. Resilient seats shall be firmly attached to the seating ring by compression-molding or other acceptable method.
- G. **Spring:** Valves in sizes 3-inch and larger shall have 316 stainless steel springs, and valves smaller than 3-inch shall have 316 stainless steel or beryllium copper springs and be suitable for the service. The spring tension of the valves shall be designed for the individual pressure condition indicated for each valve.

2.4 DOUBLE-LEAF CHECK VALVES

- A. **General:** Double-leaf check valves intended for air and gas service and where indicated, shall be of the wafer-type designed to fit between ANSI B16.1 flanges rated at 125-lb. The check valve leaves shall be spring-loaded. Flow from one direction shall cause the valve to open, and upon valve shutoff, the spring shall shut the valve leaves before reverse flow starts and at a point of zero velocity, with non-slam closure. The spring-tension of each valve shall be designed for the individual operating condition.

- B. **Body:** The valve body shall be fabricated of cast iron with integrally-cast seat, rated for minimum 150-lb working pressure at up to 250 degrees F.
- C. **Leaves:** The leaves shall be of bronze, aluminum bronze, or ductile iron, revolving on stainless steel or monel hinge pins with retainers.
- D. **Seat:** The valves shall have resilient seats designed for bubble-tight shut-off suitable for temperatures up to 250 degrees F without sticking. The seats shall be Buna-N, Viton, or other material suitable for the intended purpose. The seat rings shall be firmly attached to the body or disc by compression-molding or proper method.
- E. **Springs:** The springs shall be of Type 316 stainless steel, or inconel and recommended by the manufacturer for use in the service indicated.

2.5 SLANTING DISC CHECK VALVES

- A. **General:** Slanting disc check valves intended for water and sewage service shall have a seating angle of approximately 55 degrees. Valves shall have replaceable seat rings and disc rings. The water passage cross-sectional area shall be equal to the full pipe area. Valves shall have sufficient clearance around the pivot pins to permit free seating of the disc without binding and shall not stick in the closed position. Slanting disc check valves shall have position indicators with electrical signal switches for indication of disc position where indicated and two flanged connections for attachment of dashpots or hydraulic snubbers. The valves shall be designed for a water working pressure of 150 psi, except as otherwise indicated.
- B. **Body:** The valve body shall be fabricated with cast iron conforming to ASTM A 48 or A 126, class B, with flanged ends conforming to ANSI B 16.1, class 125 unless otherwise indicated.
- C. **Disc:** The valve disc shall be designed with an "aerofoil" configuration of cast iron or ductile iron, with bronze seating face, except that valves 10 inches or smaller shall have solid bronze or aluminum bronze discs. Discs shall be partially balanced with a short travel, designed to resist slamming.
- D. **Seat Ring:** The seat ring shall be fabricated with centrifugally cast bronze, aluminum bronze, or stainless steel, with beveled edges, and be firmly clamped or screwed into the valve body.
- E. **Pins:** The pivot pins and bushings shall be fabricated with stainless steel, bronze, or aluminum bronze, designed to allow free movement of the disc without binding.
- F. **Dashpot:** A top mounted hydraulic dashpot shall be provided to control the opening and closing cycle of the valve to prevent surge and water hammer. The dashpot shall have two control flow rates: (1) 90 percent rapid rate and (2) 10 percent slow rate during shutdown and startup. Each rate shall be independently adjustable. The dashpot shall be a self-contained oil system separate and independent from the water line media. The oil reservoir for the closing cycle shall be stainless steel and open to the atmosphere with an air breather cap to prevent oil spillage. The oil reservoir for the opening cycle shall be stainless steel and hermetically sealed to contain pressure (air over oil) and be equipped with a 3-inch diameter pressure gauge and pneumatic fill valve.

2.6 PLASTIC BALL CHECK VALVES

- A. **General:** Plastic ball check valves designed for corrosive fluids, in sizes up to 4-inch, shall be used for vertical upflow conditions only, unless the valves include spring actions.

- B. **Construction:** The valve bodies and balls shall be fabricated with polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polyvinylidene fluoride (PVDF), or polypropylene (PP) and recommended by the manufacturer for the service indicated. Valves shall include unions with socket connections, or flanged ends conforming to ANSI B16.5, class 150. Seals shall have Viton O-rings and valve design shall minimize possibility of the balls sticking or chattering. Valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F.

2.7 PLASTIC SWING CHECK VALVES

- A. **General:** Plastic swing check valves intended for corrosive fluids, in sizes up to 8 inches, may be used for either horizontal or vertical upflow conditions.
- B. **Construction:** Valve bodies and discs shall be fabricated with PVC, PP, or PVDF and recommended by the manufacturer for use in the service indicated. Valves shall have flanged ends conforming to ANSI B16.5, class 150, and flanged top access covers, and shall be designed for positive shut-off at no-flow conditions. Seats and seals shall be EPDM, Teflon, or Viton. PVC valves shall be rated for a maximum non-shock working pressure of 150 psi at 73 degrees F for sizes 3-inch and smaller. For larger sizes and other materials and temperatures the pressure rating will be recommended by the manufacturer for use in the service indicated.

2.8 MANUFACTURERS

- A. Check valves shall be manufactured by the following (or equal):

1. Swing check valves (3-inch and larger):

American-Darling Valve Co.
APCO (Valve and Primer Corp.)
Kennedy Valve Mfg. Co. (ITT Grinnell)
Mueller Company
Stockham Valves and Fittings

2. Swing check valves (2-1/2-inch and smaller):

Milwaukee Valve Company
Stockham Valves and Fittings
Wm. Powell Company

3. Internal spring-loaded check valves (globe-style):

APCO (Valve and Primer Corp.)
CPV (Combination Pump Valve Company)
Miller Valve Co., Inc.
VAL-MATIC (Valve and Manufacturing Corporation)

4. Double-leaf check valves:

APCO (Valve and Primer Corporation) TRW
Mission Manufacturing Company
VAL-MATIC (Valve and Manufacturing Corporation)

5. Slanting disk check valves:

APCO (Valve and Primer Corporation) Crane
Company
VAL-MATIC (Valve and Manufacturing Corporation)
6. Plastic ball valves:

ASAHI-AMERICA
Harrington Industrial Plastics, Inc.
NIBCO Inc. (Chemtrol)
7. Plastic swing check valves:

ASAHI-AMERICA
Harrington Industrial Plastics, Inc.

PART 3 - EXECUTION

3.1 GENERAL

- A. Valves shall be installed in accordance with Section 15100.

**** END OF SECTION ****

SECTION 15106 - BALL VALVES

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing manually-operated ball valves with epoxy coating, operators, and accessories.

1.2 RELATED SECTIONS

- A. The WORK of the following Section 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 15100 - Valves, General

1.3 FACTORY TESTING

- A. Valves shall be tested in compliance with AWWA C507 and Section 15100.
- B. Proof-of-design tests shall be submitted in compliance with Section 15100 for all ball valves size 6-inch and larger.

PART 2 – PRODUCTS

2.1 BALL VALVES (6-INCH AND LARGER)

- A. Construction: Except as otherwise indicated, ball valves in sizes 6-inches and larger shall comply with ANSI/AWWA C 507, with cast iron, ductile iron, or cast steel bodies, support legs or pads, flanged ends, and shall be designed for velocities up to 35 fps, temperatures up to 125 degrees F, and design pressures of 150 psi. The ball shall be fabricated with cast iron, ductile iron, or cast steel, and designed for shaft- or trunnion-mounting, with tight shut-off, single or double seat, and full bore. The valves shall be rubber- or metal-seated, with type 316 stainless steel or monel shafts, and shall include at least one thrust bearing. Ferrous surfaces of valves 6-inches and larger, that will be in contact with water, shall be epoxy-coated conforming to Section 09800.
- B. Operators: Except as otherwise indicated, ball valves shall have manual operators with hand wheel, position indicator, and 2-inch square operating nut. Operators for buried valves and for power operated valves shall comply with Section 15101.

2.2 BALL VALVES (4-INCH AND SMALLER)

- A. General Requirements: Except as otherwise indicated, ball valves in sizes up to 4 inches shall have manual operators with lever or handwheel. Ferrous surfaces of valves where contact with water is indicated shall be epoxy-coated conforming to Section 09800.
- B. Body: Ball valves up to 1-1/2 inches in size shall have bronze or forged brass 2- or 3-piece

bodies with ends threaded and shall be designed for a pressure rating of **not** less than 300 psi. Valves 2- inch to 4-inch in size shall have bronze forged brass or steel 2-or 3-piece bodies with flanged ends and shall be designed for a pressure rating of 150 psi.

- C. Balls: The balls shall be fabricated of solid brass, chrome plated bronze, or Type 316 stainless steel, with full openings.
- D. Stems: The valve stems shall be of the blow-out proof design, and fabricated of bronze or Type 316 stainless steel and shall include reinforced Teflon seals.
- E. Seats: The valve seats shall be of Teflon or Buna-N.

2.3 PLASTIC BALL VALVES

- A. **General Requirements:** Plastic ball valves designed for use with **corrosive** fluids shall be fabricated of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), or polyvinylidene fluoride (PVDF), as recommended by the manufacturer for use in the service indicated. Valves shall have manual operators except as otherwise indicated.
- B. **Construction:** Plastic ball valves shall have union ends or flanged ends conforming to ANSI B 16.5, class 150. Balls shall have full size ports and Teflon seats. Body seals, union O-ring seals, and stem seals shall be Viton. Valves shall be suitable for a maximum **working** pressure of 150 psi at 73 degrees F for PVC.

2.4 MANUFACTURERS

- A. Ball valves shall be manufactured by the following (or equal):

- 1. Ball Valves (6-inch and Larger):

- Grove Valve and Regulator Company
 - McNally Pittsburg, Inc.
 - Henry Pratt Company
 - Willamette Valve, Inc.

- 2. Ball Valves (4-inch and Smaller):

- Jamesbury Corporation
 - Jenkins Bros.
 - Lunkenheimer Flow Control
 - Wm. Powell Company
 - Worcester Controls

- 3. Plastic Ball Valves:

- ASAHI-America, (full port: ½ to 4 inches only)
 - G F Plastic Systems, Inc., (full port: ½ to 2 inches only)
 - NIBCO Inc., (Chemtrol), (full port: ½ to 4 inches only)
 - Spears, (full port: ½ to 6 inches only)

PART 3- EXECUTION

3.1 GENERAL

- A. Valves shall be installed in accordance with Section 15100.

**** END OF SECTION****

SECTION 15109 - GATE VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing epoxy-coated gate valves.

1.2 RELATED SECTIONS

- A. The WORK of the following Section 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 15100 Valves, General

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Buried valves shall be of the inside screw type and shall be designed for repacking under line pressure. Valves 14-inch and larger installed in vertical pipes with stems horizontal shall be fitted with bronze slides, tracks, rollers, and scrapers to assist the travel of the gate assembly. Quick-opening valves shall have quick opening levers and cams in lieu of handwheel operators. Where other operators are indicated, comply with Section 15101. Ferrous surfaces of the valves, 4-inch and larger and in contact with water shall be epoxy-coated conforming to Section 09800.

2.2 METAL-SEATED GATE VALVES (3-INCH AND LARGER)

- A. **Double-Disc Type:** Metal-seated gate valves for water service shall conform to ANSI/AWWA C 500. Valves shall be of the double-disc type with non-rising stem, opening counter-clockwise, and provided with a 2-inch square operating nut or handwheel, as indicated, except where operators are shown. Valves shall have flanged or mechanical joint ends.
- B. **Solid Wedge Type:** Gate valves for other than water service shall be of the iron-body, bronze-mounted, solid wedge type and shall conform to the double-disc type except as otherwise indicated.

2.3 KNIFE GATE VALVES

- A. Knife gate valves shall include raised faces and resilient seats for positive seating. Wetted parts shall be constructed of Type 316 stainless steel. Gates shall be finish-ground on both sides and shall prevent packing or seat damage. Valves 2 to 4 inches in size shall include cast stainless steel bodies; valves 6 to 24 inches in size shall include cast semi-steel bodies with stainless steel linings. Valve ends shall be flanged or wafer design, as indicated. Gate guides and jams shall be steel. Actuator shall be hand wheel operated. Port design shall be full-flow.

2.4 RESILIENT-SEATED GATE VALVES (3-INCH AND LARGER)

- A. Resilient-seated gate valves conforming to ANSI/AWWA C509 may be provided, in lieu of metal-seated double disc or solid disc gate valves. Resilient-seated gate valves shall have cast iron bodies with flanged, bell, or mechanical joint ends, rubber-coated cast iron disc, flanged bonnet, bronze stem, O-ring seals, and operators with hand wheel or square nut except as otherwise indicated.

2.5 GATE VALVES (SMALLER THAN 3-INCH)

- A. **Construction:** Gate valves, smaller than 3 inches, shall be heavy duty type for industrial service, with threaded or soldered ends. The bodies shall have threaded tops or union bonnets, fabricated of bronze conforming to ASTM B-62, with bronze stems, solid wedges, metal hand wheels, and Teflon-impregnated packing. Buried valves shall have non-rising stems. Exposed valves (above ground) shall have rising stems. Valves shall have a minimum pressure rating of 125 psi steam, or 200 psi cold water except as otherwise indicated.

2.6 MANUFACTURERS

- A. Products of the type or size indicated shall be manufactured by one of the following (or equal):

- 1. Metal seated gate valves (3-inch and larger):

- American-Darling Valve Co.
- Clow Corporation
- Kennedy Valve Mfg. Co. (ITT Grinnell)
- Milwaukee Valve Company
- Mueller Company
- Stockham Valves and Fittings

- 2. Knife gate valves:

- DeZurik Corporation
- Fabri-Valves
- Kennedy Valve Mfg. Co., (ITT Grinnell)
- Rovang, Inc.

- 3. Resilient-seated gate valves:

- A-C Valves, Inc.
- Clow Corporation
- Kennedy Valve Mfg. Co., (ITT Grinnell)
- Mueller Company
- Stockham Valves and Fittings

- 4. Gate valves (smaller than 3-inch)

- Crane Company
- Milwaukee Valve Company
- Wm. Powell Company
- Stockham Valves and Fittings

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Gate valves shall be installed in accordance with Section 15100.

**** END OF SECTION ****

SECTION 15110 - PLUG VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing plug valves with operators, protective coatings, and lubricating guns.

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 09800 Protective Coating
2. Section 15100 Valves, General

1.3 FACTORY TESTING

- A. **Product Testing:** Products shall be tested at the factory for compliance with the indicated requirements and as follows:
1. An independent testing laboratory shall conduct proof-of-design testing on valves 12-inch diameter and greater in accordance with AWWA C 504, Section 5, except that where the word "disc" appears in the standard, it is understood to mean "plug."
- B. **Witnesses:** The OWNER and the CONSTRUCTION MANAGER (at the option of either) reserve the right to witness factory tests.
- C. **Results:** Proof-of-design test results shall be submitted in compliance with Section 15100.

PART 2 -- PRODUCTS

2.1 LUBRICATED PLUG VALVES

- A. **Equipment Requirements:** Lubricated plug valves shall be of the tapered-plug type, worm-gear operated for sizes 4-inch and larger, with flanged ends and lever-operated for sizes 2-1/2-inch and smaller, with threaded ends, except as otherwise indicated. Valve bodies and plugs shall be fabricated of cast iron. Where not otherwise indicated, valve components shall be designed and fabricated to resist corrosion and wear due to friction and shall be recommended by the manufacturer for use in the service indicated.
- B. **Surface Coating:** Surfaces of the plugs shall be coated with a dry film lubricant (polyfluoride or equal) permanently bonded to the surfaces. Ferrous surfaces of valves, 4-inch and larger, in contact with process fluid, shall be epoxy-coated conforming to Section 09800.
- C. **Internal Sealants:** Valves shall include fittings designed to permit application of a sealant through a check valve in the stem, or through a stainless steel tube for worm-gear operated valves.

The design shall include ducts or grooves to ensure maintenance of a closed pressurized sealant system between contact surfaces of moving parts. Plugs shall be held toward seats by factory-adjusted gland assemblies set for proper sealing and operating torque. Gland assemblies shall be adjustable from the valve exteriors utilizing either spring washers or gland deflection to allow plug unseating when pressurized sealant is injected.

- D. **Valve Bodies and Plugs:** Valve bodies and plugs shall have smoothly finished water passages free from sharp corners when plugs are in the wide-open position. Valves for grit slurry service shall have stainless steel balancing springs and shall have a minimum port area of at least 89 percent of the connected piping area in the open position. Worm-gear operators shall be enclosed in watertight and dust-tight grease-packed cases, with position indicators. Valves, of sizes up to and including 24-inch, shall be designed for a minimum water-working pressure of 150 psi and larger valves shall be designed for a minimum water-working pressure of 120 psi except as otherwise indicated.
- E. **Lubricating Guns:** The WORK includes manual lubricating guns for lubricated plug valves in sizes up to 6 inches and for larger valves, pneumatically operated lubricating guns. The guns shall be manufactured by the valve manufacturer and shall be equipped with flexible connectors, pressure gauges, and safety valves, with operating instructions, furnished in labeled tool boxes. Two lubricating guns of each type shall be provided.

2.1 ECCENTRIC PLUG VALVES

- A. **Equipment Requirements:** Eccentric plug valves shall be of the non-lubricated eccentric type with cast iron bodies, resilient faced plugs, or shall include replaceable, resilient seat in the body. Except as otherwise indicated, all valves for sizes 4-inch and larger shall have worm gear operators, nickel or stainless steel seats, and ANSI 125 psi flanged or grooved ends. Valves 2-1/2 inches and smaller shall have operating levers, nickel or stainless steel seats, and threaded ends with resilient facing suitable for the intended service. Submerged and buried valves shall be equipped with worm-gear operators, lubricated and sealed to prevent entry of dirt and water into the operator. Shaft bearings shall be stainless steel furnished with permanently-lubricated bearing surfaces. Operators shall clearly indicate valve position. Valves up to and including 20 inches in size shall have an unobstructed port area of not less than 80 percent of full pipe area, and not less than 70 percent for larger valves. Eccentric plug valves shall have a pressure rating of not less than 150 psi water, oil, or gas (WOG) service and bubble-tight shut-off.
- B. **Surface Coating:** Ferrous surfaces of valves 4 inches and larger in contact with process fluid shall be epoxy-coated conforming to Section 09800.

2.2 MANUFACTURERS

- A. Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):

- 1. Lubricated Plug Valves (General Service):

Wm. Powell Company
Nordstrom Valves, Inc.
Serck Audco
Worcester Controls

2. Eccentric Plug Valves:

DeZurik Corporation
Keystone, Drum-Owens, (Homestead)
Victualic Company of America

3. Lubricated Plug Valves (For Grit Slurry Service):

Nordstrom Valves, Inc., (Model 50169)
Serck Audco Valves, (Model MRW 133 GGS)

PART 3 – EXECUTION

3.1 INSTALLATION

A. **General:** Valves shall be installed in accordance with Section 15100.

B. **Eccentric Plug Valves:** Except as otherwise indicated, the installation of eccentric plug valves in sewage, sludge, or other liquid systems containing solids, silt, or fine sand shall comply with the following:

1. Valves shall be installed with the stem in the horizontal position.
2. In horizontal piping, the plug shall swing upwards when opening to permit flushing out of solids.
3. The flow direction through the installed valve shall be such that the valve body cannot fill up with incoming solids when the valve is closed.
4. Valves where closure for extended periods is indicated (stand-by, bypass, or drain lines), and valves where reversed flow is indicated (higher pressure on downstream side forcing the plug away from its seat) shall include worm gear operators for sizes 4 inches and larger.

** END OF SECTION **

SECTION 15113 - AIR RELEASE AND VACUUM VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing air release and vacuum valves as indicated, complete and operable, including accessories and drain connections.

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 15100 Valves, General

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Air and Vacuum Valves:** Air and vacuum valves shall be capable of venting sufficient quantities of air as determined by the manufacturer's approved sizing methods, while pipelines are being filled and allowing air to re-enter while pipelines are being drained. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated.
- B. **Air-Release Valves:** Air-release valves shall vent accumulating air while system is in service and under pressure and be of the size indicated and shall meet the same general requires as specified for air and vacuum valves except that the vacuum feature will not be required. They shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated.
- C. **Combination Air Valves:** Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting sufficient quantities of air, as determined by the manufacturer's approved sizing methods, while a system is being filled or drained, respectively. They shall have the same general requirements as specified for air and vacuum valves.
- D. **Sewage Air Release Valves:** Sewage air release valves shall vent accumulating gases during system operation. They shall have long float stems and bodies to minimize clogging. The same general requirements shall apply as specified for air and vacuum valves. Each sewage air release valve shall be furnished with the following backwash accessories, fully assembled on the valve:
 - 1. Inlet shut-off valve
 - 2. Blow-off valve

3. Clear water inlet valve
4. Rubber supply hose
5. Quick disconnect couplings

2.2 MANUFACTURERS

- A. Products shall be manufactured by one of the following (or equal):
 1. APCO (Valve and Primer Corporation)
 2. Crispin (Multiplex Manufacturing Company)

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Air release and vacuum valves shall be installed at high points in piping systems and where indicated.
- B. All valves shall be installed in accordance with the manufacturer's printed recommendations.
- C. All air and vacuum release valves shall have piped outlets to the nearest acceptable drain, firmly supported, and installed in such a way as to avoid splashing and wetting of floors.

**** END OF SECTION ****

SECTION 15114 - PRESSURE REGULATING VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing pressure regulating valves indicated, complete and operable, with all accessories.

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 15100 Valves, General

PART 2 -- PRODUCTS

2.1 PRESSURE REGULATING VALVES (1-1/2 INCHES AND SMALLER)

- A. **General:** Small air and water pressure regulating valves shall be of the spring-loaded diaphragm type with a minimum pressure rating of 250 psi, with bronze body, nickel alloy or Type 316 stainless steel seat, and threaded ends. Each valve shall be furnished with built-in or separate 316 stainless steel strainer and union ends.

2.2 WATER PRESSURE REGULATING VALVES (LARGER THAN 1-1/2 INCHES)

- A. **General:** Large water pressure regulating valves shall be of the piston-type or diaphragm-actuated globe type, with cast iron body and stainless steel trim. Unless otherwise indicated, the valves shall have a pressure rating of not less than 150 psi, shall have 125-lb flanges, and shall have an adjustable downstream pressure range with a downstream setting as required.

2.3 MANUFACTURERS

- A. Products shall be manufactured by one of the following (or equal):
 - 1. Small pressure regulating valves:
 - A.W. Cash Valve Mfg. Corp.
 - Watts Regulator Company
 - Wilkins Regulator (A Division of Zurn Industries)
 - 2. Large pressure regulating valves:
 - Cla-Val Company
 - Golden-Anderson Valve Division (G A Industries, Inc.)

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Pressure regulating valves shall be installed in accordance with the manufacturer's written instructions.

**** END OF SECTION ****

SECTION 15115 - MISCELLANEOUS VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing miscellaneous valves as indicated, complete and operable, including accessories and operators.

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 15100 Valves, General

PART 2 -- PRODUCTS

2.1 BACKFLOW PREVENTER VALVES

- A. **General:** Backflow preventers shall work on the reduced pressure principle. They shall consist of 2 spring-loaded check valves, automatic differential pressure relief valve, drain valves, shut-off valves as well as test ports at each pressure chamber. The body material shall be bronze or cast iron for a working pressure of not less than 150 psi, with bronze or stainless steel trim. Drain lines with air gaps shall be provided.

2.2 SEWAGE SURGE RELIEF VALVES

- A. **Operating Requirements:** The valve shall open immediately when the system pressure exceeds the load setting 50 psi of the counterweights and shall close slowly at an adjustable speed upon return of system pressure to normal.
- B. **Valve Body:** Sewage surge relief valves shall be constructed of a heavy cast-iron or cast- steel body with a welded steel disc having rubber seating face, a non-corrosive shaft for attachment of counterweight arms and lever, and complete non-corrosive cushion chamber.
- C. **Cushion Chamber:** The cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any hammering action. The cushioning shall be by oil stored in an oil reservoir attached by piping and fittings to the cushion chamber. The cushion chamber shall be so arranged that the closing speed will be adjustable to meet the service requirements.

2.3 TEMPERATURE AND PRESSURE RELIEF VALVES

- A. **Valve Construction:** Temperature and pressure relief valves for cold and hot water, steam, and air service, unless otherwise indicated, shall have a minimum pressure rating of 250 psi, bronze, steel, or stainless steel bodies, adjustable spring action, screwed or flanged connections, and trim to suit individual applications. They shall be set for each specific condition.

2.4 CORPORATION STOPS

- A. Unless otherwise indicated, corporation stops shall be made of solid brass for key operation, with screwed ends with corporation thread or ironpipe thread, as required.

2.5 PINCH VALVES

- A. Pinch valves shall be of the manually, electrically, pneumatically or hydraulically operated type, as indicated. The valves shall have flanged, split cast iron bodies with ANSI Class 125 lb rating, unless otherwise indicated. The sleeves shall be of the best elastomer recommended for the specific application.

- 1. Pinch check valves for in-line service shall have split cast iron bodies with ANSI Class 125 lb flanged ends and elastomer sleeves best suited for the application. Check valves for end-of-line service shall be of all elastomer construction with single flanges.

2.6 MANUFACTURERS

- A. Products of the type or model indicated shall be manufactured by one of the following (or equal):

- 1. Backflow preventer valves

Cla-Val Company
Febco
Hersey Products, Inc.

- 2. Sewage surge relief valves

APCO (Valve and Primer Corporation)
Golden-Anderson Valve Division (G A Industries, Inc.)
Empire Specialty Co., Inc.

- 3. Temperature and pressure relief valves

A.W. Cash Valve Mfg. Corp.
Consolidated (Dresser Industries Valve Division)
Watts Regulator Company

- 4. Corporation stops

Ford Meter Box
Company James Jones
Company Mueller
Company

- 5. Pinch valves

Red Valve Company, Inc. RKL
(Robbins & Myers)

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Backflow preventers shall be installed in potable water lines where required by applicable codes or regulations, or wherever there is any danger of contamination, and where indicated.
- B. All valves shall be installed in accordance with the manufacturer's printed recommendations.
- C. All backflow preventers shall have piped outlets to the nearest acceptable drain, firmly supported, and installed in such a way as to avoid splashing and wetting of floors.

**** END OF SECTION ****

SECTION 15150 - METERS, GENERAL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing general requirements for meters and flow measurement devices with associated instrumentation and controls designed for indicated functions including flow measurement, density determination, and batch metering of water, wastewater, chemicals, gases, and sludges.

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 11000 Equipment General Provisions
2. Section 15000 Piping Components

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

- | | | |
|-----|-----------------------|---|
| 1. | ISA - S 5.1 | Instrumentation
Symbols and Identification |
| 2. | ANSI - B16.1 | Cast Iron Pipe Flanges and Flanged Fittings, Class 25,
125, 250, and 800 |
| 3. | ANSI/AWWA C207 | Steel Pipe Flanges for Waterworks Service - Sizes 4 In
Through 144 In. |
| 4. | ANSI/AWWA C701 | Cold-Water Meters - Turbine Type for Customer Service |
| 5. | ANSI/AWWA C702 | Cold-Water Meters - Compound Type |
| 6. | AWWA C704 | Cold-Water Meters - Propeller Type for Main Line
Applications |
| 7. | ASTM A 126 | Specification for Gray Iron Castings for Valves, Flanges,
and Pipe Fittings |
| 8. | ASTM B 61 | Specification for Steam or Valve Bronze Castings |
| 9. | ANSI/AWWA C110/A21.10 | Ductile-Iron and Gray-Iron Fittings, 3-In Through 48-In,
for Water and Other Liquids |
| 10. | ASME REPORT | Fluid Meters, Sixth Edition, 1971 |

1.4 SHOP DRAWINGS AND SAMPLES

1. Manufacturer's product data including catalogue cuts.
2. Shop drawings showing details and dimensions.
3. List of special tools.
4. Schedule of meter identifications and locations.

1.5 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL.

1. Certified performance data including curves showing flow and pressure drop.
2. Manufacturer's installation instructions.
3. Manufacturer's maintenance and operating instructions.
4. Manufacturer's certification that meters comply with published accuracies for the flow ranges indicated.
5. Certification that meters have been field-calibrated, under flow conditions.

1.6 INSPECTION, TESTING AND ACCURACY

- A. **Inspection and Testing:** The manufacturer shall provide a knowledgeable factory service representative to inspect and test meters for proper performance and installation and field calibrate meters under flow conditions.
- B. **Accuracy:** Except as otherwise indicated, flow meters shall be designed and fabricated for an accuracy of plus or minus 2 percent of actual flow throughout the range indicated. Density measuring devices shall have an accuracy within plus or minus 2 percent of actual solids content over the range indicated.

1.7 SERVICES OF MANUFACTURER

- A. **Inspection, Startup, and Field Adjustment:** An authorized service representative of the manufacturer shall visit the site for not less than 2 days to furnish the indicated services.
- B. **Instruction of OWNER'S Personnel:** The authorized service representative shall also furnish the indicated services for instruction of the OWNER'S personnel in the operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment for not less than one day.

PART 2 -- PRODUCTS

2.1 SPECIAL TOOLS

- A. The WORK includes special tools recommended by the manufacturer and one extra steel spool for each size of meter. Spools shall be labeled and shall show meter identification, size and service.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Meters shall be installed in accordance with the manufacturer's installation instructions.
- B. Meters shall be installed in easily accessible locations and oriented for ease of reading and maintenance, and, where shown, for balancing of flow. Wherever possible, meters shall be installed 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 TESTING

- A. Equipment shall be prepared for operational use in accordance with manufacturer's instructions after field calibration. The OWNER and the CONSTRUCTION MANAGER (at the option of either) reserve the right to observe field calibration.
- B. Meters shall be field tested at no less than 3 flow conditions over the total range of capability of the equipment. Where applicable, tests shall be conducted in accordance with the Test Code of the Standards of the Hydraulic Institute.

**** END OF SECTION ****

SECTION 15156 - MAGNETIC FLOW METERS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing magnetic flow meters designed and fabricated for continuous operation with minimum error due to pipe deposits.

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 15150 Meters, General

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

- 1. MIL STD 456662A Calibration System Requirements

PART 2 -- PRODUCTS

2.1 MAGNETIC FLOW MEASURING SYSTEMS

- A. **Magnetic Flowmeter Systems:** Magnetic flowmeter systems shall be of the low frequency electromagnetic induction type and produce a DC pulsed signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flowmeter system. Each magnetic flow metering system shall include a metering tube, signal cable, transmitter and flowmeter grounding rings.
- B. **Metering Tube:** The metering tube shall have the following attributes:
 - 1. Be constructed of ASTM A 316 stainless steel with flanged connections
 - 2. Utilize a minimum of 2 bullet-nosed, self-cleaning electrodes
 - 3. Include a liner in conformance with the manufacturer's recommendation for the intended service
 - 4. Have electrodes constructed of materials which are in conformance with the manufacturer's recommendation for the intended service
 - 5. Have housing rated for NEMA 6 submergence conditions and be coated with epoxy paint

- C. **Ground Rings:** Magnetic flow meters shall have 2 grounding rings which are in conformance with the manufacturer's bore and material recommendation for the intended service. Grounding rings shall be designed to protect and shield from process abrasion the liner edge interface at the metering tube end.
- D. **Transmitter:** The microprocessor-based signal converter/transmitter shall have the following attributes:
1. Utilize DC pulse technique to drive flux-producing coils
 2. Convert DC pulse signal from the tube to a standardized 4-20 mA signal into a minimum 700 ohms
 3. Include a 6 digit LCD display for flowrate, percent of span, and totalizer
 4. Include an operator interface consisting of keypads which respond to English text entry
 5. Feature an integral zero return to provide a consistent zero output signal in response to an external dry contact closure
 6. Be capable of measuring flow in both directions
 7. Integral low flow cutoff and zero return
 8. Automatic range change
 9. Programmable parameters including meter size, full scale Q, magnetic field frequency, primary constant, time constant
 10. Data retention for a minimum of 5 years without line or battery power
 11. Self diagnostics and automatic data checking
 12. Protected terminals and fuses in a separate compartment which isolates field connection from electronics
 13. Utilize "Smart" technology which employs a hand-held configuration terminal and outputs a digital flow signal superimposed on 4-20 mA signal that complies with the HART protocol.
 14. Can tolerate ambient temperature operating limits of -20 to 140 degrees Fahrenheit (-29 to 60 degrees C)
- E. **Signal Cable:** Signal cable shall be the manufacturer's standard cable for the intended application.
- F. **Performance:** The flow metering system shall conform to the following technical specifications: Time constant= 0.5 to 1000 seconds; galvanic or optic isolation: Accuracy: 0.25% of flow rate from 10 to 100% full scale for velocities over 3 fps: Repeatability: 0.25% full Scale: Power consumption: 30 watts or less: Power Requirements: 120 VAC, \pm 10%:

2.3 CALIBRATION

- A. Each flow metering system shall be hydraulically calibrated at a facility which is traceable to the National Institute of Standards and Technologies. The calibration procedure shall conform to the requirements of MIL-STD-45662A. A real-time computer generated printout of the actual calibration data indicating apparent and actual flows at 20 percent, 40 percent, 60 percent, 80 percent, and 100 percent of the calibrated range shall be submitted to the CONSTRUCTION MANAGER at least thirty (30) days prior to shipment of the meters to the project site.

2.4 MANUFACTURERS

- A. Meters shall be manufactured by one of the following (or equal):
 - 1. Fischer & Porter
 - 2. Foxboro
 - 3. Johnson Yokagawa
 - 4. Krohne

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Magnetic flow meters shall be installed in accordance with the manufacturer's installation instructions and Section 15150.
- B. Meters shall be properly grounded to the adjacent pipe where indicated to ensure full pipe grounding.

**** END OF SECTION ****

SECTION 15172 - MASS FLOW GAS METERS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing thermal dispersion type mass flow meters.

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 15150 Meters, General

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Operation:** The mass flow meters shall be designed to operate continuously on the thermal dispersion principle, at flow rates within rated range.

2.2 CONSTRUCTION

- A. **Sensor:** The mass flow meter shall be of the single insertion probe type. The insertion probe shall have flanged or one-inch screwed connections, to be installed through a packing gland and a ball valve. The packing gland shall have a 1-1/4-inch NPT connection, a packing compression collar, and a split ring locking collar. The sensor shall sense mass flow and automatically compensate for all specific changes in temperature and pressure. The sensor shall consist of two matched platinum resistance temperature detector (RTD) elements, one heated and the other passive, sheathed in a gold brazed Type 316 stainless steel insertion assembly. The gas flow shall pass directly over sheathed elements without the need for a tortuous path. The sensor probe assembly shall be mounted in an enclosure, approved for Class 1, Groups C and D hazardous areas.

- B. **Characteristics:** The meter shall have the following characteristics:

1. Accuracy - plus or minus 1 percent (at 30 degree F)
2. Repeatability - plus or minus 1 percent of full scale
3. Turndown ratio - 100:1 (max)
4. Signal output - 4-20 mA, 600 ohms max. load
5. Power input - 115 VAC, plus or minus 15 VAC, 16 watts max.
6. Pressure rating (psi) - up to 1000 psig

- 7. Probe temperature rating - minus 50 to plus 330 deg. F (probe)(deg. F)
- 8. Accuracy - plus or minus one percent of full scale
- 9. Gas flow velocities - 0.5 to 200 feet per second

C. **Electronics:** The electrical components shall be in a NEMA 4X Class 1, Groups C and D explosion-proof enclosure, with flow indicator and totalizer, Factory Mutual and CSA approved for hazardous locations. The electronics shall read flow in SCFM with digital display. The unit shall be adjustable in the field for span and zero to narrow the output range.

D. **Materials:** All wetted parts of the sensor assembly shall be made of Type 316 stainless steel with nickel braze Hastelloy C with gold braze. Electronic enclosures shall be fiberglass, Type 316 stainless steel for NEMA 4, or cast iron or aluminum for explosion-proof designations.

E. **Calibrator:** The CONTRACTOR shall furnish one calibrator. The calibrator shall plug into the main circuit board in lieu of the sensor probe and shall provide simulation of the differential resistance signal produced by the flowmeter's sensor.

2.3 MANUFACTURERS

A. Mass flow meters of the type indicated shall be manufactured by one of the following (or equal):

- 1. FCI Fluid Components, Inc., model LT 81A
- 2. Kurz Instruments, Inc., series 565

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** Mass flow meters and equipment shall be installed in accordance with the manufacturer's written instructions.

B. All probes shall be side-mounted in a horizontal or downward flow sloping pipe, with 20 pipe diameters of straight approach and 10 pipe diameters of straight pipe downstream. An efficient moisture separator shall be installed upstream of the meter.

** END OF SECTION **

SECTION 15178 - ULTRASONIC LEVEL METERS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing ultrasonic meters complete with sensor mounting hardware and transmitter to measure liquid levels.

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 13300 Instrumentation and Control
 - 2. Section 15150 Meters, General

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Basic Design:** The meter shall be a noncontact, ultrasonic echo-time measuring device, suitable for 120 volt, 60 hertz power supply. It shall consist of a piezoelectric transducer element assembly and a remote transmitter unit interconnected by manufacturer-supplied coaxial cable.

2.2 OPERATION

- A. The system shall utilize 1500 volt peak minimum energy level on the transducer and shall be suitable for measuring liquid surfaces from 2 to 35 feet below the transducer. The meter shall incorporate a reference reflector to provide instantaneous sound velocity compensation and it shall utilize microprocessor circuitry to process echo times for elimination of stray echoes and, where indicated, to provide linearization functions.
- B. The ultrasonic level meter shall produce a narrow beam angle of not more than 7 degrees total included angle. The ultrasonic sensor system shall have temperature compensation circuitry operable over the range of minus 40 degrees C to plus 50 degrees C. The sensor shall be unaffected by condensation and, if required, shall be provided with an integral heater. The transmitter shall be housed in a NEMA 4X enclosure, have a six digit display for level and "echo-lost" indication, and shall produce a 4-20 mA output signal into 800 ohms, maximum. The entire system shall be accurate within plus or minus 0.1 foot of true liquid level.

2.3 MOUNTING

- A. The meter shall be provided with flange or pipe mounting accessories as indicated for the particular installation conditions.

2.4 MANUFACTURERS

- A. Products of the type or model indicated shall be manufactured by one of the following (or equal):

1. TN/Manning
2. Milltronics, Inc.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** Ultrasonic level meters shall be rigidly mounted approximately 2 feet above maximum liquid level and accurately leveled in accordance with the manufacturer's written instructions.

3.2 FIELD TESTING

- A. Field calibration and testing of the meters shall be performed as indicated in Section 13300 for Instrumentation and Control.

**** END OF SECTION ****

SECTION 15250 - PIPE AND EQUIPMENT INSULATION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing pipe and equipment insulation for cold and hot piping, exhausts, flues, and equipment, to prevent heat loss or heat gain and injury to personnel upon contact.

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 09800 Protective Coating
2. Division 2 and 15, as applicable Piping

1.3 CODES

- A. The 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 Building Code
2. Uniform Mechanical Code
3. Uniform Plumbing Code
4. Uniform Fire Code
5. National Electrical Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. Federal Standards:

- | | |
|----------------------|---|
| FEDSPEC L-P-535E | Plastic Sheet (Sheeting) "Plastic Strip" Poly (Vinyl Chloride) and Poly (Vinyl Chloride-Vinyl Acetate), Rigid |
| FEDSPEC HH-I-558B(3) | Insulation, Blocks, Boards, Blankets, Felt Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type) |

2. Commercial Standards:

- | | |
|------------|---|
| ASTM B 209 | Aluminum and Aluminum-Alloy Sheet and Plate |
| ASTM C 533 | Calcium Silicate Block and Pipe Thermal Insulation |
| ASTM C 547 | Specification for Mineral Fiber Preformed Pipe Insulation |

1.5 SHOP DRAWINGS AND SAMPLES

- 1. Shop drawings of all thermal insulation, with manufacturer's data on materials, covering, jackets, and finish.

1.6 QUALIFICATIONS

- A. **Installer:** Authorized installer of manufacturer.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The CONTRACTOR shall insulate all indicated surfaces.
- B. All components of the insulation, including covering, mastics and adhesives shall have a flame-spread rating of not over 25, and a smoke development rating of not over 50. Ratings shall be as established by tests in accordance with ASTM E 84 and Federal Specification standards. The integrated insulation assemblies shall also conform to the above specifications. Insulation shall be applied in strict accordance with the manufacturer's instructions.

2.2 BASIC MATERIALS

- A. **Standard Insulation:** This type of insulation shall be employed for process, cold-and hot water, steam, and condensate piping and equipment with surface temperatures up to 850 degrees F. Pipe insulation and jacketing shall be applied to piping where indicated, and shall include fittings, flanges and valves. Pipe insulation shall be molded-type pipe covering, made of fibrous glass with a minimum k-factor of 0.23 at 75 degrees F mean temperature. Unless otherwise indicated the insulation thickness shall be as follows:

	Minimum Thickness of Insulation (inches)
1. Pipe Insulation:	
Hot and cold water (domestic) - 6 inches and smaller	1
Hot and chilled water process - 6 inches and smaller	1-1/2
8 inches and large	2
Low pressure steam (50 psi and less) - 8 inches and less	2
Condensate, boiler blowdown, and boiler feed - 8 inches and less	1-1/2
Heated sludge and process piping - 6 inches and smaller	1

Minimum Thickness of Insulation
(inches)

8 inches and larger	1-1/2
Heat traced piping -	
3 inches and smaller	1
4 inches and larger	1-1/2
2. Equipment and Tanks:	
Boilers, heaters and manufactured equipment -	as recommended by manufacturer
Heat exchangers, tanks, and vessels -	3

B. The insulation shall be oversized for installation over electric heating cable. Insulation shall have a factory-applied white fire-retardant vapor-barrier jacket of kraft paper and aluminum foil laminated together and reinforced with fiber glass yarn. Fittings and valves shall be covered with the same material as the pipe, cut in segments to fit snugly without open spaces, held in place with copper wire or cement, and then covered with the same jacketing material as the pipe. Insulated fittings adjacent to vapor-barrier insulation shall be sealed with an acceptable vapor-barrier cement before installation of the finish jacket. Pipe insulation and vapor-barrier shall be continuous through hangers and supports. Insulation shall be coordinated with the pipe hangers and supports and where insulation protection shields are provided the top half section of pipe insulation at support locations shall be of the same specified density, and the bottom half insulation segments provided between the pipe and the insulation protection shields shall have a density of not less than 6 lb/cu ft. All insulation shall be covered with smooth aluminum weatherproof metal or plastic preformed jacketing with a factory-attached moisture barrier. The jacket for the fittings shall consist of precision-formed smooth-sided sections and shall be sized to cover and protect the insulated fitting. Each section shall be manufactured from aluminum or PVC, in accordance with ASTM B 209 and Federal Standard L-P-535E, and all joints shall be sealed with silicon mastic or solvent welding, to provide a continuous air and weathertight joint. Strapping shall be 1/2-inch wide, Type 3003 aluminum or stainless steel.

C. **High Temperature Insulation:** This type of insulation shall be employed for engine exhaust pipes, flues, and similar pipes and equipment with surface temperatures up to 1200 degrees F. The entire engine exhaust system shall be covered with insulation of a non-combustible type and enclosed with an aluminum jacket. The high temperature insulation shall consist of 4-inch thick calcium silicate or similar pre-molded blocks in accordance with ASTM C 533 and Federal Specification HH-I-558B(3) with a minimum k-factor of 0.14, in two layers of 2-inch thickness, each, with staggered joints, all applied over a 3/4-inch high metal rib lath, or a 4-in thick, Fibrex FBX-MF 1200 pipe insulation, or equal, and held in place with stainless steel banding and covered with a 0.016 or 0.020-in aluminum jacket. The inner layer shall be suitable for 1200 degrees F, and the second layer for 1000 degrees F. All bends, voids, joints, fittings and other parts of the piping system shall be filled with insulating cement. 316 Stainless steel lagging with preformed 316 stainless steel fittings shall be banded to the insulation in a similar fashion as specified for standard insulation. Allowance shall be made for thermal expansion.

2.3 MANUFACTURERS

A. Insulation of the type indicated shall be manufactured by one of the following (or equal):

1. Armstrong World Industries, Inc.
2. Certain-Teed Corporation
3. Manville
4. Owens-Corning Fiberglas Corp.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** All insulation shall be installed by a qualified insulation contractor in strict accordance with the manufacturer's recommendations.

**** END OF SECTION ****

SECTION 15400 - PLUMBING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: All plumbing, including:
 - 1. Waste and vent system inside and outside the building including connections, new installation, indirect drains, temporary connections, etc..
 - 2. Plumbing fixtures, carriers, supports, trim, accessories, etc..
 - 3. Record drawings.

- B. Related work specified elsewhere:
 - 1. Electrical work.
 - 2. Concrete work.
 - 3. Painting.
 - 4. Structural work.
 - 5. Landscape sprinkler work.
 - 6. Air conditioning work, except as noted.
 - 7. Architectural work.

1.02 GENERAL REQUIREMENTS

- A. Base bids shall be submitted in accordance with Drawings and Specifications. Should the bidder consider substitutions advantageous to the Owner's interest, the proposed substitutions shall be included in an alternate to the base bid and the price difference indicated for each separate item.

1.03 SITE INSPECTION

- A. Before submitting bids, each bidder shall familiarize himself with the conditions at the site under which he will be required to operate in performing his part of the Contract, including verifying all utilities, and stub-outs and no allowances will be

made subsequently to the Contractor for any error through negligence in observing the site conditions.

1.04 ORDINANCES, REGULATIONS AND CODES

- A. The installation shall comply with all of the latest applicable ordinances, regulations and codes of any governmental agency having jurisdiction, including, but not limited to, the State Fire Marshal, Division of Industrial Safety, National and California Electric Code, the governing Plumbing, A.D.A., Health Department and Building Code and the California Energy Conservation Commission.
 - 1. Nothing in these Drawings and Specifications is to be construed to permit work in violation thereof. Regulations and codes are to be construed as minimum requirements.
- B. No extras will be permitted for furnishing items required by the serving utilities and local codes but not specified or shown on the Drawings.
- C. Rules and interpretations of the enforcing agencies shall be considered as part of the local codes.
- D. The responsibility of the Architect and Engineer to conduct construction review of the Contractor's performance is not intended to include the adequacy of the Contractor's safety measures in, on or near the construction site.

1.05 PERMITS, FEES AND INSPECTIONS

- A. Obtain and pay for all necessary permits, fees, assessments and complementary drawings and calculations required by any legally constituted public authorities having jurisdiction, unless otherwise noted. Arrange and pay for any required inspections or examinations and deliver certificates of such inspections to the Architect and Engineer.

1.06 DRAWINGS AND SPECIFICATIONS

- A. The Engineer's decision will be final on interpretation of the Drawings and Specifications.
- B. The Drawings and Specifications are complementary and any work called for on the Drawings and not mentioned in the Specifications, or vice versa, shall be performed as though fully set forth in both.
- C. Should there appear an error or discrepancy in or between the Drawings and

Specifications, the Contractor shall refer the matter to the Engineer for adjustment before proceeding with the work. Should the Contractor proceed with the work without so referring the matter, he does so on his own responsibility and at his own expense.

D. Drawings are diagrammatic.

1.07 SUBMITTALS

A. Before starting work, the Contractor shall furnish to the Architect six bound sets of dimensioned Shop Drawings and itemized equipment lists, complete in all details, which he proposes to install. All items shall be submitted at the same time. These submittals will be checked by the Engineer and returned to the Contractor within a reasonable length of time after receipt of same by the Architect.

B. Copies, returned to the Contractor will be reviewed with no exceptions taken, with exceptions noted thereon or will call for resubmittals. The Contractor shall make all corrections noted, resubmit if indicated before commencing the work involved.

C. Submittals shall include, but not necessarily be limited to the following:

1. Access panels.
2. Hangers and supports.
3. Insulation.
4. Pipe and fittings.
5. Pipe isolators.
6. Plumbing fixtures, fittings, trim, drains, etc.
7. Roof flashing.
8. Sleeves and escutcheons.
9. Valves.
10. Cleanouts.

D. In the event that the Contractor installs equipment or materials in a manner not

acceptable to the Architect and Engineer without having first submitted shop drawings and equipment list for approval, any changes which are required shall be made at the Contractor's expense.

1.08 RECORD DRAWINGS

- A. Contractor shall obtain from the Architect at the cost of printing, and keep up to date, an accurate dimensioned set of reproducible drawings showing all work which is installed differently from that shown on the Drawings. This shall include location, depth, etc., as referred to approved base datum of all buried or concealed lines and equipment.
- B. Contractor shall provide as-built drawings done in Microstation. Version to be determined by Owner. Deliver to Owner upon completion of the job.

1.09 QUALITY OF EQUIPMENT, MATERIALS AND WORKMANSHIP

- A. Unless otherwise specified, all equipment and materials used in the installation shall meet ASME, ASTM and IAPMO requirements and shall be new and in perfect condition when installed.
 - 1. All articles provided for the same general purpose or use shall be of the same make. All workmanship shall be of the best quality and none but competent mechanics skilled in their trades shall be employed.
 - 2. Furnish the services of a knowledgeable foreman, who shall be constantly in charge of the work, together with all necessary journeymen, helpers, and laborers required.
 - 3. All materials shall be installed as recommended by the manufacturer.

1.10 REVIEW

- A. The Architect, Engineer or Owner's Representative shall have the right to accept or reject equipment, materials, workmanship and tests and determine when the Contractor has complied with the requirements herein specified.

1.11 SELECTION AND ORDERING OF EQUIPMENT AND MATERIALS

- A. Immediately after award of the Contract and review of submittals by the Architect and Engineer, the Contractor shall arrange for the purchase and delivery of all equipment and materials required, in ample quantities and at the proper time.

1.12 LOCATIONS AND ACCESSIBILITY

- A. Install all piping above the ceiling as high as possible. Install all equipment in such a manner as to be readily accessible for maintenance and repairs. Install all piping ducts and conduit in such a manner as to preserve headroom, avoid obstructions and keep openings and passageways clear.
- B. If changes in the indicated locations or arrangements are required, they shall be made by the Contractor without additional charges.
- C. The Contractor shall call the attention of the Architect and Owner's Representative to any points of conflict between his Work and that of the trades so that the conflict may be properly adjusted before the work is installed. Work installed by this Contractor which interferes with work of other trades shall be removed and reinstalled at the Contractor's expense when so requested by the Architect. It shall be understood that no extras to the Contract will be permitted to accomplish the above results.
- D. All Architectural, structural, merchandising, fixture, high wall, air conditioning, fire sprinkler and electrical drawings are hereby made a part of these specifications and shall be consulted by this Contractor and his work adjusted to meet the conditions shown thereon.

1.13 COORDINATION WITH OTHER TRADES

- A. Contractor shall coordinate the installation of his work with the other trades in the interest of obtaining the most practical overall arrangement of equipment, piping, conduit and ducts to maintain maximum headroom and accessibility.
- B. Areas of limited clearance shall be laid out to 3/4" = 1' scale with all piping, lights, ducts, conduits, beams, etc., shown and shall be approved by the Architect, Engineer or Owner's Representative prior to installation.

1.14 VERIFICATION OF EXISTING SERVICES

- A. This Contractor shall verify locations, sizes and invert elevations of all existing piping connections prior to trenching and/or installing of piping. Any piping installed prior to verifying points of connection shall be done at this Contractor's responsibility and expense.

1.15 GUARANTEES

- A. Contractor shall guarantee all workmanship, equipment and materials, for a period

of not less than one year from the date of acceptance of the installation. Should any defects occur during this period, the Contractor shall promptly repair or replace the defective item at no additional cost to the Owner, including cost of labor, based upon normal working hours.

- B. Guarantee the complete and perfect operation of the entire system and that all apparatus will perform in accordance with the detailed Drawings and Specifications.
- C. Guarantee that all equipment or piping shall be supported in such a manner as to be free from objectionable vibration and noise.

1.16 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Contractor shall provide adequate and proper storage facilities for all equipment and materials on the site and shall make provisions to protect such equipment and materials from damage.

1.17 CLOSING-IN OF UNINSPECTED WORK

- A. Contractor shall not allow or cause any of the work to be covered up or enclosed until it has been inspected, tested and acceptable to the Architect, Engineer or Owner's Representative.
 - 1. Should any of his work be covered up or enclosed before such inspection and test, he shall at his own expense uncover the work and after it has been inspected, tested and approved, make all repairs with such materials as may be necessary to restore all his work and that of the trades to its original and proper condition.

1.18 OPENINGS

- A. Furnish information to the other trades on size and location of openings which are required in walls, slabs, etc., for piping and equipment. Any additional openings or changes to the existing ones shall be provided as acceptable to the Architect.

1.19 BUILDING FOOTING CLEARANCES

- A. Under no circumstances shall pipes or conduits run through footings. Those running parallel to footings shall have the minimum clearances as required by Code. They shall cross below footings or through sleeves above footings.

1.20 DAMAGE BY LEAKS

- A. Contractor shall be responsible for all damage to any part of the premises caused by leaks or breaks in piping, equipment or fixtures furnished and/or installed by him for a period of one year from date of acceptance of the work by the Owner.

1.21 EQUIPMENT LABELS

- A. All equipment furnished and installed under this Section shall be provided with the manufacturer's metal identification labels attached to each piece of equipment, showing complete performance characteristics, size, model, serial number, etc.

1.22 EXCAVATION, TRENCHING AND BACKFILLING

- A. All excavating, trenching and backfilling shall be done in conformity with General Conditions of the Specifications. Piping shall be installed promptly after excavation in order to keep the trenches open as short a time as possible.
- B. Backfill shall be compacted to 95% of original compaction by thoroughly tamping. Jetting or flooding of backfill will not be permitted.
- C. Trenches for cast iron pipe shall be excavated to a true gradient so that the entire barrel is supported on the subgrade.
- D. Any existing underground piping or conduit that is encountered shall be properly shored and protected from damage. Active piping shall be left intact and undamaged, or relocated and reconnected to the existing system, as directed by the Architect. Any damage resulting from the Contractor's operations shall be repaired by him at his own expense.

1.23 MAINTAINING EXISTING SERVICES

- A. The premises at the site will be in use at the time the work of this Contract is in progress. Contractor shall conduct his work so as to cause no inconvenience or danger to the personnel on the premises.
- B. He shall maintain continuity of service to the existing water, storm sewer and sanitary sewer systems, except for designated intervals during which connections can be made. The scheduling of the shut-down period shall be at a time directed by the Architect.

1.24 SEISMIC DESIGN

- A. This Contractor shall be responsible for all anchors and connections of plumbing work to the building structure, including calculations to prevent damage as a result of an earthquake, including manufactured equipment, the connection and integrity of shop fabricated and field fabricated materials and equipment. All seismic restraints will be subject to the approval of the Department having jurisdiction.

Part 2 PRODUCTS

2.01 PAINTING

- A. Painting of all piping and miscellaneous metals is included under another section of the work, however, all surfaces exposed to the weather which are not factory finished shall be painted with one coat of metal primer immediately following fabrication.

2.02 CONCRETE WORK

- A. Concrete work for equipment, pipe anchors, supports, etc., will be provided as specified in the Concrete Section of the Specifications. All sleeves, templates, anchor bolts and information pertaining to specific requirements shall be provided under this Section of the Specifications.

2.03 PIPE AND VALVE IDENTIFICATION

- A. Exposed piping shall be provided with Seton "Setmark," Westline "Snap-on" or Kolbi "Custom" pipe markers, installed in accordance with ANSI Standards and as recommended by the Manufacturer.
- B. All valves shall be provided with a 2" brass numbered valve tag with abbreviation "Plbg" complete with brass "S" mounting hood.
- C. Provide a typed valve identification list mounted in a Seton metal frame under glass, located as directed by the Architect and Engineer.

2.04 ELECTRICAL WORK

- A. The Plumbing Contractor shall furnish all controls with instructions to make the connections, and be responsible for the proper operation of his equipment, unless otherwise indicated.
- B. The line voltage electrical work and low voltage conduit when required is specified under the "Electrical Section."

2.05 PIPE AND FITTINGS

- A. Waste, vent and soil lines shall be of no-hub cast iron pipe and fittings and shall conform to the requirements of CISPI Standard 301, ASTM A-888 or ASTM A-74 for pipe and fittings or Schedule 40 galvanized steel pipe with cast iron screwed drainage type fittings for 2-1/2" and smaller above grade.
- B. Vent lines above ground 2-1/2" and smaller, shall be of no-hub cast iron, soil pipe and fittings and shall conform to the requirements of CISPI Standard 301, ASTM A-888 or ASTM A-74 or other than urinal vents, may be Schedule 40 galvanized steel pipe and cast iron fittings.
- C. Vent lines above grade 3" and larger shall be of no-hub cast iron pipe and fittings and shall conform to the requirements of CISPI Standard 301, ASTM A-888 or ASTM A-74 for pipe and fittings.
- D. Cold water, industrial cold water and indirect drain line piping shall be type "L" hard drawn copper tubing, with wrought copper fittings.
- E. Wherever dissimilar pipe is connected, the Contractor shall provide di-electric fitting by "Capitol", "Epco", "Wedgeseal", or approved equal.
- F. Install all cast iron pipe and fittings below grade inside 8 mil polyethylene tube per AWWA C-105 or ANSI B21.5.
- G. Wrap all underground cold water piping with Conway coating No. 25 factory applied coating. All joints to be field wrapped with Johns-Manville VID-20 or Scotch wrap No. 51 tape, applied as recommended by the manufacturer.
- H. All pipe and fittings shall be of domestic manufacture.

2.06 MAKING-UP PIPE

- A. Flanges shall have full faced gaskets. Gaskets shall be selected for service intended.
- B. Cast iron pipe joints shall be made up with approved Husky, Clamp-All or M.G. no-hub couplings.
- C. All cast iron soil pipe and fittings shall conform to the current Cast Iron Soil Pipe Institute Specifications.

- D. Copper joints shall be Sil-Fos brazed or soldered with approved lead-free solder.

2.07 HANGERS AND SUPPORTS

- A. Support horizontal piping with Elcen No. 94, Super Strut No. C-727, Fee & Mason No. 201, or Grinnell No. 97, adjustable steel band, pipe hangers and rod supports with sway braces at every third hanger.
- B. Steel pipe shall have hangers every 10 feet; except 1 in. and smaller, every 8 feet.
- C. Copper pipe shall have hangers every 10 feet except 1-1/2 in. and smaller, every 6 feet.
- D. Stays on exposed vertical piping shall consist of Fee & Mason Fig. 302, or Super Strut G744 or equal.
- E. Threaded rod hangers supporting pipes shall be of the following diameters:
 - Up to and including 2 in. 3/8 in. rod
 - 2 1/2 in. and 3 in. 1/2 in. rod
 - 4 in. and 5 in. 5/8 in. rod
 - 6 in. 3/4 in. rod
 - 8 in and 10 in. 7/8 in. rod
- F. Under concrete construction, hanger rods shall be hung from Underwriters' listed inserts in forms before the concrete is poured. Under steel beams construction hanger rods shall be hung from Underwriters' approved beam clamps and retaining straps. Under steel decking, piping 2" and smaller, with 3/8" diameter, 42" long rebar laid across pan webs before topping is poured. All connections to structure shall be as acceptable to the Architect.
- G. Cast iron pipe shall have a hanger at the joint of each pipe length.
- H. Support furred-in vertical piping with wrought iron split pipe clamps on floor slabs. The size of these clamps shall be in proportion to the size of the pipe they are supporting and as approved by the Architect and Engineer.
- I. Where vertical piping is exposed in the building, supports shall be from wrought iron clamps suspended from the underside of structure with hanger rods.
- J. Where piping is concealed in walls, supports shall be "Uni-Strut", "Speed-Strut", "Super-Strut", "Famet" channel, or approved equal.

- K. Where piping is exposed to weather, supports shall be galvanized steel.
- L. Where equipment and/or piping is suspended or free standing, suitable approved seismic braces or anchors shall be installed to prevent movement, and as acceptable to the Architect.
- M. In no case shall piping come in contact with the building structure. Where pipe must come in contact, provide pipe isolators as herein specified.

2.08 PIPE ISOLATORS

- A. Isolate all pipe hangers or piping supports from hot water, tempered water and cold water, piping with Semco "Trisolators," Potter-Roemer "PR-Isolators" or Elcen "Isolators."

2.10 CLEANOUTS

- A. Install cleanouts at all bends, angles and ends of all waste, sewer and storm water lines as called on the Drawings and as required by local Plumbing Code. All cleanouts shall be brought to grade, and in all cases, location shall be approved by Engineer and Owner's Representative. Use Teflon tape on all threads.
- B. Cleanouts will not be permissible in carpeted areas.
- C. Cleanout in yard areas shall be :
 1. Josam No. 58860, Smith Fig. 4253, or Zurn Z-1450-8 with Z-1460-15, cast iron surface level cleanout with lifting device, bronze plug.
 2. Cleanout in blacktop surface shall be provided with 15" concrete ring 6" below surface.
- D. Above ground caulk ferrule: Josam 58500, Smith No. 4420, or Zurn Z-1440, cast iron ferrule with counter sunk bronze plug.
- E. Wall cleanouts: Josam No. 58790, Smith Fig. 4532, or Zurn ZN-1445-1, cast iron tee with countersunk bronze plug and stainless steel access cover.
- F. Cleanouts in finished room floors shall be Josam No. 58330, Smith Fig. 4023-T, Wade W-7030 or Zurn ZN-1400-2, cast iron adjustable floor level cleanout with round nickel bronze top and bronze plug.
- G. Cleanouts in resilient tile floors shall be Josam No. 58330-12, Smith Fig. 4143-T,

Wade W-7030-T or Zurn ZN-1420-6, cast iron adjustable floor level cleanout with round nickel bronze top. Top depression to be covered with surrounding floor pattern bonded with waterproof adhesive.

2.11 ACCESS PANELS

- A. Provide access panels over all valves and other equipment which is concealed in the walls or ceiling of the building. They shall be of a size suitable for the usage and maintenance intended, not less than 12" X 12" and shall be as follows:
 - 1. Tile, block, and unpainted walls and ceilings:
 - a. Karp 214M, Smith Fig. 4762-AKL, Potter-Roemer No. 265, or Zurn Z-1460-4, stainless steel with No. 4 finish, concealed hinged type access cover with Allen key lock on door.
 - 2. Drywall or plaster walls and ceilings:
 - a. Walls - Karp 214P, Smith Fig. 4765-AKL, Potter-Roemer No. 275, or Zurn Z-1460-4, stainless steel with No. 4 finish concealed hinge type access cover with Allen key lock and plaster ground.
 - b. Ceiling - Drywall ceiling to be accessed by GFRG tapped in access doors of appropriate size.

2.12 PIPE SLEEVES AND PLATES

- A. For frame plastered construction, No. 18 gauge galvanized steel.
- B. For concrete walls and floors, Paramount Mfg. Co. telescopic type, Sperzel "Crete Sleeve" or Schedule 40 galvanized pipe.
- C. Sleeves shall be ½" diameter larger than the pipe or covering. Where fire proofing or waterproofing is required the space between pipe and sleeves shall be caulked with approved waterproof and/or fireproof caulking.
- D. Provide chrome plated set screw flanges at all finished floors, walls and ceilings.
- E. Where sleeves are installed in floors or walls with membranes, a Josam No. 26420, Smith Fig. 1720, or Zurn Z-195-10 or equal membrane clamp shall be provided.

- F. In no case shall any piping come in contact with concrete. This Contractor shall provide a dielectric material where piping runs through concrete floors and walls.

2.13 VALVES

- A. Honeywell/Braukman, Apollo, Watts, Milwaukee, Kennedy or Stockham, unless otherwise noted. All valves of the same type shall be of the same make. Valves shall be line size unless Otherwise noted. Valves in copper tubing shall be solder joint bronze type in size available. Iron body valves in copper systems shall have Maloney type "E" flange insulation for cathodic protection, complete with insulated grommets and washers.
- B. All shut-off valves: Ball valves 2 inch and smaller with Teflon seats and full port ball, 125# SWP 200# WOG with solder ends. Gate Valves 2 in. and 3 in. bronze, NRS, 125# SWP 200# WOG with threaded ends.
- C. Globe and angle valves: Bronze with Teflon seat, with threaded or solder ends 125# SWP 0# WOG.
- D. Check valves: Bronze swing check with Teflon seal, Y-pattern 125# SWP 200# WOG.
- E. Hose bibbs, Acorn No. 8131, Chicago Faucet Co.'s No. 998 or Woodford Model Y24, all bronze except seats, loose key operated, size 3/4 inch, all rough nickel plate finish, complete with keys and approved vacuum breaker.
- F. Wall Hydrants: Woodford Model B60 or approved equal by Acorn, Josam or Zurn, Freezeless, flush mounted, with mat finished stainless steel plated rim and cover, complete with shutoff valve, approved vacuum breaker and loose key.
- G. Reduced pressure backflow preventor: Approved Clayton Model RP or approved equal by Toro, Hersey or Grinnell, line-size reduced pressure backflow preventor assembly with drain piped to an approved location. Provide union at drain connection to valve assembly.
- H. Water pressure reducing valves: Braukman, Wilkins or Watts, complete with wye type model strainer with hose bibb, both units bronze and set for pressure indicated on the Drawings.

2.14 STRAINERS

- A. Hoffman No. 420, Trane No. 58, Walworth No. 3699-1/2 or Strong SYB cast bronze, "Y" type, with No. 20 mesh model screen.

2.15 WATER HAMMER ARRESTORS

- A. Approved P.P.P., Watts or Sioux Chief, shock absorber, sized and located in accordance with Plumbing and Drainage Institute.

2.16 PRESSURE GAUGES

- A. Ashcroft, Marsh, Clapp, Weiss or Trerice, 3-1/2 inch face, 1.5% accuracy, standard bottom connected, chrome ring, of suitable range, each complete with cock, bronze movement and recalibrator adjustment.

2.18 PLUMBING FIXTURES

- A. Plumbing fixture trim shall be brass with heavy polished chromium plated finish, unless otherwise specified. Individual loose key stops shall be provided for all supplies and shall be mounted under the fixtures.
- B. Where services pass through a wall, floor or ceiling, provide an escutcheon heavily chrome plated and fastened with set screw.
- C. Fixture heights shall be as directed by the Architect and Engineer.
- D. All wastes shall be separately trapped.
- E. All plumbing fixture voids between the wall and the fixture shall be filled with DAP or approved equal polyvinyl white fixture grout.
- F. All exposed bolt heads, on flanges of any fixture, and back of any fixture, or in the fixture itself, shall be square and not less than 3/4" high with a porcelain bolt cap securely cemented in place.
- G. All fixture waste accessories including waste nuts, spud nuts, etc., shall be cast brass.
- H. All fixtures installed in floors with waterproof membranes shall be provided with approved membrane clamps.
- I. Support all wall hung fixtures other than water closets with 1/8" X 6" mild steel flat iron welded to not less than three metal studs. Drill and tap plate to match fixture.
- J. Fixtures and accessories shall be American-Standard, unless otherwise noted.

Fixtures and trim shall be of one manufacturer.

WC-1 – Water Closets: Refer to plumbing plan P0.20

L-1 – Lavatory: Refer to plumbing plan P0.20

UR-1 – Urinals: Refer to plumbing plan P0.20

DF-1 – Drinking Fountain: Refer to plumbing plan P0.20

SH-1 – Shower: Refer to plumbing plan P0.20

2.19 PIPE INSULATION

- A. Storm Drainage System: All storm, roof and overflow drain bodies, vertical pipe from to elbow, elbow at drains, all horizontal runs of storm and overflow drain piping, and first elbow down.
- B. Pipe, fittings, drain bodies and other components including restraints concealed, above ceiling: Minimum 1½” thick fiberglass flexible duct insulation, minimum 1 lb. density, conductivity (K) value not more than 0.30 at 75F mean temperature difference, with factory adhered reinforced foil face flame resistant Kraft paper vapor barrier.
- C. Pipe, Fittings, Drain Bodies, and other components not concealed above ceiling: Same materials as specified for Cold water piping system.
- D. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside.
- E. Insulation materials manufactured by following list of companies will be acceptable provided they conform to these specifications. Armstrong, Certainteed, Pittsburgh-Corning, Owens-Corning, Manville Corp., Knauf, Benjamin-Foster, Childers.

Part 3 EXECUTION

3.01 SLEEVING, CUTTING AND PATCHING

- A. The Contractor shall furnish information to the other trades on size and location of openings which are required in walls, slabs, etc., for conduit piping and equipment at the proper time. Any additional openings or changes to existing ones shall be

provided as acceptable to the Architect.

3.02 GENERAL PLUMBING INSTALLATION

- A. Rough-in shall proceed as rapidly as the building construction will permit and shall be complete and the piping tested before being enclosed.
- B. All piping shall be thoroughly cleaned before installation, and all pipe openings capped to exclude dirt until fixtures are installed and final connections are made.
- A. All joints shall be smooth inside, pipe ends reamed to remove burrs, each length to be carefully inspected, and all obstructions removed prior to fabrication.
- D. Exposed plated, polished or enameled connections from fixtures shall be carefully made; shall show no tool marks or threads, and shall be provided with neat plated escutcheons with round head screws of the same finish. All finished surfaces shall be carefully taped to prevent damage during construction.
- E. Horizontal sanitary piping shall be run at a uniform grade of 1/4" per foot, unless otherwise noted.
- F. Furnish and install a water hammer arrestors in the wall on hot, tempered, and cold water supply pipes at each flush valve or quick closing valve, flush valve bank, and at each bank of two or more fixtures.
- G. Headers supplying flush valve fixtures shall run full size to the last fixture.
- H. Provide stainless steel clamps and concrete thrust blocks on all dead ends, angles or at other points where separation may occur in cast iron pipe. Provide a shut-off valve in the wall at each bank of two or more fixtures and/or where indicated on the Drawings, and where required for proper control of the system. Provide shut-off valves at the piping connections to all equipment and controls. Where valves are located in concealed piping, the Contractor shall furnish and install metal access panels of suitable size and of the type hereinafter specified.
- J. Unless flanges are indicated, a union shall be installed on equipment connections and elsewhere as indicated or required for ease of installations and servicing. Under no circumstances shall unions be installed in accessible locations.
- K. Make suitable provision for maximum expansion and contraction of all piping. Provide swing fittings and anchors as required and/or as directed on the job.
- L. Reducing fittings shall be used in lieu of bushings. Closed nipples will not be permitted.

- M. In making up lines of copper or chrome pipe, an approved type friction wrench shall be used to avoid marking of the pipe.

3.03 TESTING AND ADJUSTING

- A. Each piece of equipment and all of the systems shall be adjusted to insure proper functioning of all controls, elimination of noise and vibration and left in first class operating condition.
- B. Notify the Architect and Engineer forty eight (48) hours in advance when the piping is ready for testing. All pipes shall be tested in accordance with all local, City and State ordinances, and the tests operated in the presence of the local inspector and the Architect until acceptable.
- C. Should any piece of apparatus, any work or material fail in any of these tests, it shall be immediately removed and replaced by perfect material at the Contractor's expense. The portion of the work replaced shall again be tested by the Contractor at his own expense in the presence of the Engineer.
- D. All equipment which would be subject to damage at the test pressure shall be isolated from the system, and no test shall be made against a service valve or meter.
- E. Tests: Unless otherwise required by the Department having jurisdiction.
 - 1. Water systems: Hydrostatically at 150 pound pressure.
 - 2. Sanitary sewer and storm water systems including vent piping: With water by filling the piping to the top of the highest point, but not less than five pound pressure.
 - 3. All tests, except as otherwise noted, shall be maintained without leaks or pressure loss with allowance for temperature changes.

3.04 DISINFECTION OF POTABLE WATER SYSTEMS.

- A. The lines and fixtures shall be flushed thoroughly prior to chlorination to remove dirt, etc. Screens on faucet to be removed during injection and replaced after completion of disinfection.
- B. Injection shall start only when all fixtures are connected up and ready for operation. Both hot and cold water lines and fixture trim to be chlorinated.

- C. Chlorine shall be used as disinfecting agent as approved in Federal and AWWA procedures.
- D. A bacteriological analysis shall be required upon completion of work. The applicator must obtain water samples from tempered, hot or cold water lines and submit samples to an approved laboratory. The report must show as follows:
 - 1. That the coliform-aerogenous organisms are negative.
 - 2. That the total plate count is less than 100 bacteria per cubic centimeter.
 - 3. That the water is safe to use.
 - 4. Must show name and location of job and date the samples were obtained.
- E. If the bacteriological analysis do not satisfy the above requirements, the disinfection procedure Must be repeated.
- F. Submit approved bacteriological analysis to the Architect and Engineer prior to final acceptance by the Owner.

- END OF SECTION -

SECTION 15410 - PLUMBING PIPING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing plumbing systems with piping, supports, drains, and vent pipes (if any) for gas, vacuum, air, cold and hot water, and laboratory piping, and rainwater leaders.

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 15000 Piping Components
2. Section 15010 Mill Piping - Exposed and Buried
3. Section 15015 PVC Pressure Pipe
4. Section 15020 Pipe Supports
5. Section 15030 Piping Identification Systems
6. Section 15250 Pipe and Equipment Insulation
7. Section 15430 Plumbing Specialties
8. Section 15440 Plumbing Fixtures

1.3 CODES

- A. The 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 Plumbing Code

1.4 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 1. Shop drawings of plumbing systems.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Plumbing piping and products shall be new and manufactured for the intended usage.

2.2 BUILDING PIPING

- A. Except as otherwise indicated on the Contract Drawings, piping materials used for plumbing systems within buildings shall comply with Section 15010 and as follows:

Service	Materials
Drains (except lab and chemical drains)	Drains 2 inches and smaller shall be Schedule 40 galvanized steel pipe (black steel pipe where buried) conforming to ASTM A 53, with cast-iron taper threaded drainage fittings conforming to ANSI B16.12. Drains 2½ inches and larger shall be service weight cast-iron soil pipe conforming to ASTM A 74.
Vents (except lab and chemical vents)	Vents 2 inches and smaller shall be Schedule 40 galvanized steel pipe (black steel pipe where buried), unless noted otherwise, conforming to ASTM A 53 with cast-iron taper threaded drainage fittings conforming to ANSI B16.12. Vents 2½ inches and larger shall be service weight cast-iron soil pipe conforming to ASTM A 74.
Rain water leaders	Rain water leaders above floor slabs shall be Schedule 40 galvanized steel pipe conforming to ASTM A 53, with galvanized screwed cast-iron drainage fittings, conforming to ANSI B16.12. At the CONTRACTOR's option, grooved end pipe and fittings may be used. Piping under floor slabs shall be service weight cast-iron soil pipe, conforming to ASTM A 74.
Lab and chemical drains and vents	Drains and vents shall be corrosion-resistant (high silicon content) cast-iron pipe conforming to ASTM A 518, or tempered borosilicate glass pipe conforming to ASTM C 599 with protective jacket, where concealed or buried; or Schedule 40 polypropylene pipe with heat fused socket joints.
Piping for cold and hot water, and laboratory air and vacuum	Unless otherwise shown, piping shall be Type K copper tube conforming to ASTM B 88 with soldered joints to 2-inch size. Piping 2½ inches and larger shall be schedule 40 galvanized steel pipe (black steel pipe for hot water) conforming to ASTM A 53, with grooved-end pipe fittings.

Hydraulic fluid piping	Piping shall be Schedule 80 seamless black steel pipe conforming to ASTM A106 or A53 with welded joints, where not otherwise provided by equipment manufacturer.
Liquid petroleum gas piping	Piping shall be Schedule 80 black steel pipe, conforming to ASTM A 53 or A 106.
Natural gas piping	Piping shall be Schedule 40 black steel pipe conforming to ASTM A 53.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Piping shall be properly graded complying with the Uniform Plumbing Code, and shall be securely supported with pipe brackets and insulating strips installed to prevent transmission of noise.
- B. Drain valves shall be installed at low points of water systems. Drip legs shall be installed at low points of gas and air piping.
- C. Shut-off valves shall be installed in accessible locations or in cast-iron valve boxes with extension and cover in water and gas mains entering buildings or structures, and in branch mains to groups of fixtures.
- D. Piping shall be tested in accordance with the Uniform Plumbing Code.
- E. Piping shall be installed in accordance with the manufacturer's installation instructions and Sections 15000 and 15010.

**** END OF SECTION ****

SECTION 15430 - PLUMBING SPECIALTIES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing cast-iron floor drains, floor sinks, roof drains, cleanouts, access covers, frames, hose bibbs, trap primers, shock absorbers, hoses, nozzles, and hose racks.

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 15103 Globe Valves
 - 2. Section 15410 Plumbing Piping

1.3 CODES

- A. The 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 Plumbing Code

1.4 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Calculations for selection of water hammer arrestors.
 - 2. Shop drawings showing water hammer arrestors for fixtures and groupings.

1.5 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL:
 - 1. Manufacturer's product data.
 - 2. Manufacturer's installation instructions.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Plumbing specialties shall be new products manufactured for the intended usage.
- B. Floor drains shall be installed where equipment drains are indicated.

2.2 ROOF DRAINS

- A. **General:** Except as otherwise indicated, roof drains shall be fabricated with cast-iron body with clamping ring with 4-lb sheet lead flashing (12 inches minimum), gravel stop and aluminum dome.

2.3 FLOOR DRAINS IN TILED FLOORS

- A. **General:** Where indicated, floor drains shall be protected by brass trap primers with vacuum breaker and union connections. One-half inch copper tubes shall be connected to the traps of floor drains. Trap primers shall be installed in accessible locations. Trap primers concealed in wall shall be provided with an access panel.

2.4 FLOOR DRAINS IN CONCRETE FLOORS

- A. **General:** Floor drains in concrete floors shall be of cast iron, in the sizes indicated, with sediment buckets. Floor drains located on floors above the first level shall have a clamping collar, with 4-lb sheet lead flashing (12 inches minimum).

2.5 (NOT USED)

2.6 FLOOR SINKS

- A. **General:** Floor sinks shall be 12-inch by 12-inch by 8-inch and fabricated with acid-resistant white enameled cast iron, with epoxy-coated interior aluminum dome strainer, nickel-bronze or acid-resistant, full-, half-, or quarter-size grating, as indicated, and flashing clamp and 4-lb sheet lead flashing (12-inches minimum) for floors above the first level.

2.7 CLEANOUTS

- A. **General:** Cleanouts shall be heavy plugs with tapered shoulders and caulked lead, or heavy brass plugs. Where underground or concealed, cleanouts shall be brought to floor level and to accessible locations and shall have access covers and frames.

2.8 ACCESS COVERS AND FRAMES

- A. Except as otherwise indicated, access covers with frames shall be provided for inaccessible valves and controls, trap primers and cleanouts.
- B. Access covers and frames in finished floors or walls shall have a clear opening of not less than 8-inch by 8-inch and frames shall be of nickel-bronze with hinged cover.
- C. Access covers in unfinished concrete floors, where exposure to chemicals is not indicated, may be of galvanized cast iron, with a clear opening of not less than 8-inch by 8-inch.
- D. In chemical handling areas, access covers shall be of galvanized cast iron, with a clear opening of not less than 10 inches in diameter.

2.9 HOSE BIBBS

- A. **General:** Hose bibbs in exposed locations shall be of the non-freeze type and, where indicated, shall include vacuum breakers.
- B. 1-1/2-inch hose valves shall be specified as above or angled globe valves conforming to Section 15103 with a male/male hose adapter, cap and chain.

2.10 TRAP PRIMERS

- A. Where indicated, floor drains and floor sinks shall be protected by trap primers. One-half inch copper tubes shall be connected to the traps of floor drains and floor sinks. Trap primers shall be installed in accessible locations.

2.11 SHOCK ABSORBERS

- A. Cold and hot water piping connecting to self-closing faucets and quick-action valves shall be protected by shock absorbers, located at each fixture, or battery of fixtures as recommended by the manufacturer. Shock absorbers shall be of corrosion-resistant construction, permanently sealed, and shall be sized and installed in accordance with the manufacturer's installation instructions.

2.12 WALL-MOUNTED HOSE RACKS

- A. Wall-mounted hose racks shall be installed at locations indicated. Racks shall be of all-welded steel construction, minimum 8-gauge sheet steel, hot-dip galvanized after fabrication, and shall have a capacity to hold 100 feet of 3/4-inch or 1-1/2-inch hose. Where racks are located in open locations, racks shall be supported from two 2- by 2-by 1/4-inch galvanized steel angle posts, and shall be set in a concrete base.

2.13 HOSES AND NOZZLES

- A. The WORK includes the following quantities of the lengths indicated:
 - 4EA - 75 ft lengths of one-inch hose
- B. Hose shall include male and female connectors and nozzle and shall be seamless, extruded rubber with dacron cotton exterior and shall be designed for a working pressure of at least 200 psi.
- C. Nozzles shall be capable of complete shut-off and shall produce a solid straight stream and up to a 90-degree conical fog. Nozzle material shall be brass with polished finish, and nozzles shall include rubber bumper.

2.14 MANUFACTURERS

- A. **Manufacturers:** Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):
 - 1. Roof drains:
 - Josam Mfg. Co., Series 21500
 - Jay R. Smith Mfg. Co., Fig. 1010
 - Zurn Industries, Inc., Series Z-100
 - 2. Floor drains in concrete floors:
 - Josam Mfg. Co., Series 31120

Jay R. Smith Mfg. Co., Fig. 2350
 Zurn Industries, Inc., Series Z-520-Y

3. Floor sinks:
 Josam Mfg. Co., Series 49040
 Jay R. Smith Mfg. Co., 3150 Series
 Zurn Industries, Inc., Series ZN-1806
4. Cleanouts of the series and model number indicated shall be manufactured by one of the following (or equal) and installed in the locations indicated:

	<u>Josam Series</u>	<u>J.R. Smith No.</u>	<u>Zurn No.</u>
Exposed locations	58500-20	4405	Z-1440-A
Underground (finished floors)	56010/30	4143	ZN-1400-2
Walls, concealed locations	58790-20	4535	ZN-1445-1-A
Traffic areas	56070	4240	Z-1420-27

5. Access covers and frames in finished floors or walls:
 Zurn Industries, Inc.
 Josam Mfg. Co.
 Jay R. Smith Mfg. Co.
6. Access covers in unfinished concrete floors:
 Alhambra Foundry Co., Model A-2015
 Neenah Foundry Co. Model R-6687
7. Vacuum breakers:

 Crane Co.
 American Standard
8. Non-freeze post-type hose bibbs:
 Josam Mfg. Co., Series 71700
 Jay R. Smith Mfg. Co., Series 5910
 Zurn Industries, Inc., Fig. Z-1385 or 1390
9. Hose valves 3/4-inch and 1-inch:
 Chicago Faucet No. 7T
 Ford Meter Box Company, Inc.
10. Ball valves with hose thread:
 Ford Meter Box Co., Model B8H-233HB2
 Apollo (Conbraco Industries, Inc.), Model 78-104
11. Ball valves with hose thread adapters:
 Fire-End and Crocker Corp. No. 180
 Woodford Manufacturing Co., Models 24P or Y24
12. Trap primers:
 Josam Mfg. Co., Model 88250

Jay R. Smith Mfg. Co., Model 2699
Zurn Industries, Inc., Model Z-1022

13. Shock absorbers:
Josam "SHOKTROLS"
Jay R. Smith "HYDROTROL"
Zurn, Model Z-1022
14. Nozzles:
W.D. Allen Mfg. Co.
Fire-End and Crocker Corp.
Halprin Supply Co.
Western Fire Equipment Co.

PART 3 -- EXECUTION

3.1 PREPARATION

- A. The WORK includes coordination of roughing-in, locating wall-and floor sleeves, pipe inserts, location of drains to required invert elevations and ensuring that piping below ceilings is held as high as possible.

3.2 INSTALLATION AND APPLICATION

- A. Plumbing specialties shall be installed in accordance with manufacturer's installation instructions.
- B. Cleanouts shall be extended to finished floor or wall surfaces. Threaded cleanout plugs shall be lubricated with mixture of graphite and linseed oil.
- C. Exterior cleanouts shall be encased in concrete flush with pavement, or shall be extended to above finished grade in unpaved locations.
- D. Water hammer arrestors with isolation valves shall be installed in accessible locations.

**** END OF SECTION ****

15440 - PLUMBING FIXTURES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing plumbing fixtures and trim.

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 07920 Sealants and Caulking
2. Section 15410 Plumbing Piping

1.3 CODES

- A. The 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 Plumbing Code
2. California Code of Regulations, Title 24

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. ANSI A112.6.1 Supports for Off-the-Floor Plumbing Fixtures for Public Use
2. ANSI A112.18.1 Finished and Rough Brass Plumbing Fixture Fittings
3. ANSI A112.19.1 Enameled Cast Iron Plumbing Fixtures
4. ANSI A112.19.2 Vitreous China Plumbing Fixtures
5. ANSI A112.19.4 Porcelain Enameled Formed Steel Plumbing Fixtures
6. ANSI A112.19.5 Trim for Water-Closet Bowls, Tanks, and Urinals
7. ANSI Z124.2 Gel-Coated Glass-Fiber Reinforced Polyester Resin Shower Receptor and Shower Stall Units
8. ANSI Z358.1 Emergency Eye Wash and Shower Equipment
9. ARI 1010 Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Product data showing fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

1.6 QUALITY ASSURANCE

- A. **Fixtures:** Multiple fixtures shall be by the same manufacturer for each product type indicated.
- B. **Trim:** Trim shall be by the same manufacturer for each product type indicated

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Products 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.
- C. **Protection:** Temporary caps shall be provided.
- D. **Protection of Finishes:** Heavy paper shall be pasted on lavatories, water closets and sinks.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Plumbing fixtures shall be new first-quality products and shall be manufactured for the intended usage. Materials, capacities, features, finishes, and manufacturers shall comply with the indicated requirements and shall be compatible with elements of the work to which they relate or connect.
- B. Plumbing fixtures shall be white finish unless otherwise indicated. All exposed brass, faucets, wastes, traps, etc., shall be chrome-plated. Each fixture shall be provided with individual stops and shall be anchored firmly to the building wall or floor.

2.2 FIXTURE SCHEDULE

- A. Following fixture type shall comply with the indicated requirements:

Dwg. Callout	Fixture Type	Description
WC-1	Water Closet (wall-hung)	Water Closet: elongated wall-mounted, siphon jet bowl, solid, white, plastic, open front seat, 1-inch chrome-plated flush valve and escutcheon, cast-iron chair-carrier (with 1-1/2-inch water

supply connection).

<u>Dwg. Callout</u>	<u>Fixture Type</u>	<u>Description</u>
MS	Mop Sink	Mop Sink: Floor-mounted, porcelain-enameled cast-iron, with integral back, size 28 x 28-inch with rim guard, drain channels, 3-inch outlet with "P" trap and stainless steel strainer, and chrome-plated service sink faucet with vacuum breaker, hose, and hose bracket
DS-1	Drench Shower (and eye wash)	The emergency drench showers, not subject to freezing, with shower head, self-closing manual valve, handle, eye wash with stainless steel bowl and galvanized drain, and 1-inch supply.
EW-1	Eye-Wash Fountain	Stainless steel bowl, pipe-mounted, with push-type ball valve, chrome-plated twin heads, flow control, and stop.

2.3 FIXTURES FOR HANDICAPPED PERSONS

- A. Where indicated, fixtures for handicapped users shall comply with the California Code of Regulations, Title 24.

2.4 MANUFACTURERS

- A. Fixtures, of the type or model indicated, shall be manufactured by one of the following (or equal). Fixtures not listed below shall be manufactured by Crane Co., Kohler, American Standard, or equal.

- 1. Drench Shower (and eye wash):

HAWS Model No. 8300
Western Drinking Fountains, Inc. Model 9301

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Fixtures shall be installed with trap, easily removable for servicing and cleaning, and vented in accordance with the applicable plumbing code.
- B. The WORK of this Section includes providing chrome-plated rigid or flexible supplies to fixtures with angle stops, reducers, and escutcheons.
- C. Components shall be installed level and plumb. Supplies and wastes shall be centered on or between the wall tiles.
- D. Fixtures shall be installed and secured in place with wall supports and bolts.
- E. Fixtures shall be sealed to wall and floor surfaces with sealant complying with Section 07920.

Color shall match fixture.

- F. Fixtures shall be mounted to the heights listed in Title 24 of the California Code of Regulations.

3.2 ADJUSTING AND CLEANING

- A. Stops or valves shall be adjusted for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Plumbing fixtures and equipment shall be cleaned.

** END OF SECTION **

SECTION 15855 - AIR HANDLING AND MOVING EQUIPMENT

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing:
 - 1. Factory fabricated custom air handling units with coils.
 - 2. Air handling and moving equipment for use in corrosive environments.

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 01640 Seismic Design of Equipment and Anchorage
 - 2. Section 11000 Equipment General Provisions
 - 3. Section 11175 Pumps, General
 - 4. Section 11500 Natural Gas Engine-Generator Set
 - 5. Section 11501 Diesel Fuel Engine-Generator Set
 - 6. Section 13300, Appendix A2 – Process and Control Strategies and Design Philosophy
 - 7. Section 15000 Piping Components
 - 8. Section 15050 Vibration Isolation
 - 9. Section 15410 Plumbing Piping
 - 10. Section 15990 Testing, Adjusting and Balancing
 - 11. Section 16460 Electric Motors

1.3 CODES

- A. The 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. California Building Code
 - 2. California Mechanical Code
 - 3. California Plumbing Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. AFBMA 9 Load Ratings and Fatigues Life for Ball Bearings
2. AFBMA 11 Load Ratings and Fatigue Life for Roller Bearings
3. AMCA 99 Standards Handbook
4. AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes
5. AMCA 300 Test Code for Sound Rating Air Moving Devices
6. AMCA 301 Method of Publishing Sound Ratings for Air Moving Devices
7. AMCA 500 Test Methods for Louver, Dampers, and Shutters
8. ARI 410 Forced-Circulation Air-Cooling and Air-Heating Coils
9. ARI 430 Central Station Air Handling Units
10. ARI 435 Application of Central Station Air Handling Units
11. ARI 610 Central System Humidifiers
12. NEMA MG1 Motors and Generators
13. NFPA 70 National Electrical Code
14. SMACNA HVAC Duct Construction Standards - Metal and Flexible
15. UL 900 Test Performance of Air Filter Units

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in addition to the requirements of Section 11000:
 1. Shop drawings indicating assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics and connection requirements.
 2. Product data indicating dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, connection requirements, and gauges and finishes of materials.
 3. Fan curves with specified operating point clearly plotted.
 4. Sound power levels for both fan inlet and fan outlet and casing radiation at rated capacity.
 5. Product data for filter media, filter performance data, filter assembly, and filter frames.
 6. Electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring.

1.6 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL in addition to the requirements of

Section 11000:

1. Instructions for lubrication, motor and drive replacement, a list of 2-years' recommended spare parts from the manufacturers, and wiring diagrams.
2. Manufacturer's certification that products are designed and fabricated to the corrosive environments indicated in the Equipment Schedule at the end of this Section.

PART 2 – PRODUCTS

2.1 GENERAL

A. **Compliance:** Products shall comply with the following:

1. Meet the performance criteria set forth in the AHU Schedules presented at the end of this Section.
2. Fan Performance Ratings: conforming to AMCA 210 and bearing the AMCA Certified Rating Seal.
2. Sound Ratings: conforming to AMCA 301; tested to AMCA 300 and bearing AMCA Certified Sound Ratings Seal.
3. Fabrication: conforming to AMCA 99 and ARI 430.
4. Manufacturer shall have evidence of existing projects using this type of equipment for a minimum of 15 years and be currently fabricating similar equipment.

2.2 AIR HANDLING UNITS

A. **General:** Units shall be as follows:

1. Draw-thru and blow-thru type air handling units suitable for medium pressure operation.
2. Fan coil and filter sections.
3. Filter Media: ANSI/UL 900 listed, Class I or Class II.
4. Air Coils: certified capacities, pressure drops, and selection procedures in accordance with ARI 410.
5. Unit shall be built for outdoor installation. The larger units will require shipping splits. Units shall ship in completely assembled shipping sections. All section ends shall be sealed during shipment and equipment properly braced and protected. The manufacturer shall provide crane lift points or provisions. The Contractor shall submit a crane lift plan for each unit and placement.
6. Air Handling Units shall meet the seismic and anchorage requirements of Section 01640, Seismic Design of Equipment and Anchorage. The associated calculations and shop drawings shall be submitted to the Engineer for approval.

7. Air Handling Units shall not exceed 100 pounds per square foot load while also including all the loads for internal piping and coils filled with water. In addition, the roof of the Air Handling Units shall be designed to meet 20 pounds per square foot live load to meet the additional mechanical piping and equipment that will be installed on the roof by the Contractor per Contract Drawing 7M-4. The roof shall allow mechanical fastening of 316 stainless steel strut to support and anchor the field mechanical equipment installed on the Air Handling Unit's roof.
8. Air Handling Units shall meet the requirement of Section 13300, Appendix A2 – Process and Control Strategies and Design Philosophy.
9. Weight limit requirements: refer to AHU Schedule at end of this specification section for weight limit information.

B. General Arrangement: Products shall comply with the following:

1. Comply with the overall dimensions and layouts shown on Contract Drawings 7M-4, 7M-9, 7M-14, and 7M-15. The dimensions shown on 7M-14 and 7M-15 are maximum allowed dimensions. The access maintenance door locations and door swings shall be as shown in the Contract Drawings. No deviations will be accepted.
2. The ventilation duct penetration size and locations shall be per the Contract Documents.
3. Comply with P&ID's per Contract Drawings 7I-8 and 7I-9.
4. Comply with Electrical and Control Drawings 7E-13 thru 7E-16, and 7E-25.
5. Comply with internal LED lighting requirements per Contract Drawing 7E-7.

C. Casings: Casings (i.e. the exterior waterproof shell of the unit) shall comply with the following:

1. Casings shall be constructed of .102 aluminum #3003 and shall utilize a standing seam modular panel type construction. Channel base shall be fabricated of welded structural aluminum channel and finished to match the rest of the unit. Tubular or formed metal channel bases are not acceptable. The panels shall be caulked and attached to each other, to the roof, and to the floor using nuts and bolts on no less than 8" on center. Drive screw attachment is not acceptable. All panels shall be removable. All seams shall be sealed with an acrylic latex sealant prior to assembling the panels and after completion of the assembly. All floor openings shall have .080 aluminum framed flange around the entire perimeter of opening for duct connection. Minimum sound transmission loss (STL) through unit panels shall be as follows:

OCTAVE BAND CENTER FREQUENCY

<u>125</u>	<u>250</u>	<u>500</u>	<u>1K</u>	<u>2K</u>	<u>4K</u>
25	29	36	42	47	48

2. Frame members shall be sized to limit deflection to L/200, minimizing deflection during rigging and installation. Intermediate aluminum members are fully welded and located at lifting points and as needed to support internal components such as coils, fans, etc.

Removable lifting lugs shall be added to the perimeter channel along the longest length of the unit.

3. Structural floor panels shall be .100 aluminum #3003 with deep flanges and a maximum panel width of 24" for exceptional rigidity. Floor surface shall be smooth without visible screws. Flooring shall be welded to unit frame at the unit perimeter. All panels are fully caulked with a high performance polymer sealant. Sealant shall be low VOC and be free of silicone and isocyanates. Section splits shall be supplied with an upturned bolted flange and u-clip for field connections.
4. The entire floor and frame shall be foamed with a 2-part polyurethane foam. Minimum foam thickness shall be 2" underneath the base surface and 1/2" on flanges and angles.
5. Casing sections shall be insulated with 2 inch thick, 3 lbs per cu ft density, neoprene coated, glass fiber insulation to cover all walls and ceilings, "K" value at 75 degrees F; exposed edges of insulation shall be coated with adhesive; insulation and adhesive shall conform to NFPA 90A. There shall be no raw edges of insulation exposed to the air stream. The entire interior of all units shall be lined with minimum .032 aluminum liner. The interior liner of the fan sections, inlet plenum sections, and discharge plenum sections shall be perforated and the remaining shall be solid.
6. Outdoor casings shall be finished with an industrial grade high solids polyurethane paint applied over shot-blasted surface, to total thickness of 5-6 mils. Fixed joints shall be sealed with closed-cell foam gasket. Cap strips shall be provided over roof flanges. Rain caps and gaskets shall be provided on access doors. In addition, all fan bases, springs and structural aluminum supports shall be coated with the same finish. The paint system shall meet ASTM B Salt spray test for 2000 hours in a 5% solution. Paint shall be applied in an environmentally sealed paint chamber specifically designed for paint application.
7. Hinged, double wall, man size access doors shall be provided in all sections requiring access for maintenance or service as indicated in the Plan documents. Doors and frames shall be of Aluminum Construction, for flush mounting, with gasket, latch, and handle assemblies, hinges, and 12 x 12 inch inspection window of 1/4 inch thick plexiglass. Doors shall have same finish as the entire unit.
8. LED Lights shall be included in accessible sections with wire guards, factory wired to a weatherproof switch mounted on casing exterior.
9. Drain pans under unit mounted heat exchangers shall be constructed from 16-gauge, 316 stainless steel. Galvanized steel drain pans are not acceptable. The drain pan shall be insulated beneath the surface with 2.0", 2-part polyurethane insulation. Drain pans must be sized such that the entire coil, including headers and return bends, are inside the drain pan. Drain pans must slope in two directions so there is no standing water in drain pan. Minimum 1.25" stainless steel condensate connection shall be provided on one side of the unit. Coils shall be supported on 10 gauge stainless steel members to prevent immersion of the coil in condensate and allow for complete cleaning of drain pan beneath the coils.
10. Where bottom inlets are indicated, aluminum walking grate on structural supports shall be provided.

11. Units shall include structure to brace casings for suction pressure of 6.0 inch wg with maximum deflection of 1 in 200.

D. Fans: Fan shall include the following:

1. Fans shall meet the performance criteria set forth in the AHU Schedules presented at the end of this Section. Fan performance shall be based on sea level conditions.
2. Fans shall be powered by 480VAC, 3-phase, inverter duty, premium efficiency motors, TEFC, shall not exceed the horsepower shown in the electrical single lines and shall be in accordance with Section 16040, Electric Motors. Fan motors shall be driven remotely by a 6-pulse VFD per Contract Drawings 7E-13 thru 7E-16.
 - a. The associated diesel-engine generator AHU's-121, 125, 221, and 225 have three internal fans each. The fans are configured in a (2)-duty and (1)-installed spare arrangement.
 - b. The associated natural-engine generator AHU's-111, 115, 211, and 215 have four internal fans each. The fans are configured in a (3)-duty and (1)-installed spare arrangement.
3. Fans shall not increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from indicated values; fans shall be designed for static pressure variations of plus or minus 10 percent.
4. Fans shall be statically and dynamically balanced to eliminate vibration and noise transmission to occupied areas.
5. Fans, fan systems and components are exposed to a corrosive atmosphere and shall be of corrosion-resistant construction, or shall be coated with a protective coating. Fans, fan systems, and components in corrosive atmospheres shall be designed, fabricated, and recommended by the manufacturer for the corrosive atmosphere.
6. Fan wheels and inlet cone shall be aluminum and fan wheels shall include extruded airfoil blades. Plenum fans shall be provided with spring-style thrust restraints. There shall be no obstructions (i.e., bearings or bearing supports, etc.) at the inlet of the fan.
7. Each fan shall be sized to perform as indicated on the equipment schedule. The wheel diameter shall not be less than that shown on the equipment schedule. The fan shall be constructed to AMCA Standards for the Class Rating as indicated on the Equipment Schedule. Size fan motor HP to cover 100% of scheduled CFM with one fan off.
8. Fan Base, Spring Isolation, and Support Framing: Mount fan and motor on an internal, fully welded, rigid steel base. Base shall be free-floating at all four corners on spring type isolators with earthquake restraints. The fan assembly shall be isolated from the cabinet by steel springs with minimum deflection of 2.0" or as indicated on schedules. The spring isolators shall be mounted to structural steel members. All isolators shall be rated for zone 4 seismic requirements. The spring isolators shall be mounted on a waffle pad for vibration isolation.
9. Balancing: The fan shaft shall be sized not to exceed 75% of the first critical speed for maximum RPM of Class specified. The critical speed will refer to the top of the speed range of the fans' AMCA class. The lateral static deflection shall not exceed 0.003" per

foot of the length of the shaft. Fans shall be balanced to ISO standard G6.3. A copy of the above balance test data for this project showing calculations for deflection and critical speed of the shaft and wheel assembly shall be submitted to the engineer and a copy forwarded to the Owner.

10. All fans which are to be used in a parallel operation shall be provided with 100% shutoff dampers to prevent airflow through non-operating fans.

E. **Coils/Heat exchangers:** Coils shall include the following:

1. All coils (Heat Exchangers) shall be of the plate fin extended surface type. Tubes shall be 5/8" outside diameter seamless copper with a 0.020" minimum wall thickness. Each coil shall have individually replaceable return bends of 0.025 wall thickness on both sides of the coil. Coils incorporating a "hairpin" type design are not acceptable. Tubes shall be expanded into the fin collars to provide a permanent mechanical bond.
2. The secondary surface shall be formed of 0.010 aluminum fins and shall be spaced not closer than 14 fins per inch with integral spacing collars that cover the tube surface. Headers shall be non-ferrous seamless copper, outside the air stream and provided with brazed copper male pipe connections. **All Coils shall be coated with an Electro Fin coating for corrosion protection.**
3. All coils shall have counter flow construction with connections left or right hand as shown on the drawings. The use of internal restrictive devices to obtain turbulent flow will not be accepted.
4. Coil casings shall be of minimum 16-gauge, 304 stainless steel with double-formed 1-1/4" stacking flanges and 3/4" flanges on the side plates. Flanged tube sheets shall have extruded tube holes to prevent raw edges of tube sheets cut into copper tubes because of thermal expansion of tubes in tube holes. Tube holes with raw sheet metal edges are not acceptable. Reinforcing shall be furnished so that the unsupported length is not over 60". All coil assemblies shall be tested under water at 300 psi and rated for 150-psi working pressure. Headers are to be located inside the cabinet casing with only the pipe connections extending through the casing. All sides of coils shall be carefully blanked off with the same materials used for the coil casings, to ensure all air passes through the coil.
5. All water coils shall be rated in accordance with ARI Standard 410. The air handling unit manufacturer, for the purpose of sole source responsibility, shall manufacture all coils supplied for the air handlers.

F. **Filters:** Filters shall include the following:

1. Filter sections shall be fabricated as part of the air-handling unit. Filters shall be arranged for upstream or downstream loading as shown on the drawings. Provide filter-holding frames to accommodate scheduled filters. Filter frames shall be 316 stainless steel and shall be fully welded to reduce leakage of air through corners.
2. Flat filters shall include a 12" deep Moisture eliminating type filter over a 316 SS drain pan. Filter shall be manufactured by Califog or equal. A mesh type filter is not acceptable. Second stage of filter shall be a 4" deep 85% Minipleat filter.

3. Filter gauges 3-1/2-inch diameter diaphragm actuated dial in metal case with static pressure taps.

G. Dampers: Dampers shall comply with the following:

1. All fan inlets shall include an aluminum motorized damper to prevent air bypass or recirculation while either a fan is out of commission or fan unit is off.
2. The dampers shall have field disconnects and a test pushbutton mounted inside the Air Handling Unit per Ventilation Fan Control Diagram shown in the Contract Drawings 7E-25.

H. Testing: Shall comply with the following:

1. The manufacturer shall perform an air performance test on one selected unit in accordance to AMCA 210-85/ANSI 51-1985 "Standard for Laboratory Measurement of Airflow". Air handling unit air performance data shall be submitted for review by Owner's representative. The engineer shall be allowed to witness the airflow test. The AHU manufacturer shall notify the mechanical engineer a minimum of ten (10) days prior to test as to the location and date of the test. The travel costs incurred by test witnesses shall be borne by the equipment manufacturer

I. Airflow Port for Measuring During Commissioning: Shall comply with the following:

1. The flow measuring provisions shall consist of pressure taps pick-ups located in the inlet cone of each fan. There shall be no obstruction created on the inlet of the fan by installation of flow measuring device. Flow measuring stations installed in the inlet of fan will obstruct the fan inlet and will decrease fan efficiency and increase sound power levels. Provide a gauge with CFM scale on external side of the fan sections, which indicates the fan volume.

J. Field Instruments: Shall comply with the following:

1. **Inside Air Temperature Transmitters:** Shall comply with Contract Drawing 7I-8 and Section 13300.
2. **Differential Pressure Transmitters and Indicators:** Shall comply with Contract Drawing 7I-8 and Section 13300.
3. **Water Temperature Indicators and Transmitters:** Shall comply with Contract Drawing 7I-9 and Section 13300.

2.3 SPARE PARTS

- A. **Spare Parts:** For each unit provide a spare set of filters for each type of filter.

2.4 AIR HANDLING AND MOVING EQUIPMENT SCHEDULES

- A. Individual air handling units shall comply with the requirements indicated on the Air Handling Unit Schedules.

2.5 MANUFACTURERS

- A. **Air Handling Units:** Air handling units shall be manufactured by one of the following (or equal):
 - 1. Energy Labs Inc.
 - 2. Haakon
 - 3. Scott Springfield

PART 3 – EXECUTION

3.1 INSTALLATION

- A. **General:** Air handling and moving equipment shall be installed in accordance with the manufacturer's installation instructions and in conformance with ARI 435.
- B. **Alignment:** Equipment shall be properly aligned and operate free from defects including binding, scraping, vibration, end-shaft runout, or other defects. Drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be bolted in position and neat in appearance.

3.2 GENERAL REQUIREMENTS

- A. Fans shall not be operated for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fans have been test run under observation.
- B. Fans shall be mounted on vibration isolators as recommended by the manufacturer and complying with Section 15050.

3.3 AIR HANDLING UNITS

- A. Fan section shall be isolated with flexible duct connections.

3.4 CENTRIFUGAL FANS

- A. Centrifugal fans shall be installed with:
 - 1. Resilient mountings and flexible electrical leads.
 - 2. Flexible connections between fan inlet and discharge ductwork and in metal connectors with bands installed parallel with minimum one-inch flex between ductwork and fan while running.
 - 3. Restraining snubbers and flexible connectors.
 - 4. Fixed sheaves for final air balance.
 - 5. Safety screen where inlet or outlet is exposed.
 - 6. Scroll drains to nearest floor drain.
 - 7. Backdraft dampers on discharge of exhaust fans and as indicated.

3.5 AXIAL FANS

- A. Axial fans shall comply with the installation requirements for centrifugal (except that scroll drains are not required) and as follows:
 - 1. Adjustable blade axial fan wheels shall include access for varying blade angle setting and for varying range of volume and pressure.

AIR HANDLING UNIT SCHEDULE

	EXHAUST AHUs			
EQUIPMENT TAG	AHU-125	AHU-115	AHU-215	AHU-225
LOCATION	ROOF	ROOF	ROOF	ROOF
CAPACITY (CFM)	72,000	44,000	44,000	72,000
AHU TOTAL ALLOWABLE MAXIMUM WEIGHT (lbs)	25,900	14,200	14,200	25,900

	SUPPLY AHUs			
EQUIPMENT TAG	AHU-121	AHU-111	AHU-211	AHU-221
LOCATION	ROOF	ROOF	ROOF	ROOF
CAPACITY (CFM)	84,775	52,000	52,000	84,775
AHU TOTAL ALLOWABLE MAXIMUM WEIGHT (lbs)	12,509	9,950	9,950	12,509

The following information indicates the AHU's cooling coil requirements necessary to accept the engine generators rejected heat. The AHU's cooling capacities must be greater than the cooling capacity of the decoupling heat exchangers associated with each engine's cooling loop. Refer to specification section 11500, 11501, and drawing 7I-10 for additional information on cooling requirements.

JACKET WATER (HIGH TEMPERATURE) COOLING COILS				
EQUIPMENT TAG	AHU-125	AHU-115	AHU-215	AHU-225
COIL TYPE	HOT WATER	HOT WATER	HOT WATER	HOT WATER
ENTERING AIR TEMPERATURE (°F)	PER LT COIL	90	90	PER LT COIL
WATER FLOW (GPM)	615	350	350	615
ENTERING WATER TEMPERATURE (°F)	202	190	190	202
LEAVING WATER TEMPERATURE (°F)	170	160	160	170
HEADLOSS THROUGH COILS (FT H2O)	25	14	14	25

AUXILIARY WATER (LOW TEMPERATURE) COOLING COILS				
EQUIPMENT TAG	AHU-125	AHU-115	AHU-215	AHU-225
COIL TYPE	HOT WATER	N/A	N/A	HOT WATER
ENTERING AIR TEMPERATURE (°F)	90			90
COOLING WATER FLOW (GPM)	370			370
ENTERING WATER TEMPERATURE (°F)	108			108
LEAVING WATER TEMPERATURE (°F)	100			100
HEADLOSS THROUGH COILS (FT H2O)	10			10

** END OF SECTION **

SECTION 15990 - TESTING, ADJUSTING, AND BALANCING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes furnishing the following WORK by a Specialist company:
1. Testing, adjusting, and balancing of air systems.
 2. Testing, adjusting, and balancing of hydronic systems.
 3. Measurement of final operating condition of HVAC systems.
 4. Sound measurement of operating equipment.
 5. Vibration measurement of operating equipment.

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 11175 Pumps, General
 2. Section 15000 Piping Components
 3. Section 15050 Vibration Isolation
 4. Section 15410 Plumbing Piping
 5. Section 15855 Air Handling and Moving Equipment

1.3 CODES

- A. The 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 Mechanical Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
1. AABC National Standards for Field Measurement and Instrumentation, Total System Balance
 2. ASHRAE 1984 Systems Handbook: Chapter 37, Testing, Adjusting and Balancing
 3. NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Name of Specialist company and documentation of qualifications within 180 days after date established in Notice to Proceed.
2. Prior to commencing work, draft reports indicating adjusting, balancing, and equipment data required.
3. Draft copies of final report for review prior to final acceptance of project.
4. Detailed procedures, agenda, sample report forms, and copy of AABC National Project Performance Guaranty prior to commencing WORK.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. Final reports, letter size, complete with index page and indexing tabs, with cover identification at front end including set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.7 REPORT FORMS

A. Reports shall be prepared on AABC National Standards for Total System Balance NEBB forms.

B. Reports shall be submitted to the CONSTRUCTION MANAGER prior to requesting final payment.

C. Forms shall include the following information:

1. Title Page:
 - Company name
 - Company address
 - Company telephone number
 - Project name
 - Project location
 - Specialist's Project Engineer
 - Project Construction Manager
 - Project Contractor
 - Project altitude
2. Instrument List: Instrument
 - Manufacturer Model
 - Serial number
 - Range
 - Calibration date

3. Air Moving Equipment:
 - Location
 - Manufacturer
 - Model
 - Supply air flow, specified and actual
 - Return air flow, specified and actual
 - Outside air flow, specified and actual
 - Total static pressure (total external), specified and actual
 - Inlet pressure
 - Discharge pressure Fan
 - RPM

4. Exhaust Fan Data:
 - Location
 - Manufacturer
 - Model
 - Air flow, specified and actual
 - Total static pressure (total external), specified and actual
 - Inlet pressure
 - Discharge pressure Fan
 - RPM

5. Return Air/Outside Air Data:
 - Identification/location
 - Design air flow
 - Actual air flow
 - Design return air flow
 - Actual return air flow
 - Design outside air flow
 - Actual outside air flow
 - Return air temperature
 - Outside air temperature
 - Required mixed air temperature
 - Actual mixed air temperature
 - Design outside/return air ratio
 - Actual outside/return air ratio

6. Electric Motors:
 - Manufacturer
 - HP/BHP
 - Phase, voltage, amperage; nameplate, actual, no load
 - RPM
 - Service factor
 - Starter size, rating, heater elements

7. V-Belt Drive:

Identification/location
Required driven RPM
Driven sheave, diameter and RPM
Belt, size and quantity
Motor sheave, diameter and RPM
Center to center distance, maximum, minimum, and actual

8. Duct Traverse:
 - System zone/branch
 - Duct size
 - Area
 - Design velocity
 - Design air flow
 - Test velocity
 - Test air flow
 - Duct static pressure
 - Air temperature
 - Air correction factor

9. Air Distribution Test Sheet: Air terminal number Room number/location
 - Terminal type
 - Terminal size
 - Area factor
 - Design velocity
 - Design air flow
 - Test (final) velocity
 - Test (final) air flow
 - Percent of design air flow

10. Variable Air Volume Data:
 - Manufacturer
 - Identification/number
 - Location
 - Model
 - Size
 - Minimum static pressure

Minimum design air flow
Maximum design air flow
Maximum actual air flow
Inlet static pressure

11. Pump Data: Identification/number
Manufacturer Size/model
Impeller
Service
Design flow rate, pressure drop, BHP Actual flow rate, pressure drop, BHP
Discharge pressure
Suction pressure
Total operating head pressure
Shut off, discharge and suction pressures
Shut off, total head pressure
12. Cooling Coil Data: Identification/number
Location
Service
Manufacturer
Air flow, design and actual
Entering air DB temperature, design and actual Entering air WB temperature, design and actual Leaving air DB temperature, design and actual Leaving air WB temperature, design and actual Water flow, design and actual
Water pressure drop, design and actual
Entering water temperature, design and actual Leaving water temperature, design and actual Air pressure drop, design and actual
13. Heating Coil Data: Identification/number
Location
Service
Manufacturer
Air flow, design and actual
Water flow, design and actual
Water pressure drop, design and actual Entering water temperature, design and actual Leaving water temperature, design and actual Entering air temperature, design and actual Leaving air temperature, design and actual Air pressure drop, design and actual
14. Flow Measuring Station: Identification/station
Location
Size Manufacturer Model
Design flow rate
Design pressure drop Actual/final pressure drop Actual/final flow rate
Station calibrated setting
15. Sound Level Report:
Location
Octave bands - equipment off
Octave bands - equipment on

16. Vibration Test:
- Location of points:
 - Fan bearing, drive end
 - Fan bearing, opposite end
 - Motor bearing, center (if any)
 - Motor bearing, drive end
 - Motor bearing, opposite end
 - Casing (bottom or top)
 - Casing (side)
 - Duct after flexible connection (discharge)
 - Duct after flexible connection (suction)
 - Test readings:
 - Horizontal, velocity and displacement
 - Vertical, velocity and displacement
 - Axial, velocity and displacement
 - Normally acceptable readings, velocity and acceleration
 - Unusual conditions at time of test
 - Vibration source (if non-complying)
17. Duct Leak Test:
- Description of ductwork under test
 - Duct design operating pressure
 - Duct test static pressure
 - Duct capacity, air flow
 - Maximum allowable leakage duct capacity times leak factor
 - Test apparatus
 - Blower
 - Orifice, tube size
 - Orifice size
 - Calibrated
 - Test static pressure
 - Test orifice differential pressure
 - Leakage
18. Combustion Test:
- Boiler manufacturer
 - Model
 - Firing rate
 - Overfire draft
 - Gas meter timing dial size
 - Gas meter time per revolution
 - Gas pressure at meter outlet
 - Gas flow rate
 - Heat input
 - Burner manifold gas pressure
 - Percent carbon monoxide (CO)
 - Percent carbon dioxide (CO₂)
 - Percent oxygen (O₂)
 - Percent excess air

Flue gas temperature at outlet
Ambient temperature
Temperature difference
Percent stack loss
Percent combustion efficiency
Heat output

1.8 PROJECT RECORD DRAWINGS

A. The Specialist shall:

1. Accurately record actual locations of flow measuring stations, balancing valves, and rough setting on the Record Drawings.

1.9 QUALIFICATIONS

A. The Specialist shall be company specializing in the adjusting and balancing of systems indicated in this Section with minimum one successfully performing project completed within the recent past certified by AABC. WORK shall be performed under supervision of AABC Certified Test and Balance Engineer.

1.10 SEQUENCING AND SCHEDULING

A. The Specialist shall:

1. Sequence work to commence after installation of systems and schedule completion of WORK before Substantial Completion of Project.

1.11 TESTING, ADJUSTING AND BALANCING

A. A conference shall be convened one week prior to commencing WORK of this Section.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 EXAMINATION

A. The Specialist shall, before commencing WORK, verify that systems are complete and operable.

B. The Specialist shall ensure the following:

1. Equipment is operable and in safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place; and where required, install temporary filters in addition to final filters.
5. Duct systems are clean of debris.

6. Fan rotation is correct.
7. Fire and volume dampers are in place and open.
8. Coil fins have been cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage has been minimized.
12. Hydronic systems have been flushed, filled, and vented.
13. Pump rotation is correct.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

C. The Specialist shall:

1. Report any defects or deficiencies noted during performance of services to CONSTRUCTION MANAGER.
2. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
3. If, for design reasons, system cannot be properly balanced, report as soon as observed.
4. Acknowledge in writing that beginning of work means acceptance of existing conditions.

3.2 PREPARATION

A. The Specialist shall:

1. Provide instruments required for testing, adjusting, and balancing operations; and make instruments available to CONSTRUCTION MANAGER to facilitate spot checks during testing.
2. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

A. The Specialist shall:

1. Adjust air handling systems to plus or minus 5 percent for supply systems and plus or minus 10 percent for return and exhaust systems from quantities indicated.
2. Adjust hydronic systems to plus or minus 10 percent of design conditions indicated.

3.4 ADJUSTING

A. The Specialist shall:

1. Ensure that recorded data represents actually measured, or observed, condition.
2. Permanently mark settings of valves, dampers, and other adjustment devices and set and

lock memory stops.

3. After adjustment, take measurements to verify balance has not been **disrupted** or that such disruption has been rectified.
 4. Leave systems in proper working order, replacing belt guards, **closing** access doors, closing doors to electrical switch boxes, and restoring thermostats to **indicated** settings.
 5. At final inspection, recheck random selections of data recorded in **report**; and recheck points or areas as selected and witnessed by the OWNER.
 6. Check and adjust systems approximately six months after final **acceptance** and submit report.
- A. Total system balance shall be performed in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

3.5 AIR SYSTEM PROCEDURE

- A. The Specialist shall:
1. Adjust air handling and distribution systems to provide **required** or design supply, return, and exhaust air quantities.
 2. Make air quantity measurements in ducts by Pitot tube traverse of **entire** cross section area of duct.
 3. Measure air quantities at air inlets and outlets.
 4. Adjust distribution system to obtain uniform space **temperatures** free from objectionable drafts and noise.
 5. Use volume control devices to regulate air quantities only to extent **that** adjustments do not create objectionable air motion or sound levels; and control volume by **duct** internal devices such as dampers and splitters.
 6. Vary total system air quantities by adjustment of fan speeds; **provide** drive changes required; and vary branch air quantities by damper regulation.
 7. Provide system schematic with required and actual air quantities **recorded** at each outlet or inlet.
 8. Measure static air pressure conditions on air supply units, **including** filter and coil pressure drops, and total pressure across the fan with allowance for **50** percent loading of filters.
 9. Adjust outside air automatic dampers, outside air, return air, and exhaust **dampers** for design conditions.
 10. Measure temperature conditions across outside air, return air, and exhaust **dampers** to check

leakage.

11. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate.
12. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately static pressure differential.
13. Check multi-zone units for motorized damper leakage; and adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
14. For variable air volume units, set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 WATER SYSTEM PROCEDURE

A. The Specialist shall:

1. Adjust water systems to provide required or design quantities.
2. Use calibrated venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance; where flow metering devices are not installed, base flow balance on temperature difference across heat transfer elements in the system.
3. Adjust systems to provide indicated pressure drops and flows through heat transfer elements prior to thermal testing; perform balancing by measurement of temperature differential in conjunction with air balancing.
4. Balance system with automatic control valves fully open to heat transfer elements.
5. Adjust water distribution systems by means of balancing cocks, valves, and fittings. The Specialist shall not use service or shut-off valves for balancing unless indexed for balance point.
6. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

**** END OF SECTION ****

SECTION 16030 - ELECTRICAL TESTS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes testing, commissioning and demonstrating electrical WORK.
- B. The WORK of this Section includes circuit activation, equipment running and installation of temporary jumpers.
- C. The WORK of this Section includes correction of defects and retesting.

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 13300 Instrumentation and Control
 - 2. Section 16050 Basic Electrical Materials and Methods

1.3 CODES

- A. The WORK of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:
 - 1. National Electrical Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. NETA National Electrical Testing Association, Latest Edition

1.5 SEQUENCE AND SCHEDULING

- A. Electrical testing including functional testing of power and controls not tested under Section 13300 shall be completed before commencement of commissioning.

1.6 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Report of testing of electrical WORK.

PART 2 -- PRODUCTS

2.1 TEST EQUIPMENT AND MATERIALS

- A. Test instruments shall be calibrated to references traceable to the National Bureau of Standards and shall have a current sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required.

PART 3 -- EXECUTION

3.1 TESTING

- A. In addition to indicated testing requirements and acceptance criteria, testing shall include the following:

1. **Lighting:** N/A
2. **Power Instrumentation:** Demonstration that voltmeter and ammeter switches are functional and that meters, including kilowatt meters, are installed within catalog accuracy.
3. Demonstration of mechanical and electrical interlocking by attempting to subvert the indicated sequence.
4. Activation of ground fault tripping by operating test features provided with ground current protective systems and by injecting a known, and reasonable, current in the ground current sensor circuit. Where not otherwise indicated, ground fault tripping shall occur at a ground current equivalent to 20 percent of phase current. Current injection is not required of circuit 400 amperes or less.
5. **Cable Testing:** 480-volt circuits shall be tested for insulation resistance with a 1000-volt megohm meter. Testing shall be done after the 480-volt equipment is terminated. Phase-to-phase A-B, B-C, A-C and phase-to-ground insulation resistance tests shall be performed on each 5 kv, 15 kv, and 25 kv cable prior to termination at equipment but subsequent to stress cone makeup. Test results shall be submitted for review 30 days prior to plant operation and any system testing. Equipment which may be damaged during this test shall be disconnected. Tests shall be performed with other equipment connected to the circuit. The cable must withstand the test high voltage without breakdown, and shall exhibit steady or decreasing leakage current during the high potential test, and have satisfactory comparable megger readings in each megger test. Test results shall identify equipment used and time of test. Cable operating at more than 2,000 volts shall be tested in accordance with ICEA publications S-68-61, S-61-402, S-19-81, and S-68-516. Cable testing and reporting shall be performed by an organization recommended by the Manufacturer of the cable to be tested. The testing organization shall have a record of at least one prior successful project of comparable size and complexity. Testing shall verify the quality of cable terminations. Test results for medium and high voltage cable shall be submitted to the CONSTRUCTION MANAGER 30 days prior to the time schedule for equipment energization.
6. Functional test and testing of electrical components shall be performed prior to subsystem testing and commissioning. Compartments and equipment shall be

cleaned before commencement of functional testing. Functional testing shall include:

Visual and physical check of cables, busswork, circuit breakers, transformers, and connections associated with new and modified equipment.

Setting of protective relays in conformance with results of the Short Circuit Study and testing of relays to assure that relays will trip at the current value and time required by the Study.

Circuit breakers which are specified with adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field adjusted by a representative of the circuit breaker Manufacturer. Time and pickup setting shall correspond to the recommendations of the Short Circuit Study. Setting shall be tabulated and proven for each circuit breaker in its installed position; test results shall be certified and 7 copies shall be submitted to the CONSTRUCTION MANAGER.

7. Complete ground testing of all grounding electrodes prior to operating the equipment utilizing a three-point ground test.
- B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated to the CONSTRUCTION MANAGER and after process control devices have been adjusted. The WORK of this Section includes adjusting limit switches and level switches prior to testing and setting pressure switches, flow switches, and timing relays.
 - C. After initial settings have been completed, each subsystem shall be operated in the manual mode. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify proper start and stop sequence of pumps, proper operation of valves, proper speed control, and similar parameters.
 - D. Subsystems, in the context discussed here, mean individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, and similar equipment.

3.2 COMMISSIONING

- A. Commissioning shall not be attempted until all subsystems have been found to operate satisfactorily; commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable. Simulation of process parameters shall be considered only upon receipt of a written request by the CONTRACTOR.

**** END OF SECTION ****

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing the following:
1. Raceways, Fittings and Supports
 2. Concrete Pads, Underground Ducts, Manholes and Pull-Boxes
 3. Conductors, Wire and Cable
 4. Wiring Devices
 5. Disconnect Switches
 6. Electrical Identification
 7. Pushbuttons
 8. Cabinets and Enclosures
 9. Process Control Devices

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 02200 Earthwork
 2. Section 03300 Cast-In-Place Structural Concrete
 3. Section 05500 Miscellaneous Metalwork
 4. Section 09800 Protective Coating
 5. Section 13300 Instrumentation and Control
 6. Section 15034 Gauges
 7. Section 16030 Electrical Tests
 8. Section 16170 Grounding System
 9. Section 16431 Short Circuit and Coordination Report

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).

1.4 CODES

- A. The 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. California Building Code
 2. National Electrical Code

1.5 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. Federal Specifications:

FS W-C-596E/GEN(1) Connector, Plug, Receptacle and Cable Outlet, Electrical Power

FS W-S-896E/GEN(1) Switches, Toggle (Toggle and Lode), Flush Mounted (ac)

FS WW-C-581E Conduit, Metal, Rigid, and Intermediate; And Coupling, Elbow, and Nipple, Electrical Conduit: Steel, Zinc Coated

WW-C-581E Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Zinc Coated

2. Commercial Standards:

ANSI C80.1 Rigid Steel Conduit, Zinc Coated, Specification For

ANSI/IEEE 386 Separable Insulated Connector Systems for Power Distribution Systems Above 600V

ANSI C37.46 Specifications for Power Fuses and Fused Disconnecting Switches

NEMA TC2 Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)

NEMA ICS 6 Enclosures for Industrial Controls and Systems

NEMA 250 Enclosures for Electrical Equipment (1000 volts maximum)

NEMA WC7 Cross-Linked-Thermosetting Insulated Wire and Cable for the Transmission and Distribution of Electric Energy

ASTM B3 Soft or Annealed Copper Wire

ASTM B8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM B33 Tinned Soft or Annealed Copper Wire for Electrical Purposes

ASTM B189	Lead Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
ICEA S-68-516	Ethylene-Propylene-Rubber-Insulated Wire
IEEE 383	Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations
UL 44	Rubber-Insulated Wires and Cable
UL 83	Thermoplastic-Insulated Wires and Cable
UL 67	Underwriters Laboratories, Electric Panelboards
UL 489	Molded-Case Circuit Breakers and Circuit Breaker Enclosures
UL 50	Cabinets and Boxes

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. General

Shop drawings including the following:

- Complete material list stating manufacturer and name of each item or class of material.
- Front, side, and rear elevations and top views.
- Location of conduit entrances and access plates.
- Identification of conductors not indicated on drawings.
- Identification numbers of conductors.
- Manufacturers' equipment drawings.
- Details of shielded power cable termination.
- Component data.
- Connection, terminal and internal wiring diagrams, and conductor sizes.
- Layout drawings indicating arrangement, dimensions and weights.
- Methods of anchoring.
- Finish.
- Nameplates.
- Temperature limitations, as applicable.

Manufacturer's product data including the following:

- Catalogue cuts, bulletins, brochures, or photocopies of applicable pages for mass produced, non-custom manufactured products stamped to indicate the project name, applicable Specification section and paragraph, model number, ratings and options.

Lists of the following:

Materials, equipment, apparatus and fixtures proposed for use; with the list including sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.

Test reports of the following:

Factory-fabricated products.
Currents resulting from DC high potential testing.

2. Lighting and Power Distribution Panelboards

Manufacturer's data as follows:

Manufacturer's certification that bus bracing is capable of withstanding the specified short circuit condition.

Quantity and rating of circuit breakers provided with each panelboard.

B. General Requirement

1. All equipment furnished by the contractor shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated (UL).
2. 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), State Building Standards, and Applicable local codes and regulations.

1.7 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. Manufacturer's installation instructions.
2. Manufacturer's maintenance procedures.

1.8 PROJECT RECORD DRAWINGS

A. The following shall be included in the PROJECT RECORD DRAWINGS:

1. Accurate location of conductors including depths and routing of concealed below-grade electrical WORK.
2. Accurate location of electrical WORK (raceway and conductors) where the location differs substantially from the locations indicated.

1.9 AREA DESIGNATIONS

- A. **General:** For purposes of delineating electrical enclosure and installation requirements, certain areas are classified as defined below. Electrical installations within these areas shall conform to the indicated code requirements for the area indicated.
- B. **General Purpose Locations [(N) Electrical Building, (N) Control Room, Modified 2nd Floor Office, (E) Engine Room, (E) Electrical Room, (E) Switchgear Building, (E) PS Pump Room, (E) MCC Room]:** WORK installed in areas which are not otherwise specifically classified shall be "General Purpose." Enclosures shall comply with the requirements of these Specifications and shall be NEMA Type 1.
- C. **Damp Location [North Generator Building, South Generator Building, inside Packaged Roof AHUs]:** Locations which are indoors and 2 feet below grade elevation or which are indicated as damp locations on the Drawings shall have electrical installations which conform to the requirements for outdoor locations; except, that the air space from walls may be less than 1/4-inch and enclosures shall be NEMA Type 2. "Damp locations" shall include pipe galleries, tunnels, and basements. Rooms housing liquid handling equipment are also classified as damp locations regardless of grade elevation.
- D. **Outdoor and Corrosive Locations [including: Fuel Storage Area, and roof areas]:** Unless noted otherwise in the drawings, locations shall have stainless steel threaded hardware; electrical hardware, fittings, and raceway systems shall be PVC-coated. Enclosures shall be NEMA Type 4X of fiberglass and reinforced polyester or equal.
- E. **Hazardous Locations:** NEC "Hazardous (Classified) Locations" shall be as indicated and shall comply with NFPA 820.

1.10 FACTORY TESTING

- A. **Product Testing:** Products shall be tested at the factory for compliance with the indicated requirements and as follows:
 - 1. **Cabinets and Enclosures:** Each motor control center shall be completed, assembled, wired, and tested at the factory. All buses and wiring shall be given a dielectric test in accordance with the latest IEEE and NEMA Standards.
- B. **Witnesses:** The OWNER and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness factory tests.

1.11 FIELD TESTING

- A. **Testing:** Products shall be field-tested for compliance with the indicated requirements.

- B. **Witnesses:** The OWNER and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness field tests.

1.12 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Products 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. Products shall not be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry.
- C. **Replacement:** Damaged materials or equipment, including face plates of panels and switchboard sections, shall be replaced or refinished by the manufacturer at no expense to the OWNER.

1.13 REGULATORY REQUIREMENTS

- A. In addition to other indicated regulatory requirements, the WORK of this Section shall comply with the requirements of SSPWC Subsection 209-1.

1.14 UTILITY REQUIREMENTS

- A. The WORK of this Section includes compliance with the requirements of San Diego Gas and Electric Company and payment of related charges.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Listing:** Electrical equipment and materials shall be listed for the intended purpose by an independent testing laboratory including Underwriters Laboratories (UL) or an independent testing laboratory shall be acceptable to the inspection authority having jurisdiction.
- B. **Unlisted Products:** When a product is not available with a testing laboratory listing for the intended purpose, special testing (if any) required by the authority having jurisdiction shall be included in the original contract price.
- C. **Project/Site Conditions:** Unless otherwise indicated, equipment and materials shall be sized and rated for the ambient conditions in San Diego but not less than an ambient temperature of 40 degrees C at sea level without exceeding the manufacturer's stated tolerances.
- D. **Product Qualifications:** Equipment and materials shall be new and shall bear the UL label, where UL requirements apply. Equipment and materials shall be the products of reputable manufacturers specializing in the products indicated in this Section. Similar items in the project shall be products of the same manufacturer. Equipment and materials shall be of industrial grade and standard of construction and shall be of sturdy design and manufacture; and shall be capable of reliable, trouble-free service.

2.2 RACEWAY, FITTINGS AND SUPPORTS

A. **Raceway:** Raceway shall comply with the following:

1. **Rigid Steel Conduit:** N/A.
2. **Intermediate Metal Conduit:** N/A.
3. **Fittings:** Locknuts shall be extra heavy electrogalvanized steel for sizes through 2 inches. Locknuts larger than 2 inches shall be electrogalvanized malleable iron. Bushings shall be electrogalvanized malleable iron with insulating collar. Grounding bushings shall be locking type and shall include a feed-through compression lug for securing the ground cables. Unions shall be electrogalvanized ferrous alloy type. Threadless fittings are not acceptable. Gaskets shall be made of neoprene.

Expansion fittings in embedded runs shall be watertight and shall be provided with an internal bonding jumper. The expansion material shall be neoprene and shall allow for 3/4-inch movement in any direction.

4. **Plastic Coated Rigid Steel Conduit and Fittings:** All indoor conduit, including in the ceilings shall be plastic coated conduit shall be rigid steel conduit with PVC jacket and shall conform to Federal Specification WW-C-581E, ANSI C80.1, and to Underwriter's Laboratories specifications. The zinc surfaces of the conduit shall remain intact and undisturbed on both the inside and the outside of the conduit through the preparation and application processing. A PVC coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic. The thickness of the PVC coating shall be a minimum of 40 mils. A PVC jacketed coupling shall be provided with each length of conduit. A PVC sleeve equal to the OD of the conduit shall extend 1-1/2 inches from each end of coupling.

Fittings used with plastic coated conduit shall be similarly coated to the same thickness as the conduit and shall be provided with type 304 stainless steel hardware. Conduit and fittings shall be manufactured by the same company. Minimum size shall be 3/4 inch.

5. **Electrical Metallic Tubing:** N/A.
6. **Flexible Metal Conduit:** N/A.
7. **Liquidtight Flexible Steel Conduit:** N/A.
8. **Explosion proof Flexible Conduit:** Explosion proof flexible conduit shall be suitable for use in Class I, Division 1, Groups C and D hazardous areas complying with NEC and shall be watertight.

9. **Rigid Nonmetallic Conduit:** All buried conduit shall be rigid nonmetallic conduit shall be NEMA TC2, EPC-80-PVC high impact, polyvinylchloride (PVC). Fittings used with PVC conduit shall be PVC solvent weld type. Nonmetallic conduits shall be UL listed for applications indicated. Minimum size shall be 2 inch.
10. **Wireways:** Wireways and auxiliary gutters shall be JIC EMP-1 sectional flanged oiltight type with hinged covers and shall be 8 inches by 8 inches in cross section unless otherwise indicated.
11. **Cable Trays:** N/A.
12. **Metallic Insulation Bushings:** Metallic insulated bushings shall have ground terminals and smooth and well-rounded surfaces to protect the conductor insulation. The conduit threads shall be deep, clean and easily attached to the conduits. The bushing shall be O-Z/Gedney, Thomas and Betts, or equal.

B. Boxes and Fittings: Boxes and fittings shall comply with the following:

1. **Sheet Metal Boxes:** Boxes and fittings installed in areas where electrical metallic tubing is indicated shall be standard UL approved electro-galvanized sheet steel.
2. **Cast Ferrous Alloy Boxes:** Boxes shall be hot-dip galvanized cast ferrous alloy unless otherwise indicated. Integrally cast threaded hubs or bosses shall be provided for conduit entrances and shall provide for full 5-thread contact on tightening. Drilling and threading shall be done before galvanizing. A full body neoprene gasket shall be included with the cover. Type 304 stainless steel screws shall be provided for covers. Where two or more devices are located together, outlet and device boxes shall be gang type. Cover plates shall be hot-dip galvanized cast ferrous alloy unless the particular device requires a cover that is not manufactured in this material.
3. **Floor Boxes:** Floor boxes shall be hot-dip galvanized cast boxes with an NEMA 4 rating. Boxes shall include a recessed ring neoprene gasket, hot-dip galvanized steel checker cover plates and type 304 stainless steel machine screws of not less than 1/4 inch diameter. The cover screws shall be flat head type or recessed socket head screws designed to be flush with cover plate.
4. **Welded Sheet Steel Boxes:** Large boxes shall be fabricated from welded steel and shall be hot-dip galvanized after fabrication. Before finish is applied, a grounding pad drilled for two bolted grounding lugs or a grounding stud shall be welded to the inside of the box. Hardware shall be 304 stainless steel. Boxes shall, as a minimum, meet NEMA 12 and JIC EMP-1 requirements.
5. **Explosion proof Boxes and Seal Fittings:** In areas specified as Class I, Division 1 or 2, hazardous, boxes and fittings shall be NEMA 7, Groups C

and D, explosionproof. Seal fittings for conduit systems in hazardous atmosphere locations shall be hot-dip galvanized cast ferrous alloy. Sealing compound shall be hard type and UL listed for explosionproof sealing fittings.

6. **Hubs:** Threaded hubs for connection of conduit to junction, device or terminal boxes shall be made of cast ferrous alloy, electroplated with zinc and shall have insulated liner and insulating bushings. The hubs shall utilize a neoprene O-ring and shall ensure a watertight connection.

C. **Raceway Supports:** Raceway supports shall comply with the following:

1. **Conduit Supports:** 316 Stainless steel framing channel shall be used to support groups of conduit. Conduit supports for PVC coated rigid steel shall be one-hole PVC coated clamps or 316 stainless steel.
2. **Ceiling Hangers:** Ceiling hangers shall be adjustable galvanized carbon steel rod hangers. Straps or hangers of plumber's perforated tape are not acceptable. Unless otherwise indicated hanger rods shall be 1/2-inch full-threaded rods and shall meet ASTM A193. Hanger rods in Damp or Outdoor Locations as defined per this Section, shall be shall be 316 stainless steel.
3. **Structural Attachments (Racks):** Structural attachments shall be constructed from 316 stainless steel channel as specified.

2.3 CONCRETE PADS, UNDERGROUND DUCTS, MANHOLES AND PULL-BOXES

A. **General:** The WORK of this Section includes concrete pads, manholes, pull-boxes and concrete required for encasement, installation, or construction and shall be 2500-psi concrete conforming to the requirements of Section 03300 and the following:

1. Consolidation of encasement concrete around duct banks shall be by hand puddling, and no mechanical vibration will be permitted.
2. A workability admixture consisting of a hydroxylated carboxylic acid type in liquid form shall be used in encasement concrete, admixtures containing calcium chloride shall not be used.
3. Concrete for encasement of conduit or duct banks shall contain an integral red-oxide coloring pigment in the proportion of 8 pounds per cubic yard of concrete.

B. **Concrete Pads:** Concrete housekeeping pads shall be provided for floor-standing electrical equipment. Unless noted otherwise, housekeeping pads shall be 3 inches above surrounding finished floor or grade and shall be 2 inches larger in both dimensions than the supported equipment unless otherwise indicated.

C. **Concrete-Encased Ducts:** Where an underground distribution system is indicated, it shall be constructed of multiple runs of single bore non-metallic ducts, concrete encased, with steel reinforcing bars, with underground manholes and pullboxes.

D. **Manholes and Pull-Boxes** Manholes and pullboxes shall comply with the following:

1. Manholes and pull-boxes shall be of precast concrete. Concrete construction shall be designed for traffic loading. Covers shall be parkway type, except as otherwise indicated. "P" covers shall be identified as "High Voltage Electric." "S" covers shall be identified as "Secondary Electric" and "C" covers as "Signal." Manholes and pullboxes shall be equipped with pulling-irons opposite and below each ductway entrance. Manholes shall have concrete covers with 30-inch diameter lids. Covers and lids shall be bolted to cast-in-place steel frames with corrosion resistant hardware. Frames shall be factory-primed; covers shall be galvanized and shall have lifting handles.
2. Manholes and pullboxes shall have cable supports so that each cable is supported at 3-foot intervals within the manhole or pullbox. Cable supports shall be fastened with galvanized bolts and shall be fabricated of fiberglass or galvanized steel.
3. Duct entrances shall be grouted smooth. Ducts for primary and secondary cables shall be terminated with flush-end bells. Sections of prefabricated manholes and pullboxes shall be assembled with waterproof mastic. Each manhole or pullbox shall be set on a 6-inch bed of gravel as recommended by the manufacturer.

2.4 CONDUCTORS, WIRE AND CABLE

- A. **General:** The type, size and number of conductors shall comply with the indicated requirements. Number and types of communication, paging, and security cables shall be as required for the particular equipment provided.

Conductors, including ground conductors, shall be copper. Insulation shall bear the manufacturer's trademark, type, voltage rating, and conductor size.

- B. **Color Coding:** Color coding shall comply with the following:

1. **Control Conductors:** Control conductors color coding shall be manufacturer's standard.
2. **Power Conductors:** Single-conductor power conductors shall have the following colors for 600V or less:

	<u>120/208V</u>	<u>480/277V</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Ground	Green	Green
Neutral	White	Grey

Color coding tape shall be used where colored insulation is not available. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs.

General purpose ac control conductors shall be pink. General purpose dc control conductors shall be blue.

Cables sized No. 4 AWG and larger may be black with colored 3/4-inch vinyl plastic tape applied in 3-inch lengths around the cable at each end. The cables shall be tagged at terminations and in pull boxes, handholes and manholes.

C. **Lighting and Receptacle Branch Circuit Conductors:** Lighting conductors shall be stranded except for No. 12 AWG which shall be solid.

1. Conductors shall comply with the following characteristics:

Voltage:	600 volts.
Conductor:	Bare annealed copper; stranded in accordance with ASTM B8.
Insulation:	THWN/THHN, 90 degree C dry, 75 degree C wet, polyvinylchloride (PVC) per UL 83.
Jacket:	Nylon.
Flame resistance:	UL 83.

D. **Power and Control Conductors and Cable, 600 Volts:** Conductors and cable shall comply with the following:

1. **Single Conductors:** Single conductor cable shall be stranded and shall be installed in conduits for power and control circuits.

Conductors shall comply with the following characteristics:

Voltage:	600 volts.
Conductor:	Coated, Class B, stranded, annealed copper per ASTM B8.
Insulation:	XHHW, 90 degrees C dry, 75 degrees C wet, composite of ethylene propylene rubber (EPR) and chlorosulfonated polyethylene (CSPE) per ICEA UL 44 and NEMA WC-7.
Jacket:	Chlorosulfonated polyethylene (CSPE).

Flame resistance: IEEE 383.

2. **Multiconductor Cable:** Multiconductor cable shall be used for power and control circuits installed in cable tray. Cables shall be UL labeled, Type TC, designed for cable tray installation in accordance with NEC 340. The type of insulation, number of conductors, and size of conductor shall comply with the indicated requirements.

Multiconductor power cable shall contain three or four conductors, as indicated, plus an equipment grounding conductor.

Multiconductor power cables shall comply with the following:

Voltage: 600 volts.

Conductors: Annealed copper, stranded, per ASTM B8, coated per ASTM B33.

Insulation: THWN/THHN, 90 degrees C dry, 75 degrees C wet, ethylene propylene rubber (EPR) or a composite of EPR and chlorosulfonated polyethylene (CSPE) per ICEA S-68-516 and UL 44.

Jacket: Polyvinylchloride (PVC).

Flame resistance: IEEE 383.

Unless otherwise indicated, multiconductor control cable shall be size 14 AWG and shall comply with the following:

Voltage: 600 volts.

Conductors: Annealed copper, stranded, per ASTM B8, coated per ASTM B33.

Insulation: THWN/THHN, 90 degrees C dry, 75 degrees C wet, ethylene propylene rubber (EPR) or a composite of EPR and chlorosulfonated polyethylene (CSPE) per ICEA S-68-516 and UL 44.

Jacket: Polyvinylchloride (PVC).

Flame resistance: IEEE 383.

E. **Direct Burial:** N/A.

F. **Medium Voltage Power Conductors and Cable (5 KV-15 KV):** Conductors and cable shall comply with the following:

1. **Conductors Used In Raceway:** The medium voltage power cable shall be suitable for use in raceways except cable trays. Conductors size 250 MCM and larger may be installed in cable trays when permitted by NEC. The cable

shall comply with the requirements of ICEA S-68516, AEIC CS6, UL 1072 and the following:

Voltage: 5 kV or 15 kV as specified.

Conductor: Single conductor, uncoated copper, Class B, stranded as per ASTM B8.

Strand shield: Extruded semiconducting stress relief layer.

Insulation: Ethylene propylene (EPR), Type MV-90, rated continuous 90 degrees C, emergency 130 degrees C, short circuit 250 degrees C, wall thickness rated for 100 percent insulation level.

Insulation screen: Extruded semiconducting stress relief layer.

Shield: Coated copper tape with 12.5 percent overlap.

Jacket: Polyvinylchloride (PVC).

G. Signal Cables: Signal cables shall comply with the following:

1. **General:** Signal cable shall be provided for instrument signal transmission, alarm, communication and any circuit operating at less than 100 volts. Cables shall be color coded black and white for pairs or black, white and red for triads. Circuit shielding shall be provided in addition to cable shielding.
2. **Single Circuit:** Cable shall consist of one pair or triad, No. 16 AWG conductors with 15 mils of 90 degree C polyvinylchloride (PVC) insulation, 4 mils nylon conduit or jacket, twisted on a 2-inch lay, and covered with a 100 percent 1.35 mil aluminum-Mylar tape shield with No. 18 AWG 7-strand tinned copper drain wire and a 45 mil PVC jacket overall. Cable shall be UL listed, Type TC, rated 600 volts.
3. **Multiple Circuit:** Cable shall consist of four or more pairs or triads which are made up of No. 18 AWG conductors with 15 mils of 90 degree C PVC insulation, 4 mils nylon jacket, twisted on a staggered lay 1-1/2 to 2-1/2 inches, and covered with a 100 percent 1.35 mil aluminum-Mylar tape shield with No. 22 AWG 7-strand tinned copper drain wire. Overall cable shield shall be 2.35 mil aluminum-Mylar tape with a No. 20 AWG 7-strand tinned copper drain wire. Cable shall be UL listed, Type TC, 600 volts.
4. **Thermocouple Extension:** Extension cable shall be provided for the type of thermocouple circuit indicated. Conductors shall be 16 AWG, solid alloy, with 15 mils of 90 degree C flame-retardant polyvinylchloride insulation, twisted and covered with 100 percent 2.35 mil aluminum polyester tape and a 20 AWG, 7-strand, tinned-copper drain wire and a 35 mil, flame-retardant PVC jacket overall. Cable shall be listed for cable tray installation.
5. **Communication, Paging and Security System:** Communication, paging, and security system cables shall comply with Section 13300.
6. **Modbus cable:** Modbus cable shall be fully compatible with the network system shown on plans and meet the requirements set forth at <http://www.modbus.org/>. The contractor shall coordinate and be responsible

for all cable configurations, proof of proper resistance, impedance, shielding, and connections to the motor protection relays and VFDs communication ports.

- H. **Portable Cord:** Portable cord shall be UL listed, Type SO for sizes No. 10 AWG and smaller. Cords with conductors larger than No. 10 AWG shall be UL listed, Type G. Cords shall contain an equipment grounding conductor.

1. Cables shall comply with the following:

Conductors: Flexible rope stranded per ASTM B189 and B33. Conductors shall be coated except ground conductors may be uncoated.

Insulation: Insulation shall be ethylenepropylene (EPR) as per ICEA S-68-516 and rated for continuous operation at 90 degrees C.

Jacket: Heavy-duty neoprene as per ICEA S-68-516.

- I. **Splicing and Terminating Materials:** Splicing and terminating materials shall comply with the following:

1. **600 Volt Conductor and Cable Connectors:** Connectors shall be compression type of correct size and UL listed for the specific application. Connectors shall be tin-plated high conductivity copper. Connectors for wire sizes No. 10 AWG and smaller shall be nylon self-insulated, ring tongue or locking-spade terminals. Connectors for wire sizes No. 8 AWG and larger shall be one-hole lugs up to size No. 3/0 AWG, and two-hole or four-hole lugs for size No. 4/0 and larger. Mechanical clamp, dimple, screw-type connectors are not acceptable.

In-line splices and taps shall be used only where indicated, or shown on the shop drawings. When used, they shall be of the same construction as other connectors. Splices shall be compression type, made with a compression tool die designed for the purpose. Splice shall be covered with a heat-shrinkable sleeve or boot.

2. **5 KV and 15 KV Cable Terminators:** Terminations shall be made with a tin-plated compression type lug and a compression pressure tool recommended by the manufacturer of the lug. Tool shall be of the hydraulic pump type or the type that crimps to the required size before releasing. Electrical voltage stresses shall be controlled by high permittivity, high resistivity, heat shrinkable polymeric tubing. Termination shall be sealed using heat shrinkable tubing and heat activated adhesive. Corona extinction level for a completed termination on a cable shall not be less than 1-1/2 times the rated cable phase to ground voltage.

Splices shall be made with a tin-plated copper compression connector and a compression tool as recommended by the manufacturer of the connector. Tool shall be of the hydraulic pump type or the type that crimps to the

required size before releasing. Electrical voltage stresses shall be controlled by utilization of high permittivity, high resistivity, heat shrinkable polymeric tubing. The splice shall be sealed with a heat activated adhesive and an outer heat shrinkable jacket tubing. Splice shall provide continuity of the cable shield using a wire mesh and grounding clamps.

Load break connectors and bushings shall be rated 8.3 KV phase to ground and 14.4 KV phase to phase across contact; 95 KV BIL; 35 KV, 60 Hz, 1 minute; 11 KV corona extinction; 200 amp continuous, 300 amps, 8 hours; 15,000 amps RMS (asym), 12 cycles, 10,000 amps RMS (sym), 30 cycles; and shall comply with the requirements of ANSI C119.2. Connectors and bushings shall include items necessary for a complete installation.

Nonload-break connectors and bushings shall be rated 8.3 KV phase to ground and 14.4 KV phase to phase; 95 KV BIL; 35 KV, 60 Hz, 1 minute; 11 KV corona extinction; 600 amps continuous; 900 amps, 8 hours; 40,000 amps RMS (asym), 12 cycles; 27,000 amps RMS (sym), 4 seconds; and shall comply with the requirements of ANSI C119.2. Connectors and bushings shall include items necessary for a complete installation.

3. **Portable Cable Fittings:** Portable cable fittings for terminating the cable shall provide a watertight seal between the cord and the terminator and between the terminator and mounting hub. The cable terminator shall include neoprene liner which grips the cord jacket when the back nut on the fitting is tightened.

2.5 WIRING DEVICES

- A. **General:** Wiring devices shall be UL approved for the current and voltage indicated and shall comply with NEMA WD-1. Devices shall contain provisions for back wiring and side wiring with captively held binding screws.

Devices shall be brown, except those located in finished areas shall be ivory.

Special purpose devices shall be the color indicated.

Receptacles and switches shall conform to Federal Specifications W-C-596E and W-S-896E, respectively, and the indicated standards.

- B. **Receptacles and Plugs:** Receptacles and plugs shall comply with the following:

1. **General:** Receptacles shall be grounding type.
2. **120V Receptacles:** Receptacles indicated for indoor use in clean areas shall be duplex 20 amp, NEMA 5-20R, and shall accept NEMA 5-15P and 5-20P plug caps.

Receptacle indicated for use outdoors or in process or corrosive areas shall be duplex, 20 ampere, NEMA 5-20R, and shall accept NEMA 5-15P and

5-20P plug caps. Receptacle and plug caps shall be corrosion resistant, marine duty with yellow polycarbonate weatherproof lift covers.

3. **Ground Fault Interrupter Receptacles:** Receptacles shall be NEMA 5-20R configured and shall mount in a standard outlet box. Units shall trip at 5 milliamperes of ground current and shall comply with NEMA WD-1-1.10 and UL 943. GFI receptacles shall be capable of individual as well as "downstream" operation.
 4. **240V Receptacles:** 240-volt duplex receptacles shall be 2-pole, 3-wire, grounding type, 240-volt, ac, 20-amperes, NEMA Configuration 6-20R. Single 30-ampere receptacles shall be 2-pole, 3-wire, grounding type, 125-volt, ac, 30-amperes, NEMA Configuration 5-30R.
 5. **Plug Caps:** Male plug caps for 120 volt and 240 volt receptacles shall be of the cord grip armored type with heavy phenolic housing, of the same manufacture as the receptacle. Plug caps shall be rated 15 amps. One plug cap shall be provided for every four receptacles (minimum 2 plug caps).
 6. **Three Phase Receptacles and Plugs:** Receptacles shall be suitable for 480 volt, 3-phase, 4-wire service, with ampere ratings as indicated. Receptacles and plugs shall be designed so that the grounding pole is permanently connected to the housing. The grounding pole shall make contact before the line poles are engaged when the plug is connected to the receptacle housing. The plug sleeve shall also make contact with the receptacle housing before the line and load poles make contact. Receptacles shall include cast back box, angle adapter, gaskets, and a gasketed screw-type, weathertight cap with chain fastener. Each receptacle shall be provided with one plug.
 7. **Receptacles for Hazardous Areas:** Receptacles for use in hazardous areas shall be rated in accordance with NEC for the area in which they are to be located and shall be factory sealed. Receptacles shall be designed so the plug must be inserted and turned before load is energized. Receptacles shall be provided with mounting box, sealing chamber, and compatible plug.
- C. **Switches:** Switches shall comply with the following:
1. **General Purpose (Indoor, Clean Areas):** General purpose switches shall be quiet AC type, specification grade, and shall comply with rated capacities as required. Switches shall match receptacles in color.
 2. **Switches for Hazardous Areas:** Switches for control of lighting and small single-phase power loads in hazardous areas shall consist of a factory assembled and sealed combination general purpose type switch in an explosion-proof housing. The switch shall be rated in accordance with NEC for the area in which it is to be installed. The external operating mechanism shall consist of a wing-type handle having the "ON" and "OFF" positions visible from the front.

3. **Switches for Outdoor and Corrosive Areas:** Switches shall be heavy-duty industrial type 20-ampere pressswitch type with weatherproof/corrosion resistant neoprene plate. CONTRACTOR shall provide abuse-resistant nylon handles, and switches with corrosion-resistant steel nickel plate bridge.

D. **Device Plates:** Device plates shall be provided with switches. In noncorrosive indoor areas, receptacle device plates shall be made of sheet steel, zinc electroplated with chrome finish.

Device plates in corrosive or outdoor areas shall be corrosion-resistant/marine-duty type. Device plates for explosionproof equipment shall be factory provided with the equipment.

Device plates shall include engraved laminated phenolic nameplates with 1/8-inch white characters on black background.

Nameplates for switches shall identify panel and circuit number and area served.

Nameplates for receptacles shall identify circuit and voltage if other than 120 volts, single phase.

E. **Plug Strips:** N/A.

2.6 LIGHTING AND POWER DISTRIBUTION PANELBOARDS

A. **General:** Panelboards shall be flush, surface or motor control center mounted as indicated. Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1 and UL circuit breakers shall be group mounted. Panelboards used for service equipment shall be UL labeled for such use.

Ground fault circuit breakers shall be provided for circuits which supply convenience outlets located outdoors or within lavatory and wash down areas indoors.

Handle lock-off devices for circuit breakers which act as motor disconnect switches shall be provided as indicated in panel schedules.

Trim and cabinets of surface-mounted panels in general purpose areas shall be phosphate treated, primed and finished with baked enamel, panels of flush mounted panels shall be finished to match surrounding wall color. Surface mounted cabinets and trim in wet and damp areas shall be galvanized. Panelboards in corrosive areas shall be encased in fiberglass enclosures. The number of circuit breakers and the ampere ratings for lighting panelboard shall be in accordance with panel schedules indicated. The panelboard circuit breakers shall be group mounted and shall be Type NQOB with 3- or 2-pole main breakers as required and branch circuit breakers with 10,000 AIC, minimum or as indicated on the Contract Drawings.

Panelboards shall comply with the following:

1. **Arrangement and Construction:** The front of the panel shall have concealed trim clamps and hinges. The locks shall be flush with cylinder tumbler-type with spring loaded door pulls. The fronts shall not be removable with doors in the locked position. Panelboard locks shall be keyed alike.

Gutter space shall be provided on all sides of the breaker assembly to connect and arrange incoming wiring.

A directory holder with clear plastic plate and metal frame shall be mounted on the inside of the door.

2. **Bus:** Bus shall be tin-plated copper and shall have current ratings indicated on the panelboard schedules and shall be sized in accordance with UL 67. Ratings shall be determined by temperature rise test. Minimum bus size shall be 100 amperes. Panel fault withstand rating shall be equal to the interrupting rating of the smallest circuit breaker in the panel.

Panelboards shall include a separate ground bus.

Neutral bar shall be full-sized and shall have one terminal screw for each branch circuit; main bus bar shall be full-sized for entire length.

The neutral bus of instrument power panels shall be mounted on insulated stand-offs.

Spaces shown shall have cross connections for the maximum sized device that can be fitted.

3. **Circuit Breakers:** Circuit breakers for power panelboard shall be molded-case type designed for the current ratings and pole configurations indicated on the panelboard schedule. Circuit breakers rated 120/208 volt and 120/240 volt alternating current shall have a minimum interrupting current rating of 18,000 amperes (symmetrical) at 240V AC. Circuit breakers rated 277/480 volt alternating current shall have a minimum interrupting current rating of 25,000 amperes (symmetrical) at 480V AC or as indicated on the panelboard schedule. Circuit breakers shall be bolt-on type and shall be listed in accordance with UL 489 for the service indicated.

4. **Finish:** Panelboard cabinet shall be fabricated from hot-dip

B. **Lighting Panelboards:** Except as otherwise indicated, lighting panelboards shall be rated for 120/208-volt 3-phase operation or 120/240-volt for single phase operation. Cabinets for building panels shall be 20-inch wide minimum, with 4-inch minimum side gutters and 5-inch minimum top and bottom gutters. Panelboard trim shall be the same size as cabinet on surface-mounted panels and 3/4-inch larger all around than cabinet of flush-mounted panels.

C. **Power Panelboards:** Power panelboards shall be rated for 600 volts, 3-phase operation. Cabinets for power panelboards shall comply with the following: with

225-amp mains, 30 inches wide; with 400amp, 38 inches wide; with 1200-amp mains, 42 inches wide. Minimum bottom and top gutters shall be 8-inch, minimum side gutter shall be 5-inch.

2.7 DISCONNECT SWITCHES

- A. Disconnect switches shall be externally operated with quick-make/quick-break mechanisms. The handle shall be interlocked with the switch cover by means of a defeatable interlock device. The switch shall be lockable in the "off" position. Switches shall have nameplates with manufacturer, rating, and catalog number. Heavy-duty switches shall have arc suppressors, pin hinges, and shall be horsepower rated at 600-volts. Heavy-duty switches shall be provided for all motor circuits above 3 horsepower. In smaller motor circuits switches shall be general duty. Switch enclosure shall be NEMA 4X.

2.8 ELECTRICAL IDENTIFICATION

- A. **Nameplates:** Nameplates shall be fabricated from white-center, black-face laminated plastic engraving stock. Nameplates shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style of adequate size to be read easily at a distance of 6 feet with no characters smaller than 1/8-inch high.
- B. **Conductor and Equipment Identification:** Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place.
- C. **Identification Tape (Buried):** Identification tape for protection of buried installation shall be a 6-inch wide green polyethylene tape imprinted "CAUTION - ELECTRIC UTILITIES BELOW".

2.9 PUSHBUTTONS

- A. Remote-mounted pushbuttons shall be NEMA rated heavy duty, oiltight type with synthetic rubber boots and any special gasketing required to make the completed station watertight. Provide NEMA Type 4 pushbutton for above ground indoor unit and NEMA Type 4X constructed of stainless steel or glass polyester for dry well area.
- B. Install provisions for locking pushbuttons in the OFF position wherever lockout provisions are indicated. Locking provision shall be 316 stainless steel.

2.10 CABINETS AND ENCLOSURES

- A. **General:** The WORK of this Section includes the following requirements for control compartments of motor control sections, for control cabinets of lighting panelboards, and for separate terminal and control cabinets:
 - 1. **Terminal Cabinets:** Terminal cabinets located indoors shall be NEMA 12. Cabinets located outdoors and in corrosive areas shall be NEMA 4X.

Cabinets shall be provided with hinged doors. Cabinets shall be provided with channel mounted terminal blocks rated 30 amperes, 600 volt AC. Terminals shall be No. 8 minimum strap-screw type, suitable for ring tongue or locking spade terminals. Sufficient terminal blocks to terminate 25 percent more conductors than are indicated shall be provided.

2. **Components:** Compartments of motor control centers containing terminal blocks and control components shall be isolated from other compartments of the control center and shall have a separate hinged door with locking handle. Internal control components shall be mounted on a removable mounting pan.
3. **Relay and Control Cabinets:** Relay and control cabinets shall comply with NEMA 12 for enclosures. Floor-standing cabinets shall have locking handles with 3-point catches. Bottom conduit entrances shall be located accurately and cut to the conduit diameter using a circle cutter (not a torch). Interiors of relay and control compartments shall be finished white. Terminal block requirements shall comply with the requirements for Terminal Cabinets.

B. **Wiring:** Wiring of terminal cabinets and control cabinets shall be accomplished with stranded copper conductor rated for 600-volts and UL listed as Type MTW. Wires for annunciator and indication circuits shall be No. 16 AWG. Other wiring shall be No. 14 AWG. Color coding shall comply with the indicated requirements. Incoming wires to terminal or relay cabinets shall be terminated on a master set of terminal blocks. All wiring from the master terminals to internal components shall be factory-installed and shall be contained in plastic raceways with removable covers. Wiring to door-mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.

C. **Engraving:** Nameplates shall comply with the indicated requirements.

2.11 ELECTROLIERS (NOT USED)

2.12 PROCESS CONTROL DEVICES (NOT USED)

2.13 MANUFACTURERS

A. Products of the type or model number indicated shall be manufactured by one of the below listed manufacturers (or equal):

1. Unions:
Appleton UNF or UNY
Crouse-Hinds UNF or UNY
2. Device Boxes:
Appleton FD
Crouse-Hinds FD
3. Sealing Compound:
Chico A

4. Watertight Seals:
O.Z. Gedney Co., Type CSMC
Thunderline Corp.
Link Seal
5. Lighting and Receptacle Branch Circuit Conductors:
Okoseal-N, Series 116-67-XXXX
6. Single Power and Control Conductors and Cable, 600V:
Okonite-Okolon, Series 112-11-XXXX
Anaconda
Durasheath EP
7. Multiconductor Cables:
Okonite-Okolon, Series 202-11-3XXX
Anaconda
Durasheath EP
8. Direct Burial Cables:
Okonite
CLX
9. Medium Voltage Power Conductors and Cable (5-15 KV) Installed In
Raceway: N/A
10. Armored Cable:
Okoguard, Series 571-23-3XXX
Anaconda
Duralox Unishield EP
11. Single Circuit Signal Cable:
Okoseal-N Type P-OS
12. Multiple Circuit Signal Cable:
Okoseal-N Type SP-OS
13. Thermocouple Extension:
Okonite P-OS, Type PLTC
14. Portable Cords:
Okocord
15. Compression Tool Die For Splicing:
Thomas and Betts Corp.
16. Heat Shrinkable Moisture Seal Caps:
Raychem Corp. "Thermofit"
17. 120V Receptacles (Indoor, Clean Areas):
Hubbell IG-5362

Arrow-Hart 6766
G.E. 4107-1 (Brown)

18. 120V Receptacles (Outdoor, Process or Corrosive Areas):
Hubbell 53CM62/53CM21
General Electric GE5262-C
19. 240V Duplex Receptacles (Gray):
Hubbell 5462
General Electric G.E. 4188-9
20. 240V Single Receptacles (Black):
Hubbell 9308
General Electric G.E. 4138-3
21. Three Phase Receptacles (60 amps):
Crouse-Hinds Catalog No. AREA 6424
Hubbell Hubbellock
22. Three Phase Receptacles (30 amps):
Crouse-Hinds Catalogue No. AREA 3423
Bryant Cat. 7223FR
Russell Stoll No. JRFA6344
23. Switches (Hazardous Areas):
Crouse-Hinds EFSC2129
Appleton EFSC175-F1
24. Electrical Identification:
Nameplates
Formica Type ES-1

Imprinted Plastic Coated Cloth
Brady
Thomas & Betts
25. Device Plates:
Crouse-Hinds
Appleton
26. Plug Strips:
Plugmold
27. Manholes and Pullboxes:
Brooks
Quikset
28. Flexible Conduit:
American Brass
Anaconda

- Electroflex
29. Cable Trays:
P-W
Cope
 30. Compression Connectors:
Burndt "Hi Lug"
Thomas & Betts "Shure Stake"
 31. Spring Connectors (Wire Nuts):
3M "Scotch Lok"
Ideal "Wing Nuts"
 32. Insulating Tape:
Scotch No. 33
Plymouth "Slip knot"
 33. High Temperature Insulating Tape (Polyvinyl):
Plymouth
3M
 34. Pre-Insulated Fork Tongue Lugs:
Thomas & Betts RC Series
Burndy
 35. Epoxy Resin Splicing Kits:
3M Scotchcoat 82 Series
Burndy "Hy Seal"
 36. Stress Cone Material For Make-up Of Medium Voltage Shielded Cable:
G & W
3M
duPont
 37. Stainless Steel Covers:
Sierra S-line
Hubbell
 38. Products For Cast Boxes:
Switches at outdoor locations
Crouse-Hinds DS 128
Mackworth Rees Style 3845
Joy Flexitite

Switches at damp locations
Mackworth Rees Style 3496
Joy Flexitite

Switches at dry locations
Crouse-Hinds DS 32G

Pyle National SCT-10k

Receptacles at outdoor locations
Crouse-Hinds
Hubbell

Receptacles at damp or dry locations
Crouse-Hinds DS 23G
Pyle National N-1

Receptacles at corrosive locations
Crouse-Hinds "Ark Gard"
Appleton DTQ
Hubbell 52CM21 or 5221

39. Cast Boxes Required for Pull or Junction Boxes:
Floor boxes with checker plate covers
O-Z Type "YR",
Surface boxes
O-Z type "YH"
40. Floor Type Outlet Boxes:
Hubbell Catalog B-2530 with S-2530 cover plate
Steel City (Russell & Stoll) Catalog 78AL and 889
41. Power Outlet Boxes:
Hubbell Cat. No. SC-3098
Steel City Cat. No SFH40RG
42. Telephone Outlet Boxes:
Hubbell Cat. No. SS-309-T
Steel City Cat. No SFL10
43. Insulated Bushings:
O-Z Type A and B
Thomas & Betts
Steel City
Appleton
Efcor
Gedney
44. Insulated Grounding Bushings:
O-Z Type BL
Thomas & Betts
Steel City
Efcor
Gedney
45. Erickson Couplings:
Appleton Type EC

Thomas & Betts
Steel City
Efcor
Gedney

- 46. Liquid-tight Fittings:
Appleton Type ST
Thomas & Betts
Crouse-Hinds
Efcor
Gedney
- 47. Hubs:
Appleton Type HUB
Thomas & Betts
Myers Scrutite
Efcor
- 48. Sealing Fittings:
Appleton Type EYS
O-Z Type FSK
- 49. Expansion Couplings:
O-Z Type D
Crouse-Hinds Type

PART 3 -- EXECUTION

3.1 GENERAL

- A. **Field Control of Location and Arrangement:** The Drawings diagrammatically indicate the location and arrangement of outlets, conduit runs, equipment, and other items. Exact locations shall be determined in the field based on the physical size and arrangement of equipment, finished elevations, and obstructions. Locations shown on the Drawings shall be adhered to as closely as possible. Omissions or conflicts on Drawings or between Drawings and Specifications shall be brought to the attention of the CONSTRUCTION MANAGER for clarification before proceeding with the WORK.
- B. **Installation:** The CONTRACTOR shall make all necessary provisions throughout the site to receive the work as construction progresses and shall furnish and install adequate backing, supports, inserts, and anchor bolts for the hanging and support of all electrical fixtures, conduit, panelboard, and switches, and shall furnish and install sleeves through walls, floors, or foundations where electrical lines are required to penetrate.

Conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Fixtures, switches, convenience outlets, and similar items shall be located within

finished rooms, as shown. Where the Drawings do not indicate exact locations, locations of concealed conductors shall be as indicated on the shop drawings.

- C. **Workmanship:** Materials and equipment shall be installed in accordance with printed recommendations of the manufacturer. The installation shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.
- D. **Tests:** The WORK of this Section includes tests required by the authority having jurisdiction. Tests shall be performed in the presence of the CONSTRUCTION MANAGER. The WORK includes testing equipment, replacement parts and labor necessary to repair damage resulting from damaged equipment or from testing and correction of faulty installation. The following tests shall be performed:
 - Insulation resistance tests.
 - Operational testing of equipment.
- E. **Field Quality Control:** Conduit shall be provided with a number tag at each end and in each manhole and pullbox. Trays shall be identified by stencils at intervals not exceeding 50 feet, at intersections, and at each end.

3.2 RACEWAY, FITTINGS AND SUPPORTS

- A. **General:** Except as otherwise indicated, conduit installed in direct contact with earth and in concrete slabs on grade shall be corrosion-protected.

Conduit shall be left exposed until inspected by the CONSTRUCTION MANAGER.

Raceways shall be installed as indicated. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for the purpose intended. Factory elbows shall be used for all 3/4-inch conduits. Bends in larger sizes of metallic conduit shall be accomplished by field bending or by the use of factory elbows.

Non-metallic conduit may be run beneath structures or slabs on grade. In these instances conduit shall be placed at least 12 inches below the bottom of the structure or slab. Non-metallic conduit may be buried 24 inches minimum below grade, with a 3-inch concrete cover, in open areas or where otherwise not protected by concrete slab or structures. Top of concrete cover shall be colored red. Non-metallic conduit shall be permitted only in concealed locations as described above.

Where a run of concealed PVC conduit becomes exposed, a transition to rigid steel conduit is required. Such transition shall be accomplished by means of a factory elbow or a minimum 3-foot length of rigid steel conduit, either terminating at the exposed concrete surface with a flush coupling. Piercing of concrete walls by non-metallic runs shall be accomplished by means of a short steel nipple terminating with flush couplings.

Flexible conduit may be used in lengths required for the connection of recessed lighting fixtures; otherwise the maximum length of flexible conduit shall be 18 inches.

1. Application:

Embedded or encased in non-hazardous areas	Schedule 80 PVC
Exposed in corrosive areas	Plastic coated, rigid steel
Direct buried lighting and receptacle raceways in non-hazardous areas	Schedule 80 PVC
Hazardous and corrosive areas within stud walls, above suspended ceilings, and within elevator machine rooms	Plastic coated, rigid steel
Dry well/Pump room area	Plastic coated, rigid steel
Final raceway connections to lighting fixtures, equipment and pressure switches subject to vibration-DRY AREAS	Flexible non-metallic
Final raceway connections to Equipment	Liquidtight, flexible non-metallic

2. Conduit Runs Between Boxes: The number of directional changes of the conduit shall be limited to total not more than 270 degrees in any run between pull boxes. Conduit runs shall be limited to 400 feet, less 100 feet or fraction thereof, for every 90 degrees of change in direction. Bends and offsets shall be avoided where possible but, where necessary, shall be made without flattening or kinking, or shall be factory preformed bends. Turns shall be made with cast metal fittings or conduit bends. Welding, brazing or otherwise heating of conduit is not acceptable.

3. Junction and Pull Boxes: Cast junction or pull boxes shall be installed where required for pulling cable and as necessary to meet the indicated requirements. Pull boxes used for multiple conduit runs shall not combine circuits of different motor control centers, switchboards, or switchgear.

4. Conduit Terminations: The WORK of this Section includes conductors required to interconnect incoming annunciator, control and instrumentation except as otherwise indicated.

Two- and 3-conductor shielded cables installed in conduit runs which exceed 2,000 feet may be spliced in pullboxes. These cable runs shall have only one splice per conductor.

Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished

equipment. 120/208-volt and 480-volt branch circuit conductors may be spliced in suitable fittings at locations required. 5-kV conductors shall be spliced or terminated only at equipment terminals indicated.

Solid conductors shall be terminated at equipment terminal screws such that conductor is tightly wound around screw and does not protrude beyond screw head. Stranded conductors shall be terminated directly on equipment box lugs such that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.

Splices in 600-volt wire which are not pre-insulated shall be insulated with three layers of tape each half lapped except that splices in below grade pull boxes or in any box subject to flooding shall be made watertight using an epoxy resin splicing kit.

Splices to motor leads in motor terminal boxes shall be taped with varnished cambric tape and with high temperature tape on the exterior.

Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable manufacturer. The CONTRACTOR shall submit the proposed termination procedure as described for shop drawings.

Control devices, such as solenoid operated valves, that are normally supplied with conductor pigtails, shall be terminated as described for control conductors.

Conduit entering NEMA 1 type sheet steel boxes or cabinets shall be secured by locknuts on both the interior and exterior of the box or cabinet and shall have an insulating grounding or bonding bushing installed over the conduit end. Conduit entering other boxes shall be terminated with a threaded hub. Cast boxes and nonmetallic enclosures shall have threaded hubs. Joints shall be made with standard couplings or threaded unions. Metal parts of nonmetallic boxes and plastic coated boxes shall be bonded to the conduit system. Running threads shall not be used in lieu of conduit nipples, nor shall excessive thread be used on any conduit. The ends of conduit shall be cut square, reamed, and threaded with straight threads. Rigid steel conduit shall be made up tight and without thread compound. Exposed male threads on rigid steel conduit shall be coated with zinc-rich paint.

PVC conduit entering fiberglass boxes or cabinets shall be secured by threaded bushings on the interior of the box and shall be terminated with a threaded male terminal adapter having a neoprene O-ring. Joints shall be made with standard PVC couplings.

Conduit entering field equipment enclosures shall enter the bottom or side of the box. Where conduit comes from above, it shall be run down beside the enclosure and a tee conduit and drip leg installed.

5. Matching Existing Facilities: When new conduit is added to areas which are already painted, the conduit and its supports shall be painted to match the

existing facilities. Where new conduit is used to replace existing conduit, the existing conduit and supports shall be removed, resulting blemishes shall be patched and repainted to match original conditions. Similarly, if existing conduits are to be reused and rerouted, resulting blemishes shall be corrected in the same manner. Coating system shall comply with Section 09800.

6. Conduit Support: Exposed rigid steel or plastic coated conduit shall be run on supports spaced not more than 10 feet apart and shall be constructed with runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceiling. Exposed PVC conduit shall be run on supports spaced not more than 3 feet apart for conduits up to 1 inch, 5 feet apart for conduits 1 1/4 inches to 2 inches and 6 feet apart for conduits 2 1/2 inches and larger. No conduit shall approach closer than 6 inches to any object operating above 30 degrees C. PVC conduit shall not be provided where it will be damaged by heat.

Conduit rack and tray supports shall be secured to concrete walls and ceilings by means of cast-in-place anchors. Individual conduit supports shall use cast-in-place anchors, die-cast, rustproof alloy or expansion shields. Wooden plugs, plastic inserts or gunpowder-driven inserts are not acceptable.

7. Conduit Penetrations: Unless otherwise indicated, conduit routed perpendicular through floors, walls or other concrete structures shall pass through cast-in-place openings wherever possible. In cases where cast-in-place openings are not possible, appropriate size holes shall be bored through the concrete to accommodate the conduit passage. The size and location of the holes shall not impair the structure's integrity. After completion, grout or calk around conduit and finish to match existing surroundings. Unless otherwise protected, conduits that rise vertically through the floor shall be protected by a 3 1/2-inch high concrete pad with a sloping top.

Conduits entering manholes and handholes shall be horizontal. Conduits shall not enter through the concrete bottom of handholes and manholes. Wherever conduits penetrate outdoor concrete walls or ceilings below grade, watertight seal shall be installed.

8. Conduit Separation: Signal conduits shall be separated from AC power or control conduits. The separation shall be a minimum of 12 inches for metallic conduits and 24 inches for nonmetallic conduits.
9. Conduit Seals For Hazardous or Corrosive Areas: Conduit passing from a hazardous or corrosive area into a nonhazardous or noncorrosive area shall be provided with a sealing fitting which shall be located at the boundary in accordance with NEC.

Seal fittings for conduit systems in hazardous atmosphere locations shall be hot-dip galvanized cast ferrous alloy. Sealing compound shall be hard type and shall be UL listed for explosionproof sealing fittings. Sealing compound shall be nonhardening type for corrosive areas. Sealing compound shall not be poured in place until electrical installation has been otherwise accepted.

10. **Plastic Coated Conduit:** Plastic coated conduit shall be made up tight with strap wrenches. Conduit threads shall be covered by a plastic overlap which shall be coated and sealed in accordance with manufacturer's recommendations. Pipe wrenches and channel locks shall not be used for tightening plastic coated conduits. Damaged areas shall be patched, using manufacturer's recommended material. The area to be patched shall be built up to the full thickness of the coating. Painted fittings are not acceptable.
11. **Liquidtight Flexible Conduit:** The length of flexible liquidtight conduit shall not exceed 15 times the trade diameter of the conduit. The length of liquidtight conduit shall not exceed 36 inches.
12. **Conduit Fittings:** Fittings shall comply with the same requirements as the raceway with which they will be used. Fittings having a volume less than 100 cubic inches for use with rigid steel conduit, shall be cast or malleable non-ferrous metal. Fittings larger than one inch shall be "mogul size." Fittings shall be of the gland ring compression type. Covers of fittings, unless in "dry" locations, shall include gaskets. Surface-mounted cast fittings, housing wiring devices in outdoor and damp locations, shall have mounting lugs.

Erickson couplings shall be used at all points of union between ends of rigid steel conduits which cannot be coupled. Running threads and threadless couplings shall not be used. Couplings shall be 3-piece type.

Transition fittings to mate steel to PVC conduit, and PVC access fitting, shall be as furnished or recommended by the manufacturer of the PVC conduit.

B. Cable Tray: N/A.

3.3 UNDERGROUND DUCTS, MANHOLES AND PULL-BOXES

A. Underground Ducts: Where an underground distribution system is indicated, installation shall comply with the following:

1. Ducts shall be laid on a grade line of at least 4 inches per 100 feet, sloping towards pullboxes or manholes. Duct shall be installed and pullbox and manhole depths adjusted so that the top of the concrete envelope is a minimum of 24 inches below grade. Changes in direction of the duct envelope by more than 10 degrees horizontally or vertically shall be accomplished using bends with a minimum radius 24 times the duct diameter. Couplings shall be staggered at least 6 inches vertically. Bottom of trench shall be of select backfill or sand. Horizontal and vertical duct separation shall be maintained by plastic spacers set every 5 feet. The duct array shall be anchored every 4 feet to prevent movement during placement of the concrete envelope. Each bore of the completed duct bank shall be cleaned by drawing through it a standard flexible mandrel one foot long and 1/4-inch smaller than the nominal size of the duct through which the mandrel will be drawn. After passing of the mandrel, a wire brush and swab shall be drawn through. A raceway, in the duct envelope, which does not require

conductors, shall have a 1/8inch polypropylene pull cord installed throughout the entire length of the raceway.

2. Duct bank markers shall be installed every 200 feet along run of duct bank, at changes in horizontal direction of duct bank, and at ends of duct bank. Concrete markers, 6 by 6 inches square and one foot long, shall be set flush with grade. The letter "D" and arrow set in the concrete shall be facing in the direction of the duct alignment
- B. **Manholes and Pull-Boxes:** Manholes and handholes shall be set plumb to limit the depth of standing water to a maximum of 2 inches. Manhole covers, unless otherwise indicated, shall be set at grade. Sections of pre-fabricated manholes and pullboxes shall be assembled with waterproof

3.4 CONDUCTORS, WIRE AND CABLE

- A. **General:** Pulling wire and cable into conduit or trays shall be completed without damaging or putting undue stress on the cable insulation. The cable pulling compound shall be polymer-based and UL approved. It shall be non-toxic, non-flammable, non-corrosive and compatible with all cable types. The product shall dry to a thin semi-liquid film that will not clog the conduit. The cable pulling lubricant shall be AquaGel II by Ideal Industries, or equal. Raceway construction shall be complete, cleaned, and protected from the weather before cable is installed.

Whenever a cable leaves a raceway, a cable support shall be provided.

When flat bus bar connections are made with unplated bar, the contact areas shall be "scratch-brushed" before connection. Bolts shall be torqued to the bus manufacturer's recommendations.

- B. **600 Volt Conductor and Cable:** Conductors in panels and electrical equipment, No. 6 AWG and smaller, shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing shall be made up with plastic cable ties. Lacing is not necessary in plastic panel wiring duct. Conductors crossing hinges shall be bundled into groups not exceeding 12 and shall be so arranged that they will be protected from chafing when the hinged member is moved.

Slack shall be provided in junction and pull boxes, handholes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls of the box. Amount of slack shall be equal to largest dimension of the box. Where plastic panel wiring duct is installed for wire runs, lacing is not required. Plastic panel wiring duct shall not be used in manholes and handholes.

Stranded conductors shall be terminated. Conductors shall be terminated directly on the terminal block. Compression lugs and connectors shall be installed using manufacturer's recommended tools.

Lighting and receptacle circuits may be in the same conduit in accordance with derating requirements of the NEC. However, lighting and receptacle circuits shall not be installed in conduits with power or control conductors.

Solid wire shall not be lugged nor shall electrical spring connectors be used on any except for solid wires in lighting and receptacle circuits. Lugs and connectors shall be installed with a compression tool.

Terminations at 460 volt motors shall be made by bolt-connecting the lugged connectors. Connections shall be insulated and sealed with factory-engineered kits. Motor connection kits shall consist of heat-shrinkable, polymeric insulating material over the connection area and a high dielectric strength mastic to seal the ends. Bolt connection area shall be kept free of mastics and fillers to facilitate rapid stripping and re-entry. Motor connection kits shall accommodate a range of cable sizes for both in-line and stub-type configurations.

In-line splices and tees shall be made with tubular compression connectors and insulated as for motor terminations, except that conductors No. 10 AWG and smaller may be spliced using self-insulating connectors. Splices and tees in underground handholes or pull boxes shall be insulated using Scotch-cast epoxy resin splicing kits. Terminations at devices with 120V pigtail leads, at solenoid valves, 120 volt motors, and other devices furnished with pigtail leads shall be made using self-insulating tubular compression connectors.

Conductor and cable markers shall be provided at splice points.

- C. **Signal Cable:** Circuits shall be installed as individually shielded twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever 3-wire circuits are required. Terminal blocks shall be provided at instrument cable junctions, and circuits shall be identified at such junctions unless otherwise indicated. Signal circuits shall be installed without splices between instruments, terminal boxes, or panels.

Shields are not acceptable as a signal path, except for circuits operating at radio frequencies and utilizing coaxial cables.

Common ground return conductors for two or more circuits are not acceptable.

Unless otherwise indicated, shields shall be bonded to the signal ground bus at the control panel and isolated from ground and other shields at other locations. Terminals shall be installed for running signal leads and shield drain wires through junction boxes.

Spare circuits and the shield drain wire shall be terminated on terminal blocks at both ends of the cable run and be electrically continuous through terminal boxes. Shield drain wires for spare circuits shall not be grounded at either end of the cable run.

Terminal boxes shall be installed at instrument cable splices. If cable is buried or in raceway below grade at splice, an instrument stand shall be provided as specified with terminal box mounted approximately 3 feet above grade.

Cable for paging, telephone, and security systems shall be installed and terminated in compliance with the manufacturer's recommendations.

D. **5 KV and 15 KV Cable:** Cable shall comply with the following requirements:

1. **Terminations:** Terminations shall be in exact conformance with the written instructions accompanying the splicing or terminator kits. Special care shall be exercised to ensure that cable insulation is not damaged during stripping back of jacket, semiconductor layers, shields; or penciling operations. All stripping, back operations involving the cutting of nonmetallic layers of the cable shall be accomplished using a ringing tool. The usage of pocket or jack knives for stripping back or penciling operations is prohibited.

2. **Installation:** Cable installation shall comply with the following:

Cable Placement: Cable shall be carefully checked as to condition, size, and length before being pulled into raceways. Cable pulled into the incorrect raceway or cut too short to rack, train, or splice shall be removed and replaced.

Cable In Manholes: Cable shall be supported at all times during handling, without short bends or excessive sags, and shall not be permitted to lie on the manhole floor. Cable ends shall be sealed. Cable racks or trays shall be installed for permanent support. Temporary support required during placement shall be with rope slings or timbers.

Supports: Cable supports and securing devices shall have bearing surfaces oriented parallel to the surfaces of the cable sheath and shall be installed to provide adequate support without deformation of the cable jackets or insulation. Adequate cable end lengths shall be provided and properly placed in electrical equipment or manholes to avoid longitudinal strains and distorting pressures on the cable at termination points and duct end bells. Final inspection shall be made after all cable is in place. Where supports, bushings, and end bells deform the cable jacket, additional supports shall be installed.

Cable Racks: Cable racks shall be installed according to the drawings and as required to provide the proper cable support. Cable racks shall be installed on spacings of not greater than 36 inches and shall be bolted to permanent wall surfaces with anchors or continuous slot concrete inserts.

3. **Cable Pulling:** Cable pulling shall comply with the following:

Pulling Lines: Raceway cleaning mandrels and cable pulling shall be done with manila hemp line to prevent damage to the raceway. Nylon or stranded steel pulling lines shall not be used. "Fishing" may be done with CO₂-propelled polyethylene cord.

Cable Grips: Factory-installed pulling eyes shall be used for pulling cable where they are available. Where pulling eyes are not available, woven wire cable grips shall be used to pull all single-conductor cable. When a cable grip or pulling eye is used for pulling, the area of the cable covered by the grip or seal, plus 6 inches, shall be cut off and discarded when the pull is completed. As soon as the cable is pulled into place, the pulling eyes on cable grips shall be removed and the cable shall be resealed.

Swivels: A reliable, nonfreezing type of swivel, or swivel connection, shall be inserted between the pulling rope and the cable pulling eye, grip, or loop to prevent twisting under strain.

Reel Inspection: Before unreeling, the outside of each cable reel shall be carefully inspected and protruding nails, fastenings, or other objects which might damage the cable shall be removed. A thorough visual inspection for flaws, breaks, or abrasions in the cable sheath shall be made as the cable leaves the reel, and the pulling speed shall be slow enough to permit this inspection. Damage to the sheath or finish of the cable shall be sufficient cause for rejecting the cable. Cable damaged in any way during installation shall be replaced. **Feeding Tubes:** A flexible feeding tube, with a removable nozzle sized to fit the raceway shall be used in pulling all cable. The feeding tube shall be long enough to extend from the raceway entrance to the outside of the manhole and shall be arranged such that it will be impossible for the cable to drag across the edge of the manhole ring or any other damaging surface. Cable pulling into, through, or out of new manholes shall be done with the entire concrete manhole lid removed.

Lubricant: A cable lubricant shall be used on conductors in all pulls, and shall be of the type, and applied in the quantity, recommended by the cable manufacturer. Only lubricants recommended by the cable manufacturer shall be used.

Pulling Tension: The pulling tension of the cable shall not exceed the maximum tension recommended by the cable manufacturer. Pulling mechanisms of both manual and power types shall have the rated capacity (in pounds) clearly marked on the mechanism. A dynamometer shall be used to show the tension on the cable during all pulls and the indicator shall be constantly watched. If any excessive strain develops, the pulling operation shall be stopped at once and the difficulty determined and corrected. Under no circumstances shall cable be pulled using equipment not monitored by a dynamometer. The use of motor vehicles in pulling cable is prohibited. Any cable so pulled shall be removed and replaced. The dynamometer shall have a maximum tension indicator to show the maximum tension developed during a pull. The cable play-out reel shall be equipped with a suitable brake and shall be constantly manned during all pulls.

Sidewall Pressure: To avoid insulation damage from excessive sidewall pressure at bends in raceway runs, the pulling tension in pounds exiting a bend shall not exceed 200 times the radius of the bend in feet.

Cable Bends: Extreme care shall be exercised during the placement of all cable to prevent tension and bending conditions in excess of the manufacturer's recommendations. The permanent radius of bend after cable installation shall be in accordance with the cable manufacturer's recommendations.

4. **Moisture Seals:** Cable shall be kept sealed except when termination and splicing work is being performed. The ends of all cables shall be sealed with heat-shrinkable caps. Cap sizes shall be as recommended by the cap manufacturer for the cable outside diameter and insulation. Caps shall contain sufficient adhesive that shrinkage of the cap during application results in formation of a positive, watertight seal. Before and after pulling, the leading end seal of each length of cable shall be examined and replaced if necessary. All cut cable ends shall be promptly sealed after cutting except those to be spliced or terminated immediately.
 5. **Splices:** Power cable circuits may be spliced only at locations indicated. Splices shall not be made to utilize short lengths of cable, nor shall they be made to provide correct lengths on cable initially cut too short for a particular circuit.
 6. **Terminations:** Cable shall be trained into place without bending the cable in a radius less than the manufacturer's recommended minimum bending radius. If the cable is bent at any time to a radius less than the minimum bending radius, the cable shall be terminated at a point at least 6 inches below the bend. Where the shape and configuration of terminal fittings make workmanlike insulation of the bare connection impractical, the contours of the connection shall be smoothed by filling voids and molding over irregular surfaces with a moldable filler material as recommended by the terminator kit manufacturer before application of the recommended thickness of insulating material.
- E. **Portable Cord:** Portable cord feeding permanent equipment, such as pendant cords, pumps, cranes, hoists, and portable items shall have a wire mesh cord grip of flexible stainless steel wire to take the tension from the cable termination. Connection of portable cords to permanent wiring shall be accomplished with the use of terminals. In-line taps and splices shall be used only where indicated.
- F. **Testing:** Testing shall comply with the requirements of Section 16030 and the following:
1. **Signal Cable:** Each signal pair or triad shall be tested for electrical continuity. Any pair or triad exhibiting a loop resistance of less than or equal to 50 ohms shall be deemed satisfactory without further test. For pairs with greater than 50 ohm loop resistance, the expected loop resistance shall be calculated considering loop length and intrinsic safety barriers if present. Loop resistance shall not exceed the calculated value by more than 5 percent.
- Each shield drain conductor shall be tested for continuity. Shield drain conductor resistance shall not exceed the loop resistance of the pair or triad.

Each conductor (signal and shield drain) shall be tested for insulation resistance with all other conductors in the cable grounded.

Instruments used for continuity measurements shall have a resolution of 0.1 ohms and an accuracy of better than 0.1 percent of reading plus 0.3 ohms. A 500 volt megohmmeter shall be used for insulation resistance measurements.

2. 5-15 KV Cable: N/A. Cables rated 5 kV and above shall be tested using the DC high potential test method and the following:

DC High Potential Testing: After insulation resistance testing is completed, a DC high potential test shall be performed on cables. The procedure for DC high potential testing shall be in accordance with Section 16030 as modified below.

The test voltage shall be direct current at 80 percent of final factory DC test voltage or approximately 50 percent of the basic impulse level (BIL) voltage. The test voltage shall not exceed the maximum voltages specified as follows:

<u>Test voltage, kV</u>			
<u>Rated circuit Voltage Conductor phase-to-phase volts</u>	<u>100 percent size, AWG or KCMIL</u>	<u>133 percent insulation level</u>	<u>insulation level</u>
2001-5000	8-1000	25	25
5001-8000	6-1000	35	35
8001-15000	2-1000	55	65

Test results shall demonstrate that the leakage current decreases or remains constant after reaching the specified test voltage.

3.5 WIRING DEVICES

- A. **General:** Boxes shall be independently supported by galvanized brackets, expansion bolts, toggle bolts, or machine or wood screws as appropriate. Wooden plugs inserted in masonry or concrete shall not be used as a base to secure boxes, nor shall welding or brazing be used for attachment.

Unless otherwise indicated, receptacles and switches installed in sheet steel boxes shall be flush mounted and shall be located 18 inches above the floor unless otherwise indicated.

Switch boxes and receptacles installed in cast device boxes shall be mounted 48 inches above the floor.

- B. **Application of Boxes and Covers:** Boxes and covers shall be installed as follows:
 1. Outlet, switch, and junction boxes for flush-mounting in general purpose locations shall be sheet metal.

2. Outlet, switch, and junction boxes where surface mounted in exposed locations shall be cast alloy ferrous boxes with mounting lugs, zinc or cadmium plating, and enamel finish. Surface mounted boxes in concealed locations may be welded sheet steel boxes.
3. Outlet, control station, and junction boxes, including covers, for installation in corrosive locations shall be fiberglass-reinforced polyester and shall include mounting lugs.
4. Sheet metal boxes for flush-mounting in concrete shall include with cast, malleable box covers and gaskets. Covers for pressed steel boxes shall be one-piece pressed steel, cadmium plated, except that boxes for installation in plastered areas shall be stainless steel over plaster rings.
5. Outlet boxes shall be used as junction boxes wherever possible. Where separate pullboxes are indicated, they shall include screw covers. Outdoors boxes shall be galvanized and shall be provided with gasketed covers and threaded hubs. Indoor boxes shall be painted.

3.6 LIGHTING AND POWER DISTRIBUTION PANELBOARDS

- A. **General:** The circuit description as indicated on the record drawings or panelboard schedule shall be typed on the circuit directory.
- B. **Testing:** Panelboards shall be tested for proper operation and function.

3.7 CABINETS AND ENCLOSURES

- A. The installation of cabinets and enclosures shall comply with the following:
 1. Cabinets: Cabinets shall be set plumb at an elevation such that the maximum circuit breaker height shall be less than 5 ft 6 inches. Top edge of trim of adjacent panels shall be at the same height. Panels which are indicated as flush mounted shall be set so cabinet is flush and serves as a "ground" for plaster application.
 2. Connections: Factory bus and wire connections shall be made at shipping splits, and all field wiring and grounding connections shall be made after the assemblies are anchored.
 3. Finishes: Enclosures smaller in volume than 500 cubic inches shall be finished in accordance with the manufacturer's standard procedures. Finish color shall be No. 61 complying with ANSI Z55.1.

Enclosures larger in volume than 500 cubic inches shall comply with Section 09800.

3.8 EQUIPMENT ANCHORING

- A. Freestanding or wall-hung equipment shall be anchored in place by methods that will meet seismic requirement in the area where project is located. Wall-mounted panels that weigh more than 500 pounds or which are within 18 inches of the floor shall be provided with fabricated steel support pedestal(s). Pedestals shall be of welded steel angle sections. If the supported equipment is a panel or cabinet and enclosed with removable side plates, it shall match supported equipment in physical appearance and

dimensions. Transformers hung from 4-inch stud walls and weighing more than 300 pounds, shall have auxiliary floor supports.

- B. Anchoring methods and leveling shall comply with the printed recommendations of the equipment manufacturers.

3.9 CONDUCTOR AND EQUIPMENT IDENTIFICATION

- A. The completed electrical installation shall include adequate identification to facilitate proper control of circuits and equipment and to reduce maintenance effort.
- B. Control and instrumentation wire and cable shall be assigned a unique identification number. Numbers shall be assigned to conductors having common terminals. Identification numbers shall appear within 3 inches of conductor terminals. "Control" shall be defined as any conductor used for alarm, annunciator, or signal purposes or any connect switch or relay contacts or any relay coils.
 - 1. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number will form a part of the individual wire number. All individual control conductors and instrumentation cable shall be identified at pull points as described above.
 - 2. The instrumentation cable numbers shall incorporate the loop numbers shown.
 - 3. Refer to Section 13300 for numbering details.
- C. Spare conductors shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.
- D. Nameplates shall be provided for panelboards, panels, starters, switches, and pushbutton stations. In addition to the name plates indicated, control devices shall be equipped with standard collar-type legend plates, as required.
- E. Terminal strips shall be identified by imprinted, varnished, marker strips attached under the terminal strip.
- F. Three-phase receptacles shall be consistent with respect to phase connection of receptacle terminals. Errors in phasing shall be corrected at the bus, not at the receptacle.
- G. Toggle switches which control loads out of sight of switch, and all multi-switch locations of more than 2 switches, shall have suitable inscribed finish plates.
- H. Empty conduits shall be tagged at both ends to indicate the destination at the far end. Where it is not possible to tag the conduit, destination shall be identified by marking an adjacent surface.

- I. Identification tape shall be installed directly above buried raceway. Tape shall be installed 8 inches below grade and parallel with raceway. Identification tape shall be installed for buried raceway not under buildings or equipment pads except identification tape is not required for protection of street lighting raceway.

** END OF SECTION **

SECTION 16170 - GROUNDING SYSTEM

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing grounding for electrical systems, exposed non-energized metal surfaces of equipment and metal structures.

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 03300 Cast-In-Place Structural Concrete
2. Section 05120 Structural Steel
3. Section 05500 Miscellaneous Metalwork
4. Section 16050 Basic Electrical Materials and Methods

1.3 CODES

- A. The WORK of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:

1. National Electrical Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. IEEE 81 Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System, Guide for
2. UL 467 Standard for Grounding and Bonding Equipment

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:

1. Shop drawings showing details of grounding system.
2. Product data for grounding electrodes and connections.

1.6 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL:

1. Manufacturer's instructions including instructions for storage, handling, protection, examination, preparation and installation of exothermic welded connectors.

2. Test reports indicating overall resistance to ground and resistance of each electrode.

1.7 PROJECT RECORD DRAWINGS

A. The following shall be included in the PROJECT RECORD DRAWINGS:

1. Accurate record of actual locations of grounding electrodes.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials:** Products 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.

PART 2 -- PRODUCTS

2.1 GENERAL

A. The WORK of this Section includes the following:

1. Products listed and classified by Underwriters Laboratories, Inc. or the testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

2. Except as otherwise indicated, grounding products and systems shall comply with the NEC.

2.2 ROD ELECTRODE

A. Rod electrodes shall be 3/4 inch copper-clad steel, sectional type, joined by threaded copper alloy couplings. Length of rods forming an individual ground array shall be equal in length and shall be of the length required to obtain a minimum ground resistance of 5 ohms. Top of ground rod shall be fitted with a coupling and steel driving stud. Rods shall be of sufficient length to ensure contact with ground water and shall be not less than 10 feet.

2.3 CABLE

A. Ground cable shall be annealed bare copper, concentric stranded wire. If cable sizes are not indicated, the minimum sizes shall be as follows:

- | | | |
|----|---------------------------|---------|
| 1. | 5 and 15 kV switchgear | 4/0 AWG |
| 2. | 5 kV motor starters | 4/0 AWG |
| 3. | 15 kV-5 kV transformers | 4/0 AWG |
| 4. | 5 kV-480V transformers | 4/0 AWG |
| 5. | 480V switchgear | 4/0 AWG |
| 6. | 480V MCC and switchboards | 2/0 AWG |
| 7. | Cable tray | 2/0 AWG |
| 8. | Lighting panels | 2 AWG |

9. Exposed metal 2 AWG

2.4 MECHANICAL CONNECTORS

A. Compression connectors shall comply with the following:

1. Material: Cast Copper

2.5 GROUNDING WELL COMPONENTS

A. Grounding well components shall comply with the following:

1. Well Pipe: 8 inch diameter by 24 inch long concrete pipe with belled end.

2. Well Cover: Cast iron with legend "GROUND" embossed on cover.

2.6 MANUFACTURERS

A. Products indicated shall be manufactured by one of the following (or equal):

1. Rods and Fittings:

Copperweld
Blackburn
Weaver

2. Compression Connectors:

Thomas and Bett

PART 3 -- EXECUTION

3.1 GENERAL

- A. Embedded and buried ground connections shall be made by compression connectors utilizing diamond or hexagon dies and a hand compression tool for wire sizes 2 AWG and smaller and a hydraulic pump and compression head for wire sizes 2/0 AWG and larger. Compression connections shall be prepared in accordance with the manufacturer's instructions. Exposed ground connections to equipment shall be made by bolted clamps unless otherwise indicated. Solder shall not be used in any part of the ground circuits.
- B. Embedded ground cables and fittings shall be securely attached to concrete reinforcing steel with tie wires and prevented from displacement during concrete placement. As each part of the grounding system which is laid below finished grade is completed, the CONSTRUCTION MANAGER shall be notified 2 hours prior to backfilling.
- C. Grounding conductors which are extended beyond concrete surfaces for equipment connection shall be extended a sufficient length to reach the final connection point without splicing. Minimum extension shall be 3 feet. Grounding conductors which project from a concrete surface shall be located as close as possible to a corner of the equipment pad, protected by conduit, or terminated in a flush grounding plate. Exposed grounding conductors shall be

supported by noncorrosive metallic hardware at 4-foot intervals maximum. Grounding conductors for future equipment shall be terminated using a two-hole copper flush mounted grounding plate.

- D. Grounding conductor shall not be used as a system neutral.
- E. Lightning arresters shall be directly connected to the ground system using copper conductors.

3.2 FACILITY GROUNDING

- A. Ground continuity throughout the facility shall be maintained by installing an electrically-continuous metallic raceway system, or a non-metallic raceway with a grounding conductor.
- B. Metallic raceway shall be installed with double lock nuts or hubs at enclosures. Metallic conduits shall be assembled to provide a continuous ground path. Metallic conduits shall be bonded using insulated grounding bushings and shall be connected to the grounding system. Cable trays shall have No. 2/0 AWG bare copper ground conductor run on the outside of each tray. Conductor shall be connected to each section or fitting using a carriage bolt and clamp.
- C. Non-metallic raceway containing dc conductors operating at more than 50 volts to ground, or any ac conductors, shall contain a copper grounding conductor either bare, or green if insulated. Such conductor shall be bonded to terminal and intermediate metallic enclosures.

3.3 EQUIPMENT AND ENCLOSURE GROUND

- A. Electrical and distribution equipment and metal equipment platforms which support any electrical equipment shall be bonded to the nearest ground bus or to the nearest switchgear ground bus. This grounding requirement is in addition to the indicated raceway grounding.
- B. Connection to ground electrodes and ground conductors shall be exothermic welded where concealed and shall be bolted pressure type where exposed. Bolted connectors shall be assembled wrench-tight.
- C. Insulated grounding bushings shall be employed for all grounding connections to steel conduits in switchboards, in motor control centers, in pullboxes, and elsewhere where conduits do not terminate at a hub or a sheet metal enclosure.
- D. Where insulated bushings are required, they shall be installed in addition to double lock-nuts.
- E. Shielded power cable shall have its shield grounded at each termination in a manner recommended by the cable manufacturer. Shielded instrumentation cable shall be grounded at one end only; this shall be at the Motor Control Board or otherwise at the "receiving" end of the signal carried by the cable except as otherwise indicated. Termination of each shield drain wire shall be on its own terminal screw. All of these terminal screws in one rack shall be connected with No. 16 solid tinned bare copper wire jumper; connection to ground shall be accomplished with a No. 12 green insulated conductor to the main ground bus.
- F. Nonelectrical equipment with metallic enclosures shall be connected to the grounding system.

3.4 ISOLATED GROUNDING

- A. Where the manufacturer of equipment supplied from 120 volt instrument power panels requires an isolated ground, an additional isolated ground conductor from the equipment through the instrument power panel for connection to a single point ground bus in the automatic transfer switch enclosure shall be provided. The isolated ground conductor shall have green insulation with a yellow stripe and shall be run in the same raceway as the power and neutral conductors.
- B. The neutral conductor from the ultra-isolation transformers shall be grounded only at the single point ground bus in the automatic transfer switch.

3.5 EXAMINATION

- A. The WORK of this Section includes verification that final backfill and compaction has been completed before driving rod electrodes.

3.6 INSTALLATION

- A. Rod electrodes and additional rod electrodes as required to achieve specified resistance to ground shall be installed at locations indicated.
- B. Grounding well pipes with cover shall be installed at each rod location where indicated with well pipe top flush with finished grade.
- C. Number 4 AWG bare copper wire shall be installed in foundation footing where indicated.
- D. Grounding electrode conductor shall be installed and connected to reinforcing steel in foundation footing where indicated.
- E. Metal siding not attached to grounded structure shall be bonded together and to ground. E.

Reinforcing steel and metal accessories shall be bonded to structures.

- F. Transient suppression plates shall be installed where indicated
- G. Ground grid shall be installed under access floors where indicated. Grid shall be constructed of 2 AWG bare copper wire installed on 24 inch centers both ways. Each access floor pedestal shall be bonded to grid.
- H. Metallic raceway, pipe, duct and other metal object entering space under access floors shall be bonded together and to underfloor ground grid using 2 AWG bare copper conductor.
- I. Isolated grounding conductors shall be installed for circuits supplying personal computers.
- J. Where equipment grounding conductors are indicated, separate insulated conductors shall be installed within each feeder and branch circuit raceway. Ends shall be terminated on suitable lug, bus, or bushing.

3.7 FIELD QUALITY CONTROL

- A. Grounding and bonding system conductors and connections shall be inspected for tightness and proper installation.

3.8 GROUNDING SYSTEM TESTS

- A. Suitable test instruments shall be used to measure resistance to ground of system. Testing shall be performed in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.
- B. The grounding test shall comply with IEEE Standard 81. A plot of ground resistance readings for each isolated ground rod or ground mat shall be submitted on 8-1/2 x 11 inch size graph paper. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test. The measurements shall be made at 10-foot intervals beginning 25 feet from the test electrode and ending 75 feet from it, in direct line between the ground rod or center of grid and the current reference electrode.
- C. A grounding system that shows greater than 2 ohm resistance for the flat portion of the plotted data shall be considered inadequately grounded. Additional parallel connected ground rods and/or deeper driven rods shall be provided until the ground resistance measurements complies with the indicated requirements. Use of salts, water or compounds to attain the specified ground resistance is not acceptable.

** END OF SECTION **

SECTION 16300 - MEDIUM VOLTAGE DISTRIBUTION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all electrical service sections, distribution switchgears, special control panels, control and terminal cabinets, control devices, circuit breakers, interrupter switches, and all appurtenant work, complete and operable. The switchgear manufacturer shall comply with the requirements in Section 13300 - Instrumentation and Control and Section 13350 - Commissioning. The protective relays, controls, and overall single line configuration shall be per the Contract Drawings.

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 13300 Instrumentation and Control
 2. Section 13350 Commissioning
 3. Section 16030 Electrical Tests
 4. Section 16050 Basic Electrical Materials and Methods
 5. Section 16431 Short Circuit and Coordination Report

1.3 CODES

- A. The 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. National Electrical Code (NEC) NFPA 70

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
1. ANSI/IEEE C37.06 Preferred Ratings and Related Required Capabilities for AC High Voltage Circuit Breakers on a Symmetrical Current Basis
 2. ANSI/IEEE C37.09 Test Procedures for AC High Voltage Circuit Breakers Rated on Symmetrical Current Basis
 3. ANSI/IEEE C37.20 Switchgear Assemblies, including Metal-Enclosed Bus
 4. ANSI/NEMA ICS-2 Devices, Controllers, and Assemblies for Industrial Control

5. NEMA SG6 Metal Enclosed Switchgear

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Shop drawings of the service section and switchgear. After review of shop drawings of the service section by the CONSTRUCTION MANAGER, said drawings shall also be submitted to the utility company for approval prior to fabrication.
2. Certified design test reports conducted in the factory testing facilities on similar assemblies.
3. Time/current characteristics for each type of protective device.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. Operating procedures.
2. Maintenance procedures.
3. Manufacturer's parts list, illustrations, assemblies and diagrams.
4. Recommended spare parts list.

1.7 WARRANTY

- A. The Contractor shall provide a 1-year warranty. Should the equipment fail during the 1-year period after acceptance by OWNER, the Contractor, at its own expense, shall repair the equipment.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Materials:** All equipment and materials furnished under this specification shall be new and shall bear the Underwriters' Laboratories label where such service is regularly available.
- B. **Equipment:** All equipment for the same purpose shall be of the same make.
- C. **Enclosure Requirements:** All outdoor equipment, fixtures, and wiring devices shall be of weatherproof construction.
- D. **Standard Products:** Materials and equipment submitted for approval shall be the cataloged products of companies regularly engaged in the manufacture of such items, shall be the latest standard design that conforms to the specification requirements, and shall essentially duplicate material and equipment that has been in satisfactory use for several years.

2.2 SWITCHGEAR MEDIUM VOLTAGE

- A. The main circuit breaker shall be a metal-clad vacuum circuit breaker and shall be rated 5 KV, 3000 AMP continuous current and 350 MVA interrupting capacity at nominal system voltage, and shall be complete with all necessary devices and hardware to result in a complete operable unit. Incoming and outgoing sections shall have ample spaces for 15 kV, 133 percent shielded, jacketed single conductor stress-cone terminations, and lightning arresters. All terminals and lugs shall be of the solderless type suitable for copper cables of the size indicated. The following devices and provisions shall be included:
1. A wheel-mounted, draw-out type vacuum circuit breaker with operating, test and isolation positions. Switchgear cubicle or compartment shall be provided with a mechanical means for moving the circuit breaker to and from its operating position. Suitable guide rails and positive stops shall be provided for centering the circuit breaker in the proper position when inserting or removing the circuit breaker. All necessary accessories required for removing and transferring the circuit breaker shall be furnished. Cubicle shall be provided with a positive overtravel of the circuit breaker when moving it into the OPERATING and TEST position. An indicator or equivalent indicating means shall be provided to clearly show when the circuit breaker is in the TEST or OPERATING position.
 2. A complete mechanical interlock system to prevent moving the vacuum breaker from and into operating position when the vacuum breaker is closed. Removal of the circuit breaker shall be possible only by operating a mechanical device.
 3. A power terminal disconnecting system with automatic shutter, covering all high-voltage parts when the vacuum breaker is moved out of operating position. All disconnecting devices shall be accurately jig aligned and securely mounted to maintain alignment.
 4. The main contacts and their supports shall be guaranteed not to distort or fail under any or all of the following conditions, individually or concurrently:
 - a. Mechanical stresses resulting from the momentary current specified.
 - b. Misalignment of disconnects of plus or minus 1/8-inch.
 5. All contact surfaces shall be silver-to-silver pressure contacts. In general, these contacts, whether stationary or movable, shall be of rugged silverplated copper one-piece construction, with springs on fingers to provide uniform contact with the male part of all operating and environmental conditions.
 6. The circuit breaker control voltage shall be 125V DC. A control bus with all necessary control battery, battery charger and an AC auxiliary power source, fuses and control disconnects shall be provided. The wires shall be carried in a wire trough, gutter, or equivalent method within the switchgear assembly. All wiring shall be protected from sharp edges and corners. Terminal blocks shall be provided on one side of a shipping split for termination of the interconnecting wires, with adequate lengths and identification furnished to permit reconnecting the circuits. Wiring provided for the external connection to other locations shall be wired to terminal blocks.
 7. The vacuum circuit breaker shall be operated by an electrically charged, mechanically and electrically trip-free, stored energy operating mechanism. Provision shall be included for

manual charging of the mechanism and for slow closing of the main contacts for inspection or adjustments. A manual charging lever shall be furnished with the main circuit breaker. The stored energy mechanism shall discharge when the breaker is withdrawn from the cubicle.

8. Facilities shall be provided for padlocking the trip mechanism to block the closing of the circuit breaker.
9. The withdrawable vacuum circuit breaker assembly shall be equipped with self-coupling primary, secondary and grounding contacts.
10. In addition to the "Operating" and "Isolated" positions, an intermediate "Test" position shall be provided to facilitate the operation of the vacuum circuit breaker with the primary circuit disconnected. Transfer of the vacuum circuit breaker between the service, test, and isolated positions shall be mechanically prohibited with the circuit breaker closed.
11. Auxiliary switches shall be directly coupled to the circuit breaker mechanism to indicate the open and closed positions of the circuit breaker positively.
12. Mechanical indication of the following circuit breaker positions - open, closed, operating, test, and isolated, shall be positively indicated at the operating face of the equipment. Electrical indication of the following circuit breaker status - open, closed, and spring charged, shall also be provided at the operating face of the equipment.
13. Close and trip circuits for breaker shall be separately fused with cascaded connection for the closing circuit. Fuse blocks shall be dead front, pullout type to provide the control disconnecting means.
14. Protective Relays:

It shall be the responsibility of the switchgear manufacturer or supplier to complete the detail design of the complete protective relaying system in accordance with the functional requirements indicated in the one-line diagram. The switchgear manufacturer shall provide the quantity, type and rating of protective relays as indicated.

Protective-type relays shall be suitable for operation at a frequency of 60 Hz with current transformers having 5-ampere secondary circuits, and with potential transformers having 120-volt secondary circuits. The relays shall not be damaged by the stresses resulting from the momentary and short-circuit currents indicated. The manufacturer shall guarantee the compatibility of ground sensor current transformers and the associated instantaneous overcurrent relays.

Protective-type relays shall have draw-out type cases of a uniform dull black finish, shall be semi-flush-mounted on the front door operating face of the equipment, and shall be of the rectangular dust-tight type. The relay cases shall be provided with glass covers and gaskets to render them dust-tight. Auxiliary relays shall be surface mounted at easily accessible locations in each cubicle. All protective relays shall be equipped with built in targets or indicating lights which indicate a trip condition.

Resistors and other auxiliary components associated with the relays shall be furnished to provide a complete and functional system.

- B. The main interrupter switch shall be three-pole, single-throw unit, operated by a stored energy spring mechanism such that the speed of switch opening or closing shall be independent of the operator. Switch shall have a means for manually opening or closing if control power is not available or if a motor fails.

Incoming and outgoing switch sections shall have ample spaces for 15 kV, 133 percent shielded, jacketed single conductor stress-cone terminations and lightning arresters. All terminals and lugs shall be of the solderless type suitable for copper cables of the size indicated.

- C. Power fuses shall be provided for fault protection. Fuse rating shall be as indicated. Provisions shall be made to indicate blown fuses. The fuses shall be one of the types indicated below.
 - 1. Current limiting type, where available in rating, of the self-contained design to provide fast clean interruption with minimum let-through current. Fuses shall operate during the first half cycle on maximum fault condition with no expulsion of gas or vapor.
 - 2. Where ratings of current limiting fuses are not available, expulsion power fuses with fast acting characteristics shall be provided.
- D. Access control shall be provided as follows:
 - 1. Doors providing access to interrupter switch with power fuses shall be mechanically or key interlocked to guard against:
 - a. Opening the fuse door if the interrupter switch on the source side of the power fuse is closed.
 - b. Closing the interrupter switch if the door is open.
 - 2. The fuse compartment door shall be interlocked with the switch mechanism to prevent access when the switch is closed.
- E. A high impact type contact viewing window shall be provided in door over the switch.

2.3 MAIN SERVICE SWITCHGEAR

- A. **General:** The main service switchgear shall consist of a free-standing assembly which complies with the Contract Documents. The assembly shall consist of pull section, main breaker, metering section, transition section, and distribution switchgear.
- B. **Main Circuit Breaker Section:** The main circuit breaker shall be as described in subsection 2.2 above and shall have the rating indicated. The service neutral shall be brought to a terminal in the main circuit breaker compartment. A disconnecting link shall be provided in a buss bar connection between the neutral terminal and the switchgear ground bus. Protective relays shall be provided and shall be coordinated and set per utility requirement.
- C. **Metering Section:** The metering section shall comply with all utility requirements.

- D. **Distribution Switchgear:** Switchgear shall rear accessible. The distribution circuit breaker shall be constructed similar to the main circuit breaker as described in subsection 2.2 above.

2.4 SWITCHBOARD INSTRUMENTS

- A. Instrument transformers shall comply with ANSI/IEEE C37.20 and shall have standard accuracy for relaying and metering with the burdens imposed. Mechanical and thermal ratings of current transformers shall be coordinated with short circuit ratings of related circuit breakers. Potential transformers shall be mounted on a disconnecting rack and shall have primary fuse protection.
- B. Protective relays shall be mounted within draw-out cases; current measuring circuits shall be fitted with jacks to short circuit current transformers when relays are withdrawn. Relays shall have means for testing measuring circuitry with the relay in place. Relays may be induction disc or solid state type but shall be products of the switchboard manufacturer.

2.5 SURFACE PREPARATION, PAINTING AND CLEANLINESS

- A. Cleanliness of the equipment furnished shall be such that it is smooth and free of all foreign matter such as scales, sand, blisters, weld splatters, metal chips and shavings, oil, grease, organic matter and rust.
- B. All metal enclosures shall be chemically cleaned and treated in a process which provides a phosphate coating, then primed and finished with a corrosion resistant enamel paint.
 - 1. Exterior surfaces shall be finish painted with dark gray ANSI 61 finish coat, in accordance with the manufacturer's standard practice for the environmental conditions indicated. In addition, the undersurfaces shall be covered with a corrosion resistant protective coating.

2.6 NAMEPLATES, TOOLS AND SPARE PARTS

- A. Nameplates shall be black and white 1/8-inch thick lamincoid, with lettering engraved through the white surface exposing the black lamination beneath. Letter height shall be 1/8-inch minimum unless otherwise indicated. Nameplates shall be fastened near top side of front panel using two matching screws.
- B. A warning nameplate shall be provided on each compartment with external circuit. Warning nameplates shall be red background with white letters and shall read:

"CAUTION - THIS UNIT CONTAINS AN EXTERNAL VOLTAGE SOURCE"

Permanently attached tags shall be provided inside each compartment to indicate location of remote disconnecting means.

- C. A circuit-breaker lifting device, which is capable of lifting the rollout circuit breakers from the switchgear assembly, shall be provided. The lifting device shall have 40-inch diameter locking wheels, a steel platform base, and a hoist mechanism to lift the circuit breaker from the assembly and lower it to the platform base. The entire assembly shall be suitable designed to prevent capsizing during movement of circuit breaker to the platform.

- D. The CONTRACTOR shall furnish paint, matching each color used, for field "touch-up" after installation of the equipment. Two one-pint aerosol spray cans of each color shall be supplied per assembly.

2.7 MANUFACTURERS

- A. Products of the type indicated shall be manufactured by one of the following (or approved equal):
Westinghouse, General Electric, Eaton

PART 3 -- EXECUTION

3.1 INSTALLATION - GENERAL

- A. All electrical equipment materials shall be installed securely in place. Equipment shall be mounted parallel and perpendicular to the walls, floors, and ceilings.
- B. All anchors and fasteners shall be types designed for the intended purpose and shall be capable of adequately, safely, and permanently securing the material in place. Screws shall be used on wood surfaces, masonry anchors in concrete or brick, toggle bolts on hollow walls, machine screws, bolts, or welded studs on steel. Nails shall be used only for temporary attachment or support.
- C. Floor standing equipment shall be leveled with shims as required to maintain horizontal surfaces within 1/32-inch per horizontal foot; after leveling, equipment shall be anchored, then grouted so that no space is existing between concrete and equipment support beams.

3.2 TESTING

- A. The WORK of this Section shall be tested in compliance with the requirements of Section 16030.

3.3 PROTECTIVE RELAY SETTINGS

- A. The relays shall be set in the field by a qualified representative of the manufacturer, retained by the CONTRACTOR in accordance with settings designated in the coordination study specified in Section 16431.

****END OF SECTION****

SECTION 16321 – PAD MOUNTED TRANSFORMERS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Contractor shall furnish and install the pad-mounted transformer(s) as specified herein and as shown on the contract drawings.

1.2 RELATED SECTIONS

- A. 01640 Seismic Design of Equipment and Anchorage

1.3 REFERENCES

- A. The pad-mounted transformer(s) and all components shall be designed, manufactured and tested in accordance with the latest applicable NEMA (NEMA 210), IEEE and ANSI standards (ANSI C57).

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:

1. Front view elevation or outline drawing and weight
2. Nameplate diagram
3. Conduit entry/exit locations
4. Ratings (on nameplate) including:
 - a. kVA
 - b. Primary and secondary voltage
 - c. Taps
 - d. Basic Impulse level
 - e. Impedance

5. Product data sheets

- B. Where applicable, the following additional information shall be submitted to the Engineer:

1. Busway connection
2. Specified accessories

1.5 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.4, and shall incorporate all changes made during the manufacturing process
2. Wiring diagrams

3. Production test reports
4. Installation information
5. Seismic certification as specified

1.6 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
 1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
 2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
 3. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.
 4. The Contractor shall provide anchorage details stamped and signed by a structural engineer registered in the State of California.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

1.9 FIELD MEASUREMENTS

- A. Measure primary and secondary voltages and make appropriate tap adjustments.

PART 2 – PRODUCTS

2.1 MANUFACTURERS OR EQUAL

- A. Eaton
- B. Schneider Electric
- C. Cooper
- D. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 RATINGS

- A. The ratings of the transformer shall be as follows or as shown on the drawings:

kVA Rating	1500 ONAN
Impedance	5.75%
HV	4.16 kV Wye
HV BIL	60 kV
HV de-energized Taps	+/- 2 - 2-1/2% full capacity
LV	480 V Wye Solidly Grounded
LV BIL	60 kV

2.3 CONSTRUCTION

- A. The unit shall be mineral oil filled and shall be in accordance with the latest edition of the NEC. High fire point fluids shall be Factory Mutual and UL approved. Units shall be rated for outdoor use.
- B. The transformer shall carry its continuous rating with average winding or temperature rise by resistance that shall not exceed 65 degrees C rise, based on an average ambient of 30 degrees C over 24 hours with a maximum of 40 degrees C.
- C. The transformer shall be designed to meet the sound level standards for liquid transformers as defined in NEMA and ANSI.
- D. High-voltage and low-voltage windings shall be copper. Insulation between layers of the windings shall be by thermally set insulating paper or equal.
- E. The main transformer tank and attached components shall be designed to withstand pressures greater than the required operating design value without permanent deformation. Construction shall consist of carbon steel reinforced with external, internal or sidewall braces. All seams and joints shall be continuously welded.
- F. The assembly shall be individually welded and receive a quality control pressurized check for leaks. The entire tank assembly shall receive a similar leak test before tanking. A final six-hour

leak test shall be performed. The transformer(s) shall be compartmental-type, self-cooled and tamper-resistant for mounting on a pad. The unit shall restrict the entry of water (other than flood water) into the compartments so as not to impair its operation. There shall be no exposed screws, bolts or other fastening devices which are externally removable.

- G. The transformer(s) shall consist of a transformer tank and full-height, bolt-on high- and low-voltage cable terminating compartments located side-by-side separated by a rigid metal barrier. Each compartment shall have separate doors, designed to provide access to the high-voltage compartment only after the low-voltage has been opened. There shall be at least one additional fastening device accessible only after the low-voltage door has been opened, which must be removed to open the high-voltage door. Doors shall be mounted flush with the cabinet frame. The low-voltage door shall have a handle-operated, three-point latching mechanism designed to be secured with a single padlock. A hex-head or penta-head bolt shall be incorporated into the low-voltage door latching mechanism. Both high and low-voltage doors shall be incorporated into the low-voltage door latching mechanism. Both high and low-voltage doors shall be equipped with stainless steel hinges and door stops to secure them in the open position.
- H. Compartment sills, doors and covers shall be removable to facilitate cable pulling and installation. The high-voltage door shall be on the left with the low-voltage door on the right. Compartments shall be designed for cable entry from below.
- I. Transformer(s) shall be supplied with a welded or bolted main tank cover and be of a sealed-tank construction designed to withstand a pressure of 7 psig without permanent distortion. The tank cover shall be designed to shed water and be supplied with a tamper-resistant access handhole sized to allow access to internal bushing and switch connections. Transformers supplied with "less flammable" fluids shall be manufactured to withstand 12 psig without rupture. The transformer shall remain effectively sealed for a top-oil temperature of -5 degrees C to 105 degrees C. When necessary to meet the temperature rise rating specified, cooling panels shall be provided.
- J. The transformer manufacturer shall certify that the transformer is non-PCB containing less than 1 part per million detectable PCBs. Nonflammable transformer liquids including askarel and insulating liquids containing tetrachloroethylene, perchloroethylene, chlorine compounds, or halogenated compounds are not acceptable and shall not be provided.
- K. When high-voltage taps are specified above, full-capacity taps shall be provided with a tap changing mechanism designed for de-energized operation. The tap changer operator shall be located within one of the compartments.
- L. The coil windings shall be designed to reduce losses and manufactured with the conductor material as specified above. All insulating materials shall be rated for 120 degrees C class.
- M. For grounded wye to grounded wye application, the core assembly shall be a 5-legged, distributed-gap, wound core, designed to meet NEMA TR-1 sound levels measured per ANSI standards.
- N. The core material shall be high-grade, grain-oriented, non-aging silicon core steel with high magnetic permeability, low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below saturation to allow for a minimum of 10 percent overvoltage excitation. The cores shall be properly annealed to reduce stresses induced during the manufacturing processes and reduce core losses.

- O. The core frame shall be designed to provide maximum support of the core and coil assembly. The core frame shall be welded or bolted to ensure maximum short-circuit strength.
- P. The core and coil assembly shall be designed and manufactured to meet the short-circuit requirements of ANSI C57.12.90. The core and coil assembly shall be baked in an oven prior to tanking to “set” the epoxy coating on the insulating paper and remove moisture from the insulation prior to vacuum filling.
- Q. Transformer shall be vacuum-filled with the appropriate fluid as indicated above. The process shall be of sufficient vacuum and duration to ensure that the core and coil assembly is free of moisture prior to filling the tank.

2.4 ACCESSORIES

- A. Transformer features and accessories shall include:
 - 1. Dial-type thermometer
 - 2. Liquid level gauge
 - 3. Drain valve with sample valve
 - 4. Pressure relief valve
 - 5. Non-PCB label
 - 6. Upper fill/filter press connection or valve

2.5 PRIMARY CONNECTIONS

- A. Transformer primary connections shall be 600 A dead break wells and inserts for cable sizes shown on the drawings.

2.6 PRIMARY FUSING

- A. Where shown on the drawings, provide the following fuses:
 - 1. Provide full-range, current limiting fuses in loadbreak drywell canisters

2.7 FINISH

- A. Transformer units shall include suitable outdoor paint finish. The paint shall be applied using an electrostatically deposited dry powder system to a minimum of three (3) mils average thickness. Units shall be painted padmount green, Munsell No. 7GY3.29/1.5.

PART 3 -- EXECUTION

3.1 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest applicable ANSI and NEMA standards.
 - 1. Resistance measurements of all windings on the rated voltage connection
 - 2. Ratio tests on the rated voltage connection and on all tap connections

3. Polarity and phase-relation tests on the rated voltage connections
 4. No-load loss at rated voltage on the rated voltage connection
 5. Exciting current at rated voltage on the rated voltage connection
 6. Impedance and load loss at rated current on the rated voltage connection
 7. Applied potential test
 8. Induced potential tests
- B. The manufacturer shall provide three (3) certified copies of factory test reports to the Engineer upon request.
- C. The following special factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest applicable ANSI and NEMA standards.
1. Temperature test(s) shall be made on all units. Tests shall not be required when there is available a record of a temperature test on an essentially duplicate unit
 2. ANSI impulse test on all primary windings

3.2 MANUFACTURER'S CERTIFICATION

- A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.3 TRAINING

- A. The contractor shall provide a training session for up to five (5) owner's representatives for 1 normal workday at a job site location determined by the owner.
- B. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers and major components within the assembly.

3.4 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- B. All necessary hardware to secure the assembly in place shall be provided by the contractor.

3.5 FIELD ADJUSTMENTS

- A. Adjust taps to deliver appropriate secondary voltage.

3.6 FIELD TESTING

- A. Measure primary and secondary voltages for proper tap settings.

- B. Megger primary and secondary windings.
- C. Liquid transformers – Test oil for dielectric strength.

****END OF SECTION****

SECTION 16400 - LOW VOLTAGE ELECTRICAL SERVICE AND DISTRIBUTION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all electrical service sections, distribution switchboards, special control panels, control and terminal cabinets, control devices, circuit breakers, and all appurtenant work, complete and operable.

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 16030 Electrical Tests
2. Section 16050 Basic Electrical Materials and Methods
3. Section 16480 Motor Control

1.3 CODES

- A. The 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. National Electrical Code (NEC) NFPA 70

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. ANSI/IEEE C37.20 Switchgear Assemblies, including Metal-Enclosed Bus
2. ANSI/NEMA ICS-2 Devices, Controllers, and Assemblies for Industrial Control
3. ANSI/UL 1008 Automatic Transfer Switches, Safety Standard for
4. NEMA PB2 Dead Front Distribution Switchboard

1.5 SHOP DRAWINGS AND SAMPLES

1. Shop drawings of the service section and switchboards. After review of shop drawings of the service section by the CONSTRUCTION MANAGER, said drawings shall also be submitted to the utility company for approval prior to fabrication.
2. Design test reports conducted for similar assemblies at the factory.

1.6 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL.

1. Operating procedures.
2. Maintenance procedures.
3. Manufacturer's parts list, illustrations, assemblies and diagrams.

1.7 WARRANTY

The Contractor shall provide a 1-year warranty. Should the equipment fail during the 1-year period after acceptance by OWNER, the Contractor, at its own expense, shall repair the equipment.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Materials:** All materials and equipment furnished under this Specification shall be new and shall bear the Underwriters' Laboratories label where such service is regularly available.
- B. **Equipment:** All equipment for the same purpose shall be of the same make.
- C. **Enclosure Requirements:** All outdoor equipment, fixtures, and wiring devices shall be of weatherproof construction.
- D. **Standard Products:** Materials and equipment shall be catalogue products of companies regularly engaged in the manufacture of such items, shall be the latest standard design that conforms to the specification requirements, and shall essentially duplicate material and equipment that has been in satisfactory use for several years.

2.2 SWITCHBOARDS

- A. Indoor construction shall be of the universal frame type using die-formed welded and bolted members. Enclosing panels shall be 14-gauge steel and shall be bolted in place. In addition, indoor construction shall conform to the following:
 1. Outdoor switchboards shall be totally enclosed, NEMA 4X, gasketed.
 2. Indoor switchboards shall be totally enclosed, NEMA 1.
 3. Bus bar shall be copper fully insulated. Copper shall be silver plated at joints. Bus bars shall be braced for short circuit currents of 65,000 amperes minimum, or as indicated. A full length copper ground bus bar shall be provided at the bottom of the switchboard enclosure.
- B. Outdoor construction shall be as described in the previous paragraph, except that switchboard installation shall be rodent- and bird-proof. Outdoor construction shall be NEMA 4X, non-walk-in type. An insulating compound shall be applied to the interior surface of roof panels for condensation control.
- C. Floor-standing distribution switchboards and the main service switchboard shall be catalogue products of the main circuit breaker manufacturer. Switchboards shall be shipped fully assembled and tested.

2.3 MAIN SERVICE SWITCHBOARD

- A. **General:** The main service switchboard shall consist of a free-standing assembly which complies with the requirements for switchboards.
- B. **Switchboard:** Switchboard shall be front- and side-accessible. Switchboards shall be constructed to accommodate additional distribution sections. The switchboard shall consist of the sections described in the following paragraphs.
- C. **Service Section:** The service section shall consist of an underground pull compartment and a revenue metering compartment which comply with utility requirements. Components such as meter bases, busses, lugs, auxiliaries shall be provided.
- D. **Main Circuit Breaker Compartment:** The main circuit breaker unit shall have the ratings indicated. Service neutral shall be brought to a terminal in the main circuit breaker compartment. A disconnecting link shall be provided in a bus bar connection between the neutral terminal and the switchboard ground bus.

The main circuit breaker shall have protective features with capability of selective tripping characteristics which can be used to provide overcurrent protection from overloads, short-circuits and ground faults.

Circuit breakers shall be equipped with solid-state programmers.

- E. The main circuit breaker shall be individually mounted draw-out of the size and type indicated. Motorized spring charging shall be provided where indicated.
- F. **Distribution Section:** The distribution section shall consist of individually mounted molded case circuit breakers of the size indicated. Full length vertical bus shall be provided for each distribution section. Unless indicated otherwise, rating shall be 300-amperes minimum.

2.4 SWITCHBOARD INSTRUMENTS

- A. Indicating instruments shall be approximately 4-1/2-inch square with 250-degree scales and white dials with black graduations. Case shall be semi-flush mounted with anti-glare glass. Front access zero adjustment shall be provided. Indication accuracy shall be as indicated.

Indicating meters shall be of the following type:

- 1. Main incoming circuit breaker:
 - 1 - voltmeter 0-600V, single-phase, one percent accuracy
 - 1 - voltmeter transfer switch with pistol grip handle to permit a single-phase voltmeter to indicate voltage between phase of a three-phase system. Switch shall have an "Off" position
 - 1 - AC indicating ammeter, five amperes full scale, single-phase, 0-full scale amperes dial, one percent accuracy

1 - Ammeter transfer switch with pistol grip handle to permit a single-phase ammeter to indicate current in each phase of a three-phase system. Switch shall have an "Off" position

1 - Watt-hour demand meter with 15-minute demand register, three-phase, two-element

1 - Varmeter with 3-phase, three-wire, cross-phase, three current coils on open-delta potential transformers, coil rating five amperes

2. Distribution feeder circuit breaker:

1 - AC indicating ammeter, five amperes full scale, single-phase, amperes dial, one percent accuracy

1 - Ammeter transfer switch with pistol grip handle to permit a single-phase ammeter to indicate current in each phase of a 3-phase system. Switch shall have an "Off" position

Where they are shown on the single line diagram, the following shall be provided:

1 - Watt-hour demand meter with 15-minute demand resistor, 3-phase, two-element

1 - Varmeter with three-phase, three-wire, cross phase, three current coils on open-delta potential transformers, coil rating 5-amperes

- B. Instrument transformers shall comply with ANSI/IEEE C37.20 and shall have standard accuracy for relaying and metering with the burdens imposed. Mechanical and thermal ratings of current transformers shall be coordinated with short circuit ratings of related circuit breakers. Potential transformers shall be mounted on a disconnecting rack and shall have primary fuse protection.
- C. Protective relays shall be mounted within draw-out cases; current measuring circuits shall be fitted with jacks to short circuit current transformers when relays are withdrawn. Relays shall have means for testing measuring circuitry with the relay in place. Relays shall be solid-state type and shall be product of the switchboard manufacturer.

2.5 TRANSFORMERS

- A. All indoor transformers shall be dry-type and shall conform to or exceed the requirements of the latest applicable IEEE, NEMA, and ANSI standards. Transformers rated 3 kva and below shall be designed not to exceed 80-degree C temperature rise; 5 kva and greater shall be designed not to exceed 115-degree C temperature rise.
- B. Transformers rated 15 kVA and above shall have four 2-1/2 percent taps, two above and two below 480 volts. Transformers shall be floor type.
- C. **Isolation Transformers:** Isolation transformers shall be designed to lessen effects of transient generation into the supply power and shall act as a buffer for SCR current surges. Transformers shall have full capacity taps, four 2.5 percent taps, two above and two below primary windings. Transformers shall have a 150 degree C insulation and shall be UL listed.

2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Circuit breakers having a frame size of 150-amperes or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units. Breaker contact material shall be a non-weldable silver alloy. Breakers shall have arc-extinguishing chutes. Ground fault tripping, where required, shall be as indicated below.
- B. Circuit breakers with a frame size of 225 amperes to 600 amperes shall be molded case with interchangeable thermal and adjustable magnetic trip elements. Ground fault protection shall be provided by means of a core balance transformer encircling all feeder leads. The transformer shall energize a surface-mounted, solid-state relay, adjustable from 10-20 percent of phase current with an adjustable time delay of zero to 36 cycles. Ground fault protection shall include a test panel containing indication and test tripping circuits.
- C. Circuit breakers with a frame size more than 600 amperes shall be molded case as described in the foregoing paragraph, except if power circuit breakers are indicated. Molded case circuit breakers shall have an integral, solid state over-current trip unit and line current sensors. Trip units shall have adjustable long time tripping in the range of 60 to 100 percent of continuous rating, instantaneous tripping adjustable in the range of 300 to 1000 percent of continuous rating, and ground fault tripping adjustable in the range of 20 to 60 percent of continuous rating with adjustable delay of approximately 5 to 40 cycles.
- D. Power circuit breakers shall be draw-out; power circuit breakers shall be air break units or insulated case units. Draw-out mechanism shall be 4-position: connected, test, disconnect and remove. The circuit breaker element shall be able to assume the connected, test, and disconnected positions with the circuit breaker cubicle door closed.
- E. Interlocks shall be provided to assure that the circuit breaker element is open before movement from a position is possible; stored energy mechanism shall be discharged automatically upon removal of the circuit breaker element from its cubicle. Charging of stored energy springs shall be motorized; closing of the main power contacts shall automatically charge the tripping springs. A manual trip button, position indicators, and status of stored energy mechanism shall be fitted to the front panel.
- F. Power circuit breakers shall be equipped with an integral solid-state 3-phase tripping unit as described above.
- G. Circuit breaker interlocking shall include an anti-pumping circuit.
- H. An external power source shall not be required for circuit breaker tripping. A bell alarm switch shall be provided to close only on circuit breaker overload.
- I. Circuit breaker accessories shall include switchgear mounted traveling lift-out hoist.

2.7 MANUFACTURERS

- A. Products of the type indicated shall be manufactured by the following (or equal):

- 1. Solid state programmers for circuit breakers:

General Electric Micro-Versatrip
Square D Micrologic Trip System

2. Indicating meters

Voltmeter

Westinghouse Type KA-251
General Electric Type AB-40

Voltmeter transfer switch

Westinghouse Type W
General Electric Type SB-1

AC indicating ammeter

Westinghouse Type KA-241
General Electric Type AB-40

Ammeter transfer switch

Westinghouse Type W
General Electric Type SB-1

Water-hour demand meter

Westinghouse Type CB
General Electric Type DSM 63

Varmeter

Westinghouse Type KP-261
General Electric Type AB-40

3. Automatic transfer switch

ASCO
Russelectric
Westinghouse
Zenith

4. Transformers

General Electric
Westinghouse
Square D

5. Molded case, insulated case and power circuit breakers

Westinghouse Pow-R-Gear
General Electric Power Break
Square D

6. Switchboard

General Electric, AV-Line
Westinghouse, Pow-R-Line C

PART 3 -- EXECUTION

3.1 INSTALLATION - GENERAL

- A. All electrical equipment materials shall be installed securely in place. Equipment shall be mounted parallel and perpendicular to the walls, floors, and ceilings.
- B. All anchors and fasteners shall be types designed for the intended purpose and shall be capable of adequately, safely, and permanently securing the material in place. Screws shall be used on wood surfaces, masonry anchors in concrete or brick, toggle bolts on hollow walls, machine screws, bolts, or welded studs on steel. Nails shall be used only for temporary attachment or support.
- C. Omissions or conflicts on Drawings or between Drawings and Specifications shall be brought to the attention of the CONSTRUCTION MANAGER for clarification before proceeding with the work.
- D. The CONTRACTOR shall make all necessary provisions throughout the site to receive all equipment as construction progresses and shall provide adequate backing, supports, inserts, and anchor bolts for the hanging and support of all electrical cabinets, enclosures, conduit, panelboards, and switches, and shall provide sleeves through walls, floors, or foundations where electrical lines are required to penetrate.
- E. Floor standing equipment shall be leveled with shims as required to maintain horizontal surfaces within 1/32-inch per horizontal foot; after leveling, equipment shall be anchored, then grouted so that no space is existing between concrete and equipment support beams.

3.2 PREPARATION AND FINISH

- A. All equipment cabinets or enclosures furnished under this Section shall have a finish which conforms to Section 16480.

3.3 TESTING

- A. All WORK shall be tested per Section 16030.

**** END OF SECTION ****

SECTION 16431 - SHORT CIRCUIT AND COORDINATION REPORT

PART 1 -- GENERAL

1.1. WORK OF THIS SECTION

- A. The WORK of this Section includes providing a short circuit and protective device coordination study and harmonic measurement for the electrical power system.
- B. The studies shall include the electrical distribution system for normal and standby power sources distribution system.
- C. The studies shall include protection studies for motors supplied with factory-installed solid state overload and overcurrent protection devices.
- D. The WORK of this Section includes measurement of harmonic current and the installation of filters required for harmonic suppression.

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 16050 Basic Electrical Materials and Methods
 - 2. Section 16400 Low Voltage Electrical Service and Distribution

1.3 CODES

- A. The WORK of the Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:
 - 1. National Electrical Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. ANSI/IEEE 141 Recommended Practice for Electrical Power Distribution for Industrial Plants
 - 2. ANSI/IEEE 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. ANSI C 37.010 Standard Application Guide for AC High-Voltage Circuit Breakers
 - 4. ANSI C 37.5 Calculation of Fault Currents for Application of Power Circuit Breakers
 - 5. ANSI C 37.13 Low-Voltage AC Power Circuit Breaker (600-Volt Insulation Class)

6. IEEE 519 Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Studies related to distribution system protection and coordination shall be submitted to the CONSTRUCTION MANAGER prior to submittal of distribution equipment shop drawings and/or release of equipment for manufacture. A preliminary submittal shall be made with sufficient detail to review the adequacy of products and to indicate the computer program selected for use in performing the WORK of this Section.
2. Studies for harmonic current, voltage and line notching test results shall be forwarded to the CONSTRUCTION MANAGER prior to acceptance of the project and after installation of harmonic generating and harmonic sensitive equipment.
3. Submittals for solid state motor protective devices shall be forwarded to the CONSTRUCTION MANAGER prior to loading the motor.
4. Protective device and coordination evaluation studies must be approved by the CONSTRUCTION MANAGER prior to acceptance testing.
5. Submittals shall indicate proposed changes to the protection scheme and equipment selection which will result in improved system reliability and safety.
6. Documentation of at least one successful study of comparable size and complexity completed in the recent past, including contact names, addresses, and telephone numbers.

1.6 QUALIFICATIONS

- ### A.
- Short circuit studies, protective device evaluation studies, and protective coordination studies shall be performed by the medium voltage switchgear manufacturer or an electrical testing service regularly engaged in short circuit and protective device coordination studies, having at least one successful study of comparable size and complexity completed in the recent past.

1.7 STUDY REPORTS

- ### A.
- The results of the power system study and harmonic current, voltage and line notching measurements shall be summarized in a final report, signed by the professional electrical engineer, registered in the State of California responsible for the studies. Six bound copies of the final report shall be submitted and shall include the following:

1. Single-line diagram
2. Impedance diagram
3. Tabulation and identification of protective devices on a single-line diagram.

4. Time/current coordination curves
5. Computerized fault current calculations
6. Test instrumentation, condition and connections, as applicable, for each study
7. Harmonic measurement results
8. Specific recommendations (if any)

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **General:** The report shall include a single-line and an impedance diagram of the power system. This diagram shall identify components included in the study and the ratings of power devices including transformers, circuit breakers, relays, fuses, busses, and cables. The resistances and reactance of cables shall be indicated in the impedance diagram. The study shall include written data regarding maximum available short circuit current, voltage, and X/R ratio of San Diego Gas and Electric Co.

2.2 SHORT CIRCUIT STUDY

- A. The short circuit study shall be performed with the aid of a computer program complying with ANSI C 37.5, IEEE Standard 242, and IEEE Standard 141.

2.3 PROTECTIVE DEVICE EVALUATION STUDY

- A. A protective device evaluation study shall be performed to determine the adequacy of circuit breakers, molded case switches, automatic transfer switches, and fuses. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the CONSTRUCTION MANAGER's attention in writing but in no case more than 7 days after discovery.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

- A. A protective device coordination study shall be performed including calculations required to review the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low-voltage breaker trip characteristics and settings.

2.5 TIME/CURRENT COORDINATION CURVES

- A. The time/current coordination curves for the power distribution system shall include, on 5-cycle log-log graph paper, at least the following:
 1. Time/current curves for each protective relay or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified, and tap and time dial settings shall be shown.
 2. Time/current curves for each device shall be positioned to provide the maximum

selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, the CONSTRUCTION MANAGER shall be promptly notified of the cause in writing but in no case more than 7 days after discovery.

3. Time/current curves and points for cable and equipment damage.
4. Circuit interrupting device operating and interrupting times.
5. Maximum fault values.
6. Sketch of bus and breaker arrangement.
7. Magnetizing inrush points of transformers.
8. Compliance with Code requirements and proper coordination intervals and separation of characteristics curves.
9. Thermal limits of motors 250 hp and above.

2.6 HARMONIC MEASUREMENT

- A. The report of the distribution system, at all voltage levels, shall indicate the harmonic currents anticipated at each voltage level. The report shall indicate sources of harmonic currents, voltages, and line notching of equipment. The report shall state the tolerance of sensitive equipment to harmonics.
- B. The report shall include measurement of harmonics present in the output of harmonic-generating equipment at the input terminals of sensitive equipment. Filters required to prevent equipment malfunction due to harmonics shall be installed. Harmonic measurements shall be performed and documented after the filter installation.
- C. Equipment which is required to conform with IEEE 519 shall be measured to determine output harmonic content. Corrective action necessary for compliance with IEEE 519, Tables 2 and 4 General System Class shall be made. Measurements and documentation shall be performed to demonstrate compliance with 5 percent voltage distortion limitation.

2.7 MOTOR PROTECTION

- A. Where overload protection as phase overcurrent for medium voltage motors is specified to be solid state protective modules, modules shall be adjusted for actual installed motor torque, current and thermal characteristics. Protective settings shall be submitted, and reviewed, before motors are run under load.

PART 3 -- EXECUTION

3.1 TESTING, CALIBRATION, AND ADJUSTMENT

- A. The medium voltage equipment manufacturer shall provide the services of a qualified field engineer and necessary tools and equipment to test, calibrate, and adjust the protective relays and circuit breaker trip devices as recommended in the power system study for 2 days.

**** END OF SECTION ****

SECTION 16450 – MEDIUM VOLTAGE LOAD BANK

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and Subcontractors to review all sections to insure a complete and coordinated project.
- B. Provide labor, equipment, supervision, and materials for the installation, testing, and start-up of fully integrated medium voltage resistive/inductive load bank as shown on the Drawings and as specified herein. The load bank shall provide adjustable KVA load to generators provided under this contract.
- C. The required number and identification of the medium voltage load bank unit is as follows:
 - 1. BNK-3000
- D. The load bank shall consist of all system components, Fully Integrated, in a single continuous lineup, required to meet the performance, protection, testing, and certification criteria of this specification. These components include but are not limited to the following:
 - 1. 2500kW, 4,160VAC, 3ph, 60 Hz load bank
 - 2. Outdoor Type 2 Aluminized Steel enclosure for salt-air environment
 - 3. Incoming 4,160VAC gang operated load break switch, with primary fusing
 - 4. Outdoor rated dry type step-down isolation transformer with secondary fusing
 - 5. 600VAC Class power and control equipment
 - 6. Resistive load bank in 100kW steps to 2500kW
 - 7. Vertical air discharge with weather proof exhaust hood
 - 8. Internal control power transformer
 - 9. 120VAC space heaters powered from exterior source
 - 10. Local HMI display
 - 11. Communication network using Modbus over Ethernet IP
- E. Provide on-site instructions and training on load bank operation for the CITY's personnel.
- F. Provide load bank communication network programming and coordination to connect to pump station control system network as specified under Division 13. Include time, travel, per diem and all other costs for a programming technician to provide assistance and coordination during startup and testing.

G. The Contractor shall coordinate load bank footprint foundation and anchoring. Anchorage bolts to be sized by the load bank manufacturer as required herein and Section 01640, Seismic Design of Equipment Anchorage.

H. Related sections:

1. Section 01640 - Seismic Design of Equipment and Equipment Anchorage
2. Section 09800 - Protective Coating
3. Section 13300 - Instrumentation and Control
4. Section 13350 - Commissioning
5. Section 16030 - Electrical Tests
6. Section 16050 - Basic Electrical Materials and Methods

1.2 QUALITY ASSURANCE

- A. Load bank shall utilize a field proven design. The load bank manufacturer shall be able to demonstrate at least two years of knowledge in manufacturing load banks of the design proposed for this project at medium voltage. A user's list of similar design equipment, complete with contact names and telephone numbers, shall be furnished upon request that demonstrates the load bank manufacturer's capability to provide parts and service support.
- B. The load bank equipment shall be listed or labeled by Underwriters Laboratories or other equivalent, nationally recognized independent testing laboratory for the class of service intended. A nationally recognized testing laboratory is defined as one which is approved in accordance with OSHA regulations, by the United States Secretary of Labor. Provide certification of listed equipment.
- C. The load bank shall be factory tested and inspected prior to shipment to site for installation. The load bank manufacturer shall submit factory test and inspection reports to the CITY for approval prior to shipping the load bank.

1.3 SUBMITTALS

- A. Initial set of equipment submittals shall be made within 60 days of Notice to Proceed.
- B. The submittal shall include a deviation list including a paragraph by paragraph description for each proposed deviation item.
- C. All load bank drawings shall be submitted on drawings in 11-inch x 17-inch format.
- D. The Contractor shall furnish submittals for approval as outlined below:
 1. Equipment outline drawings showing elevation, plan and interior views, front panel arrangement, dimensions, weight, shipping splits, conduit entrances, and anchor bolt pattern
 2. Installation data showing clearance requirements for access, conduit entry space, weights of largest assemblies to be moved, mounting requirements and electrical clearances

required in existing locations. The feasibility of installation of the proposed equipment shall be clearly noted on the submitted plan drawings based on information included in the Bid Documents. Submitted drawings shall include means and method for equipment delivery and installation.

3. Complete itemized Bill of Material with catalog data sheets and manuals for all equipment and devices comprising the load bank system. Where catalog cuts and other brochures depicting product characteristics are supplied, clearly annotate to show product to be used on this project.
4. Load bank performance specifications and ratings.
5. Power and control schematics including all external connections and network communications in conformance with the Contract Documents.
6. Details for all external electrical power inputs required for all equipment. Information shall include voltage, power, and phase requirements and shall indicate function of each circuit related to the load bank requirements.
7. Details of exhaust fans, disconnect switch, or other devices integral to the load bank. Details shall include catalog cuts, dimensional information, and interconnection details.
8. Complete load bank system operation description.
9. List of all available load bank status, monitoring, and control data available over the network interface specified herein. Submit a list of the manufacturer's recommended load bank performance and diagnostic data for use by the CITY in implementing an asset management strategy for the load bank.
10. Equipment anchorage calculations. Calculations must be stamped by a Licensed Engineer in the State of California
11. Detailed load bank equipment warranty information including conformance with extended equipment warranties as specified herein.
12. Instruction and replacement parts books: Include a complete list of recommended spare parts with item descriptions, recommended quantities, and unit costs. The recommended list should be based on an assumed maintenance plan where the CITY will remove and replace failed items to the lowest replaceable stock module/component level.
13. Certified factory test and inspection reports including testing procedure outline.
14. Field test and inspection reports including test procedure outline.
15. Submit proposed storage location of the load bank during construction. Indicate environmental controls included to maintain temperature of the storage facility per the manufacturer's recommendations.
16. Support information:
 - a. The location(s) nearest to the CITY where spare parts are stocked.

17. As-built final drawings including all “as-left” settings for all load bank programming parameters. Provide load bank programming parameters on electronic storage media suitable for direct download to the load bank.

E. Network Interface - Submit details regarding communication network module and programming requirements as follows:

1. Products and materials used for the Ethernet network communications system including Ethernet switches, media converters, and internal load bank topology diagram including IP addresses for all drops.
2. Verification that the Ethernet interface and protocol is directly compatible physically and in software with the Facility control system as shown on the Contract Documents.
3. Addressing scheme used for the network communications system including IP addresses for the load bank coordinated with CITY requirements as specified in Section 13300 and 13350.
4. Network communications system factory testing procedures. Procedures shall include a method for 100% testing of all variables associated with the load bank system and delivery of that data over the same network link and devices as will be used at the PS2. Furnish the use of a laptop or other device(s) suitably configured to mimic the CITY’s control system for testing and verifying addressing and delivery of all network data. Procedure shall include factory/shop test forms with sign-off sheets indicating successful testing of each load bank, each network component (fiber cable, converters, switches, etc.), and each data point properly addressed.
5. Network field test results following the same approved test procedures used for factory testing. Field network test results shall be submitted as a separate submittal for review by the Engineer. Equipment installation shall not be considered to be substantially complete until successful network testing has been accomplished and test submittal results submitted and favorably reviewed.

1.4 REFERENCE STANDARDS

- A. Title 24, Part 3 – 2007 California Electrical Code (CEC)
- B. American National Standards Institute
 1. ANSI C84.1 – American National Standard for Electric Power Systems and Equipment – Voltage Ratings (60 Hz)
- C. InterNational Testing Association Inc. (NETA)
 1. NETA Acceptance Testing Specification
- D. National Electrical Manufacturers Associations (NEMA)
 1. NEMA ICS 6 – Industrial Control and Systems Enclosures.
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 PERFORMANCE

- A. The load bank shall provide adjustable load from 100kW to 2500kW in 100kW increments at 4,160VAC, 3 ph. Each load step shall be accurate to within 3% of the selected load.
- B. The acoustic noise level of the load bank shall not exceed 90dBA at a distance of 3 feet from the load bank in open air with the doors closed at 100% load.

1.6 DELIVERY, STORAGE AND HANDLING

- A. The load bank system shall be delivered to the site pre-assembled and wired with all specified interconnecting wiring and cable. Cabling for connection across shipping splits shall be neatly coiled and identified. Exposed sections of equipment shall be fully protected from damage during shipment. All necessary hardware for reconnecting shipping splits shall be provided. Coordinate any onsite storage location with the CITY.
- B. The Contractor shall be responsible for all system interconnections across shipping splits at the site.
- C. Complete instructions for handling and storage shall be provided prior to delivery of the equipment. All equipment shall have provisions for handling by overhead crane or a fork lift truck.
- D. The load bank shall be packaged with suitable covering to protect it from moisture, dust and physical damage.
- E. Load bank shall be stored in an environmentally controlled structure suitable for protecting the load bank from dust, moisture, heat and physical damage. At no time shall the load bank be stored outdoors where exposed to the environmental elements.

1.7 SPARE PARTS

- A. Provide spare parts or standard spare part kits per manufacturer's recommendations. Provide two (1) lots of spare parts from manufacturer's recommended list or (1) standard spare part kits shall be provided.
- B. If not already included with the manufacturer's standard spare parts and kits provided, the following items shall be included at minimum:
 - 1. 3 primary fuses
 - 2. 3 secondary fuses.
 - 3. 3 secondary fuses for each load step
 - 4. Five of each type of panel lamp
 - 5. Two of each type of control or auxiliary power supplies
 - 6. One fully configured EEPROM or other storage media used for storing load bank parameters.
 - 7. One quart of equipment touchup paint

- C. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturer's name, description and part number on the exterior of the package.

1.8 MANUFACTURER'S FIELD SERVICES

- A. The load bank manufacturer shall provide the field services of a factory technician as necessary to supervise/inspect installation, test and start-up all equipment provided as part of the price proposal. The price shall include all travel and living expenses in addition to the technician's time required to complete supervision of the installation, testing and start-up. All equipment required for testing, start-up and performance verification shall be provided by the manufacturer's technician.
- B. The manufacturer shall provide their own portable laptops and software with diagnostic features for trouble shooting and during start up and testing for checking parameters and alarms.
- C. At a minimum the manufacturer shall provide the following technician person-days:

Description	Person Days
Inspection	.5
Installation Assist	1
Settings, Adjustments	1
Start Up and Testing	1
Training	1

1.9 JOB CONDITIONS

- A. The load bank shall be capable of continuous operation in an average ambient temperature between 0° C and 40°C at an elevation up to 3000 feet above MSL without derating.
- B. The load bank shall be simultaneously suitable for continuous operation in a maximum humidity between 0 and 95% non-condensing.
- C. The load bank shall not produce exhaust fan noise in excess of 90dba at 3 feet.

1.10 WARRANTY

- A. In addition to the standard warranty the load bank manufacturer shall provide an extended warranty such that an additional warranty of 3 years will be included after Notice of Completion and Acceptance by the CITY. The extended warranty shall be coordinated with the sequence of construction such that the load bank shall have full warranty from the time they are energized (or shipped, whichever comes first) until the end of the 3 year warranty.
- B. The warranty shall include parts and labor.
- C. Standard warranty shall start from the date of being energized.
- D. The manufacturer shall provide all details about the warranty in the submittal documents.

PART 2 -- PRODUCTS

2.1 GENERAL

A. The load bank shall meet the following requirements:

1. The load bank shall be capable of providing resistive load from 100kW to 2500kW in 100kW steps at 4,160VAC, 3 ph, 60Hz.
2. Input voltage: 4,160 volts, 3 phase, 60Hz
3. Ambient temperature: 0° C to 40° C.

2.2 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with these specifications, provide equipment, systems and accessories as manufactured by:

1. Emmerson Avtron
2. Simpson
3. Approved equal

2.3 COMPONENTS

A. General

1. The general arrangement of the equipment is shown on the Drawings. The load bank lineup shall not be greater than the specified dimensions shown on the Drawings.

B. Enclosure

1. The enclosure shall be a dead-front free standing assembly. Cabinets and doors shall be fabricated using heavy gauge Type 2 aluminized steel (12-gauge minimum) for sturdy construction to meet CSA and IEC specs and dimensional integrity to assure long-term fit and function. All doors shall be gasketed to provide environmental protection and secure fits. Conduit entry and exit shall be at bottom of enclosure.
2. All load bank enclosures shall be mounted and wired in a grounded continuous, multi-section enclosure.
3. Manufacturer shall provide a color pallet for the CITY to choose. Paint procedures and materials shall be manufacturer's system designed and proven for resistance to chemical attack in industrial environments.
4. Microprocessor and control logic boards and their power supplies shall be housed in the NEMA 1 enclosure and be safely accessible without exposure to high voltages and without load bank shutdown. All low voltage wiring shall be fully isolated from medium voltage compartments by metal barriers.
5. It shall be the responsibility of the load bank manufacturer to provide all cooling or heating equipment for the internal components of the load bank in order for it to operate

satisfactorily without failure in accordance with the job conditions stated herein. The cooling system shall include but not be limited to the following:

- a. Resistor banks shall have cooling fan motors with a minimum of 10 year design life. Power and control to the fans shall be from an integral dry type transformer mounted within the load bank cabinet.
- b. The load bank enclosure shall include input circuit breakers and motors starters for the cooling fans.

C. Operator interface and Display

1. Provide a door-mounted keypad/display with integral digital display capable of controlling and monitoring the load bank and setting load bank parameters. The display shall indicate all diagnostic messages and parameter values in Standard English language and engineering units without the use of codes.
2. At a minimum the following door mounted indicating lights shall be provided:
 - a. Power On
 - b. Cooling fan Fault
3. The following door mounted manual switch controls shall be provided:
 - a. Fault/Alarm Reset control.
4. At a minimum the operational controls accessible from the digital display/keypad and remotely over the network link shall include but not be limited to:
 - a. Load step increase/decrease.
 - b. Local/Remote Selection.

D. Controller

1. The controller shall be a solid-state microprocessor with non-volatile memory housed in the control section of the load bank lineup. The controller shall include at a minimum the following:
 - a. Action to shutdown the load bank on high temperature

E. Control Power

1. All load bank control circuits shall be 120 VAC single phase. Manufacturer shall provide an internal control power transformer suitably rated to provide all load bank required control power.
2. Each control power transformer shall be individually fused on the primary and secondary circuits in conformance with the NEC.
3. The control power circuit shall be disconnected when the input isolation or disconnection switch

2.4 FAULT CAPABILITY

- A. The following fault shall be provided and available to the operator from the HMI:
 - 1. Indication of the following fault conditions:
 - a. Ground Fault.
 - b. Blown Fault.
 - c. Control power failure.
- B. Provide complete built-in fault indication to enable maintenance personnel to rapidly and accurately identify the cause of equipment failure by means of operator interface at the load bank or via the Ethernet link. Provide addressing and memory map configuration for CITY access to the available diagnostic data.

2.5 SURFACE PREPARATION AND SHOP COATINGS

- A. All non-current carrying metal parts of the equipment cabinet shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pre-treatment to inhibit rust.
- B. Unpainted non-current carrying parts shall receive a protective zinc plating to prevent corrosion. Printed circuit boards shall be coated with a protective conformal epoxy. All device contacts shall be silver cadmium plated.

2.6 COMMUNICATION INTERFACE

- A. Provide load bank with integral Ethernet interface hardware. Ethernet interface shall be fully configured and suitable for direct interface to the Plant's Control System as shown on the Drawings.
- B. Provide communication capability using Ethernet protocols. Coordinate TCP/IP addresses with CITY and fully configure and setup all port addressing and load bank variable memory maps and register addressing at the factory.
- C. Provide copper to fiber optic converter to interface the load bank communication interface to the plant control system.
- D. The load bank integral communication Interface shall be installed in a low voltage control compartment. Operators and maintenance staff shall not be exposed to voltages over 150 Volts to ground when accessing the communication interface.
- E. Provide power supply for the communication interface integral to the load bank.

PART 3 -- EXECUTION

3.1 FACTORY QUALITY CONTROL

- A. Perform manufacturer's standard factory testing and inspection.

- B. Factory test shall be witnessed by the Engineer and the CITY and follow the submitted and favorably reviewed factory test procedure submitted under Part 1 of this specification. At least two weeks' advance notice shall be given to the CITY prior to the test.
- C. The Contractor shall include all travel expenses for factory tests.
- D. Factory test procedures shall include verification of the communication interface Ethernet device addressing and transmission of all load bank data to a suitably configured manufacturer's laptop or other computer configured to mimic the CITY's PLC and HMI control system components. Coordinate testing monitoring requirements with the CITY.
- E. After completion of the factory test a statement of certification shall be provided by the supplier that the load bank has completed the test successfully. The statement of certification shall be type written on the supplier's letterhead and a copy of the factory test results submitted to the Engineer.

3.2 INSTALLATION

- A. Install the equipment in accordance with the manufacturer's instructions.
- B. Touch-up damaged paint finishes.

3.3 ACCEPTANCE TESTING

A. Manufacture's Inspection

1. The manufacturer shall provide a trained field technician to inspect the installation of the load bank and to verify that the load bank is installed per the manufacture's requirements.
2. Upon completion of the inspection by the field technician, the manufacturer shall provide written certification that the load bank has been properly installed and ready for energization.

B. NETA Acceptance Testing

1. The load bank shall be inspected and tested per the NETA guidelines for load banks per Section 16030.

C. Communication Interface

1. Demonstrate the Ethernet communication interface after load bank Acceptance Testing but prior to commencement of Operational Testing. Furnish all necessary test equipment, cables, terminators, software, etc. to demonstrate successful transmission of the monitored equipment data using the hardwired and Ethernet protocol to the CITY's control system. All units furnished shall be tested. Testing shall occur at the PLC end of the Ethernet cables and shall be witnessed by the Engineer.

D. Operational Testing

1. Upon successful certification of the manufacturer's Inspection and NETA Acceptance Testing the Contractor shall complete operational testing.

3.4 TRAINING

- A. The cost of training programs to be conducted with plant personnel shall be included in the Contract price including travel costs. The training and instruction shall be directly related to the load bank being supplied.
- B. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the load bank.
- C. All training schedules shall be coordinated with, and at the convenience of CITY. The training classes shall be scheduled a minimum of 2 weeks in advance of when they are to be given. Each training class shall be conducted twice during separate weeks and at different times to allow for scheduling of shift based CITY personnel.
- D. Proposed training material, including a detailed outline of each lesson, shall be submitted for review at least 30 days in advance of when the lesson is to be given. Training submittal shall be reviewed for suitability and comment provided that shall be incorporated into the course.
- E. Each training class shall be a minimum of four (4) hours in duration. Separate classes shall be conducted for CITY's maintenance and operating personnel as required by and at the convenience of the CITY. Maintenance classes shall stress troubleshooting, repair, and other technical aspects of the load bank. Operator classes shall stress operational theory and use of the load bank controls and communication networks.
- F. Training shall include on-site training.
 - I. On-site (field) training shall be performed at PS2 following successful completion of the FAT. On-site testing shall include individual sessions covering the following:
 - a. Detailed hands-on instruction to the CITY operations personnel covering; system operations including local and remote operation of the load bank.
 - b. Identification of all load bank hardware, verify with shop drawings.
 - c. Verify safety shutdown including verification that power has been disconnected and lockout tag-out procedures are in place.
 - d. Address troubleshooting, maintenance procedures, and replacement of devices, suitable for performance by operations staff.
 - e. Operator interface and display device: Provide demonstration on setting up parameters on the load bank, reading the display, understanding alarms, resetting alarms, usage of the keypad, etc.
- G. The load bank supplier shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

3.5 CLEANING

- A. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

**** END OF SECTION ****

SECTION 16460 - ELECTRIC MOTORS

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing electric motors with accessories.

1.2 RELATED SECTIONS

- A. The WORK of the following Section 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 11000 Equipment General Provisions
2. Section 11175 Pumps, General
3. Division 16 Electrical, as applicable

1.3 CODES

- A. The WORK of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:

1. National Electrical Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. AFBMA 9 Load Ratings and Fatigue Life for Ball Bearings.
2. AFBMA 11 Load Ratings and Fatigue Life for Roller Bearings.
3. ANSI/IEEE 112 Standard Test Procedure for Polyphase Induction Motors and Generators.
4. IEEE 841 Standard for Petroleum and Chemical Industry—Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 500 HP
5. NEMA ICS 2 Industrial Control Devices, Controllers and Assemblies.
6. NEMA ICS 6 Enclosures for Industrial Controls and Systems.
7. NEMA MG 1 Motors and Generators.
8. UL 674 Motors and Generators, Electric, for Use in Hazardous Locations, Class I, Groups C and D, Class II, Groups E, F and G.
9. UL 1004 Motors, Electric

1.5 SHOP DRAWINGS AND SAMPLES

1. Machine name and submitted data on driven machine.
2. Motor manufacturer.
3. Motor type, model and dimensioned drawing.
4. Nominal horsepower.
5. NEMA design.
6. Frame size.
7. Enclosure.
8. Winding insulation class and treatment.
9. Rated ambient temperature.
10. Service factor.
11. Voltage, phase, and frequency rating.
12. Full load current at rated horsepower and indicated voltage.
13. Starting code letter, or locked rotor kVA, and current.
14. Special winding configuration.
15. Rated full load speed.
16. Power Factor at full load.
17. Details of water cooling (if any) for thrust bearings.
18. Motor efficiencies.

1.6 WARRANTY

- A. The Contractor shall provide a 1-year warranty. Should the equipment fail during the 1-year period after acceptance by OWNER, the Contractor, at its own expense, shall repair the equipment.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. **Conformance:** Electric motors driving identical machines shall be identical.
- B. **Rating:** The nominal rated motor horsepower shall be adequate for the driven machine without infringing upon the indicated motor service factor, unless more restrictive motor requirements are specified for a specific equipment item.
- C. **Minimum Motor hp:** The motor horsepower shall be not less than the minimum indicated for each driven machine. If the minimum horsepower is not adequate, the motor with the next larger horsepower, circuit breakers, magnetic starters, motor feeder conductors and conduit shall be provided.
- D. **Exempt Motors:** Except as otherwise indicated, motors intended for valve operators, submersible pumps and hoists, motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven equipment, part of commercial use or domestic equipment and torque-rated motors shall be motors recommended by the manufacturer for use in the application indicated.

2.2 DESIGN REQUIREMENTS

- A. **General:** Electric motors shall comply with ANSI/NEMA MG 1.

- B. **NEMA Design:** Except as otherwise indicated, electric motors shall be NEMA Design B, constant speed squirrel-cage induction motors designed for normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value indicated in ANSI/NEMA MG 1. Motors shall be suitable for part-winding, star delta starting, or 2 speed winding, where indicated.
- C. **Motor Voltage Ratings:** Motors shall be rated in accordance with the following:
 1. Motors below 1/2-hp shall be rated 115 volts, single-phase, 60-Hz. Dual voltage motors rated 115/230-volts, 115/208-volts, or 120-240 volts are acceptable.
 2. Motors 1/2-hp and larger shall be rated 460 volts, or 4160 volts, 3-phase, 60-Hz. Dual voltage motors rated 230/460 volts or 208/230/460 volts are acceptable.
- D. **Explosion-Proof Motors:** Motors which will be installed in Class I or Class II areas (exposed to flammable vapors, gases, or dust) shall be explosion-proof and shall bear Underwriter's approval on name plate and serial number.
- E. **Insulation (Standard Duty Motors):** Standard duty motors shall include Class F insulation, rated to operate at an ambient temperature of 40 degrees C without exceeding Class B temperature rise limits at the motor's nominal rating.
- F. **Insulation (Heavy Duty Motors):** Heavy duty motors shall include Class F insulation, rated to operate at an ambient temperature of 50 degrees C without exceeding Class B temperature rise limits at the motor's nominal rating.
- G. **Motors Installed Outdoors:** Motors 50 Hp or smaller which will be installed outdoors shall be totally enclosed, fan cooled (TEFC) with a Service Factor of 1.15.
- H. **Motors larger than 50 hp:** Motors larger than 50 hp which will be installed outdoors shall be Weather-Protected Type II. Motors larger than 50 hp shall have a minimum service factor of 1.15 and 2 cycles of solid, baked epoxy vacuum impregnation and shall include rodent screens.
- I. **Motors Installed Indoors:** Except as otherwise indicated, all motors which will be installed indoors shall be open drip-proof with a service factor of 1.15 minimum except that motors larger than 50 hp, located in damp environment (pump and pipe galleries, tunnels, chemical feed and sludge areas) shall have 2 cycles of solid baked epoxy vacuum impregnation.
- J. **High Efficiency Motors:** Motors with a nameplate rating of 5 hp and above shall be "high efficiency" units with efficiencies determined by the test set forth in ANSI/IEEE 112, Method B with stray load loss adjustment as modified by NEMA MG 1-12.53(a) and (b).
- K. **Efficiency Index:** Efficiency index, nominal efficiency, and minimum efficiency shall be defined in accordance with ANSI/NEMA MG 1-12.53.b. Motor nameplate data shall include the nominal efficiency value.
- L. **Minimum Motor Full Load Power Factor:** 0.85
- M. **High efficiency Motors:** High efficiency motors shall conform to the following minimum efficiency requirements for full load values:

Motor hp	<u>Guaranteed Minimum Efficiency</u>		(percent)	
	<u>Synchronous Speed, rpm</u>	<u>Open</u>	<u>Enclosed</u>	
5	3600	86	86	
	1800	87	87	
	1200	88	88	
7-1/2	3600	86	86	
	1800	89	89	
	1200	88	88	
10	3600	89	89	
	1800	89	89	
	1200	89	89	
15	3600	89	89	
	1800	90	90	
	1200	90	90	
20	3600	90	90	
	1800	91	91	
	1200	90	90	
25	3600	90	90	
	1800	92	92	
	1200	90	90	
30	3600	91	91	
	1800	92	92	
	1200	90	90	
40	3600	92	92	
	1800	92	92	
	1200	92	92	
50	3600	91	91	
	1800	92	92	
	1200	92	92	
75	3600	93	93	
	1800	94	94	
	1200	92	92	
100	3600	93	93	
	1800	94	94	
	1200	93	93	

125	3600	94	93
	1800	94	94
	1200	94	94
150	3600	93	93
	1800	95	95
	1200	94	94
200	3600	94	94
	1800	95	95
	1200	94	94
300	3600	95	95
	1800	95	95

- N. **Motors for VFD Drives:** Motors for variable frequency drives (VFD) shall be specifically rated for inverter duty and shall be severe duty NEMA MG 1 design A or B, high efficiency, totally enclosed fan cooled (TEFC) with NEMA MG 1 Class F insulation. Winding temperature rise shall be limited to Class B rise when operating over the speed range specified in Section 16481 Low Voltage VFD and Section 16482 Medium Voltage VFD with the specified load speed/torque characteristic. Six 100-ohm platinum resistance temperature detectors (RTDs) shall be provided in the stator windings for motors 100 Hp and larger. Motor insulation shall be designed to meet NEMA MG 1, Part 31 (1600-volt peak at a minimum of 0.1 microsecond rise time). Motors shall conform to IEEE 841. All internal surfaces shall be coated with epoxy paint.

Inverter duty motors shall be specifically certified by the motor manufacturer to be compatible with the VFD to be used with the motor. Inverter duty motors shall be designed to operate over the speed or frequency range specified. Inverter duty motors shall be provided with Type 2 thermal protection as specified in NEMA MG 1-12.53.2.

Inverter duty motors shall be equipped with a shaft-grounding unit mounted on the fan housing with stub shaft extended from the motor shaft. Grounding unit shall be equipped with two brushes, totally enclosed and sealed against environmental contamination.

Where specified, or required by the specified application requirements, inverter duty motors shall be totally enclosed, air-over blower-cooled (TEBC). Blowers shall be driven at constant speed by 460-volt, 3-phase, 60 Hz motors. Blower motor shall be TEFC in conformance with paragraph 16040-2.2 G. Blower and ducting shall be an integral part of the main motor frame. Air intake filter shall be provided. Scroll case shall be cast aluminum or iron, and fan wheel shall be Type 304 stainless steel.

- O. **Stator Windings and Resistance Temperature Detectors:** Stator windings shall be copper. Except as otherwise indicated, six 100-ohm platinum resistance temperature detectors (RTDs) shall be provided in the stator windings for motors greater than 250 Hp; and one PTC thermister shall be provided on the stator windings for motors from 50 to 250 Hp.
- P. **Space Heaters:** 120 volt space heaters shall be provided on all 15 Hp and larger motors that may not operate continuously.

2.2 MOTOR BEARINGS

- A. **General:** Bearings shall comply with Section 11000.
- B. **Standard Duty:** Except as otherwise indicated, motors shall be standard duty and shall include bearings with a minimum L-10 life of 50,000 hours.
- C. **Heavy Duty:** Where equipment for heavy duty service is indicated, motors shall be heavy duty and shall include bearings designed for a minimum rated L-10 life of 100,000 hours.
- D. **Fractional Horsepower:** Fractional horsepower through 2 hp motors shall be furnished with self lubricated ball bearings.
- E. **Horizontal Motors Over 2 hp:** Motors larger than 2 hp shall include relubricatable ball bearings except where vertical pump motors are indicated.
- F. **Vertical Motors Over 2 hp:** Vertical motors larger than 2 hp shall be furnished with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall comply with the manufacturer's recommendations.
- G. **Water-Cooled Motors:** If water cooling is required for the thrust bearings, cooling water lines shall be provided with shut-off valve, strainer, solenoid valve, flow indicator, thermometer and throttling valve.
- H. **Temperature Detectors:** Except as otherwise indicated, one RTD per sleeve bearing (or vibration switch for ball bearings) shall be provided for motors greater than 250 Hp.

2.3 ACCESSORY REQUIREMENTS

- A. **General:** Horizontal motors 3 hp and larger, and all vertical motors, shall have split-type cast metal conduit boxes. Motors other than open drip-proof shall include gaskets.
- B. **Lifting Devices:** All motors weighing 50 lbs or more shall include lifting devices designed for installation and removal.
- C. **Terminal Boxes:** Motors rated at 4160-volts shall have extra-large terminal boxes to accommodate stress cone terminations as recommended by cable manufacturers.
- D. **Space Heaters:** Except as otherwise indicated, all motors 25 hp and larger shall be furnished with space heaters. Space heater rating shall be 120 volts, single-phase, unless otherwise indicated.
- E. **Nameplate:** Motors shall include a permanent, non-corrosive nameplate indelibly stamped or engraved with NEMA Standard motor data, including bearing description and lubrication instructions, insulation class, ambient temperature, and power factor at full load.

2.4 MANUFACTURER

- A. Motors shall be manufactured by the following (or equal):

General Electric Company
Louis Allis (Division of Magnatek, Inc.)

U.S. Motors Corporation
Westinghouse Electric Corporation

B. Inverter duty motors shall be manufactured by the following (or equal):

Baldor, Inverter Motor
Reliance, RPM-XT
U.S. Motors, Inverter Grade

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Motors shall be installed in accordance with the manufacturer's installation instructions and written requirements of the manufacturer of the driven equipment.

**** END OF SECTION ****

SECTION 16461 – MEDIUM VOLTAGE INDUCTION ELECTRIC MOTORS

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. **General:** The CONTRACTOR shall provide two (2) electric motors, accessories, and appurtenances complete and operable, in conformance with the Contract Documents. The electric motors shall be coupled to an existing shaft driving the existing main sewage pumps at PS2 per the Contract Drawings. The Manufacturer shall take full responsibility of the existing pump shaft, re-analyze shaft dynamics and make appropriate couplings to the shaft per the standard requirements in Section 11175 Pumps, General.
- B. The provisions of this Section apply to medium voltage AC squirrel cage induction motors throughout the Contract Documents.
- C. The CONTRACTOR shall assign to the motor manufacturer the responsibility to provide suitable electric motors for the existing equipment. The choice of motor manufacturer shall be subject to review by the ENGINEER. Such review will consider future availability of replacement parts and compatibility with driven equipment.
- D. The CONTRACTOR/MOTOR MANUFACTURER shall review the Contract Documents and existing pumps to properly select the motors.

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 01640 Seismic Design of Equipment and Equipment Anchorage
 - 2. Section 11005 Machine Alignment
 - 3. Section 11020 Vibration and Critical Speed Limitations
 - 4. Section 11175 Pumps, General
 - 5. Section 13300 Instrumentation and Control
 - 6. Section 13350 Commissioning
 - 7. Section 16030 Electrical Tests
 - 8. Section 16050 Basic Electrical Materials and Methods
 - 9. Section 16482 Medium Voltage Variable Frequency Drives

1.3 CONTRACTOR SUBMITTALS

- A. Complete motor data and shop drawings shall be submitted including detailed coupling to existing pumps. Motor data shall include, but not limited to:

1. Machine name
2. Motor manufacturer
3. Motor type or model and dimension drawing. Include motor weight.
4. Nominal horsepower
5. NEMA design
6. Frame size
7. Winding insulation class and temperature rise class
8. Voltage, phase, and frequency ratings
9. Service factor
10. Full load current at rated horsepower for application voltage
11. Full load speed
12. Guaranteed minimum full load efficiency. Also nominal efficiencies at 1/2 and 3/4 load.
13. Enclosure details; material, finish, termination boxes, vibration RTD and transmitter, grounding.
14. Stator details; RTD's, winding connections, insulation, CT's
15. Rotor details; balancing, bar and end rings, ratches,
16. Bearing details; thrust rating, insulation for VFD application, RTD
17. Wiring diagram for devices such as RTD, Vibration devices, CT's,
18. Confirmation motor is inverter duty type. Include minimum speed at which motor may be operated.
19. Shaft mounted tachometer for VFD input.
20. Painting

1.4 WARRANTY

- A. The Contractor shall provide a 1-year warranty. Should the equipment fail during the 1-year period after acceptance by OWNER, the Contractor, at its own expense, shall repair the equipment.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Motors shall be identical.

- B. Motors shall be inverter duty with written certification submitted by motor manufacturer.
- C. Motor Capacity
- D. Motors shall be rated for 2,250 HP, 514 rpm
- E. Motors shall be rated for an altitude up to 3300 feet (1000 meters).

2.2 DESIGN REQUIREMENTS

- A. **General:** Motors shall comply with NEMA MG-1 - Motor and Generator and IEEE 112.
- B. **NEMA Design:** Motors shall be NEMA Design B. Starting torque and breakdown torque shall be as specified in NEMA MG-1. Motors shall be suitable for VFD starting method.
- C. **Motor Voltage Ratings:** Motors shall have voltage ratings in accordance with the following:
 - 1. Motors shall be rated 4,160 volts, 3 phase, 60 Hz.
- D. **Enclosure:** Motor enclosures shall be Weather-Protected NEMA Type II (WP-II).
- E. **Stator:** Windings and end turn connections shall be copper and fully braced.
- F. **Rotor:** Shaft construction shall be solid core and mechanically designed for 120% overspeed. The rotor cage shall consist of fabricated copper bars and end rings.
- G. **Insulation:** Motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C, and at an altitude of less than 3300 feet without exceeding Class B temperature rise limits stated in NEMA MG-1. Motors shall be provided with insulation systems to withstand volt spikes, with dV/dt as defined in NEMA MG-1.
- H. **Space Heater:** Motors shall have 120 VAC space heaters, wired to a terminal strip in a low voltage motor junction box.
- I. See Contract Documents for additional requirements.

2.3 ACCESSORY REQUIREMENTS

- A. **General:** Motor shall have split-type cast metal gasketed conduit box of ample size to enclose the 6 main leads brought out, current transformers and stress cores on incoming cables.
- B. **Lifting Devices:** Motors shall have suitable lifting eyes for installation and removal.
- C. **Grounding Lugs:** Provide motor grounding lug suitable to terminate ground wire, sized as indicated.
- D. **Nameplate:** Motors shall be fitted with permanent stainless steel nameplates indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1.
- E. **Vibration monitoring:** Motor shall include vibration monitoring and trip as shown in the Contract Documents.
- F. **Tachometer:** Motors shall include shaft driven tachometer with pulse output, wired to a terminal strip in a low voltage motor junction box.

- G. **Current Transformers for Differential Protection:** Motors to have 6 leads brought out for 3 CT method of differential protection. Motor manufacturer to supply and mount CT's in conduit box.
- H. **Abrasion Resistant Treatment:** All winding, stator, and rotor parts will be treated with suitable abrasion resistant material. Motor bearing will also be equipped with dust-tight seals.
- I. **Air Filters -** The motor will be equipped with suitable dry type renewable air filters mounted in air inlet openings. They will be readily accessible for inspection and cleaning.
- J. **Guard Screens -** The motor will be equipped with suitable corrosion resistant guard screens.

2.4 MOTOR THERMAL PROTECTION

- A. **RTDs:** Motor shall include bearing RTDs, stator winding RTDs (2 per phase) and motor casing RTD, wired to a terminal strip in a low voltage motor junction box. RTDs shall be 100 ohm platinum.

2.5 MOTOR BEARINGS

- A. **General:** Bearings shall conform to specific needs of existing pumps.
- B. **Plate thrust bearings:** Bearings shall be plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.
- C. **Insulation:** Bearings shall be insulated or rotor shaft shall have grounding means to eliminate circulating currents from VFD operation.

2.6 FINISH PAINT

- A. The motor frame surfaces will be prepared in according to SSPC – SP 10. All parts will receive one coat of primer except finished or machined surfaces which will be coated with protective coating to prevent rusting during shipment and installation.
- B. Primer epoxy polyamid with dry thickness of 5.5 mils (140 microns)
- C. Finish coat of polyurethane enamel with dry thickness of 2.4 mils (60 microns)
- D. Total dry thickness: 7.9 mils (200 microns)

2.7 MANUFACTURERS, OR EQUAL

- A. **General Electric Company**
- B. **U.S. Motors Corporation**
- C. **Westinghouse Electric Corporation**
- D. **WEG**
- E. **Baldor/Reliance Electric**

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.
- B. Related electrical WORK involving connections, controls, and switches shall be performed in accordance with the applicable sections of Division 16.

3.2 FACTORY TESTING

- A. Motors shall be factory tested in conformance with IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-1. Test report shall indicate test procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted to the ENGINEER.
- B. Full-load readings of current, power and speed at rated voltage and frequency
- C. Mechanical vibration measurement per NEMA MG-1.
- D. Test insulation (high-pot) in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

3.3 FIELD TESTING

- A. The CONTRACTOR shall perform the following field tests:
 - 1. Inspect each motor installation for any deviation from rated voltage, phase, frequency, and improper installation.
 - 2. Visually check for proper phase and ground connections.
 - 3. Check winding and bearing temperature detectors, tachometer, and space heaters for functional operation.
 - 4. Test for proper rotation prior to connection to the driven equipment.
 - 5. Test insulation (high-pot test) in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.
 - 6. Test motor vibration once connected to driven equipment as specified per motor and driven equipment manufacturers.

3.4 TRAINING

- A. Contractor shall provide 8 hours of on-site training to plant personnel including:
 - 1. Inspection and maintenance of Air filters, rotor grounding, tachometer, CT's, vibration, hi-pot testing, and cable inspection and termination.

- END OF SECTION -

SECTION 16480 - MOTOR CONTROL

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing group-mounted and unit motor control as required for motors provided.
- B. If motors furnished are different from those indicated, then starters, overload elements, and branch circuit protection shall be adjusted and coordinated as required to control and protect the motors provided.

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 16030 Electrical Tests
 - 2. Section 16050 Basic Electrical Materials and Methods
 - 3. Section 16400 Low Voltage Electrical Service and Distribution
 - 4. Section 16431 Short-Circuit and Coordination Report

1.3 CODES

- A. The 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. National Electrical Code (NEC) NFPA 70

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. NEMA ICS-1 General Standards for Industrial Controls
 - 2. NEMA ICS-2 Industrial Control Devices, Controllers, and Assemblies
 - 3. UL 845, 489, 508 Electric Motor Control Centers, Molded Case Circuit Breakers, and Industrial Control Equipment

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Shop drawings of all motor control centers and components.
 - a. Shop drawing submittals shall comply with the "Shop Drawings and Samples" paragraph of Section 16050. The submittal shall also include conduit entrance

locations and requirements; nameplate legends; size and number of bus bars per phase and ground; electrical characteristics including voltage, frame size and trip ratings of overcurrent devices, short circuit withstand ratings, and protective device time-current curves of all equipment and components.

2. Product data on motor starters and combination motor starters, relays, pilot devices and switching and overcurrent protective devices.
3. A wiring diagram and an elementary control diagram for each motor control center cubicle. An identifying number shall be assigned to each wire.
4. Seismic design certification and anchorage sketches in accordance with Section 16050.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. Spare parts data listing.
2. Source and current prices of replacement parts.
3. Recommended maintenance procedures and intervals.
4. Factory test reports.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Motor control centers shall be stored in a clean, dry space. Maintain factory wrapping or provide an additional heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Motor control centers shall be handled carefully to avoid damage to motor control center components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All similar products of the same type shall be furnished by a single manufacturer.
- B. Motor control assemblies (motor control centers) shall conform to the standards for NEMA Class II, type B assemblies.
- C. Components and assemblies shall comply with NEMA ICS 2.

2.2 DESIGN, CONSTRUCTION AND MATERIAL REQUIREMENTS

- A. The motor control center(s) shall be 600 volt class suitable for operation on a three-phase 60 Hz system. The system operating voltage and number of wires shall be as indicated.
- B. The main horizontal bus shall be copper with minimum ampacity of 600 amperes or rated as indicated. Main bus shall be copper, silver-plated and enclosed in an isolated compartment.
- C. The vertical bus in each section shall consist of a single silver plated copper conductor per phase with a current capacity of not less than 300 amps. The vertical bus shall be completely isolated

and insulated.

- D. All power busses shall be braced to withstand 65,000 amps RMS symmetrical.
- E. A continuous copper ground bus shall be provided full width at the bottom of the motor control center line-up.
- F. Where indicated, fully-rated, continuous, neutral bus shall be furnished through the control center. Lugs of appropriate capacity shall be furnished.
- G. A separate vertical wireway shall be provided adjacent to each vertical unit and shall be covered by hinged door. Each individual unit compartment shall be provided with a side barrier to permit pulling wire in the wire trough area without disturbing adjacent unit compartments.
- H. Indoor enclosure(s) shall be NEMA type 1-gasketed.
- I. Motor control sections shall be nominally 90 inches high and 20 inches deep for front mounted units.

2.3 MOTOR STARTERS -- GROUP MOUNTED

- A. Group-mounted starters shall be mounted in standard motor control center assemblies and arranged as indicated.
- B. Each motor starter unit shall consist of a combination magnetic starter and circuit breaker all mounted in a completely enclosed cubicle. Short circuit protective device shall be a Motor Circuit Protector (MCP). Where continuous rating exceeds 400 amperes the protective device shall consist of a molded case circuit breaker with a thermal-magnetic trip unit. MCP unit shall have low level sensing and shall incorporate a device to prevent setting trip levels in excess of 1300 percent of continuous rating. Contactor circuit shall include 3- phase thermal overload protection, ambient compensated. Reset of thermal overload elements or adjustment of instantaneous trip settings shall be possible with unit door closed. Overload trip units shall be furnished to suit the nameplate full load current of the equipment installed. IEC rated starters are not acceptable.
- C. Magnetic starters shall have auxiliary contacts as required by electrical motor control diagrams including one spare N.O. and one N.C. contacts. The combination motor starters shall be drawout-type for size 3 and below. The fixed-type unit assembly shall be so constructed that it can be easily removed from its panel after disconnecting the wires to the terminal block and withdrawing from the primary bus. Removal of a unit assembly shall be possible without rear access and without disturbing any other unit in the motor control center.
- D. Each starter unit shall have its own control power transformer; it shall have a 120-volt grounded secondary. One secondary fuse and 2 primary fuses shall be provided. Unit control power transformers shall be sized to accommodate the control devices indicated. Local control devices shall be mounted independently of the cover door. All starters having automatic control shall have a local "red" running lamp. All cubicle control wires shall be terminated at a disconnecting (separable) or pull-apart terminal block at the cubicle.
- E. The motor control center manufacturer shall be responsible for identifying each control wire within each motor starter unit with wrap-around permanent plastic markers. Each control wire shall be as identified at both ends.
- F. Motor starter units shall be NEMA size I or larger.

- G. Each motor control center shall be fitted with the manufacturer's nameplate which shall include the NEMA Standard electric rating and other pertinent data, including sales order number, date of manufacture, and place of manufacture.
- H. "Spaces" shall be starter cubicles arranged for future addition of the door and NEMA size starter indicated on the drawings. The vertical bus shall extend to, but not be exposed within "spaces."
- I. Transient surge suppressors shall be provided in each starter. Suppressor shall be encapsulated in a small module suitable for mounting directly to the starter or relay coil.

2.4 MAIN AND FEEDER CIRCUIT BREAKERS

- A. Circuit breakers having a frame size of 150 amperes or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units. Breaker contact material shall be a non-weldable silver alloy. Breakers shall have arc-extinguishing chutes.
- B. Circuit breakers with a frame size of 225 amperes to 800 amperes shall be molded case with interchangeable thermal and adjustable magnetic trip elements. Main circuit breakers with a frame size of 1000 amperes and larger shall be insulated case type fully rated circuit breakers.
- C. The interrupting capacity of all main and feeder circuit breakers shall be a minimum of 65,000 RMS symmetrical amperes.

2.6 MOTOR CONTROL CENTERS

- A. The CONTRACTOR shall:
 - 1. Provide one convenience outlet within each motor control center.
 - 2. Provide ventilation louvers at top and bottom of each vertical section; louvers shall be fitted with filters and shall be rodent and bird proof.

2.7 PREPARATION AND FINISH

- A. The CONTRACTOR shall have the manufacturer of the motor control center enclosures prepare them in strict accordance with the following requirements:
 - 1. NEMA 1 gasketed indoor assemblies shall be prepared and finished using materials and methods of the manufacturer's standard finish and colors, except that at least 2 coats of the final finish shall be applied by the manufacturer.

2.8 CONTROL DEVICES

- A. **Selector Switches:** Selector switches shall be rated 10 amperes at 600 volts, shall be heavy-duty, oil-tight, shall have the number of positions and poles indicated. Each shall have a factory-engraved legend plate, as indicated.
- B. **Pushbutton Switches:** The pushbutton stations shall be heavy-duty type with NEMA enclosures of the type indicated. When required, provisions shall be made for padlocking the "Stop" button. Pushbutton devices in damp or outdoor

locations shall be fitted with appropriate neoprene boots.

- C. **Indicating Lights:** Indicating lights shall be full-voltage, push-to-test type, and shall be heavy-duty, oil-tight as specified above for selector switches. Each shall be nickel-plated with a screwed-on glass prismatic lens approximately one-inch in diameter.
- D. **Magnetic Relays:** Magnetic relays shall be machine tool type with 115-volt ac coils and 10-amp contacts, unless otherwise shown. Contacts shall be field convertible. Relays shall be base-mounted to a common mounting channel. Mounting dimensions and drilling for AC and DC relays shall be identical.
- E. **Time Delay Relay:** Time delay relays shall be pneumatic on-delay or off-delay with calibrated time range dials, adjustable as indicated.
- F. **Timers:** Timers shall be synchronous motor driven with a solenoid operated clutch. Timer shall be on-delay or off-delay for semi-flush panel-mounting. The timers shall be rated 120-volt, 60-Hz, with 10-amp rated contacts and with time range as indicated.
- G. **Elapsed Time Meter:** Elapsed time meter (ETM) shall be non-reset type; shall register hours and tenths of an hour; shall have flush panel-mount case not less than 3 inches square; shall be suitable for operation at 120 volts, 60-Hz, AC.
- H. **Terminal Blocks:** Terminal blocks for control wiring shall be molded type with barriers, rated not less than 600 volts. Crimped eyelets or approved equal shall be used on all stranded control wire wherever wires are terminated on screw terminals. White or other light-colored marking strips, fastened by screws to the molded sections at each block, shall be provided for circuit designation. Each connected terminal of each block shall have the circuit designation or wire number imprinted on the marking strip with permanent marking fluid. Provide at least 20 percent spare terminals.

2.9 FACTORY TESTES

- A. The motor control centers and components shall be given manufacturer's standard electrical and mechanical production tests and inspections with complete test reports submitted to the CONSTRUCTION MANAGER for approval. The tests shall include, but not be limited to, electrical continuity check, dielectric tests for each circuit and inspection for proper functioning of all components, including controls, protective devices, metering and alarm devices.
- B. Motor control centers shall be tested in accordance with NEMA ICS-2.

2.10 NAMEPLATES, TOOLS AND SPARE PARTS

- A. **Spare Parts:** The WORK includes the following spare parts:
 - 1. 1 unit control transformer for each size of magnetic starter
 - 2. 3 bezels of each color installed in pilot indicators
 - 3. 1 dozen panel lamps

4. 1 dozen control fuses of each size provided in the WORK

Spare parts shall be stored in tool boxes and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

2.11 MANUFACTURERS

- A. Products of the type indicated shall be manufactured by one of the following (or equal):

1. Motor Control Centers

Westinghouse
General Electric
Allen Bradley

PART 3 - EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall install the motor control center in accordance with manufacturer's published instructions. Conduit installation shall be coordinated with manufacturer's as-built drawings so that all conduit stub-ups are within the area allotted for conduit. Conduit shall be stubbed up in the section which contains the devices to which conductors are terminated.

3.2 INSTALLATION

- A. The motor control center shall be set level within 1/32-inch per horizontal foot. After leveling and shimming, the CONTRACTOR shall anchor motor control center to concrete pad and shall grout in place so that no space exists between the pad and support beams.

- B. The CONTRACTOR shall:

1. Torque all bus bar bolts to manufacturer's recommendations; tighten all sheet metal and structure assembly bolts.
2. Adjust all MCP devices to lowest setting consistent with reliable operation under normal conditions. Verify that overload devices are proper for equipment installed; make necessary changes in overload devices as required for motors having power factor correcting capacitors.
3. After equipment is installed, touch up scratches and verify that nameplate and other identification is accurate and in compliance with these Specifications.

- C. The CONTRACTOR shall install pushbutton stations that are remote from the motor control centers, as shown on the drawings.

3.3 FIELD TESTING

- A. The CONTRACTOR shall test all pilot lamp indicators and test all controls prior to plant startup.

B. The CONTRACTOR shall perform all the testing required by Section 16030.

**** END OF SECTION ****

SECTION 16481 – LOW VOLTAGE VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. **General:** The CONTRACTOR shall provide variable frequency drive (VFD) units, complete and operable, in accordance with the Contract Documents. It is the intent of this Section to require complete, reliable, fully tested variable frequency drive systems suitable for attended or unattended operation.
- B. **Single Manufacturer:** Like products shall be the end product of one manufacturer in order to standardize appearance, operation, maintenance, spare parts, and manufacturer's services. This requirement, however, does not relieve the CONTRACTOR of overall responsibility for the WORK.
- C. **Coordination:** Equipment provided under this Section shall operate the electric motor driver and the driven equipment as indicated under other equipment specifications.

1.2 REFERENCE SECTIONS, CODES, AND STANDARDS

- 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 13300 – Instrumentation and Control
 - 2. Section 16050 - Basic Electrical Materials and Methods
 - 3. Section 16460 – Electric Motors
 - 4. Section 16480 – Motor Control
 - 5. Section 16485 – Local Control Panels
- B. Commercial Standards
 - NFPA 70 National Electrical Code (NEC)
 - IEEE Standard 519 Guide for Harmonic Control and Reactive Compensation of Static Power Converters

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with the Contract Documents, except that Shop Drawing information for the drives shall be submitted as part of the information for the driven equipment.
- B. **Shop Drawings:** Shop Drawings shall include the following information:
 - 1. Equipment information
 - a. Name of drive manufacturer
 - b. Type and model

- c. Assembly drawing and nomenclature
 - d. Maximum heat dissipation capacity in kW
2. Conduit entrance provisions
 3. Circuit breaker type, frames, and settings
 4. Information related to relays, timers, pilot devices, control transformer VA, and fuse sizes. Include catalog cuts.
 5. System schematic ladder diagram and interconnection diagrams. The schematic ladder diagram shall include remote devices. The ladder diagram shall incorporate the control logic on the corresponding elementary schematic on the Contract Drawings. Submittals with drawings not meeting this requirement will not be reviewed further and will be returned to the CONTRACTOR stamped "REJECTED"
 6. Factory test data certifying compliance of similar equipment from the same manufacturer with requirements of this Section.
- C. The Technical Manual shall contain the following documentation:
1. Manufacturer's 2 year warranty.
 2. Harmonic analysis report
 3. Field test report.
 4. Programming procedure and program settings.
- D. **Spare Parts List:** Information for parts required by this Section plus any other spare parts recommended by the controller manufacturer.

PART 2 -- PRODUCTS

2.1 EQUIPMENT

- A. The power supply shall be an adjustable frequency inverter designed to convert incoming 3 phase, 480 volt, 60 Hertz power to a DC voltage and then to adjustable frequency AC by use of a 3 phase inverter. The inverter shall be a voltage source design producing a pulse-width-modulated type output. Inverters shall be designed to operate 460 volt, 3 phase, 60 Hertz, NEMA B, open drip-proof (1.15 SF) or TEFC (1.15 SF), squirrel-cage high efficiency inverter duty induction motors over the range of 60-100 percent of base speed without derating or requiring any motor modifications. Inverters shall be capable of delivering nameplate horsepower exclusive of service factor without the need for mandatory thermostats or feedback tachometers. The VFD shall vary both the AC voltage and frequency simultaneously to operate the motor at required speeds. Current source inverters will not be acceptable. Inverters shall be sized to match the KVA and inrush characteristics of the motors actually provided. The CONTRACTOR shall be responsible for matching the controller to the load (variable torque or constant torque) as well as the speed and current of the actual motor being controlled. The CONTRACTOR shall provide "clean power" 18 pulse VFD's for VFD's operating motors greater than or equal to 100 HP. Motors less than 100 HP shall be powered by 6 pulse VFDs.

- B. The minimum VFD inverter efficiency shall be 95 percent at 100 percent speed and load, and 85 percent at 60 percent speed and load.
- C. The VFD shall shut down in an orderly manner when a power outage occurs on one or more phases. Upon restoration of power and a "start" signal, the motor shall restart and run at the speed corresponding to the current process input signal.
- D. The VFD shall be provided with additional features described below:
 - 1. Inrush current adjustment between 50 and 110 percent of motor full load current (factory set at 100 percent).
 - 2. Overload capability at 110 percent for 60 seconds for variable torque loads and 150 percent for constant torque loads.
 - 3. Adjustable acceleration and deceleration.
 - 4. Input signal of 4 - 20 mA from process.
 - 5. Output speed signal of 4 - 20 mA. Signals other than 4 - 20 mA are not acceptable.
 - 6. On loss of input signal, the VFD shall operate at a preset speed.
 - 7. A minimum of 2 selectable frequency jump points to avoid critical resonance frequency of the driven system.
 - 8. Additional devices and functions as indicated.
 - 9. Communication per Contract Drawings s to transmit VFD data to/from a plant DCS-based control system.
- E. **Protection:** The VFD shall have, as a minimum, the following protection features:
 - 1. Input line protection provided with metal oxide varistor (MOV) and RC network.
 - 2. Protection against single phasing.
 - 3. Instantaneous overcurrent protection.
 - 4. Electronic overcurrent protection.
 - 5. Ground fault protection.
 - 6. Overtemperature protection for electronics.
 - 7. Protection against internal faults.
 - 8. Ability to start into rotating motor (forward or reverse rotation).
 - 9. Additional protection and control as indicated and as required by the motor and driven equipment.
- F. **Service Conditions:** The VFD shall be designed and constructed to satisfactorily operate within the following service conditions.

1. Elevation to 3300-feet. For elevation greater than 3300-ft, the VFD shall be derated per the manufacturer recommendation.
 2. Ambient temperature: 0 to 40 degrees C
 3. Humidity: 0 to 95 percent, non-condensing
 4. AC line voltage variation: plus 10 percent to minus 10 percent.
 5. AC line frequency variation: plus and minus 2 Hertz.
- G. Electrical equipment provided in addition to the adjustable frequency inverter for each drive shall include:
1. 3-winding secondary, phase shift input transformer for 18 pulse front end VFDs greater than or equal to 100 HP, or,
 2. 2 1/2 percent (minimum) Line Reactor integral to the drive enclosure.
 3. Fused 480 - 120 volt control transformer to provide system control power for the logic and pilot lamps.
 4. Bypass Starters
 - a. Bypass starters and circuit breakers shall be provided for VFD's where indicated. Starters shall be NEMA-rated, Size 1 minimum. Starters shall be FVNR-type for motors less than 200 HP and be solid-state reduced-voltage type for motors 200 HP and above. The bypass starter shall include an instantaneous, magnetic only, MCP circuit breaker, fused 120 V control transformer, and overload protection, in accordance with NEC requirements. NEMA rated output contactor shall be provided with the VFD to allow disconnection of the inverter output while operating on the bypass starter. IEC rated devices are not acceptable.
 - b. The bypass starter and related circuitry shall be mounted in a segregated compartment of the VFD enclosure or MCC, enabling total isolation of the VFD for purposes of servicing, while operating the drive through the bypass starter.
 5. Input circuit breaker.
 6. Provide overload heaters with auxiliary contacts to protect the motors in both VFD and bypass modes. Refer to Elementary Schematics on the Contract Drawings. Heaters shall be sized for the motor actually provided.
- H. The inverter signal circuits shall be isolated from the power circuits and be designed to accept an isolated 4 - 20 mA signal in the automatic mode of operation. The inverter shall follow the setting of a remote or local potentiometer control when in the manual mode. Refer to the Electrical Elementary Schematic drawings for speed control and start/stop methods. The following operator monitoring and control devices for the inverter shall be provided on the face of the VFD enclosure, either as discrete devices, or as part of a multi-function microprocessor-based keypad access device. Access to set-up and protective adjustments shall be protected by key-lockout.
1. Auto/Hand selection from a remote logic relay or switch. In "Auto", the inverter shall operate from the remote 4 - 20 mA input, where applicable, and in "Hand" control, shall

operate from a local or remote manually operated speed potentiometer. Speed pot ratings shall be coordinated with the supplier of the Local Control Station.

2. Speed indicator calibrated in percent speed
3. Inverter fault trip pilot light and output alarm contacts
4. Trip reset pushbutton
5. "Run" and "Off" indicating lights
6. Other controls and readouts normally furnished as standard equipment, or as otherwise indicated on the Electrical Contract Drawing Elementary Schematics

- I. Properly identified screw type terminal boards shall be provided for interconnection to remote controls and instrumentation
- J. Pilot devices, control relays, time delay relays, elapsed time meters, and indicators provided as a part of the VFD equipment package shall meet the applicable requirements of Section 16485 – Local Control Panels.

2.2 HARMONIC ANALYSIS FOR DRIVES

- A. The CONTRACTOR shall perform a harmonic study of the facilities included in this Contract.
- B. The following assumptions shall be utilized:
 1. The distribution system is a "general" system as classified by IEEE 519 under low voltage systems.
 2. Assume 90 percent of total plant operating load is motor load and 10 percent is resistive.
 3. Assume a 70 percent plant diversity factor (70 percent of total plant load is operating). Motors other than VFD's shall operate at 90 percent of nameplate horsepower.
 4. Assume all VFD's are operating.
 5. Results shall be submitted prior to VFD shipment. Excessive harmonic distortion shall be specifically denoted and recommended. Corrective measures shall be submitted for action by the ENGINEER.

2.3 SPARE PARTS

- A. The CONTRACTOR shall furnish the spare parts listed below, suitably packaged and labeled with the corresponding equipment number.
- B. At any time prior to Substantial Completion, the CONTRACTOR shall notify the ENGINEER in writing about any manufacturer's modification of spare part numbers, interchangeabilities, or model changes. If the ENGINEER determines that the modified parts no longer apply to the equipment provided, the CONTRACTOR shall furnish other applicable parts as part of the WORK.
- C. The following spare parts shall be furnished:
 1. Ten spare control and power fuses of each type and rating.

2. Two dozen pilot lamps for replaceable incandescent lamps, as applicable.
3. One of each type of device within VFD
 - a. Control board
 - b. Input & output power boards
 - c. Front panel display module
 - d. Interface module as used
 - e. Control power transformer
4. One set of any special tools required for maintenance of VFD units

2.4 MANUFACTURERS, or equal

- A. **ABB**
- B. **Allen-Bradley**
- C. **Eaton**
- D. **General Electric**
- E. **Siemens**

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. **General:** An authorized service representative of the manufacturer shall be present at the Site for 3 Days to furnish the services listed below. For the purpose of this paragraph, a Day is defined as an 8 hour period excluding travel time.
- B. **Inspection, Startup, Field Adjustment:** The authorized service representative shall supervise the following and certify the equipment and controls have been properly installed, aligned, and readied for operation.
 1. Installation of the equipment
 2. Inspection, checking, and adjusting the equipment
 3. Startup and field testing for proper operation
 4. Performing field adjustments such that the equipment installation and operation comply with requirements.
- C. **Instruction of OWNER's Personnel:** The authorized representative shall instruct the OWNER's personnel in the operation and maintenance of the equipment, including step by step troubleshooting with test equipment. Instruction shall be specific to the VFD models provided. Training shall be scheduled a minimum of 3 weeks in advance of the first session. Training shall include individual sessions for 4 shifts of plant personnel. Proposed training materials shall be

submitted for review, and comments shall be incorporated. Training materials shall remain with the trainees. The OWNER may videotape the training for later use with the OWNER's personnel.

3.2 INSTALLATION

- A. Conduit stub-ups for interconnected cables and remote cables shall be located and terminated in accordance with the drive manufacturer's recommendation.
- B. The CONTRACTOR shall perform programming of drive parameters required for proper operation of the VFD's included in this project. Submit records of programming data in the equipment Technical Manual, including setup and protective settings.

3.3 FIELD TESTING

- A. Testing, checkout, and startup of the VFD equipment in the field shall be performed under the technical direction of the manufacturer's service engineer. Under no circumstances shall any portion of the drive system be energized without authorization from the manufacturer's representative.
- B. The CONTRACTOR shall test the completed installation for actual harmonic distortion at the point of common coupling.
 - 1. Harmonic analysis shall be performed in accordance with IEEE 519 - Harmonic Control and Reactive Compensation of Static Power Converters at unit full load using a harmonic analyzer by **Hewlett Packard**, or equal
- C. Tests shall prove that the harmonic voltage distortion at the 480 volt distribution bus of the panelboard, motor control center, or switchgear serving the VFD is limited to a magnitude of 5 percent of the fundamental and with the maximum number of drives, as permitted by the process, in operation and in conformance with the applicable requirements of IEEE-519. The report shall include the following:
 - 1. Expected harmonic voltage (THD) through the 35th harmonic.
 - 2. Actual RMS value and measured percentage of the THD in the field.

- END OF SECTION -

SECTION 16482 – MEDIUM VOLTAGE VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide air cooled active or phase-shift isolation transformer pulse width modulated (PWM) voltage or current source inverter variable frequency drive (VFD) units, designed to operate with the indicated induction motors, complete and operable, in accordance with the Contract Documents and as follows:
- B. Drive ratings shall be coordinated with the nameplate ratings of the pump motor in Section 16461 – Medium Voltage Electric Motors.
- C. Each variable frequency drive shall be produced and assembled by the manufacturer at a facility owned or operated by the manufacturer and under the direct supervision and control of the manufacturer.

1.2 REFERENCE SECTIONS, CODES, AND STANDARDS

- 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 01640 – Seismic Design of Equipment and Equipment Anchorage
 - 2. Section 13300 – Instrumentation and Control
 - 3. Section 13350 – Commissioning
 - 4. Section 16030 – Electrical Tests
 - 5. Section 16050 – Basic Electrical Materials and Methods
 - 6. Section 16461 – Medium Voltage Induction Electric Motors
- B. Commercial Standards
 - NFPA 70 National Electrical Code (NEC)
 - IEEE Standard 519 Guide for Harmonic Control and Reactive Compensation of Static Power Converters

1.3 SHOP DRAWINGS AND SAMPLES

- A. The CONTRACTOR shall submit the listing of the VFD manufacturer's qualifications within 30 days after receiving Notice of Proceed.
- B. Submit the following:
 - 1. Calculation of VFD efficiencies at 50, 75, and 100 percent speed. The system efficiency shall include power losses from the cooling system, controls, contactors, isolation transformers, line reactors, and filters.
 - 2. Continuous and fault ratings of drive and disconnecting means.

3. Description of proposed factory test procedure and sketch of test setup.
4. Harmonic analysis results.
5. VFD output pulse maximum peak voltage, pulse rise time, and pulse rate of rise. Include motor manufacturer's certification that motor insulation will withstand long-term over voltages caused at motor terminals due to output pulse data.
6. Complete system rating, including all nameplate data and continuous operation load capability throughout speed range of 0 to 110 percent rated speed.
7. Controller dimensional drawings, weight, and information on size and location of space for incoming and outgoing conduit.
8. Maximum heat dissipation from enclosure.
9. VFD enclosure shall consist of a fully integrated unit including MV fused disconnect, contactor, drive, inlet and outlet filters, low and medium voltage termination enclosures, PLC, motor management relay (MMR), vibration monitoring panel, and UPS.
10. Furnish complete dimensional information including location of space for incoming and outgoing conduit, weight, maximum heat loss, and minimum current carrying capacity and recommended wire size of required interconnecting circuits.
11. Layout of controller face showing pushbuttons, switches, instruments, indicating lights, HMI display unit, etc.
12. Complete system operating description.
13. Complete system elementary schematic wiring diagrams.
14. Complete system interconnection diagrams between controller, drive motor, and all related components or controls external to system, including wire numbers and terminal board point identification.
15. One-line diagram of system, including component ratings.
16. Description of diagnostic features being provided.
17. Descriptive literature of all devices such as PLC, HMI, MMR, vibration monitoring system, relays, etc.
18. Itemized bill-of-materials listing all system components.
19. Annotated and cross referenced PLC and HMI unit program printout.
20. The names and recent VFD knowledge of the manufacturer's qualified and knowledgeable representatives who will be responsible for: Field testing, calibration, startup, and Operator training.
21. A letter certifying that manufacturer's representatives have read and studied the Contract Documents and agree to the requirements of this Section.

1.4 MANUFACTURER'S QUALIFICATIONS

- A. The variable frequency drive manufacturer shall have been actively involved in the manufacture of VFD systems under the same corporate name for a minimum of 2 years.
- B. The VFD manufacturer shall furnish a listing of at least ten medium voltage variable frequency drive installations, size 2000 hp or larger, and voltage for systems operating for at least 3 years on which the VFD manufacturer performed systems engineering, including harmonic filter and system fabrication and installation, documentation (including schematic, wiring, and panel assembly drawings), field testing, calibration and startup, operator instruction, and maintenance training. At least five such installations shall be within the continental United States of America. The list shall include the following information for each installation:
 - 1. Name of facility, City of facility, contact name, address, and telephone number.
 - 2. Name and type of driven equipment, including horsepower, voltage, speed range, and application.
- C. The VFD manufacturer shall furnish the services of qualified and knowledgeable representatives.
- D. The VFD manufacturer shall agree in writing to the requirements of this Section.

1.5 SERVICES OF MANUFACTURER

- A. Inspection, Startup and Field Adjustment: An authorized service representative of the manufacturer shall visit the Site for not less than 2 days per drive system to perform the following services:
 - 1. Verify proper installation of the equipment.
 - 2. Inspection, checking and adjusting the equipment.
 - 3. Startup and field testing of the VFD controllers.
 - 4. Commissioning of VFD, MMR, Vibration, and UPS.
- B. Instruction of CITY's Personnel
 - 1. An authorized service representative or training instructor shall instruct the CITY's personnel in all aspects of drive operation and maintenance, including step-by-step troubleshooting procedures with necessary test equipment. Instructions shall be given after all VFD's are in place and in full service condition. Instruct a maximum of 8 personnel for a total of 2 days.
 - 2. The representative shall have at least 2 years of knowledge in training. A resume for the representative shall be submitted.
 - 3. Training shall be scheduled a minimum of 3 weeks in advance of the first session.
 - 4. Proposed training material and a detailed outline of each lesson shall be submitted for review at least 4 weeks before training is conducted. Comments shall be incorporated into the material.
 - 5. The training materials shall remain with the trainees.
 - 6. The CITY may videotape the training for later use with its personnel.

PART 2 -- PRODUCTS

2.1 DRIVE NAME VFD-400 and VFD-500

A. General

Number of drive units	2
Driven equipment	Centrifugal pump
Driven equipment specification	16461 MV Electric Motors
Drive voltage	4160 volt

B. Service Conditions: The VFD shall be designed and constructed to operate within the following service conditions:

Elevation	to 3,300 feet
Ambient Temperature Range	0 degrees C to 40 degrees C
Atmosphere	Noncondensing relative humidity to 95 percent
AC Line Voltage Variation	minus 5 percent to plus 10 percent
AC Line Frequency Variation	plus or minus 3 Hz

C. Operating Conditions

1. Minimum VFD efficiency shall be 95 percent at 100 percent speed and 87 percent at 60 percent speed based on nominal 514 motor speed with load horsepower to vary as cube of speed.
2. Distribution voltage shall be 4.16 kV, three phase, three wire, **high** resistance wye connected ground, 60 Hz as indicated.
3. Total harmonic distortion with filtration shall be not more than 5 percent in accordance with IEEE Standard 519.
4. Notching area, as defined by IEEE 519, shall be not more than 22,800 volt-microseconds. Notch depth shall not exceed 10 percent of normal peak voltage for line-to-neutral observations.

2.2 GENERAL

- #### A. **Basic Description:**
- The VFD shall consist of 5 sections: fused load break disconnecting means, active or isolated phase-shift transformer, converter, DC link, and inverter. These sections shall be fully integrated into an operating system. Solid-state devices in the converter and inverter sections shall be standard grade devices bearing manufacturer's standard catalog numbers such that they can be readily cross - referenced and interchanged with other manufacturer's devices. Solid state catalog numbers shall be submitted as part of the submittal package.

1. Fused load break disconnect device: The disconnect shall include adequate space for bottom entry power cables, and interlocked door with disconnect operator.
 2. Input filter: The input filter shall be internal to the VFD enclosure, if needed.
 3. Converter: The converter section shall consist of an active or isolating phase shifting transformer arrangement converter to change the input AC power to DC power. The output of the converter shall feed a DC link. The current limit feature of the converter shall be sufficiently fast and effective so as to protect against a sudden or random application of a short circuit to the output terminals of the VFD.
 4. Inverter: The inverter section shall convert the DC power to adjustable frequency power to the motor. The VFD shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque, and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation.
 5. Input converter module shall be interchangeable with output converter module.
- B. The motor shall be squirrel-cage induction design in accordance with Section 16461 – Medium Voltage Electric Motors, suitable for variable speed operation with the following additional features:
1. Copper windings.
 2. 6 RTDs in stator windings.
 3. 1 RTD per bearing
 4. Vibration sensors per Contract Drawings
 5. Tachometer per Contract Drawings
 6. 1 RTD for Motor Case temperature per Contract Drawings
 7. Class F insulation (Class B rise).
 8. 120-volt space heaters.
 9. High efficiency.
- C. **Basic Features:** The controller(s) shall be compatible for use with the medium voltage pump drive motor designated for operation from the VFD and shall be capable of operating the motor at full rated horsepower.
- D. The door of each power unit shall include:
1. Input disconnect switch handle integrally interlocked with power unit door. Handle shall be down for open and up for closed.
 2. One manual speed control means.
 3. Controls and displays per Contract Drawings.
 4. A speed indicating meter with a range of 0 to 110 percent of full speed.
 5. One elapsed time meter with five digits, without reset.

6. One VFD fault reset pushbutton.
7. One ammeter with a range of 0 to 125 percent of drive current rating.
8. One output voltmeter with a range of 0 - 5 kV
9. VFD fault diagnostics.
10. Indicating lights to show running and ready status.
11. One power factor meter.
12. The "HAND - OFF - REMOTE" switch in the "HAND" position, the drive output speed shall be controlled by the manual potentiometer.
13. The VFD shall be selectable to provide automatic restart after a trip condition resulting from overcurrent, overvoltage, undervoltage, or over - temperature. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function is not successful within a maximum of 3 attempts within a short time period.
14. Control Circuit: Fused 120 VAC control transformer and control relays for system logic functions. For system logic, see Electrical Drawings. Provide control relay for motor heaters and external power source.
15. Status and alarm outputs, each consisting of SPDT electrically isolated auxiliary contacts rated 5 amp at 120 VAC.
16. Alarm output shall consist of 2 separate outputs; VFD fault and motor fault. VFD fault is either:
 - Output or input under - voltage.
 - Solid state device over - temperature.
 - Instantaneous overcurrent.
 - Convertor or Inverter fault.
 - Current limit timeout.
 - Incorrect phase sequence or control power failure.
17. VFD and motor failure shall latch in the trip mode and shall require operator intervention to reset the drive.
18. Status outputs shall consist of three separate unpowered outputs; 2 run status outputs, and a VFD enable output. VFD enable status contacts shall monitor the emergency (coast to a stop) circuit. Wiring shall be as required by the electrical control diagrams.
19. Automatic and safety inputs, each consisting of a remote contact closure rated 5 amp at 120 VAC maximum. Opening of the automatic input remote contact shall cause the motor speed to ramp down to zero speed by controlled deceleration. Opening of the safety input remote contact shall cause the VFD SCRs to be shorted and motor speed to coast to a complete stop. Wiring shall be as required by the electrical control diagrams.
20. Adjustable minimum to maximum frequency limits of 30 to 66 hertz.

21. Independent timed linear acceleration and deceleration functions, adjustable from 4 to 300 seconds.
22. 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.
23. Frequency regulator to operate within the following tolerances:
 - Frequency regulator span shall be 4 mA at minimum speed and 20 mA at maximum speed.
 - Frequency regulator accuracy shall be within 1.0 percent of span.
 - Frequency regulator deadband shall be within 0.5 percent of span.
 - Frequency regulator repeatability shall be within 0.5 percent of span.
24. Frequency reference signal input resistance shall be 0 to 550 ohms.

2.3 ENCLOSURE

- A. The enclosure shall be a dead-front, freestanding assembly with cabinet base and maximum dimensions as indicated. Doors shall be 11- gauge sheet steel with full length piano hinges. Removable lifting angles shall be provided.
- B. Unless otherwise indicated, the enclosure shall be NEMA 1 with gasketed doors and door openings. Enclosure shall be front or side access only, as indicated. No rear access shall be provided. Rear panel cover shall not be used for mounting of internals. Enclosure shall be suitable for either top or bottom cable entry as indicated.
- C. Enclosure shall be painted ANSI 61. Inside shall be white.

2.4 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 motor winding and bearing temperature detectors and any vibration switches indicated. All analog temperature and vibration signals shall be input to electronic protective device for proper equipment protection. RTD relays or similar devices shall be selected and provided by VFD manufacturer in coordination with the motor manufacturer. RTD relays or similar devices shall be mounted within the VFD cabinet.
 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. When power is restored after a complete power outage, the VFD shall be capable of catching the motor while it is still spinning in the forward direction and restoring it to proper operating speed.
- 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. Failure to commutate inverter due to severe overload or other conditions.
 3. Opening of VFD output contactor during VFD operation.
 4. Loss of input power due to opening of VFD input disconnect device or utility power failure during VFD operation.
 5. Loss of one phase of input power.
- C. Drive shall be provided with a lockable input fused disconnect switch, mechanically interlocked with the drive cabinet door. Interlock shall be provided with defeater. Unless otherwise indicated fuse shall have a minimum short circuit interrupting capacity of 65,000 RMS symmetrical amps.

2.5 MOTOR MANAGEMENT RELAY (MMR)

- A. The MMR shall have the following features:
1. Mounted in the low voltage section of VFD.
 2. MMR controls and display accessible on the front of VFD.
 3. Refer to Contract Documents for MMR input/output configurations.

2.6 CONTROL DEVICES

- A. Pilot devices and instruments shall be flush mounted on a VFD unit door. Pilot devices shall be heavy duty with contacts rated 10 amp minimum at 600 VAC. Indicating lights shall be "push - to - test" type. Lens colors shall be in accordance with details on Drawings. Door - mounted indicating lights shall be removable without removing related wiring. The control units of a given type and size shall be made interchangeable. Relays shall be hermetically sealed.

2.7 UNINTERRUPTABLE POWER SUPPLY (UPS)

- A. The UPS shall have the following features:
1. Mounted within the VFD low voltage section.
 2. Powered from 120 VAC source within the VFD low voltage section.
 3. Disconnecting means from 120 VAC incoming source.
 4. Distribution breakers on 120 VAC output section for individual load isolation.
 5. Failure alarm to VFD PLC for HMI display and relay to plant's SCADA system.

6. 15 minute capacity to power VFD PLC, MMR, motor vibration monitor, and Modicon Modbus connection to plant's SCADA system.

2.8 DIAGNOSTICS

- A. The VFD shall be provided with the following diagnostics:

1. HMI to indicate a failure of converter or inverter.
2. HMI to indicate the following fault conditions:
 - a) No fault
 - b) Incorrect phase sequence
 - c) Blown power fuse
 - d) Control power failure
 - e) Under - voltage
 - f) Instantaneous overcurrent
 - g) Sustained overload
 - h) Power Device over - temperature
 - i) Output over - voltage
3. Meter with switch to test the following control signals:
 - a) Frequency command
 - b) Voltage command
 - c) Motor voltage feedback
 - d) Inverter bus voltage
 - e) Converter command
 - f) Filtered inverter bus voltage
4. Test lead and jack for monitoring logic cards
5. Circuitry for the following test modes

- B. Manual operation of the inverter through each firing sequence to test power circuit and logic.

- C. Operation of the drive open circuit.

2.9 POWER FACTOR CORRECTION

- A. The collective power factor of the VFD and the motor, when running at full load amps, shall not be less than 0.95.

2.10 SPARE PARTS

A. Spare Parts: Furnish the following spare parts for each VFD:

1. 1 complete converter section
2. 1 complete inverter section
3. 5 spare light bulbs of each type used
4. 3 spare fuses of each type used
5. 2 spare relays of each type used
6. 2 cans of aerosol spray touchup paint

2.11 FACTORY TESTING

A. Component Tests

1. Components shall be 100 percent tested. Components shall be burned - in for 24 hours at 125 degrees F and retested to detect any drift. Printed circuit boards shall be burned - in continuously for 24 hours at 65 degrees C. The printed circuit boards shall be tested after burn - in to ensure they are functioning within specification. Every thyristor 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 .
2. Control power shall be applied to microprocessors, printed circuit boards, diagnostic boards and similar devices including software to test for proper operation, sequencing, logic, and diagnostics.
3. All wiring shall be checked for continuity and for compliance with the wiring diagrams.

B. VFD Tests

1. Submit a sketch of the proposed test setup, along with a description of the proposed testing procedure to the ENGINEER for acceptance at least 10 weeks in advance of the proposed testing date. No tests shall be performed until the test procedure meets with the ENGINEER's approval.
2. In addition, furnish the ENGINEER with at least 2 weeks advance written notice of the date and location of the tests.
3. Testing shall be performed at the manufacturing facility of the VFD supplier.
4. The CITY and the ENGINEER (at the option of either or both) reserve the right to witness the tests. Travel living and incidental expenses will be paid by the CITY.

2.12 MANUFACTURERS, OR APPROVED EQUAL

A. ABB

B. Allen Bradley

- C. Eaton
- D. General Electric
- E. Siemens

PART 3 -- EXECUTION

3.1 FIELD TESTING

- A. Field testing shall be performed in accordance with the Contract Documents.

- END OF SECTION -

SECTION 16485 - LOCAL CONTROL PANELS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing local control panels including enclosures, wiring and control devices.

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 13300 Instrumentation and Control
 - 2. Section 16050 Basic Electrical Materials and Methods

1.3 CODES

- A. The WORK of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:
 - 1. National Electrical Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. JIC EGP-1 Electrical Standards for General Purpose Machine Tools
 - 2. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 3. UL Underwriters' Laboratories

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. Manufacturer's product data including catalogue cut sheets showing classifications.
 - 2. Arrangement drawings of the local control panel enclosure indicating the front door and rear panel equipment arrangement and dimensions.
 - 3. List of materials and components.
 - 4. Connection diagrams.
 - 5. Shop drawings indicating mounting of devices, discrete inputs and outputs, and termination points.

1.6 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL:
 - 1. Manufacturer's installation instructions.
 - 2. Manufacturer's maintenance procedures.
 - 3. Manufacturer's certification that products comply with the indicated requirements.

1.7 FACTORY TESTING

- A. **Product Testing:** Panels shall be tested at the factory for sequence of operation.
- B. **Witnesses:** The OWNER and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness factory tests.

1.8 FIELD TESTING

- A. **Testing:** Panels shall be field-tested for functional operation after connection of external conductors and prior to equipment startup.

PART 2 -- PRODUCTS

2.1 LABELING

- A. Products shall bear the UL label.

2.2 CLASSIFICATION

- A. Unless otherwise indicated, enclosures installed indoors shall be NEMA 12 with gasketed doors. Enclosures installed outdoors or in corrosive areas shall be NEMA 4X. Enclosures installed in the indicated hazardous areas shall comply with the NEC requirements for that area.

2.3 SIZE

- A. Unless otherwise indicated, the minimum enclosure area, height by width, shall be twice the sum of the areas of the individual components mounted on the back panel. The enclosure depth shall not be less than 6 inches.

2.4 LOCAL CONTROL PANELS (LCP)

- A. The LCP shall be designed to provide the indicated sequence of operations. The LCP controls shall be 120 VAC. Control conductors shall comply with the requirements of Section 16050.
- B. Each LCP shall include terminal strips identified for the connection of external conductors. The LCP shall include sufficient terminal blocks to connect 25 percent additional conductors for future use. Termination points shall be identified in accordance with shop drawings. The LCP shall be the source of power for 120 VAC solenoid valves interconnected with the LCP. Equipment associated with the LCP shall be ready for service after connection of conductors to equipment, controls, and LCP.
- C. Internal wiring shall be factory-installed and shall be enclosed in plastic raceways with removable covers. Wiring to door-mounted devices shall be extra flexible and shall be anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent contact.
- D. Enclosures shall be either freestanding, or designed to be mounted on pedestals or equipment skids or as indicated. Internal control components shall be mounted on a removable mounting pan. Interior of enclosure and mounting pan shall be finished white. Enclosure shall include 100-watt incandescent light (min.) designed to be controlled by a hand-operated switch and a circuit breaker and 15-amp duplex receptacle.

- E. The main feeder disconnect shall be flange-mounted unless otherwise indicated.
- F. Each source of voltage and motor control shall include a means for disconnecting by disconnecting or pull-apart terminal blocks or a disconnect operable from the panel front.
- G. Motor starters: N/A.
- H. Discrete outputs from the LCP shall be provided by electrically isolated dry contacts rated for 5 amps at 120 VAC. Analog inputs and outputs shall be isolated 4-20 mA two-wire signal with power supply complying with Section 13300.
- I. Identification of panel-mounted devices, conductors, and electrical components shall comply with Section 13300.
- J. LCPs shall include programmable logic controllers (PLCs) in accordance with Section 13300.
- K. Indicating lights shall be "Push-to-Test" type.

2.5 COLOR CODING

- A. Wiring shall be color coded complying with Section 16050.

2.6 LABELING AND NAMEPLATES

- A. **Labeling:** Local control panel components shall be labeled to match the description on the elementary diagram. Internal components of the local control panel on the back side of the door shall be labeled with the same description as provided on the front side. Labeling shall be permanently marked on or near each component. Plastic embossed labels such as "Dymo" tape will not be accepted.
- B. **Nameplates:** External door-mounted components and the local control panel description shall be identified with plastic nameplates.

2.7 GROUNDING

- A. Neutrals of locally derived control circuits shall be grounded to the mounting plate using a copper bus or grounding lug. A grounding lug for a size No. 2 AWG bare copper conductor shall be included to ground the panel to the plant's grounding system.

2.8 MANUFACTURERS

- A. Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):

Hoffmann Engineering Co., Bulletin A
E.M. Wiegman and Co., Inc.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Products, equipment, conduit, conductors and terminations shall be installed in accordance with the manufacturer's written installation instructions and Section 16050.

- B. LCP interior and exteriors shall be cleaned and coatings shall be touched up to match original finish upon completion of the WORK.
- C. Alternating current control circuits shall be grounded. One terminal of each load device shall be connected to the grounded conductor. Control contracts shall be installed in the ungrounded side of the circuit.
- D. Signal and control wiring shall be separated and installed in separate wireways.
- E. The panel shall be grounded to the plant grounding system as indicated.
- F. Local control panel centers shall be mounted at 36 inches minimum above the finished floor.
- G. A copy of the wiring diagrams shall be placed on the inner panel door. Drawings shall be enclosed in a transparent, protective jacket. A metal pocket measuring not less than 10 inches wide by 8 inches high by 3/4-inch deep shall be provided on the inside of the door for the drawings.

** END OF SECTION **

SECTION 16500 - LIGHTING

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing lighting fixtures, accessories, and controls required for a complete and operable lighting system.

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.

Section 16050 Basic Electrical Materials and Methods

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)- REFERENCE STANDARDS.

1.4 CODES

- A. The WORK of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

National Electrical Code (NEC), NFPA 70
Uniform Building Code (UBC)

1.5 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

UL	Underwriters Laboratories
CBM	Certified Ballast Manufacturer's Association

1.6 SHOP DRAWINGS AND SAMPLES

- A. List of all fixture types with manufacturer's name and full catalog number.
 - 1. Catalog information for each fixture, accessory, and control device. Each equipment submittal shall clearly describe make, materials, and dimensions. Catalog information shall clearly show manufacturer's name and full catalog number. Additional information is required for the following items:
 - a. Fixtures. Material description shall include diffuser, hardware, gasketing, reflector and chassis, and finish.

- b. Ballasts. Type of ballast, power factor, starting characteristics, temperature and sound rating, input watts and lamp watts.
- c. Utilization factors for calculation of illumination levels by the zonal cavity method.

1.7 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL:
 - 1. Manufacturer's installation instructions.
 - 2. Manufacturer's maintenance procedures, including dismantling procedures and parts list.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Lighting materials including lighting fixtures, accessories, hardware, and controls shall conform with the detailed requirements indicated on the lighting fixture schedule. Lighting fixtures shall be provided where indicated. Raceway and wire shall be in accordance with Section 16050. Refer to Lighting Fixture Schedule on plans for manufacture, catalog number, lamp, ballast, emergency backup battery unit requirement and etc.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. **General:** Raceways and lighting circuits shall be provided from the fixtures, switches, and fixture outlets to the power panelboard in accordance with the NEC. Raceways and wire, shall be provided in accordance with Section 16050. Installation requirements for street lighting shall be in accordance with SSPWC section 307. Fixtures shall be aligned and directed to illuminate an area as indicated.
- B. **Fixtures:** Internally wired conductors of fixtures having a temperature rating exceeding 75 degrees C shall be spliced to circuit conductors in a separately mounted junction box. Fixture shall be connected to junction box using flexible conduit with a temperature rating equal to that of the fixture.
- C. **Supports:** Fixture supports shall be braced for seismic loads in accordance with UBC for Seismic Zone 4. Fixtures shall be directly and rigidly mounted on their supporting structures. Unless otherwise indicated, conduit system shall not be used to support fixtures. Where brackets or supports for lighting fixtures are welded to steel members, the welded area shall be treated with rust-resistant primer and finish paint. Where recessed fixtures are required, the fixture shall be provided with mounting hardware for the ceiling system indicated. Recessed fixtures shall be installed light-tight to the ceiling and shall be provided with auxiliary safety supports attached directly to the building structure. Such safety supports shall consist of #12 AWG soft-drawn galvanized wire or #10 AWG aluminum wire. Pendant-mounted fixtures installed from sloping ceilings shall be suspended by ball-joint hangers. Fixtures weighing more than 25 pounds shall be supported independently of the fixture outlet box.

3.2 CLEANUP

- A. Labels and marks, except the UL label, shall be removed from exposed parts of the fixtures. Fixtures shall be cleaned when the project is ready for acceptance.

**** END OF SECTION ****

SECTION 16611 - UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification describes continuous duty, on-line, solid-state uninterruptible power systems, hereafter referred to as UPS. Each UPS shall operate in conjunction with the electrical system to provide high-quality power for electrical equipment loads with backup battery power. Each UPS shall consist of, as required by the project, the UPS module, battery cabinets, and accessory cabinet(s) for transformers, maintenance bypass, and distribution terminations, and other features as described in this specification.
- B. This specification identifies two UPS systems as follows:
 - 1. 208VAC, 3 ph, 4 wire input, 120/208VAC 3 ph, 4 wire output, 20kVA with battery capacity for 30 minute output.
 - 2. 208VAC, 3 ph input, 125VDC output, 20kW with battery capacity for 30 minute output.

1.2 UPS SYSTEM DESCRIPTION

- A. UPS System Components: Each UPS system shall consist of the following main components:
 - 1. UPS module containing a Rectifier, Inverter, Battery Charger, Static Bypass, cable termination lugs, and associated Control and Monitor Panel as required.
 - 2. Battery strings in Line-and-Match Battery Cabinets.
- B. 120/208VAC 3 ph output UPS Module Modes of Operation: The UPS Module shall operate as an on-line, fully automatic system in the following modes:
 - 1. Normal: Utilizing commercial AC power, the critical loads shall be continuously supplied by the Inverter. The Inverter shall power the load while regulating both voltage and frequency. The Rectifier shall derive power from the commercial AC source and shall supply DC power to the Inverter. Simultaneously, the Battery Charger shall charge the battery.
 - 2. Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source.
 - 3. Recharge: Upon restoration of the AC source, the Charger shall recharge the batteries and simultaneously the Rectifier shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.
 - 4. Bypass: If the UPS module must be taken out of the Normal mode for overload, load fault, internal failures, or maintenance, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal mode of operation shall be automatic. No-break transfer to and from Bypass mode shall be capable of being initiated manually from the front panel.
 - 5. Energy Saver: The UPS shall continuously monitor the voltage and frequency of the bypass source. When the source parameters are within acceptable limits, the UPS will utilize a minimal/optimal combination of its internal subsystems to ensure acceptable power is always delivered to the critical load, at a system efficiency of 99% or greater, over the range of 10% to 100% load. The Energy

Saver System shall be enabled by the user, and shall be adjustable. It shall incorporate a "High Alert Mode" to automatically (without user intervention) provide maximum power conditioning any time bypass source variation levels exceed preset, adjustable limits. When Energy Saver System is utilized, the UPS must attenuate ANSI C62.41-type line transients to within IEC and ITIC limits. The Energy Saver System shall be able to distinguish between upstream (utility) faults and downstream (load) faults, and react appropriately to protect and support the critical load, without interruption.

- C. 125VDC output UPS Module Modes of Operation: The UPS Module shall operate as an on-line, fully automatic system in the following modes:
1. Normal: Utilizing commercial AC power, the critical loads shall be continuously supplied by the Rectifier. The Rectifier shall derive power from the commercial AC source and shall supply DC power to DC loads. Simultaneously, the Battery Charger shall charge the battery.
 2. Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the battery, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source.
 3. Recharge: Upon restoration of the AC source, the Charger shall recharge the batteries and simultaneously the Rectifier shall provide power to the DC loads. This shall be an automatic function and shall cause no interruption to the critical load.

1.3 REFERENCES

- A. UL 1778 (Underwriters Laboratories) – Standard for Uninterruptible Power Supply Equipment. Product safety requirements for the United States.
- B. NEMA PE-1 – (National Electrical Manufacturers Association) – Uninterruptible Power Systems standard.
- C. (UPS) – Part 1-1: General and safety requirements for UPS used in operator access areas.
- D. UL 924 (Underwriters Laboratories) – Standard for Emergency Lighting and Power Equipment

1.4 SUBMITTALS

- A. Each UPS shall be supplied with sufficient documentation, including the following manuals:
1. Installation and Operation Manual: One copy of the installation and operation manual shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians or representatives to install and operate the UPS equipment and accessories. The manual shall include the following major items:
 - a) UPS description
 - b) UPS details; capacity, batteries, rectifier, inverter, harmonics, and bypass.
 - c) UPS site planning and unpacking
 - d) UPS installation
 - e) Optional accessory installation
 - f) UPS theory of operation
 - g) Operating procedures
 - h) System alarms and warnings

- i) UPS maintenance
- j) Performance and technical specifications
- k) Wiring requirements and recommendations
- l) Physical features and requirements
- m) Cabinet dimensions

1.5 QUALIFICATIONS

- A. Both UPS systems shall be provided by the same manufacturer.
- B. The UPS manufacturer shall have a minimum of two years of knowledge in the design, manufacturing and testing of solid-state UPS systems to be supplied for this project. A list of installed UPS systems of the same type as the manufacturer proposes to furnish for each application shall be supplied upon request.
- C. Field Engineering Support: The UPS manufacturer shall directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment as provided for this project. The organization shall consist of local offices managed from a central location. Field engineers shall be deployed in key population areas to provide on-site emergency response within 24 hours.
- D. Spare Parts Support: Parts supplies shall be located in the field to provide 80% of all emergency needs. The factory shall serve as the central stocking facility where a dedicated supply of all parts shall be available within 24 hours.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Each UPS shall withstand any combination of the following external environmental conditions without operational degradation.
 - 1. Operating Temperature: 0 degrees C to + 40 degrees C without de-rating (excluding batteries).
 - 2. Storage Temperature: - 25 degrees C to + 40 degrees C.
 - 3. Relative Humidity (operating and storage): 95% maximum non-condensing.
 - 4. Elevation: Operational: 1500 m maximum without de-rating.

1.7 SAFETY

- A. Each UPS shall be certified by Underwriters Laboratories in accordance with UL 924 and UL1778.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Eaton Corporation
 - 2. GE Westinghouse
 - 3. Storage Battery Systems
 - 4. Or approved equal

2.2 UPS MODULE STANDARD FEATURES

Each UPS module shall consist of the following standard components as required:

- A. **Rectifier/Charger:** The rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter or load and for charging the battery. The rectifier/charger shall be a high-frequency PWM design, using Insulated Gate Bi-polar Transistors (IGBTs). The modular design of the UPS shall permit safe and fast removal and replacement of the rectifier/charger module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode. The rectifier/charger module shall also provide the following:
1. The rectifier shall be capable of drawing power from the utility with a power factor of 0.99 under nominal conditions.
 2. The rectifier shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.
 3. An option shall be provided to allow the rectifier to be capable of operating from a delta transformer output or high impedance grounded transformer.
- B. **Inverter:** The inverter shall feature an IGBT pulse-width-modulation (PWM) design with high speed switching. The inverter shall also have the following features:
1. The inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.
 2. The modular design of the UPS shall permit safe and fast removal and replacement of the inverter module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode.
 3. The inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.
- C. **Static Bypass:** The bypass shall serve as an alternative source of power for the critical load when an abnormal condition prevents operation in normal mode. The bypass shall consist of a fully rated, continuous duty, naturally commutated static switch for high-speed transfers. The bypass shall feature the following transfer and operational characteristics.
1. Transfers to bypass shall be automatically initiated for the following conditions:
 - a) Output overload period expired.
 - b) Critical bus voltage out of limits.
 - c) Internal over temperature period expired.
 - d) Total battery discharge.
 - e) UPS failure.
 2. Uninterrupted automatic re-transfer shall take place whenever the inverter is capable of assuming the critical load.
 3. Uninterrupted automatic re-transfers shall be inhibited for the following conditions:
 - a) When transfer to bypass is activated manually or remotely.
 - b) In the event of multiple transfers/re-transfer operations the control circuitry shall limit "cycling" to three (3) operations in any ten-minute period. The fourth transfer shall lock the critical load on the bypass source.

- c) UPS failure.
 - 4. Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to bypass and from bypass shall be possible with the inverter logic. During manual transfers to bypass mode, the inverter must verify proper bypass operations before transferring the critical load to the bypass.
 - 5. All transfers to bypass shall be inhibited for the following conditions:
 - a) Bypass voltage out of limits (+/- 10% of nominal)
 - b) Bypass frequency out of limits (+/- 3 Hz, adjustable, factory set)
 - c) Bypass out of synchronization
 - d) Bypass phase rotation / installation error
 - 6. Static transfer time: No break, complete in less than 4ms.
 - 7. The bypass shall be manually energized using the control panel or remotely through a building alarm input.
- D. Monitoring and control components: The following components shall provide monitor and control capability:
- 1. Control panel with status indicators.
 - 2. Alarm and metering display.
 - 3. Building alarm monitoring.
 - 4. Communication ports. _____
- E. Battery management system: Each UPS shall contain a battery management system which has the following features:
- 1. The battery management system shall provide battery time remaining while operating in normal mode and battery mode. Battery time available information shall be displayed real-time, even under changing load conditions. Upon commissioning, battery runtime information shall be available.
 - 2. The battery management system shall automatically test the battery strings to ensure that the battery is capable of providing greater than 80% of its rated capacity. Testing the batteries shall not jeopardize the operation of the critical load. Upon detection of the battery strings not capable of providing 80%, the UPS system will alarm that the battery needs attention/replacement. The battery test shall be able to detect the following:
 - Open battery string
 - Shorted battery string
 - Battery capacity (runtime) less than 80% of "new" battery capacity
 - 3. The UPS shall communicate battery test and monitoring data to the UPS manufacturer's remote monitoring site. Battery life remaining, capacity, and number of on-battery events shall be provided in a monthly report.
 - 4. An optional temperature sensor shall be available to monitor the ambient temperature internal to the battery cabinet. If the ambient temperature increases, the UPS system charger shall automatically reduce the charging voltage to a level recommended by the battery manufacturer. If the ambient temperature is decreased the UPS shall automatically increase the battery charge voltage to that recommended by the battery manufacturer.

- F. **Wiring Terminals:** The neutral output compression terminal shall be sized for 200% of UPS module rated current to accommodate higher neutral currents associated with non-linear loads. The UPS module shall contain mechanical compression terminals (adequately sized to accommodate 90°C wiring) for securing user wiring to the following locations:
1. Rectifier/charger input connections (3-wire plus ground)
 2. Bypass input connections 3-wire plus ground for 3-wire plus ground output configuration or 4-wire plus ground for 4-wire plus ground output configuration
 3. DC link connections for battery cabinets (positive and negative).
 4. AC output connections (3 or 4 wires plus ground).

2.3 UPS MODULE ACCESSORIES

Each UPS system shall consist of the following accessories as required:

- A. **Integrated Maintenance Bypass, , and Accessory Cabinet(s):** Integrated Line-and-Match cabinet(s) shall be provided that include(s):
1. All hardware and interconnecting cable for connection to UPS module.
 2. Manual maintenance bypass switch to isolate UPS module from commercial AC input and critical load. Switch shall provide complete isolation of UPS for servicing and, if necessary, complete removal and replacement of UPS while still providing bypass power to critical load. Switch shall be make-before-break, interlocked between UPS and bypass to prohibit improper operation.
 3. K-1, K-13 or K20 rated output isolation transformer.
 4. Output termination lugs and cable pull sections properly sized for output cable termination and routing of cables to remote distribution panels
- B. **Modicon Modbus IP hardware and software and UPS Power Monitoring Software:** Modicon Modbus IP hardware and software shall provide a communications interface between the UPS module and plant SCADA system. This capability shall allow the units to be monitored remotely over an Ethernet network using a standard web browser.
1. **UPS Power Monitoring Software:** This system shall continuously monitor critical power elements associated with the UPS, using the communications port on each module and a customer furnished PC. The system shall automatically alarm if any problems arise and notify local or remote personnel of the alarm condition via email, page, or text message.
- C. **Battery Cabinet:** The battery cabinet shall feature valve regulated, high-rate discharge, lead-calcium batteries which provide energy to the support the critical load during a loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements. The battery cabinet shall have the following features:
1. Plates: Lead-calcium-tin alloy grid
 2. Casing material: ABS flame retardant V) plastin
 3. Electrolyte: Absorbed gas mat
 4. The battery cabinet shall be the same depth and height as the UPS module.
 5. The battery cabinet shall feature a mechanical enclosure of like appearance to the UPS module and shall feature casters. Each battery cabinet shall require front

access only for installation, service and maintenance. The battery cabinet shall provide top and bottom cable entry.

6. Power wiring internal to each battery cabinet shall be factory provided. Each battery cabinet shall feature 10 battery trays which can be individually disconnected from the battery cabinet power wiring with quick disconnect devices. Each battery tray shall be firmly secured to the battery cabinet frame with fasteners. Each battery tray shall be removable from the front of the battery cabinet.
7. Each battery cabinet shall feature a DC rated circuit breaker. The circuit breaker within the battery cabinet shall only provide protection to the battery string within that battery cabinet. For battery configurations involving multiple battery cabinets, a battery string in one battery cabinet may be isolated from the DC link via its circuit breaker without removing other battery strings from the DC link and the UPS module.
8. The circuit breaker in each battery cabinet shall feature an A/B auxiliary switch. The UPS module shall be capable of monitoring and alarming an open battery cabinet circuit breaker condition.
9. The circuit breaker in each battery cabinet shall feature a DC under voltage release device. The UV device shall operate to trip the battery breaker(s) for an emergency power off command or battery disable command.
10. Power and Control wiring between the battery cabinet and the UPS shall be factory provided with compression type connectors between cabinets.
11. Expected battery life: 15 years

2.4 MECHANICAL DESIGN

- A. Enclosures: Each UPS shall be housed in free-standing double front enclosures (safety shields behind doors) equipped with casters and leveling feet. Front doors shall have locks to prevent unauthorized entry.
- B. Ventilation: Each UPS shall be designed for forced-air cooling. Air inlets shall be on the front of the unit. Air outlets shall be on the top. Eighteen inches of clearance over the UPS outlets shall be required for proper air circulation. Air filters shall be commonly available sizes.
- C. No back or side clearance or access shall be required for each system. The back and side enclosure covers shall be capable of being located directly adjacent to a wall.
- D. Cable entry: Standard cable entry for the UPS cabinet shall be through either the enclosure bottom or top. A dedicated wireway shall be provided within the UPS cabinet for routing user input and output wiring.
- E. Front access: All serviceable subassemblies shall be modular and capable of being replaced from the front of the UPS (front access only required). Side or rear access for installation, service, repair or maintenance of the UPS system shall not be required.
- F. Service area requirements: The system shall require no more than thirty-six (36) inches of front service access room and shall not require side or rear access for service or installation.

2.5 CONTROLS AND INDICATORS

- A. Microprocessor controlled circuitry: Each UPS controls shall have the following design and operating characteristics:
 1. Fully automatic operation of the UPS shall be provided through the use of microprocessor controlled Digital Signal Processing. DSP shall eliminate

- variances from component tolerance or drift, and provide consistent operational responses.
2. All operating and protection parameters shall be firmware controlled, thus eliminating a need for manual adjustments. The logic shall include system test capability to facilitate maintenance and troubleshooting. Printed circuit board replacement shall be possible without requiring calibration.
 3. Start-up and transfers shall be automatic functions.
- B. Digital Front Panel Display: Each UPS control panel shall be a digital front panel display that features an 8x40 (8 lines, each with 40 characters) backlit LCD display. The LCD shall display UPS status, metering, battery status, alarm/event queue, active alarms and UPS configurations. The front panel display shall show a system mimic diagram with an outlined power path, current operating mode and event logs.
- C. Control Panel Indicators: Each UPS control panel shall provide the following monitoring functions with indicator LED's:
1. NORMAL: This shall indicate that the commercial AC utility or generator source is supplying power to the rectifier and the inverter is supporting the critical load. A text message shall indicate if the bypass line is not within tolerance.
 2. BYPASS: This shall indicate that the UPS has transferred the load to the bypass circuit.
 3. BATTERY: This shall indicate that the commercial AC utility or generator source has failed and the battery is supplying power to the inverter, which is supporting the load. A text message shall indicate if the battery charge is low or if the battery is installed but disconnected.
 4. ALARM: This shall indicate that the UPS detects an alarm condition, outlined in detail in the operator's manual.
- D. Control Panel Controls: Per UL 924 standards, the control push buttons must be protected, preventing the push buttons from being actuated without the use of a "tool." Each UPS control panel shall provide the following functions from front panel push buttons:
1. EVENTS: Displays the list of Active System Events and a historical log of system events. Historical logs shall include a detailed time stamped list of the latest 128 events.
 2. METERS: Displays performance meters for the system or critical load. When selected, the front display shall show individual screens of input parameters, output parameters or bypass parameters including; voltage, current and frequency. In addition, the battery display shall show runtime remaining.
 3. CONTROLS: Displays a System Controls screen. Allows selection of operating mode, normal, bypass, charger on/off and Power Module on/off.
 4. SETUP: Allows display contrast, date and time information serial communication port configuration and display of firmware revision numbers.
 5. RETURN: Confirms selection or returns to previous screen.
- E. Interface panel: Each UPS shall be equipped with an interface panel, located behind a protective cover, which provides the following signals and communication features in a Class 2 environment:

1. Alarm contact: A dry contact for annunciating a summary alarm shall be provided for customer use. This contact shall be Form "C" capable of supplying both N/O and N/C contacts. Contact ratings shall be 5A max at a voltage not to exceed 28VDC or 277VAC.
 2. RS232 (EIA / TIA-232) communications interface: Circuitry shall be provided for one RS232 (EIA / TIA-232) communication port for connection to automated service department diagnostic tools. This port may be used with simple ("dumb") terminals to gain remote access to all unit operation information.
 3. Building alarms: Two inputs shall be provided for monitoring the status of external dry contacts. Building alarms shall be set up through the UPS configuration mode function on the RS232 (EIA / TIA-232) port.
 4. External EPO contacts: Shall be provided to connect an external remote emergency power off switch to shutdown the UPS and de-energize the critical load.
 5. Battery control contacts: Contacts shall be provided to connect the battery UVR and auxiliary signals from a battery breaker or battery disconnect switch.
 6. External bypass indicator connection: A connection point shall be provided to acknowledge that an external maintenance bypass has been closed around the UPS, placing the critical load on utility power.
 7. The system shall have options to add four (4) additional building alarms, 384 logged events, 4 additional languages, Mandarin or Russian as a primary language.
- F. Manual Operable Test Switch
1. Per UL 924 standards, the UPS shall be provided with an automatic load control switching device or manually operable test switch, or provisions for the connection of an external test switch, to simulate the conditions under which the load control switching device is intended to operate (such as loss of the normal supply).
 2. For the purpose of meeting the requirement, the test switch is considered accessible only to authorized persons if it is mounted within an enclosure, or if it is of the key-operated type. If the test switch is mounted within an enclosure, the cover of the enclosure shall be hinged.

2.6 COMMUNICATIONS

- A. Communications Bay: The UPS shall be equipped with field configurable communications bays that will accommodate four (4) communication devices
- B. Remote Monitoring:
1. Optional WEB/SNMP communication capabilities will be available for all systems.
 2. The UPS shall be able to be monitored remotely via communications devices. UPS manufacturer shall provide optional communications devices capable of communicating via various industry standard protocols such as RS232 and ModBus. Monitoring of UPS status may also be performed through isolated dry contact Form C relays.
 3. Remote monitoring of the UPS shall also be possible through status indicators elsewhere in the same facility through a device that replicates these indicators.

The UPS communication capability should be able to integrate into any industry standard Building Management System (BMS) and/or Network Management System (NMS). The UPS must also be able to be monitored via any standard Internet browser (i.e. Internet Explorer and Netscape).

All optional hardware interfaces shall be "Hot-swappable" (UPS maintains power to critical applications while changing interfaces).

C. Shutdown:

1. There shall be a mechanism that provides graceful, orderly, unattended, sequential shutdown of one or multiple computers powered by one UPS. This shutdown shall be performed via in-network or out-of-network means. The order of shutdown shall be user-defined, allowing the maximization of runtime on battery for more critical systems.
2. Shutdown of AS/400 computers shall be possible through open-collector relay contacts or isolated, dry contact, Form-C relays.
3. The UPS shall also be capable of interfacing with an operating system's built-in shutdown routine, e.g. Windows NT. This shall be done through a cable connection to the optional serial port on the UPS.

D. Notification:

1. There shall be a mechanism to send alerts to key personnel via email or SNMP traps. An alarm notification may also be sent by a network message.
2. Dial-out to a computer for alarm notification may be performed. The user may respond by dialing-in to retrieve alarm history and a summary of current meter status.
3. Management: A remote battery test may be performed via an Ethernet network. The UPS shall be tested through invoking a single command.

2.7 UPS MODULE PROTECTION

- A. Rectifier/Charger and Bypass protection shall be provided through individual fusing of each phase.
- B. Battery protection shall be provided by thermal-magnetic molded-case circuit breakers in each battery cabinet (if standard battery pack is provided) or external protective device for an external battery.
- C. Electronic current limiting circuitry and fuses in the Inverter circuit shall provide output protection.
- D. To comply with agency safety requirements, the UPS module shall not rely upon any disconnect devices outside of the UPS module to isolate the battery cabinet from the UPS module.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in compliance with all City and local standards.

3.2 COMMISSIONING

- A. Factory start-up shall be provided on a 5x8 basis. Start-up service shall be provided at no extra charge and shall include one visit to perform all procedures and tests specified within UPS Installation and Operation manual. UPS manufacturer shall also offer the following optional services:
 1. Pre-energize visit to inspect installation and provide guidance to installers as required.

2. Post-start-up visit for alarm notification configuration, operator training, generator testing, etc.
- B. The following procedures and tests shall be performed by Field Service personnel during the UPS startup:
1. Visual Inspection:
 - a) Visually inspect all equipment for signs of damage or foreign materials.
 - b) Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.
 2. Mechanical Inspection:
 - a) Check all the power connections for tightness.
 - b) Check all the control wiring terminations and plugs for tightness or proper seating.
 3. Electrical Pre-check:
 - a) Check the DC bus for a possible short circuit.
 - b) Check input and Bypass power for proper voltages and phase rotation.
 - c) Check all lamp test functions.
 4. Initial UPS Startup:
 - a) Verify that all the alarms are in a "go" condition.
 - b) Energize the UPS module and verify the proper DC, walkup, and AC phase on.
 - c) Check the DC link holding voltage, AC output voltages, and output waveforms.
 - d) Check the final DC link voltage and Inverter AC output. Adjust if required.
 - e) Check for the proper synchronization.
 - f) Check for the voltage difference between the Inverter output and the Bypass source.
 - g) Optional on site full-load, step-load, and battery discharge tests using supplier furnished load bank, shall also be offered.
 5. Operational Training: Before leaving the site, the field service engineer shall familiarize responsible personnel with the operation of the UPS. The UPS equipment shall be available for demonstration of the modes of operation.

3.3 WARRANTY

All components of each UPS system shall be covered by a standard one-year limited factory warranty and service protection package.

One-year limited factory warranty shall include replacement coverage for the UPS parts for a period of 18 months from shipment or 12 months from start-up, whichever occurs sooner.

One-year service protection package shall include 7x24 on-site repair/replacement labor for UPS parts and batteries; 7x24 technical support coverage; and 7x24 remote monitoring service (with monthly reports for UPS and battery performance). Standard response time shall be 8 hours from receipt of call. Manufacturer shall also offer, as an option, 7x24 on-site service support with guaranteed response times of 4, or 2 hours in certain major metropolitan areas. Additional

preventive maintenance visits shall be available as an option for both UPS and battery components.

Manufacturer shall also include Start-up services consisting of: 5x8 Start-up service of UPS and batteries, with option for 7x24 Start-up. On-site user training, Site Audit, installation and commissioning of monitoring service, and validation of one-year limited factory warranty will be performed during the start-up.

Manufacturer shall also offer an optional service plan to provide 7x24 on-site coverage (preventive and corrective) for UPS and batteries, guaranteed response time, remote monitoring, Web access to service site history, annual Site Audit, UPS and battery preventive maintenance visit, and discounts on upgrade and modification kits. Manufacturer shall also provide an optional battery service plan to provide parts-and-labor coverage for partial and full battery strings, either with preventive maintenance or replacement coverage.

**** END OF SECTION ****

SECTION 16720 - FIRE AND SMOKE ALARM SYSTEM

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. Related fire protection and life safety devices shown on the Contract Drawings and related control strategies in Section 13300 are for plant Operations use only. Any additional fire and smoke alarm systems required by DSD shall be the responsibility of the Contractor. The Contractor shall provide, design, and submit for approval any and all fire protection monitoring and apparatus per local City of San Diego DSD Building Department requirements. The Contractor shall pay for any permit and inspection fees.

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 08710 Finish Hardware
 - 2. Section 13300 Instrumentation and Control
 - 3. Section 16050 Basic Electrical Materials and Methods

1.3 CODES

- A. The WORK of the Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:
 - 1. Uniform Building Code
 - 2. Uniform Fire Code
 - 3. National Electrical Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. NFPA 72A Installation, Maintenance, and Use of Local Protective Signaling System for Guard's Tour, Fire Alarm, and Supervisory Service.
 - 2. NFPA 72B Installation, Maintenance, and use of Auxiliary Protective Signaling System for Fire Alarm Service.
 - 3. NFPA 72C Installation, Maintenance, and Use of Remote Station Protective Signaling System.
 - 4. NFPA 72E Automatic Fire Protectors.
 - 5. NFPA 72G Notification Appliances for Protective Signaling Systems.

6. NFPA 72H Guide for Test Procedures for Protective Signaling Systems.
7. NFPA 101 Life Safety Code.

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Manufacturer's product data including catalogue cuts.
2. Block diagram showing system relationships of major components, quantities and interconnecting cables.
3. Plans showing locations of devices.
4. Connection details (typical) for each device.
5. Control panel factory wiring and field wiring terminations, devices, and special mounting details.
6. Initiating device circuit descriptions with programming.
7. Wiring diagrams showing terminal identification for field-installed wiring.
8. Manufacturer's certificate that system complies with indicated requirements.
9. Documentation of Fire Department approval of manufacturer and installer.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL:

1. Operating instructions and maintenance and repair procedures.
2. Manufacturer representative's letter stating that system is operational.

1.7 QUALIFICATIONS

- A. **Manufacturer:** Company specializing in [smoke detection and] fire alarm systems and having Fire Department approval.
- B. **Installer:** Company specializing in smoke detection and fire alarm systems certified by the Fire Department as fire alarm installing contractor.

1.8 SERVICES OF MANUFACTURER

- A. **Local Service:** The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.

1. **Demonstration:** Operation of the fire alarm system shall be demonstrated to the

CONSTRUCTION MANAGER to prove that the system operates and complies with this Specification.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The system shall:
 - 1. Be UL and FM listed.
 - 2. Conform to requirements of NFPA 101.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** System and products shall be installed in accordance with the manufacturer's written installation.

3.2 FIELD QUALITY CONTROL

- A. Systems shall be tested in accordance with NFPA 72H and local fire department requirements.
- B. The WORK of this Section includes the services of certified technician to supervise installation, adjustments, final connections, and system testing.

3.3 FIRE ALARM AND CABLE COLOR CODE

- A. Except as otherwise indicated or required by requirements of the City of San Diego Fire Department, fire alarm circuit conductors with color coded insulation, or color coded tape at each conductor termination and in each junction box shall comply with the following:
 - 1. Power Branch Circuit Conductors: Black, red, white.
 - 2. Initiating Device Circuit: Black, red.
 - 3. Detector Power Supply: Violet, brown.
 - 4. Signal Device Circuit: Blue (positive), white (negative).
 - 5. Door Release: Gray, gray.
 - 6. Municipal Trip Circuit: Orange, orange.
 - 7. Municipal Fire Alarm Loop: Black, white.

**** END OF SECTION ****

SECTION 16781 - OUTDOOR FIBER OPTIC CABLE SYSTEMS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing and installing a fiber optic conduit system including fiber optic cable (FOC), conduit, pullboxes, splices, terminations and testing.
- B. The Work includes splicing and testing individual fiber cables installed under this CONTRACT, and testing a completed fiber link as shown on the Contract Drawings.

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 02200 Earthwork

1.3 STANDARD SPECIFICATIONS

- A. The earthwork portions of the work shall be governed by the Standard Specifications for Public Works Construction (SSPWC), commonly known as the "Greenbook"; and the City Supplement to the SSPWC, commonly known as the "Whitebook".
- B. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC) and the "Whitebook".

1.4 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted:
 - 1. **Catalog Data:** Catalog data on conduit system, pullboxes, conduit fittings, conduit plugs, pull rope, identification tape, warning signs.
 - 2. Detailed bill of materials.
 - 3. Drawings indicating the locations of all pullboxes with station numbers.
 - 4. Catalog data on all testing devices proposed for use plus certifications of accuracy, calibration, and traceability to standards of the National Institute for Standards and Testing.
 - 5. Cable pulling calculations for all conduit runs. Indicate on the submittal any additional pullboxes that are required, including station number and a written description of the location.
 - 6. A cable pulling and splicing work plan shall be submitted a minimum of 45 days prior to the planned initiation of cable pulling. The pulling plan and pull tension calculations may be

prepared by using a software program such as Pull-Planner 2000 by American Polywater Corporation, or equal. The cable pulling and splicing work plan must be approved a minimum of 15 days prior to pulling cable. Work plan shall include the following:

- a. Pull tension calculations
 - b. Calculated amount of lubrication required
 - c. Detailed description of pull operation methods for all conduit runs
 - d. Tools and equipment to be used for cable installation and testing
 - e. Physical location of equipment setup and type
 - f. Exact location of splice points
 - g. Safety and manual assist cable pulling operations
 - h. Detailed schedule for pulling and testing cables
7. Information on at least one successfully performing fiber optic cable installation of comparable size and complexity installed in the recent past with name, address, and telephone number of facility owner, name of project and completion date, and type of conduit system and length of cable pulled.
8. The name and qualifications of the supervisory personnel that will be directly responsible for the installation of the conduit system.

1.5 STANDARDS

- A. **Cable Certification:** The cable manufacturer shall certify that the cable is suitable for direct installation in 2-inch to 4-inch conduit in an underground environment. The CONTRACTOR shall submit a sample and its certification to the CONSTRUCTION MANAGER for approval prior to installation. The CONTRACTOR shall submit laboratory test reports on representative samples of similar cable design to demonstrate compliance with the following requirements prior to cable installation:
1. Tensile Strength per EIA-RS-455-33A and EIA-RS-455-28A
 2. Jacket Shrinkage per EIA-RS-455-86
 3. Cable Twist per EIA-RS-455-85
 4. Environmental Temperature Cycling per EIA-RS-455-3A
 5. Flexing per EIA-RS-455-104
 6. Impact Resistance per EIA-RS-455-25A
 7. Compressive Strength per EIA-RS-455-41
 8. Freezing Test per EIA-RS-455-98A
 9. Mechanical Bend Test per EIA-RS-455-37
- B. The cable manufacturer shall be ISO 9001 registered.

1.6 APPLICABLE DOCUMENTS

- A. The optical fiber cable shall conform to the latest issue of the following standards documents which are incorporated by reference into this specification:
1. EIA-455 Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.
 2. EIA-359 Standard Colors for Color Identification and Coding.
 3. MIL-202 Test Methods for Electronic and Electrical Component Parts.
 4. MIL-454 Standard General Requirements for Electronic Equipment.

5. ML-810 Environmental Test Methods and Engineering Guidelines.

- B. All fiber optical cables shall be constructed in accordance with EIA-455 and one hundred percent (100%) of all optical fibers and jacketing shall meet or exceed the requirements contained in this specification.

1.7 QUALITY ASSURANCE

- A. All work described in this Section shall meet or exceed the applicable provisions of the following documents:

1. ANSI, C8.471983, American National Standard Institute for Polyolefininsulated Thermoplastic Jacketed Communication Cables.
2. EIA-455 (addendum 1 through 5) Standard Test Procedures for Fiber Optics, Cables, Transducers, Connecting and Terminating Devices.
3. EIA-455-27A, Method of Measuring (Uncoated) Diameter of Optical Waveguide Fibers.
4. EIA-455-28A, Method For Measuring Tensile Failure Point of Optical Waveguide Fibers.
5. EIA-455-34, Interconnection Device Insertion Loss Test.
6. EIA-455-89, Fiber Optic Cable Jacket Elongation and Tensile Strength.
7. Underwriters Laboratories (UL) Standard 651 (Conduit)
8. Underwriters Laboratories (UL) Standard 514 (Accessories)
9. National Electrical Manufacturers Association (NEMA) TC-2 (Conduit)
10. National Electrical Manufacturers Association (NEMA) TC-3 (Accessories)

1.8 WARRANTY

- A. The Contractor shall provide an unconditional warranty on all installed cable for a minimum period of two (2) years.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. **Conduit:** Conduit shall be Schedule 80 PVC electrical conduit including fittings for underground installation.
- B. **Cabinets:** Cabinets shall be standard CALTRANS Type 332, furnished without traffic control components. Cabinet material shall be 0.125 inch aluminum, with full front and back doors, shall have stainless steel handles with padlock feature, and shall be furnished with Best locks (lock core will be provided by the City). Finish shall be natural aluminum. Cabinets shall accommodate 19-inch standard EIA rack assemblies. Cabinets shall be installed on reinforced concrete pads.

- C. **Pullboxes:** Pullboxes shall be Caltrans standard No. 6, approximately 32 inches wide by 49 inches long by 36 inches deep, designed for H-20 traffic loading unless otherwise indicated. Covers for pullboxes in paved areas shall be galvanized steel, rated for H-20 traffic loading. Covers for pullboxes in sidewalks and unpaved areas shall be concrete. Bolts shall be 316 stainless steel. Covers shall have the words "MWWF Fiber Optic" in raised letters on the top. Covers shall have locking devices and form a watertight seal to prevent surface water from entering. Knockouts in the sidewalls shall permit underground conduit side entry and exit.
- D. **Conduit Duct Plugs:** Jackmoon Simplex Duct Plugs with bushing sleeves **or equal**.
- E. **Pull Rope:** Low friction, polyethylene jacketed polypropylene rope with 1800 psi tensile strength. Provide Vikamatic "Fiber Glide" **or equal**.
- F. **Fiber Optic Cable**
1. **Cable type:** All-dielectric outdoor plant stranded loose-tube, gel-filled fiber optic cable, Corning Altos or Lucent Lightpack.
 2. **Number of fibers:** per Contract Drawings.
 3. **Buffer Tubes:** All optical fibers shall be grouped and placed inside a loose buffer tube. The tubes shall be color coded and arranged symmetrically around the central member.
 4. Each fiber shall be numbered and color-coded.
 5. The colors of the individual fibers shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.
 6. The fibers shall not adhere to the inside walls of the loose buffer tube. Buffer tubes shall be kink resistant within the specified minimum bend radius.
 7. Filler may be included in the cable core composition to lend symmetry to the cable cross-section where needed.
 8. A central anti-buckling member shall be included into the cable to prevent buckling of the cable. The anti-buckling member shall be composed of a glass reinforced plastic rod.
 9. Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents.
 10. Buffer tubes shall be stranded around a central member using the reverse oscillation, or "S-Z", stranding process.
 11. The cable core shall contain a water-blocking material. The water blocking material shall be non-nutritive to fungus, electrically non-conductive and homogenous. It shall also be free from dirt and foreign matter and shall be readily removable with conventional nontoxic solvents.
 12. Binders shall be applied with sufficient tension to secure the buffer tubes to the member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking and

dielectric with low shrinkage.

13. Tensile strength shall be provided by a combination of high tensile strength dielectric yarns. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.
14. The all-dielectric cable shall be sheathed with medium density polyethylene (MDPE). The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and water blocking material. The jacket or sheath shall be free of holes, splits, and blisters. The cable jacket shall contain no metallic elements and shall be of a consistent thickness.
15. The cable shall contain at least one ripcord under the sheath for easy sheath removal.

G. Fan-Out Termination for Loose Tube Cables

1. Individual fibers within the loose tube cable require handling protection inside the termination cabinets. Fan-out kits shall be installed in the patch panel enclosures to transition the loose tube fibers to ruggedized tight-buffered fiber pigtail cables. Fan-out tubes or furcation kits shall not be used. Optical fusion splices shall connect the loose tube fibers to the tight-buffered pigtail cables. The optical splice loss shall comply with the specifications for optical splices. Splice protection sleeves shall be employed on all splices to protect the splices. A wall-mountable splice center shall house the splices and serve to fully protect excess lengths of loose tube fibers from exposure.
2. The tight-buffered pigtails shall be terminated with STTM connectors as specified.

H. Fan-out Pigtail Cable Specifications

1. Singlemode fiber (Corning SMF-28TM or equal) shall be used in the pigtails. Optical characteristics shall comply with the optical fiber performance specifications.

Buffer material	Thermoplastic
Buffer O.D.	900 um
Strength Member	Kevlar
Jacket Material	PVC
Jacket O.D.	3.0 mm
Temperature Range	-20 to + 70 C

I. Fiber Optic Termination Patch Panels

1. Where shown on the plans, the fiber optic cable shall terminate inside a communications cabinet on a termination patch panel. All fiber sub-cables within the cable shall be terminated with STTM compatible connectors. The patch panel shall have a fiber capacity equal to the total number of fibers (connected and spare) for all cables to be connected. Patch panels shall be designed for either rack mounting on a standard equipment rack or housed in an enclosure for direct wall mounting. The patch panel shall contain STTM type bayonet couplings. All unused couplings shall have protective dust

covers. All panels shall be furnished with locking doors. Factory-terminated, tight-buffered, agamid-reinforced fiber optic jumper assemblies or interconnect cables, standard 3.0 mm O.D., shall connect the optical cable terminations to the patch panel couplings. Panels shall be equal to the following manufactured by Secure:

Mounting	Fiber Capacity	Model Number
Rack	48	C.H.-02U
Rack	72	C.H.-03U
Wall	48	AC-048L with lock
Wall	72	AC-072L with lock

2. The termination patch panel shall be equipped with a suitable means for routing and securing of cables and shall provide a suitable means of protection for the mounted fiber connectors, to prevent damage to fibers and connectors during all regular operation and maintenance functions. All cables shall be provided with strain relief. Bend diameters on cable fibers and jumpers must be greater than four (4) inches at all times to ensure optical and mechanical integrity of the optical fibers.

J. Optical Connectors

1. All connectors shall be field-install able and perfectly matched to the cable used. The connectors shall provide tight fitting termination to the cladding and buffer coating. Epoxy- based or “hot melt “ adhesives shall be used to bond the fiber and buffer to the connector ferrule and body prior to polishing the end face. No dry-termination or “quick crimp” connectors are allowed.
2. After termination with connectors, the fiber ends must be visually inspected at a magnification of not less than 100 power to check for cracks or pits in the end face of the fiber. If any irregularities found cannot be removed by further polishing, the entire process must be redone by cutting off and disposing the connector body.
3. Connectors shall have a maximum allowable connection loss of 0.3 dB per mated pair, as measured per EA.-455-34. No index-matching gel is to be used, dry interfaces only. Singlemode connectors shall be capable of field installation on 9/125 micron fibers with 900 micron buffers (OD).
4. Each connector shall be of the industry standard ST type compatible, designed for singlemode tolerances, and shall meet or exceed the applicable provisions of EA.-455-5, 455-2A, and 455-34, and shall be capable of 100 repeated matings with a maximum loss increase of 0.1 dB. Connectors shall incorporate a key-way design and shall have a zirconia ceramic ferrule. Connector bodies and couplings shall be made of corrosion-resistant and oxidation-resistant materials, such as nickel plated zinc, designed to operate in humid environments without degradation of surface finishes.

K. Splice Closures

1. Splice closures shall be of the re-enterable type, with an external moisture-proof shell, inner closure and encapsulant.

2. Closure shall have removable interior splice trays.
3. Closures shall be Corning Cable Systems (Secure) type SCN **or equal**.

2.2 TRENCH BACKFILL MATERIALS:

- A. Slurry backfill for the installation of conduits that will contain fiber optic cable shall be a medium to dark, red or orange color to clearly distinguish the concrete backfill from other concrete and soil. The concrete shall be pigmented by the addition of commercial quality cement pigment to the concrete mix. The red or orange concrete pigment shall be LM Scofield Company; Orange Chromix Colorant; Davis Colors, **or equal**.
- B. For trenches in pavement areas, only the top 4 inches of concrete backfill will be required to be pigmented concrete. At the option of the Contractor, the full depth may have the pigment.

PART 3 -- EXECUTION

3.1 CONDUIT INSTALLATION

A. General

1. Conduit sections shall be joined in accordance with the Manufacturers' recommendations. All joints shall be watertight.
2. All conduit shall be cleaned and tested prior to installation of cables.
3. CONTRACTOR shall install pull rope in the conduit.
4. Conduits entering pullboxes shall be sealed with Jackmoon Simplex duct plugs.
5. The conduit shall gradually and smoothly slope up to the elevation of the pullbox entrance. Use of manufactured bends shall be limited to an absolute minimum. Factory bends, if required, shall be no more than 22½ degrees.
6. Conduit trenching and backfill shall comply with San Diego Regional Standard Drawing G-33, Type A, with the following change to Note 10: Select material with a minimum sand equivalent of 50 shall be backfilled to 3 inches minimum above the conduit. Sand cement slurry backfill may not be substituted for select material.
7. A trace wire shall be installed along the entire fiber optic cable route for use in active cable location. The trace wire shall be a #8 AWG bare-copper solid strand. No insulation or other coating material shall be on the trace wire. The trace wire shall provide a termination at each pullbox for connection to testing equipment.
8. **Identification Tape:** A 6-inch wide magnetically detectable warning tape with orange protective polyethylene jacket resistant to alkalis, acids, and other destructive elements shall be installed along the entire length of the conduit route. The polyethylene tape shall be continuously imprinted "CAUTION-FIBER OPTIC CABLE". The warning tape shall be Teletrace by Vikamatic, **or equal**.

B. Conduit Installation along Pipelines

1. Conduits shall be installed on one side of the trench, at least 2 inches and not more than 12 inches from the trench wall, at a depth of 3 to 4 feet below grade along the entire pipeline route. The conduit shall not cross over the pipe.
2. For conduits installed with a pipeline, conduits shall clear concrete structures and vaults associated with the pipeline by a minimum of one foot.
3. Conduit shall be installed in the annular space between the carrier pipe and the casing or tunnel liner for all two-pass tunnel or jack and bore sections of the pipeline alignment.
4. On installations along pipelines, CONTRACTOR shall install marker signs for fiber optic cable on all marker posts for the pipeline as indicated.

3.2 FIBER OPTIC CABLE INSTALLATION

A. General

1. The Contractor shall determine a suitable cable installation method to ensure that all cable installation requirements shall be met in all conduit sections. All work shall be carried out in accordance and consistent with the highest standards of quality and craftsmanship in the communication industry with regard to the electrical and mechanical integrity of the connections; the finished appearance of the installation; as well as the accuracy and completeness of the documentation.
2. The Contractor shall make a physical survey of the project site for the purpose of establishing the exact cable routing and cutting lengths prior to the commencement of any work or committing any materials.
3. The cable shall be carefully inspected for jacket defects as it is removed from the reel. If defects are noticed, the pulling operation shall be terminated immediately and the CONSTRUCTION MANAGER notified.
4. Fiber optic cables shall be installed in continuous lengths without intermediate splices throughout the project. Cable installation personnel shall be familiar with the manufacturer's recommended procedures including, but not limited to the following:
 - a. Proper attachment to the cable strength elements for pulling during installation. Depending on cable design, this will involve direct attachment to internal strength members or attaching an external "Kellums" or split mesh grip using a 600 lb breakaway swivel.
 - b. Cable tensile limitations and tension monitoring procedures.
 - c. Cable bending radius limitations.
 - d. Cable twisting limitations.

B. Cable Protection During Installation

1. All fiber optic cable shall be pulled in conduit except as specified on the plans. Care shall be exercised during cable pulls through conduit bends and looping in pullboxes.

2. The Contractor shall comply with the cable manufacturer's recommended installation procedures at all times. Cable installation procedures shall conform to Belcore guidelines.
 3. To reduce the possibility of damage to the outer jacket of the fiber optic cable, protective measures shall be used when the cable is installed. The requirements herein shall be followed, but does not limit the installation to only those identified. The purpose of the installation specifications is to ensure protection of the fiber optic cable when it is installed. Other protective measures not specified herein may be taken during installation if it will ensure protection of the cable.
 4. A cable feeder guide shall be used between the cable reel and the face of the duct and conduit to protect the cable and guide it off the reel and into the duct. The cable shall be carefully inspected for jacket defects as it is removed from the reel. If defects are noticed, the pulling operation shall be terminated immediately and the CONSTRUCTION MANAGER notified.
 5. Precautions shall be taken during installation to prevent the cable from being kinked, crushed or twisted. A pulling eye shall be attached to the cable end and be used to pull the cable through the duct and conduit system. As the cable is pulled off the reel and into the cable feeder guide, it shall be lubricated with a lubricant that shall be of the water- based type and approved by the cable manufacturer.
 6. Crushed or kinked cable shall be replaced with new cable.
 7. Dynamometers or break away pulling swings shall be used to ensure the pulling line tension does not exceed the installation tension values specified by the cable manufacturer. The mechanical stress placed upon the cable during installation shall not be such that the cable is twisted and stretched. Maximum allowable cable strain during installation shall be less than 0.75 %.
- C. **Lubrication:** As the cable is pulled into the conduit system, it shall be sufficiently lubricated with a lubricant that shall be the water-based type and approved by the cable manufacturer. Lubricant shall be applied at a rate to provide a continuous 10-mil coating, as recommended by the manufacturer. Lubricant shall be Polywater F® manufactured by American Polywater or equal.
- D. To accommodate long continuous installation lengths, bi-directional "center pull" techniques for pulling of the fiber optic cable is acceptable and shall be implemented as follows:
1. From the midpoint, pull the fiber optic cable into the conduit from the shipping reel in accordance with the manufacturer's specifications.
 2. When this portion of the pull is complete, the remainder of the cable must be removed from the reel to make the inside end available for pulling in the opposite direction.
 3. This is accomplished by hand pulling the cable from the reel and laying into large "figure eight" loops on the ground.
 4. The purpose of the figure eight pattern is to avoid cable tangling and kinking.

5. The loops shall be laid carefully one upon the other (to prevent subsequent tangling) and shall be in a protected area.
 6. The inside reel end of the cable is then available for installation.
 7. In some cases, it may be necessary to set up a winch at an intermediate cable vault.
 8. The required length of cable shall be pulled to that point, and brought out of the cable vault and coiled into a figure eight.
 9. The figure eight is then turned over to gain access to the free cable end. This can then be reinserted into the duct system for installation into the next section.
- E. When power equipment is used to install fiber optic cables, the pulling speed shall not exceed 30 meters per minute. The pulling tension, bending radius and twist limitation for fiber optic cable shall not be exceeded under any circumstances.
- F. Large diameter wheels, pulling sheaves, and cable guides shall be used to maintain the appropriate bending radius. Tension monitoring shall be accomplished using commercial dynamometers or load-cell instruments.
- G. The pulling eye/sheath termination hardware on the fiber optic cables shall not be pulled over any sheave blocks.
- H. All pulls shall be documented by a graph which is annotated with the following information:
1. Reel number
 2. Station from and station to
 3. Date and time
 4. Explanations of abnormalities in readings or interruptions
 5. Sign-off by CONTRACTOR and CONSTRUCTION MANAGER.
- I. Under no conditions shall the FOC be left exposed or unattended.
- J. **Repairs:** Repair of cable jacket shall not be permitted. Jacket damage shall require removal and re-installation of a new cable run at the Contractor's expense.
- K. **Installation at Pullboxes**
1. The pulling of the cable shall be hand assisted at each handhole or pullbox. The cable shall not be crushed, kinked or forced around a sharp corner. Sufficient slack shall be left at each end of the cable to allow proper cable termination.
 2. The cable shall be looped in all pullboxes as noted on the plans to provide approximately fifteen (15) feet of extra cable in the pullbox. At termination points, such as at cabinets or computers, a fifteen (15)-foot loop shall also be provided wherever space permits. The fiber optic cable shall be coiled and secured with cable ties in the pullbox. The Contractor shall ensure that the minimum bending radius of the fiber optic cable is not compromised when preparing this stored cable slack.
 3. Imprinted plastic coated cloth identification/warning tags shall be securely attached to the cables in at least two locations in each handhole. Tags shall be by Brady or Thomas &

Betts.

4. When all cables at each pullbox are securely racked, unused conduits and void areas around conduit containing cables shall be sealed.
5. **Cable Marking:** At each pullbox and at each cabinet, the cable shall be visibly marked with yellow warning tape as follows:

"CAUTION - FIBER OPTIC CABLE"

L. Splicing

1. Splicing of fiber optic cable shall not be permitted except in emergency conditions or as specified on the plans or in the special conditions for a specified project. Fiber optic cable runs and required looping of the cable shall be provided in one continuous length. When splicing is authorized by the CONSTRUCTION MANAGER, splicing shall be by trained, authorized persons only. Any allowed splicing of fiber optic cable shall be by fusion splice only, no mechanical splices are permitted.
2. All fusion splicing equipment shall be in good working order, properly calibrated, and meeting all industry standards and safety regulations. Cable preparation, closure installation and splicing shall be accomplished in accordance with accepted and approved industry standards.
3. Splices shall be made in pullboxes and shall use re-enterable splice closures.
4. The average splice loss shall be 0.1 dB or less per splice. The average splice loss is defined as the summation of the loss as measured in both directions using an optical time domain reflectometer (OTDR) through the fusion splice, divided by two. No individual splice loss measured in a single direction shall exceed 0.15 dB.
5. Upon completion of the splicing operation, all waste material shall be deposited in suitable containers, removed from the job site, and disposed of in an environmentally acceptable manner.

3.3 PULLBOXES

A. Field Location of Pullboxes

1. The drawings diagrammatically indicate the desired location of pullboxes, conduit runs and other items. Exact locations shall be determined by the CONTRACTOR based on physical size and arrangement of equipment, finished elevations, calculated cable pulling tensions, field obstructions, and the criteria below. Locations shown on the drawings should be followed as closely as possible, however, pullboxes shall be located according to the following criteria:
 - a. At no point shall the cable pulling tension exceed 600 pounds. If cable pulling tension is calculated to exceed 600 pounds, additional pullboxes shall be provided at no extra cost to the OWNER.
 - b. The maximum distance between any two pullboxes shall not exceed 1,200 feet.

- c. Within the 1,200-foot distance, the CONTRACTOR shall install pullboxes at locations wherever the cumulative change of direction of the conduit exceeds 180 degrees.
- d. The minimum bending radius for conduit shall be 3 feet.
- e. A pullbox shall be installed on one side of a tunneled crossing. However, for any crossing which requires more than 180 degrees of conduit bends to account for elevation differences or route adjustments, a pullbox shall be provided on both sides of the crossing.
- f. Pullboxes shall be installed a minimum of 12 inches from all structures.

B. Construction

- 1. The CONTRACTOR shall install the pullbox covers so that the top of the cover is flush with the restored pavement. Pullboxes installed in soil areas shall be installed so that the top of the cover is at least one inch but not more than 4 inches above the final grade level of the restored surface to prevent accumulation of dirt, silt and debris on the top of the hand hole cover. Pullboxes installed in areas not subject to flooding or standing water shall have a minimum of five (5) 3/4-inch drainage holes in the bottom of the box.
- 2. CONTRACTOR shall perform conduit integrity tests for each section between the pullboxes after backfilling and compaction using the test and procedures described in this Section. These tests shall be performed prior to installation of the pull rope.
- 3. Pullbox conduit entries shall be sealed with duct plugs to prevent the intrusion of water and debris into the pullboxes.
- 4. Pullboxes shall be installed on a compacted level foundation consisting of 4 inches of granular material complying with Section 02200.
- 5. Compaction around pullboxes and associated details shall be performed in accordance with Section 02200.
- 6. Upon final acceptance of the conduit system all pullboxes shall be free of debris and water, and be ready for cable installation.

3.4 MODIFICATIONS

- A. All dimensions and exact locations of underground substructures shall be field verified. Minor changes in locations of pullboxes which result in no additional costs for material or labor shall be made at no additional cost to the OWNER. However, the CONTRACTOR shall prepare proposals consisting of detailed material lists, cost estimates, and schedules for rerouting the conduit around existing unforeseen underground utilities and structures which result in additional cost. The CONSTRUCTION MANAGER will consider the proposals in accordance with the provisions of the General Conditions.
- B. The CONTRACTOR shall consider the following when preparing proposals:
 - 1. Manufactured bends shall be minimized

2. Required bends shall be less than 22½ degrees
3. Clearances between conduits and other structures shall be:

Power or other foreign conduit: 12 inches

Pipe for gas, oil, water, sewage: 6 inches when crossing; 12 inches when parallel

3.5 CONDUIT SYSTEM CLEANING AND TESTING

- A. Following the backfill placement and compaction, all conduits shall be cleared of loose material by brush and compressed air.
- B. Conduit shall be tested for leakage by air testing at 5 psi, maintaining the pressure for one hour without showing any leakage.
- C. Following the leakage test, a test mandrel ¼ inch smaller than the inside diameter shall be passed through all conduits to detect alignment and deformation problems. Mandrel shall be passed in both directions.
- D. Cleaning and testing of the conduit shall be performed by the CONTRACTOR and witnessed by the CONSTRUCTION MANAGER. The cleaning and testing operation shall be conducted for each conduit section between adjacent pullboxes, a section at a time, for the entire route. The results of tests shall be documented by the CONTRACTOR and signed by the CONSTRUCTION MANAGER and the CONTRACTOR.
- E. The CONTRACTOR shall provide a five-day advance notice of the schedule and location of test to the CONSTRUCTION MANAGER.
- F. The CONTRACTOR shall remove and replace conduit which fails either test and shall repeat the test.

3.6 FIBER OPTIC CABLE TESTING

- A. **General:** The CONTRACTOR shall perform pre-installation and post-installation FOC tests. The CONSTRUCTION MANAGER shall be notified a minimum of 10 days in advance so that these tests are witnessed. All test equipment shall be traceable to LIST standards.
- B. **Test equipment:** The CONTRACTOR shall use the following to perform pre-installation and post-installation FOC tests:
 1. **Optical Time Domain Reflectometer (OTDR):** The OTDR shall be laser precision, ALT Inc MODEL 5200 LRFL, or equal.
- C. **Pre-Installation Tests**
 1. The purpose of these tests is to perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specifications, and is free of defects, breaks and damages by transportation and manufacturing processes.
 2. Prior to removal of each cable from the delivery reel, all optical fibers within the cables shall be tested by the CONTRACTOR using an OTDR. The OTDR tests shall consist of end-to-end length and fiber attenuation (dB/km) measurements to ensure proper

performance of the fiber optic cable. The tests shall be performed from both ends of each fiber to ensure complete fiber continuity within the cable structure.

3. Pre-installation, "on-reel" test results shall be compared with the manufacturer's test report delivered with the cable. Gross dissimilarities shall be noted and remedied between the contractor and manufacturer. In all cases, all fibers must meet the optical attenuation specifications prior to cable installation.
4. The CONTRACTOR shall perform tests on all reels of cable. The CONSTRUCTION MANAGER shall be notified a minimum of 15 days prior to any test.
5. The CONTRACTOR shall document each test and submit the report to the CONSTRUCTION MANAGER for review. Documentation shall consist of both hard copy and 3½-inch electronic disk complete with all application software.
6. Cable shall not be installed until the CONSTRUCTION MANAGER has reviewed the test report.
7. Maximum allowable attenuation is 0.5 dB/km at 1310 and 1550 nm. The CONTRACTOR shall replace any cable in which any fiber does not meet this requirement.

D. **Post-Installation Tests:** After FOC has been installed the following tests shall be performed:

1. A recording OTDR shall be used to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with a 1310 nm and 1550 nm light source for the single mode fiber (SMF). The OTDR shall have an X-Y plotter to provide a hard copy record of each trace of each fiber. The OTDR shall be equipped with sufficient internal masking to allow the entire cable section to be tested. This may be achieved by using an optical fiber pigtail of 30 feet or more to display the required cable section.
2. The maximum permissible end-to-end loss shall be 0.5 dB/km. The CONTRACTOR shall replace any cable in which any fiber does not meet this requirement.
3. The OTDR shall be calibrated for the correct index of refraction to provide proper length measurement for the known length of reference fiber.
4. A transmission test shall be performed with the use of a 1310 and 1550 nm stabilized light sources and 1310 nm/1550 nm power meters for SMF. This test shall be conducted in both directions on each fiber of each cable.
5. Hard and electronic copy of test documentation shall be submitted to the CONSTRUCTION MANAGER. The documentation shall include the trace plot, index, dB/km loss, cable length, date and time of test, wavelength, pulse width, the test site, cable ID, fiber number and type, and operator's initials. The CONTRACTOR shall compare the pre-installation test results to the post-installation results. If a deviation of greater than one dB occurs, the CONSTRUCTION MANAGER shall be notified in writing by the CONTRACTOR, and the cable shall be removed and replaced at no additional cost to the OWNER.
6. Upon completion of the previous tests all FOC coils shall be secured with ends capped to prevent intrusion of dirt and water.

E. Required OTDR Trace Information

1. All traces shall display the entire length of cable under test, highlighting any localized loss discontinuities (installation-induced losses and/or connector losses). The trace shall display fiber length (in kilofeet), fiber loss (dB), and average fiber attenuation (in dB/km) as measured between two markers placed as near to the opposite ends of the fiber under test as is possible while still allowing an accurate reading. Care shall be taken to ensure that the markers are placed in the linear region of the trace: away from the front-end response and far-end Fresnel reflection spike. Time averaging shall be used to improve the display signal to noise ratio. The pulse width of the OTDR shall be set to a sufficient width to provide adequate injected power to measure the entire length of the fiber under test.
2. If connectors exist in the cable under test, then two traces shall be recorded. One trace shall record the fiber loss (dB) and average attenuation (dB/km) of the entire cable segment under test, including connectors. The second trace shall display a magnified view of the connector regions, revealing the connector losses (dB). All connector losses shall be measured using the 5-point splice loss measurement technique.
3. The OTDR trace shall also include the following information:
 - a. The date and time of the test
 - b. The cable ID number
 - c. The cable segment ID number
 - d. The fiber color or sub-cable number
 - e. Launch point connector number
 - f. The optical wavelength used for the test
 - g. The refractive index setting of the OTDR
 - h. The pulse width setting of the OTDR
 - i. The averaging interval of the test

3.7 RECORD DRAWINGS

- A. The CONTRACTOR shall upon completing the construction of the fiber optic system, shall submit to the CITY Record Drawings showing the following:
 1. Horizontal alignment of fiber optic conduit.
 2. Vertical alignment of fiber optic conduit.
 3. Location of all pullboxes using Station Number, and the exact Northing and Easting of each pullbox using the North American Datum (NAD) 83 coordinate system.

**** END OF SECTION ****

SUPPLEMENTARY SPECIAL PROVISIONS

APPENDICES

APPENDIX A

NOTICE OF EXEMPTION AND COASTAL DEVELOPMENT PERMIT

NOTICE OF EXEMPTION

(Check one or both)

TO: X RECORDER/COUNTY CLERK
P.O. BOX 1750, MS A-33
1600 PACIFIC HWY, ROOM 260
SAN DIEGO, CA 92101-2422
 OFFICE OF PLANNING AND RESEARCH
1400 TENTH STREET, ROOM 121
SACRAMENTO, CA 95814

FROM: CITY OF SAN DIEGO
DEVELOPMENT SERVICES DEPARTMENT
1222 FIRST AVENUE, MS 501
SAN DIEGO, CA 92101

PROJECT NO.: WBS # S-00312.02.06 PROJECT TITLE: Pump Station No. 2 Power Reliability & Surge Protection

PROJECT LOCATION-SPECIFIC: The project is located at 4077 N. Harbor Drive adjacent to the San Diego International Airport – Lindbergh Field

PROJECT LOCATION-CITY/COUNTY: San Diego City/San Diego County

DESCRIPTION OF NATURE AND PURPOSE OF THE PROJECT: Pump Station No. 2 is fed from three electric SDG&E feeds; two of which are from the same substation. If two feeds fail, there is only one feed to power the pump station, which does not meet the U.S. Environmental Protection Agency standards for backup power. The purpose of the project is to improve the overall power reliability and provide standby power at the pump station, thus protecting against surges during power outages and ultimately preventing sewage spills. The project proposes the removal of two office trailers, removal of two natural gas engines, removal of an existing lube oil vault, installation of two electric motors on pumps 4 and 5, and the modification of four heat exchanger units and associated ancillary systems to cool the generators. Proposed improvements include construction of a 6,766 sq. ft. power generation building to house two natural gas and two diesel generators with associated ancillary systems, a separate 3,024 sq. ft. covered loading and fuel/oil storage area, the addition of a canopy, stairway, and ADA catwalk to 2nd floor office space in the existing pump station building, replacement of landscaping, catch basins, a concrete swale, and new fencing.

NAME OF PUBLIC AGENCY APPROVING PROJECT: City of San Diego

NAME OF PERSON OR AGENCY CARRYING OUT PROJECT: Filemon Sevilla, Public Works Department
525 B Street, Suite 750 (MS 908A)
San Diego, CA 92101, 619-533-5196

EXEMPT STATUS: (CHECK ONE)

- MINISTERIAL (SEC. 21080(b)(1); 15268);
- DECLARED EMERGENCY (SEC. 21080(b)(3); 15269(a));
- EMERGENCY PROJECT (SEC. 21080(b)(4); 15269 (b)(c))
- CATEGORICAL EXEMPTIONS: 15301(B) EXISTING FACILITIES AND 15303 NEW CONSTRUCTION OR CONVERSION OF SMALL STRUCTURES

REASONS WHY PROJECT IS EXEMPT: The City of San Diego conducted an environmental review which determined that this project meets the categorical exemption criteria set forth in CEQA State Guidelines, Section 15301 (b) [Existing Facilities], which allows for minor repair or alteration of existing facilities involving no or negligible expansion of use. This project does not propose to add new pumps to the facility. It involves only replacement of existing engines and installation of back-up power generators. In addition, other minor site improvements such as adding a canopy, stairway and ADA catwalk to 2nd floor office space in the existing building, replacement of landscaping, catch basins, concrete swales and new fencing is included. The project also meets the criteria set forth in CEQA State Guidelines Section 15303 [New Construction or Conversion of Small Structures] for the addition of a 6, 766 sq. ft. building to house the proposed generators and an associated 3,024 sq. ft. covered fuel/oil area. This project will have no impact on sensitive resources since construction will be occur entirely within the previously graded developed areas of the facility and none of the exceptions listed in Section 15300.2 would apply.

LEAD AGENCY CONTACT PERSON: MYRA HERRMANN

TELEPHONE: 619-446-5372

IF FILED BY APPLICANT:

1. ATTACH CERTIFIED DOCUMENT OF EXEMPTION FINDING.
2. HAS A NOTICE OF EXEMPTION BEEN FILED BY THE PUBLIC AGENCY APPROVING THE PROJECT?
() YES () NO

IT IS HEREBY CERTIFIED THAT THE CITY OF SAN DIEGO HAS DETERMINED THE ABOVE ACTIVITY TO BE EXEMPT FROM CEQA



SENIOR PLANNER

APRIL 22, 2015

SIGNATURE/TITLE

DATE

CHECK ONE:

- (X) SIGNED BY LEAD AGENCY
() SIGNED BY APPLICANT

DATE RECEIVED FOR FILING WITH COUNTY CLERK OR OPR:

CALIFORNIA COASTAL COMMISSION

San Diego Coast District Office
 7575 Metropolitan Drive, Suite 103
 San Diego, CA 92108-4402
 (619) 767-2370

Date: January 22, 2015

Permit Application No.: 6-14-1548

Page: 1 of 6

**NOTICE OF INTENT TO ISSUE PERMIT**

(Upon satisfaction of special conditions)

THIS IS NOT A COASTAL DEVELOPMENT PERMIT

THE SOLE PURPOSE OF THIS NOTICE IS TO INFORM THE APPLICANT OF THE STEPS NECESSARY TO OBTAIN A VALID AND EFFECTIVE COASTAL DEVELOPMENT PERMIT ("CDP"). A Coastal Development Permit for the development described below has been approved but is not yet effective. Development on the site cannot commence until the CDP is effective. In order for the CDP to be effective, Commission staff must issue the CDP to the applicant, and the applicant must sign and return the CDP. **Commission staff cannot issue the CDP until the applicant has fulfilled each of the "prior to issuance" Special Conditions.** A list of all of the Special Conditions for this permit is attached.

The Commission's approval of the CDP is valid for two years from the date of approval. To prevent expiration of the CDP, you must fulfill the "prior to issuance" Special Conditions, obtain and sign the CDP, and commence development within two years of the approval date specified below. You may apply for an extension of the permit pursuant to the Commission's regulations at Cal. Code Regs. title 14, section 13169.

On **January 7, 2015**, the California Coastal Commission approved Coastal Development Permit No. 6-14-1548, requested by **City of San Diego Public Works Department** subject to the attached conditions, for development consisting of: **Upgrades to an existing waste water pump station, including removal of existing office trailers, oil lube vault, and 9 trees; replacement of existing fence, two pump engines, heat exchanger unit pipes, and asphalt; construction of a new 51.5-ft. tall, 6,766 sq. ft. generation building, 25.5-ft. tall, 3,024 sq. ft. storage structure, and underground conduits; 3,850 cu. yds. of grading; drainage improvements; and landscaping, more specifically described in the application file in the Commission offices.** **Commission staff will not issue the CDP until the "prior to issuance" special conditions have been satisfied.**

The development is within the coastal zone at 4077 North Harbor Drive, Peninsula Community, San Diego, San Diego County (APNs 450-790-12, 450-790-13, 450-790-02)

NOTICE OF INTENT TO ISSUE PERMIT

(Upon satisfaction of special conditions)

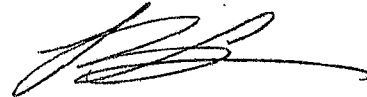
Date: January 22, 2015

Permit Application No.: 6-14-1548

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If you have any questions regarding how to fulfill the "prior to issuance" Special Conditions for CDP No. 6-14-1548, please contact the Coastal Program Analyst identified below.

Sincerely,
CHARLES LESTER
Executive Director



By: Brittney Laver
Coastal Program Analyst
Date: January 22, 2015

ACKNOWLEDGMENT

The undersigned permittee acknowledges receipt of this Notice and fully understands its contents, including all conditions imposed.

2-10-15

Date



Permittee

Please sign and return one copy of this form to the Commission office at the above address.

STANDARD CONDITIONS

1. **Notice of Receipt and Acknowledgment.** The permit is not valid and development shall not commence until a copy of the permit, signed by the permittee or authorized agent, acknowledging receipt of the permit and acceptance of the terms and conditions, is returned to the Commission office.
2. **Expiration.** If development has not commenced, the permit will expire two years from the date on which the Commission voted on the application. Development shall be pursued in a diligent manner and completed in a reasonable period of time. Application for extension of the permit must be made prior to the expiration date.
3. **Interpretation.** Any questions of intent or interpretation of any condition will be resolved by the Executive Director or the Commission.

NOTICE OF INTENT TO ISSUE PERMIT

(Upon satisfaction of special conditions)

Date: January 22, 2015

Permit Application No.: 6-14-1548

Page 3 of 6

4. **Assignment.** The permit may be assigned to any qualified person, provided assignee files with the Commission an affidavit accepting all terms and conditions of the permit.
5. **Terms and Conditions Run with the Land.** These terms and conditions shall be perpetual, and it is the intention of the Commission and the permittee to bind all future owners and possessors of the subject property to the terms and conditions.

SPECIAL CONDITIONS:

The permit is subject to the following conditions:

1. **Final Plans. PRIOR TO THE ISSUANCE OF THIS COASTAL DEVELOPMENT PERMIT,** the applicant shall submit to the Executive Director for review and written approval final project plans. Said plans shall first be stamped approved by the City of San Diego and be in substantial conformance with the preliminary plans submitted with this application on August 25, 2014 by the City of San Diego Public Works Department.

The permittee shall undertake the development in accordance with the approved final plans. Any proposed changes to the approved final plans shall be reported to the Executive Director. No changes to the approved final plans shall occur without a Coastal Commission approved amendment to this coastal development permit unless the Executive Director determines that no amendment is legally required.

2. **Final Landscape Plans. Prior to the issuance of the coastal development permit,** the applicant shall submit to the Executive Director for review and written approval, final landscape plans for the proposed development. Said plans shall first be stamped approved by the City of San Diego and be in substantial conformance with the revised plans submitted by the City of San Diego Public Works Department on December 17, 2014, and shall include the following:

- a. The nine existing trees proposed to be removed from the subject site shall be replaced with a minimum of nine drought tolerant and native or non-invasive trees. The trees shall be planted in a manner which helps screen and break up the façade of the proposed generation building.
- b. Additional vegetation and landscaping shall be planted in a manner which helps screen and break up the façade of the proposed generation building.
- c. All proposed landscaping shall be drought tolerant and native or non-invasive plant species. No plant species listed as problematic and/or invasive by the California Native Plant Society, the California Exotic Pest Plant Council, or as may be identified from time to time by the State of California shall be employed or allowed to naturalize or persist on the site. No plant species listed as “noxious weed” by the State of California or the U.S. Federal Government shall be utilized within the property.

NOTICE OF INTENT TO ISSUE PERMIT

(Upon satisfaction of special conditions)

Date: January 22, 2015

Permit Application No.: 6-14-1548

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The permittee shall undertake the development in accordance with the approved final landscape plans. Any proposed changes to the approved final plans shall be reported to the Executive Director. No changes to the approved final plans shall occur without a Coastal Commission approved amendment to this coastal development permit unless the Executive Director determines that no such amendment is legally required.

3. Drainage and Runoff Control Plan. PRIOR TO THE ISSUANCE OF THIS COASTAL DEVELOPMENT PERMIT, the applicant shall submit to the Executive Director for review and written approval, a final drainage and runoff control plan that has been stamped and approved by the City of San Diego. The plan shall be prepared by a licensed engineer and shall incorporate any structural and non-structural Best Management Practices (BMPs) necessary to control the volume, velocity and pollutant load of storm water leaving the developed site, as specified below. All calculations supporting the proposed design of the facilities shall be detailed in the plan. Specifically, the plan shall be in substantial conformance with the following requirements:

- a. The fuel transfer area shall be designed and constructed to fully contain any spilled fuel.
- b. A list of source control BMPS shall be provided that will be used to prevent potential pollutants from entering runoff leaving the site, including procedures to promptly clean up any spilled fuel or lubricants, remove sediment build-up, and clean equipment.

The permittee shall undertake development in accordance with the approved final drainage and runoff control plans. Any proposed changes to the approved final drainage and runoff control plans shall be reported to the Executive Director. No changes to the approved final plans shall occur without an amendment to this coastal development permit unless the Executive Director determines that no amendment is legally required.

4. Erosion Control and Construction BMPs Plan. PRIOR TO THE ISSUANCE OF THIS COASTAL DEVELOPMENT PERMIT, the applicant shall submit to the Executive Director for review and written approval, an Erosion Control and Construction Best Management Practices Plan, prepared by a licensed professional.¹ The licensed professional shall certify in writing that the Erosion Control and Construction Best Management Practices (BMPs) Plan includes the following items:

1. Erosion Control Plan.
 - a. The plan shall delineate the areas to be disturbed by grading or construction activities and shall include any temporary access roads, staging areas and stockpile areas.
 - b. Include a narrative report describing all temporary run-off and erosion control measures to be used during construction.

¹ A licensed professional may be a California Registered Professional Civil Engineer, Geologist, Engineering Geologist, Hydrogeologist, or Landscape Architect qualified to complete this work.

NOTICE OF INTENT TO ISSUE PERMIT

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- c. The plan shall identify and delineate on a site or grading plan the locations of all temporary erosion control measures.
 - d. The plan shall specify that should grading take place during the rainy season (November 1 – March 31) the applicant shall install or construct temporary sediment basins (including debris basins, desilting basins or silt traps); temporary drains and swales; sand bag barriers; silt fencing; stabilize any stockpiled fill with geofabric covers or other appropriate cover; install geotextiles or mats on all cut or fill slopes; and close and stabilize open trenches as soon as possible.
 - e. The erosion control measures shall be required on the project site prior to or concurrent with the initial grading operations and maintained throughout the development process to minimize erosion and sediment from runoff waters during construction. All sediment should be retained on-site, unless removed to an appropriate, approved dumping location either outside of the coastal zone or within the coastal zone to a site permitted to receive fill.
 - f. The plan shall also include temporary erosion control measures should grading or site preparation cease for a period of more than 30 days, including but not limited to: stabilization of all stockpiled fill, access roads, disturbed soils and cut and fill slopes with geotextiles and/or mats, sand bag barriers, silt fencing; temporary drains and swales and sediment basins. The plans shall also specify that all disturbed areas shall be seeded with native grass species and include the technical specifications for seeding the disturbed areas. These temporary erosion control measures shall be monitored and maintained until grading or construction operations resume.
2. Construction Best Management Practices
- a. No demolition or construction materials, debris, or waste shall be placed or stored where it may enter sensitive habitat, receiving waters or a storm drain, or be subject to wave, wind, rain, or tidal erosion and dispersion.
 - b. Any and all debris resulting from demolition or construction activities shall be removed from the project site within 24 hours of completion of the project.
 - c. Demolition or construction debris and sediment shall be removed from work areas each day that demolition or construction occurs to prevent the accumulation of sediment and other debris that may be discharged into coastal waters.
 - d. All trash and debris shall be disposed in the proper trash and recycling receptacles at the end of every construction day.
 - e. The applicant shall provide adequate disposal facilities for solid waste, including excess concrete, produced during demolition or construction.

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(Upon satisfaction of special conditions)

Date: January 22, 2015

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- f. Debris shall be disposed of at a legal disposal site or recycled at a recycling facility. If the disposal site is located in the coastal zone, a coastal development permit or an amendment to this permit shall be required before disposal can take place unless the Executive Director determines that no amendment or new permit is legally required.
- g. All stock piles and construction materials shall be contained so that materials cannot be conveyed to drain inlets and any waterway, and shall not be stored in contact with the soil.
- h. Machinery and equipment shall be maintained and washed in confined areas specifically designed to control runoff. Thinners or solvents shall not be discharged into sanitary or storm sewer systems.
- i. The discharge of any hazardous materials into any receiving waters shall be prohibited.
- j. Spill prevention and control measures shall be implemented to ensure the proper handling and storage of petroleum products and other construction materials. Measures shall include a designated fueling and vehicle maintenance area with appropriate berms and protection to prevent any spillage of gasoline or related petroleum products or contact with runoff. The area shall be located as far away from the receiving waters and storm drain inlets as possible.
- k. The applicant shall provide a map delineating the construction site, construction phasing boundaries, and the location of all temporary construction-phase BMPs (such as silt fences, inlet protection, and sediment basins).

The final Erosion Control and Construction Best Management Practices Plan shall be in conformance with the site/development plans approved by the Coastal Commission. Any changes to the Coastal Commission approved site/development plans required by the consulting civil engineer/water quality professional shall be reported to the Executive Director. No changes to the Coastal Commission approved final site/development plans shall occur without an amendment to the coastal development permit, unless the Executive Director determines that no amendment is legally required.

5. Sensitive Species Monitoring. PRIOR TO ISSUANCE OF THE COASTAL DEVELOPMENT PERMIT, a qualified biologist shall conduct a site survey for evidence of active colonial water bird, raptor, or owl nests in all on-site trees that are proposed to be removed. Two weeks prior to any construction activities during colonial water bird, raptor, or owl breeding/nesting season (Jan 31st – Sept 15th), a qualified biologist shall conduct a site survey for active nests. If an active nest is located, then no construction work may be conducted within a 300 foot radius in all directions from the nest and a 500 foot radius of raptors, until the young have fledged and are independent of the adults or the nest is otherwise abandoned. The results of the site survey shall be submitted to the San Diego office of the California Coastal Commission.

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.)

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SUBJECT FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)	PAGE 2 OF 10	EFFECTIVE DATE October 15, 2002
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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.

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SUBJECT FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)	PAGE 3 OF 10	EFFECTIVE DATE October 15, 2002
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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.

CITY OF SAN DIEGO CALIFORNIA DEPARTMENT INSTRUCTIONS	NUMBER DI 55.27	DEPARTMENT Water Department
SUBJECT FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)	PAGE 4 OF 10	EFFECTIVE DATE October 15, 2002
	SUPERSEDES DI 55.27	DATED April 21, 2000

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.

CITY OF SAN DIEGO CALIFORNIA DEPARTMENT INSTRUCTIONS	NUMBER DI 55.27	DEPARTMENT Water Department
SUBJECT FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)	PAGE 5 OF 10	EFFECTIVE DATE October 15, 2002
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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

CITY OF SAN DIEGO CALIFORNIA DEPARTMENT INSTRUCTIONS	NUMBER DI 55.27	DEPARTMENT Water Department
SUBJECT FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)	PAGE 6 OF 10	EFFECTIVE DATE October 15, 2002
	SUPERSEDES DI 55.27	DATED April 21, 2000

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

CITY OF SAN DIEGO CALIFORNIA DEPARTMENT INSTRUCTIONS	NUMBER DI 55.27	DEPARTMENT Water Department
SUBJECT FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)	PAGE 7 OF 10	EFFECTIVE DATE October 15, 2002
	SUPERSEDES DI 55.27	DATED April 21, 2000

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

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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.

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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. These 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.

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- 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).

**Larry Gardner
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)

(For Office Use Only)

NS REQ.	FACH
DATE	BY

METER SHOP (619) 527-7449

Meter Information

Application Date	Requested Install Date:
------------------	-------------------------

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:	<input type="checkbox"/>	<input type="checkbox"/> 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: <small>(PERSON IN ACCOUNTS PAYABLE)</small>			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:		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

City of San Diego, Field Engineering Div., 9485 Aero Drive, SD CA 92123		Contractor's Name:	
Project Name:		Contractor's Address:	
Work Order No or Job Order No.			
City Purchase Order No.		Contractor's Phone #:	Invoice No.
Resident Engineer (RE):		Contractor's fax #:	Invoice Date:
RE Phone#:	Fax#:	Contact Name:	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%	\$ -
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%	\$ -
18					\$ -		\$ -		\$ -	0.00%	\$ -
CHANGE ORDER No.					\$ -		\$ -		\$ -	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:	

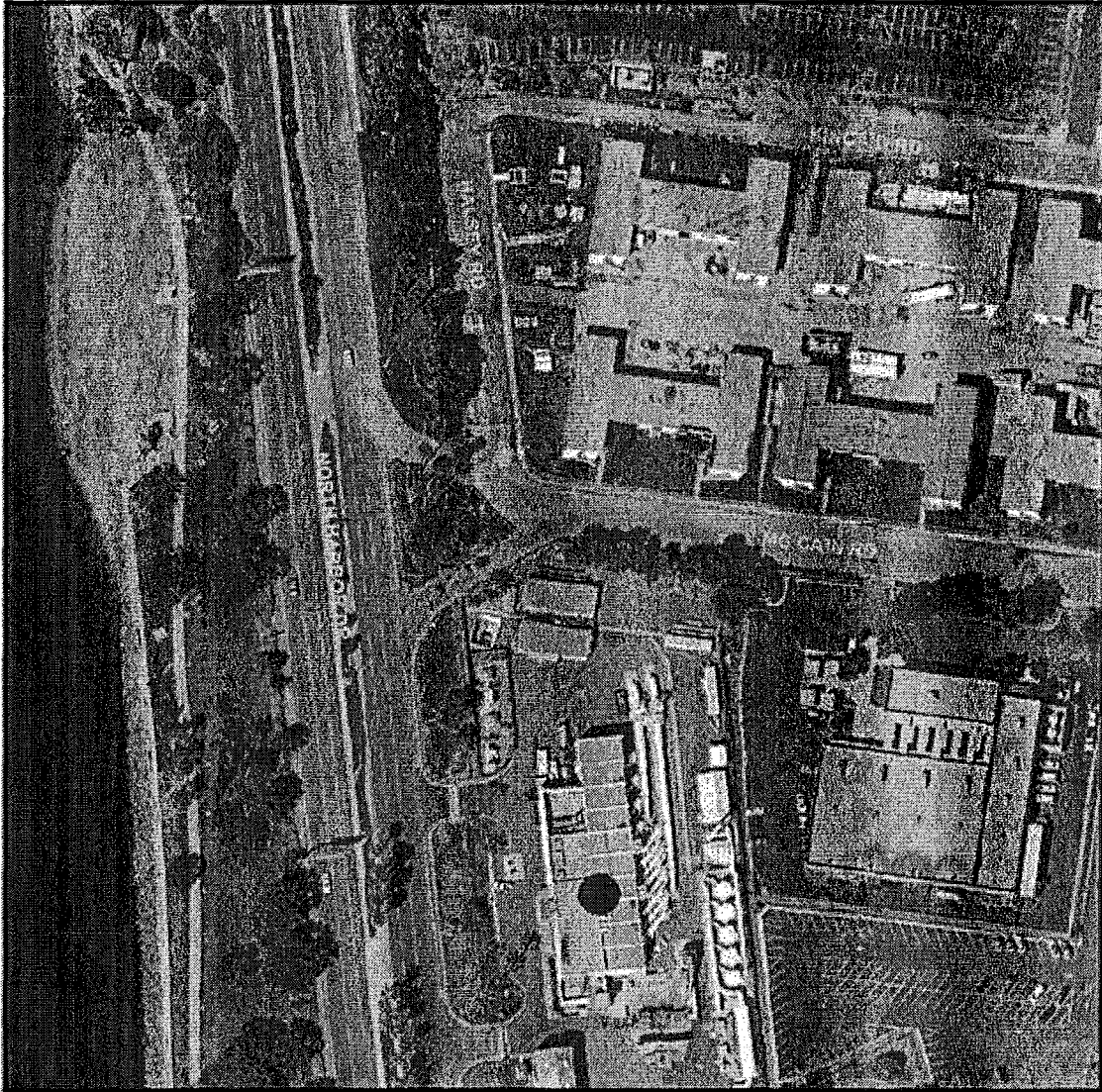
Contractor Signature and Date: _____

APPENDIX E
LOCATION MAP

Pump Station 2 Power Reliability & Surge Protection

4077 North Harbor Drive

San Diego, CA 92101



APPENDIX F
ADVANCED METERING INFRASTRUCTURE (AMI) DEVICE PROTECTION

Protecting AMI Devices in Meter Boxes and on Street Lights

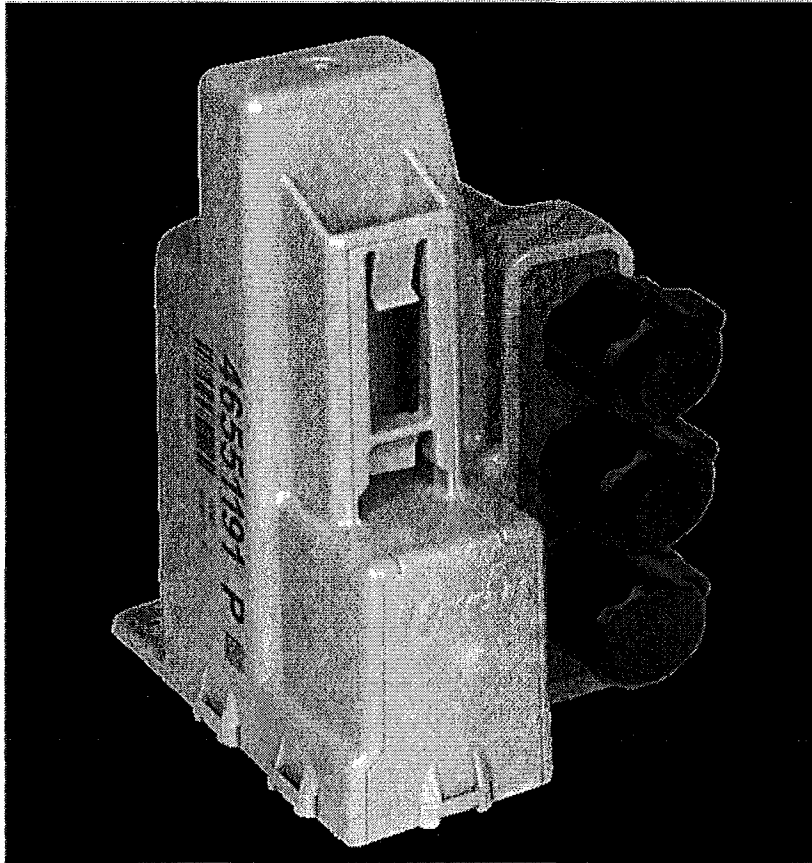
The Public Utilities Department (PUD) has begun the installation of the Advanced Metering Infrastructure (AMI) technology as a new tool to enhance water meter reading accuracy and efficiency, customer service and billing, and to be used by individual accounts to better manage the efficient use of water. **All AMI devices shall be protected per Section 5-2, "Protection", of the 2015 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:

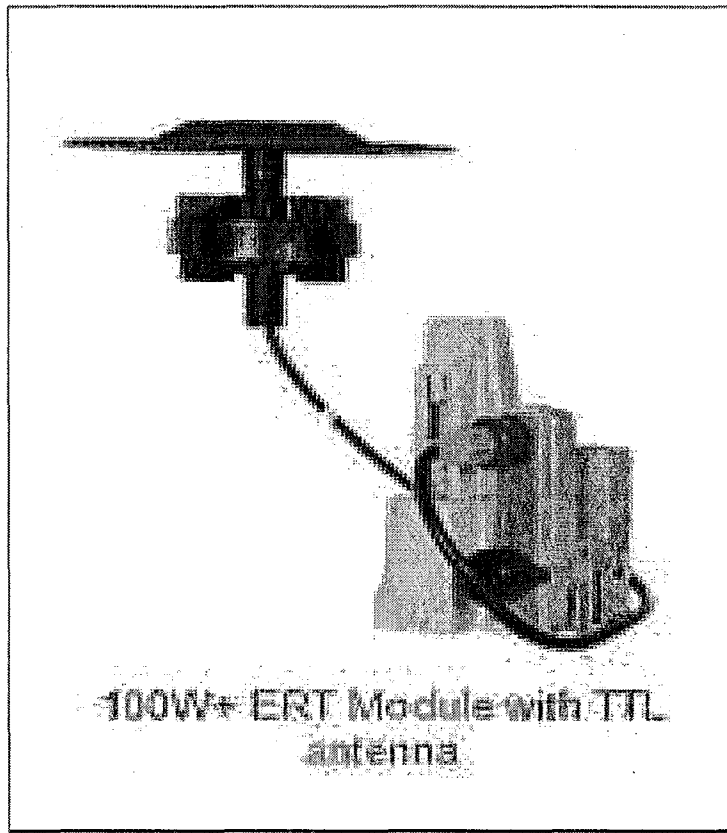
- A. Endpoints, see Photo 1:

Photo 1



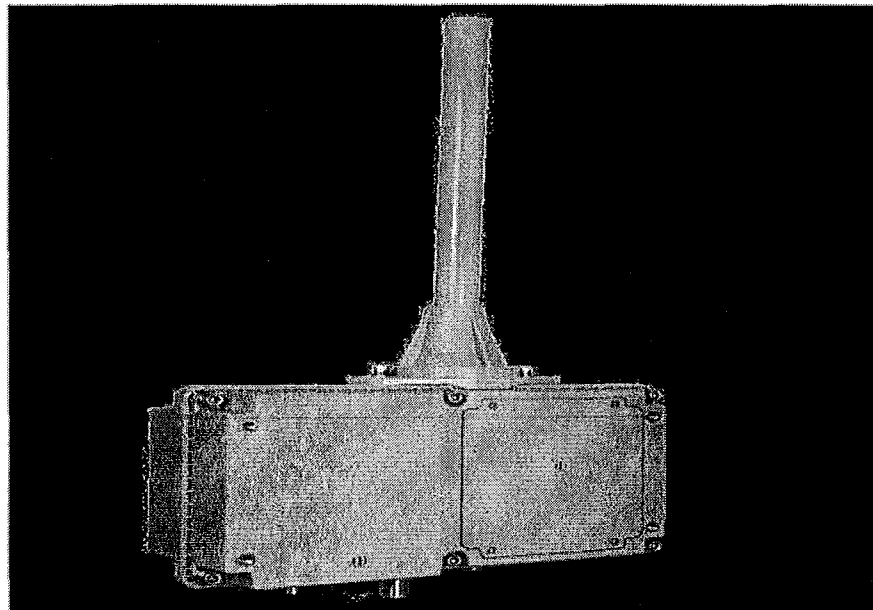
B. AMI Antenna attached to Endpoint (antenna not always required), see Photo 2:

Photo 2



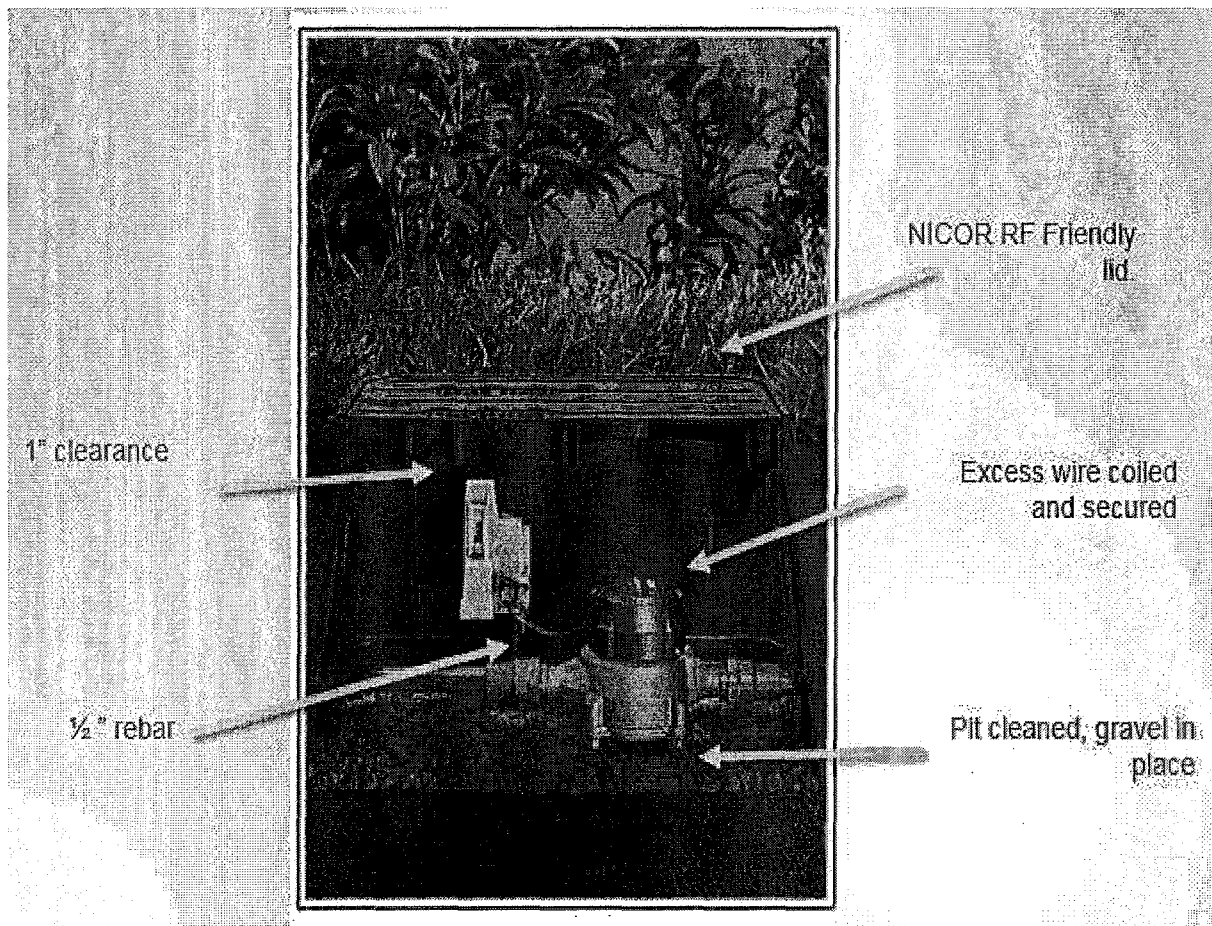
Network Devices, see Photo 3:

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

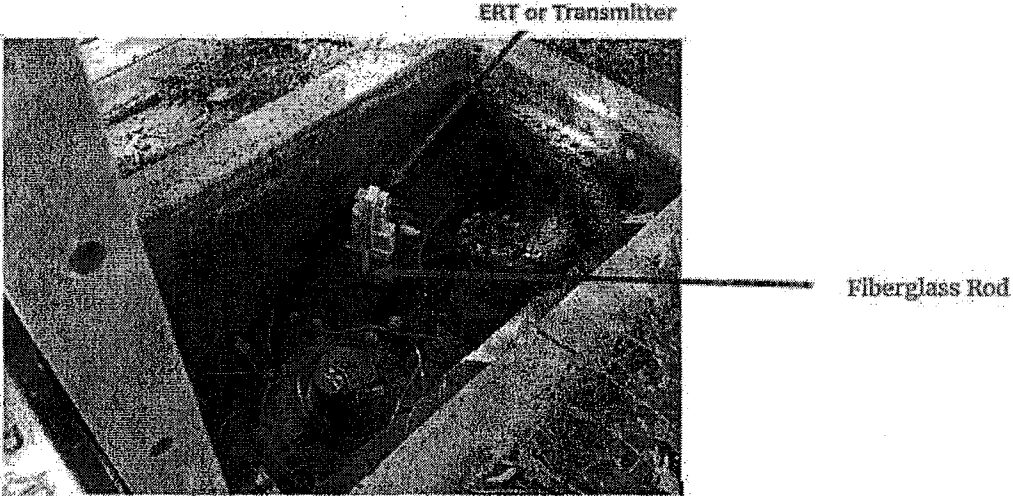
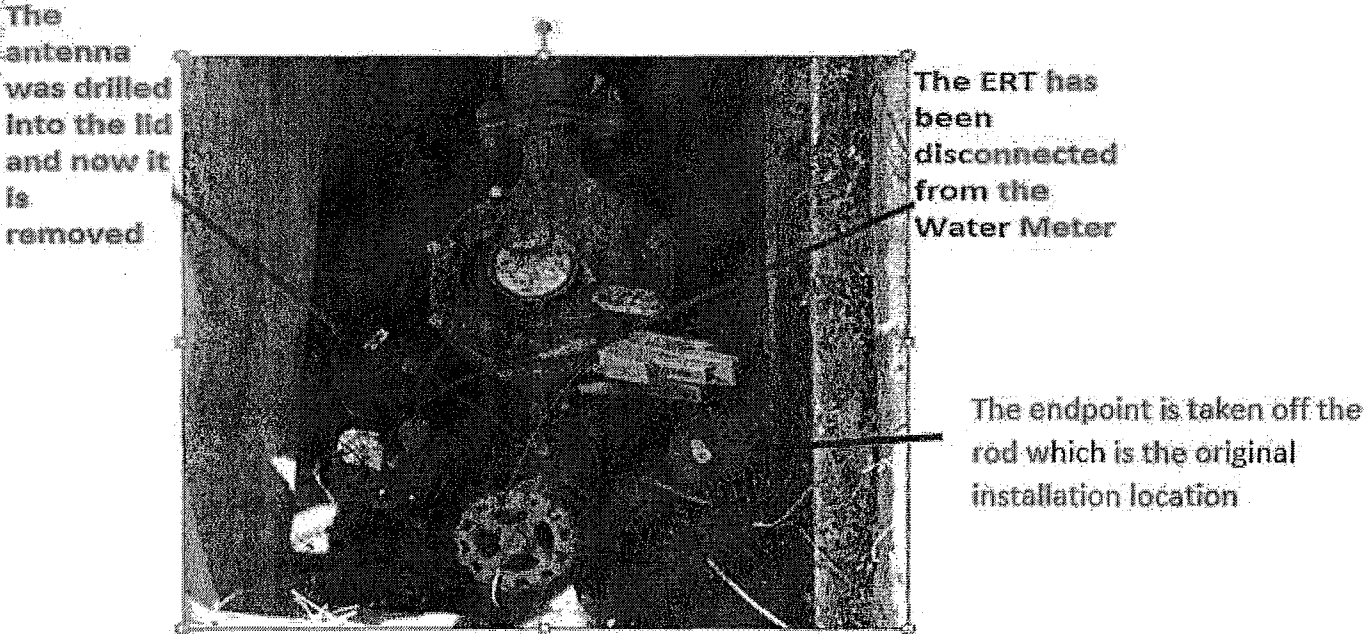


Photo 6 below is an example of disturbance that shall be avoided:

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:

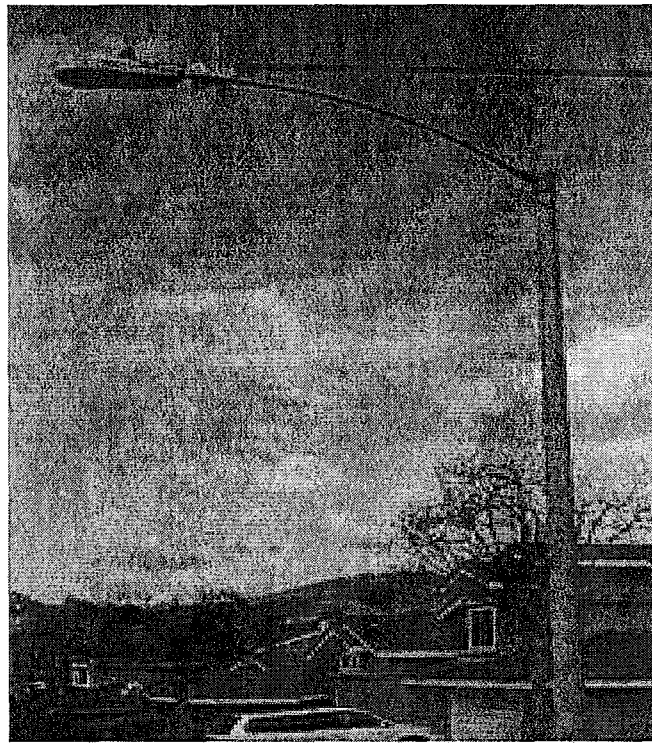
Photo 7



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.**

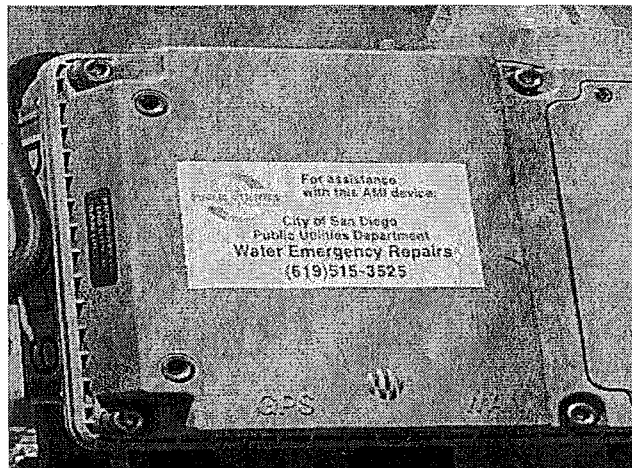
Photo 8 shows an installed network device on a street light. On the back of each Network Device is a sticker with contact information. See Photo 9. **Call PUD Water Emergency Repairs at 619-515-3525 if your work will impact these street lights.** These are assets that belong to the City of San Diego and you shall be responsible for any costs of disruption of this network.

Photo 8



Network Device

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 G
HYDROSTATIC DISCHARGE FORM

Hydrostatic Discharge Requirements Certification (Discharge Events ≥ 325,850 gpd)

All discharge activities related to this project comply with the Regional Water Quality Control Board (RWQCB) Order No. R9-2010-0003, General Permit for Discharges of Hydrostatic Test Water and Potable Water to Surface Water and Storm Drains as referenced by (http://www.waterboards.ca.gov/sandiego/board_decisions/adopted_orders/2010/R9-2010-0003.pdf), and as follows:

Discharged water has been dechlorinated to below **0.1** (mg/l) level; and effluent has been maintained between **6 and 9** (pH) based on:

Is Discharge Within Limits?

Comment/Action Taken

Event #	Discharge Date	Item Tested	Duration	Amount (gpd)	Description of the Proposed Discharge	Method and Test Result	Is Discharge Within Limits?		Comment/Action Taken
							YES	NO	
		Chlorine							
		pH							
		Chlorine							
		pH							
		Chlorine							
		pH							
		Chlorine							
		pH							

Qualified Personnel Conducting Tests (Print Name):

SAP No.(s):

***Signed:**

Project Name:

* By signing, I hereby certify and affirm under penalty of perjury that all of the statements and conditions for hydrostatic discharge events are correct.

Have any thresholds been exceeded? Per Order No. R9-2010-0003, would this be a reportable discharge and must be reported **within 24 hours** of the event? [Reportable discharge would include violation of maximum gallons per day, any upset which exceeds any effluent limit]

APPENDIX H
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 HRL. 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 | HAZARDOUS PROPERTIES FLAMMABLE TOXIC
 SOLID LIQUID | CORROSIVE REACTIVE 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? | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Did anyone, other than employees in the immediate area of the release, evacuate? | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Did the release cause off-site damage to public or private property? | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Is the release greater than or equal to a reportable quantity (RQ)? | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Was there an uncontrolled or unpermitted release to the air? | <input type="checkbox"/> | <input type="checkbox"/> |
| 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? | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Will control, containment, decontamination, and/or clean up require the assistance of federal, state, county, or municipal response elements? | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Was the release or threatened release involving an unknown material or contains an unknown hazardous constituent? | <input type="checkbox"/> | <input type="checkbox"/> |
| 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)? | <input type="checkbox"/> | <input type="checkbox"/> |
| 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? | <input type="checkbox"/> | <input type="checkbox"/> |

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 <input type="checkbox"/> Yes <input type="checkbox"/> 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?: <input type="checkbox"/> Yes <input type="checkbox"/> 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 <input type="checkbox"/> GAL <input type="checkbox"/> LBS <input type="checkbox"/> FT ³
Chemical	Quantity <input type="checkbox"/> GAL <input type="checkbox"/> LBS <input type="checkbox"/> FT ³
Chemical	Quantity <input type="checkbox"/> GAL <input type="checkbox"/> LBS <input type="checkbox"/> 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 NOTIFIED OES (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
E	CHECK IF CHEMICAL IS LISTED IN 40 CFR 355, APPENDIX A <input type="checkbox"/>	CHECK IF RELEASE REQUIRES NOTIFICATION UNDER 42 U.S.C. Section 9603 (a) <input type="checkbox"/>	
F	PHYSICAL STATE CONTAINED <input type="checkbox"/> SOLID <input type="checkbox"/> LIQUID <input type="checkbox"/> GAS	PHYSICAL STATE RELEASED <input type="checkbox"/> SOLID <input type="checkbox"/> LIQUID <input type="checkbox"/> GAS	QUANTITY RELEASED
G	ENVIRONMENTAL CONTAMINATION <input type="checkbox"/> AIR <input type="checkbox"/> WATER <input type="checkbox"/> GROUND <input type="checkbox"/> OTHER	TIME OF RELEASE	DURATION OF RELEASE — DAYS — HOURS — MINUTES
H	ACTIONS TAKEN		
I	KNOWN OR ANTICIPATED HEALTH EFFECTS (Use the comments section for addition information)		
J	<input type="checkbox"/> ACUTE OR IMMEDIATE (explain) _____ <input type="checkbox"/> CHRONIC OR DELAYED (explain) _____ <input type="checkbox"/> NOTKNOWN (explain) _____		
K	ADVICE REGARDING MEDICAL ATTENTION NECESSARY FOR EXPOSED INDIVIDUALS		
L	COMMENTS (INDICATE SECTION (A - G) AND ITEM WITH COMMENTS OR ADDITIONAL INFORMATION)		
M	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.

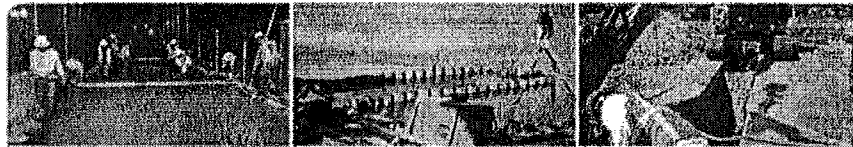
Block I: Print or type the name of the facility representative submitting the report. Include the official signature and the date that the form was prepared.

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 I
SAMPLE OF PUBLIC NOTICES



CONSTRUCTION NOTICE

PROJECT NAME

Trenching on your street is complete.

What you need to know:

- Pipe installation on your street is complete and construction crews are now installing new pipeline for this project at another location.
- You may see temporary trench plates or trench cap for some time, even after construction activities have concluded on your street.

Street resurfacing:

- Your Streets will be resurfaced once the entire pipeline project is complete. Concrete streets will not be resurfaced curb to curb; only the trench will be backfilled.
- Street resurfacing may be delayed due the City's slurry seal moratorium

Estimated resurfacing completion on your street:

(Insert Date-Month and Year)

For questions related to this work

Call: (619) 533-4207

Email: engineering@sandiego.gov



This information is available in alternative formats upon request.



APPENDIX J

SAMPLE CERTIFICATION LETTER FOR AIS IMPLEMENTATION

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 (XXXXXXXXXXXX)

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 (XXXXXXXXXXXX)

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

ATTACHMENT F

INTENTIONALLY LEFT BLANK

ATTACHMENT G

CONTRACT AGREEMENT

CONTRACT AGREEMENT

CONSTRUCTION CONTRACT

This contract is made and entered into between THE CITY OF SAN DIEGO, a municipal corporation, herein called "City", and Steve P. Rados, Inc., herein called "Contractor" for construction of **Pump Station 2 Power Reliability and Surge Protection**; Bid No. **K-17-1456-DBB-3**; in the amount of Fifty Six Million Two Hundred Twenty Eight Thousand Dollars and Zero Cents (\$56,228,000.00), which is comprised of the Base Bid.

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) That certain documents entitled **Pump Station 2 Power Reliability and Surge Protection**, on file in the office of the City Clerk as Document No. **S-00312**, 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 **Pump Station 2 Power Reliability and Surge Protection**, 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.


CONTRACT AGREEMENT (continued)

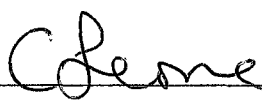
IN WITNESS WHEREOF, this Agreement is signed by the City of San Diego, acting by and through its Mayor or designee, pursuant to Resolution No. R - 311217 authorizing such execution.

THE CITY OF SAN DIEGO

APPROVED AS TO FORM

Mara W. Elliott, City Attorney

By 

By 

Print Name: JACEY LOUDERICO

Print Name: Christine Leone


Mayor or designee

Deputy City Attorney

Date: 7-12-17

Date: 7/13/17

CONTRACTOR

By 

Print Name: Walter S. Rados

Title: Co-President

Date: 7-14-17

City of San Diego License No.: B2017000629

State Contractor's License No.: 484452 A, B

DEPARTMENT OF INDUSTRIAL RELATIONS (DIR) REGISTRATION NUMBER: 1000007814

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, "California Building Code and California Code of Regulations Title 24 and 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 and Pledge of Compliance"), of the project specifications, and that Contractor has complied with those requirements.

I further certify that each of the Contractor's subcontractors whose subcontracts are greater than \$50,000 in value has completed a Pledge of Compliance attesting under penalty of perjury of having complied with City of San Diego Municipal Code § 22.3004.

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:

(Name of Project or Task)

as particularly described in said contract and identified as Bid No. _____ ; SAP No. (WBS/IO/CC) _____; 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 _____, _____.

_____ Contractor

by

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

ELECTRONICALLY SUBMITTED FORMS

**THE FOLLOWING FORMS MUST BE SUBMITTED IN PDF
FORMAT WITH BID SUBMISSION**

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. EQUAL BENEFITS ORDINANCE - CERTIFICATION OF COMPLIANCE**
- D. LOBBY PROHIBITION, CERTIFICATION AND DISCLOSURE**

**Bids will not be accepted until ALL 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 Steve P. Rados, Inc. as Principal, and
Travelers Casualty and Surety Company of America 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


Pump Station 2 Power Reliability and Surge Protection

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 21st day of October,
2016

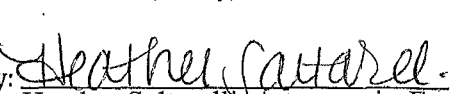
Steve P. Rados, Inc. (SEAL)

(Principal)

By: 
(Signature)

Travelers Casualty and
Surety Company of America (SEAL)

(Surety)

By: 
Heather Saltarelli, Attorney-in-Fact
(Signature)

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

CIVIL CODE § 1189

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 Orange)

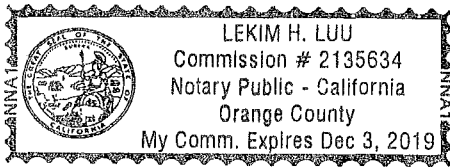
On OCT 21 2016 before me, Lekim H. Luu, Notary Public
Date Here Insert Name and Title of the Officer

personally appeared Heather Saltarelli
Name(s) of Signer(s)

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.



Signature [Handwritten Signature]
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document

Title or Type of Document: _____ Document Date: _____
Number of Pages: _____ Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____
 Corporate Officer — Title(s): _____
 Partner — Limited General
 Individual Attorney in Fact
 Trustee Guardian or Conservator
 Other: _____
Signer Is Representing: _____

Signer's Name: _____
 Corporate Officer — Title(s): _____
 Partner — Limited General
 Individual Attorney in Fact
 Trustee Guardian or Conservator
 Other: _____
Signer Is Representing: _____

POWER OF ATTORNEY



Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company

St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company

Attorney-In Fact No. 230992

Certificate No. 006959203

KNOW ALL MEN BY THESE PRESENTS: That Farmington Casualty Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company are corporations duly organized under the laws of the State of Connecticut, that Fidelity and Guaranty Insurance Company is a corporation duly organized under the laws of the State of Iowa, and that Fidelity and Guaranty Insurance Underwriters, Inc., is a corporation duly organized under the laws of the State of Wisconsin (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint

Jeri Apodaca, Rhonda C. Abel, Kimi Luu, Mike Parizino, Rachele Rheault, James A. Schaller, Heather Saltarelli, Maria Guise, and T. Craig Williams

of the City of Newport Beach, State of California, their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, 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 29th day of August, 2016.

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company

St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company



State of Connecticut
City of Hartford ss.

By: [Signature]
Robert L. Raney, Senior Vice President

On this the 29th day of August, 2016, before me personally appeared Robert L. Raney, who acknowledged himself to be the Senior Vice President of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty 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 the corporations 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.



[Signature]
Marie C. Tetreault, Notary Public

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

CIVIL CODE § 1189

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 Orange)

On November 29, 2016 before me, Sandra Lucero Po, Notary Public,
Date Here Insert Name and Title of the Officer

personally appeared Walter S. Rados
Name(s) of Signer(s)

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.



Signature *Sandra L. Po*
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document

Title or Type of Document: _____ Document Date: _____

Number of Pages: _____ Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____

Corporate Officer — Title(s): _____

Partner — Limited General

Individual Attorney in Fact

Trustee Guardian or Conservator

Other: _____

Signer Is Representing: _____

Signer's Name: _____

Corporate Officer — Title(s): _____

Partner — Limited General

Individual Attorney in Fact

Trustee Guardian or Conservator

Other: _____

Signer Is Representing: _____

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.

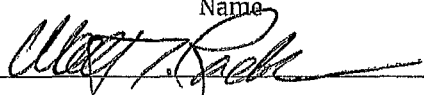
CHECK ONE BOX ONLY.

- 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	Initiation (Y/N)	Status	Resolution/Remedial Action Taken
2/8/07	Sacramento County	Constructive Wrongful discharge; Discrimination & harassment	Case No. 07AS00620	Settle prior to court action	Confidential settlement All allegations denied by Defendant (Rados)

Contractor Name: STEVE P. RADOS, INC.

Certified By Walter S. Rados Title Co-President

Name

 Signature

Date 10/27/2016

USE ADDITIONAL FORMS AS NECESSARY

**EQUAL BENEFITS ORDINANCE
CERTIFICATION OF COMPLIANCE**



For additional information, contact:
CITY OF SAN DIEGO

EQUAL BENEFITS PROGRAM

202 C Street, MS 9A, San Diego, CA 92101

COMPANY INFORMATION

Company Name: STEVE P. RADOS, INC.	Contact Name: Mike Gigliotti
Company Address: 2002 E. McFadden Ave., Ste 200 Santa Ana, CA 92705	Contact Phone: (714) 835-4612
	Contact Email: mgigliotti@radoscompanies.com

CONTRACT INFORMATION

Contract Title: Pump Station 2 Power Reliability & Surge Protection	Start Date:
Contract Number (if no number, state location): K-17-1456-DBB-3	End Date:

SUMMARY OF EQUAL BENEFITS ORDINANCE REQUIREMENTS

The Equal Benefits Ordinance [EBO] requires the City to enter into contracts only with contractors who certify they will provide and maintain equal benefits as defined in SDMC §22.4302 for the duration of the contract. To comply:

- Contractor shall offer equal benefits to employees with spouses and employees with domestic partners.
 - Benefits include health, dental, vision insurance; pension/401(k) plans; bereavement, family, parental leave; discounts, child care; travel/relocation expenses; employee assistance programs; credit union membership; or any other benefit.
 - Any benefit not offer an employee with a spouse, is not required to be offered to an employee with a domestic partner.
- Contractor shall post notice of firm's equal benefits policy in the workplace and notify employees at time of hire and during open enrollment periods.
- Contractor shall allow City access to records, when requested, to confirm compliance with EBO requirements.
- Contractor shall submit *EBO Certification of Compliance*, signed under penalty of perjury, prior to award of contract.

NOTE: This summary is provided for convenience. Full text of the EBO and Rules Implementing the EBO are available at www.sandiego.gov/administration.

CONTRACTOR EQUAL BENEFITS ORDINANCE CERTIFICATION

Please indicate your firm's compliance status with the EBO. The City may request supporting documentation.

- I affirm compliance with the EBO because my firm (*contractor must select one reason*):
- Provides equal benefits to spouses and domestic partners.
 - Provides no benefits to spouses or domestic partners.
 - Has no employees.
 - Has collective bargaining agreement(s) in place prior to January 1, 2011, that has not been renewed or expired.
- I request the City's approval to pay affected employees a cash equivalent in lieu of equal benefits and verify my firm made a reasonable effort but is not able to provide equal benefits upon contract award. I agree to notify employees of the availability of a cash equivalent for benefits available to spouses but not domestic partners and to continue to make every reasonable effort to extend all available benefits to domestic partners.

It is unlawful for any contractor to knowingly submit any false information to the City regarding equal benefits or cash equivalent associated with the execution, award, amendment, or administration of any contract. [San Diego Municipal Code §22.4307(a)] Under penalty of perjury under laws of the State of California, I certify the above information is true and correct. I further certify that my firm understands the requirements of the Equal Benefits Ordinance and will provide and maintain equal benefits for the duration of the contract or pay a cash equivalent if authorized by the City.

Walter S. Rados _____ 10/27/16
Name/Title of Signatory Signature Date

FOR OFFICIAL CITY USE ONLY

Receipt Date: EBO Analyst: Approved Not Approved -- Reason:

(Rev 02/15/2011)

LOBBY PROHIBITION, CERTIFICATION AND DISCLOSURE

In acknowledgment that funds received under this agreement have been provided pursuant to a Federal grant, recipient hereby recognizes the prohibitions against lobbying the Federal government with any of these funds. Recipient agrees that it shall comply with the laws set forth at 31 U.S.C. § 1352 (1989) and 24 C.F.R. part 87, to wit:

A. Conditions on use of funds

Recipient shall not expend any funds received pursuant to this agreement to pay any person to influence an officer or employee of Federal agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with any of the following Covered Federal actions:

- (1) The awarding of any federal contract
- (2) The making of any Federal grant
- (3) The making of any Federal Loan
- (4) The entering into of any cooperative agreement
- (5) The extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

For purposes of defining the terms of this part of the agreement, the definitions set forth in 24 C.F.R. § 87.105 are hereby adopted and incorporated herein by reference.

B. Certification and Disclosure

Each recipient at every tier under this agreement shall file a certification regarding lobbying, and a Disclosure Form-LLL, where required by 24 C.F.R. § 87.110. The certification form and Disclosure Form-LLL are attached to this agreement.

C. Certifications must be filed:

- (1) By any person upon each submission that initiates agency consideration for an award of a Federal contract, grant, or cooperative agreement exceeding \$100,000, or a Federal loan or loan guarantee exceeding \$150,000.
- (2) Upon receipt by any person of a Federal contract, grant, or cooperative agreement exceeding \$100,000, or upon receipt of a Federal loan or loan guarantee exceeding \$150,000.
- (3) By any person who requests or receives from a person referred to in subsections 1 and 2 of this paragraph:
 - a. A subcontract exceeding \$100,000 at any tier under a Federal contract;
 - b. A subgrant, contract or subcontract exceeding \$100,000 at any tier under a Federal grant;
 - c. A contract or subcontract exceeding \$100,000 at any tier under a Federal loan exceeding \$150,000;
 - d. A contract or subcontract exceeding \$100,000 at any tier under a Federal cooperative agreement.

D. Disclosure Forms-LLL must be filed in every instance when a person applies for, requests, or receives Federal appropriations exceeding \$100,000 pursuant to a contract, subcontract, grant, subgrant, loan, or cooperative agreement when such person has paid or expects to pay any sum, in cash or in kind, to influence or attempt to influence any officer or employee of an agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress. Further, Disclosure Form-LLL must be filed by recipients at any tier at the end of each calendar quarter in which there occurs any event that requires disclosure or materially affects information submitted in prior disclosures. Such events include:

- (1) 1. An increase of \$25,000 in the amount paid or expected to be paid for influencing or attempting to influence a covered Federal action;
- (2) 2. A change in the person(s) influencing or attempting to influence a covered action;
- (3) 3. A change in the officer(s), employee(s), or member(s) contacted to influence a covered action.

All disclosure Forms-LLL, but not certifications, shall be forwarded from tier to tier until received by the principal recipient, which in turn will file them with the appropriate Federal agency.

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.

According to the Paperwork Reduction Act, as amended, no persons are required to respond to a collection of information unless it displays a valid OMB Control Number. The valid OMB control number for this information collection is OMB No. 0348-0046. Public reporting burden for this collection of information is estimated to average 30 minutes per response, including time for reviewing instructions, searching existing datasources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Management and Budget, Paperwork Reduction Project (0348-0046), Washington, DC 20503.

DISCLOSURE OF LOBBYING ACTIVITIES Approved by OMB
 Complete this form to disclose lobbying activities pursuant to 31 U.S.C. 1352
 (See reverse for public burden disclosure)

0348-0046

1. Type of Federal Action: N/A <input type="checkbox"/> a. Contract a. Grant b. Cooperative agreement c. Loan d. Loan guarantee e. Loan insurance	2. Status of Federal Action: N/A <input type="checkbox"/> a. bid/offer/application b. initial award c. post-award	3. Report Type: N/A <input type="checkbox"/> a. initial finding b. material change For Material Change Only year _____ quarter _____ date of last report _____
4. Name and Address of Reporting Entity: <input type="checkbox"/> Prime <input type="checkbox"/> Subawardee N/A Tier _____, if known: Congressional District, if known:	5. If Reporting Entity in No. 4 is a Subawardee, Enter Name and Address of Prime: N/A Congressional District, if known:	
6. Federal Department/Agency: N/A	7. Federal Program Name/Description: N/A CFDA Number, if applicable: _____	
8. Federal Action Number, if known: N/A	9. Award Amount, if known: \$ _____ N/A	
10. a. Name and Address of Lobbying Entity (if individual, last name, first name, M) N/A	b. Individuals Performing Services (including address if different from No. 10a) (last name, first name, MI): N/A (attach Continuation Sheet(s) SF-LLL, if necessary)	
11. Amount of Payment (check all that apply) \$ _____ <input type="checkbox"/> actual <input type="checkbox"/> planned N/A	13. Type of Payment (check all that apply) <input type="checkbox"/> a. retainer <input type="checkbox"/> b. one-time fee <input type="checkbox"/> c. commission <input type="checkbox"/> d. contingent fee <input type="checkbox"/> e. deferral <input type="checkbox"/> f. other: specify: _____ N/A	
12. Form of Payment (check all that apply) N/A <input type="checkbox"/> a. cash <input type="checkbox"/> 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: N/A (attach Continuation Sheet(s) SF-LLA, if necessary)		
15. Continuation Sheet(s) SF-LLA attached: <input type="checkbox"/> Yes <input type="checkbox"/> No N/A		
16. Information requested through this form is authorized 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 may be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.	Signature: <u>Walter S. Rados</u> Print Name: <u>Walter S. Rados</u> Title: <u>Co-President</u> Telephone No.: <u>(714) 835-4612</u> Date: <u>10/27/16</u>	
Federal Use Only		Authorized for Local Reproduction Standard Form LLL (Rev. 7-07)

DISCLOSURE OF LOBBYING ACTIVITIES Approved by
CONTINUATION SHEET

OMB0348-0046

Reporting Entity: _____ Page _____ of _____

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Standard Form - LLL-A

City of San Diego

CITY CONTACT: Michelle Muñoz, Contract Specialist, Email: MichelleM@sandiego.gov

PHONE No. (619) 533-3482, Fax No. (619) 533-3633

ADDENDUM "B"

e - Bidding FOR



PUMP STATION 2 POWER RELIABILITY AND SURGE PROTECTION

BID NO.:	K-17-1456-DBB-3
SAP NO. (WBS/IO/CC):	S-00312
CLIENT DEPARTMENT:	2012
COUNCIL DISTRICT:	2
PROJECT TYPE:	BP

BID DUE DATE:

2:00 PM

DECEMBER 6, 2016

CITY OF SAN DIEGO

PUBLIC WORKS CONTRACTS

1010 SECOND AVENUE, 14th FLOOR, MS 614C

SAN DIEGO, CA 92101

ENGINEER OF WORK

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

Eric Lovering

11/15/2016

Seal:

1) Registered Engineer

Date



[Handwritten Signature]

11/18/16

Seal

2) For City Engineer

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. BIDDER'S QUESTIONS

- Q1. Engine exhaust noise levels measured at any point on the roof top parapet is for a single engine operating without additional contributions from ambient noise sources, engine room transmission noise and other equipment operating when noise level is being measured.
 - A1. Concur.
- Q2. Specification Section 16461 2.3 E states the motors shall include vibration monitoring. Please specify the type of vibration monitoring device including the location and mounting details.
 - A2. Specification Section 16461,2.3,E.; also states to refer to the Contract Documents. Refer to Drawings 1I-1 and 7E-11, which shows the I/O signals and power requirements for the vibration controller/monitoring device and the other associated devices/elements. See Section 13300 for the process and control strategy. Vibration monitoring device shall meet the process and control strategy, and the intent of the project/Contract Documents.
- Q3. Specification Section 16461 2.3 F states the motors shall include shaft driven tachometer with pulse output. Please specify the tachometer volts/1000 rpm output required.
 - A3. Refer to Drawings 1I-1 and 1E-2, which shows the I/O signals and requirements for the tachometer. The tachometer shall meet the process and control strategy, and intent of the project/Contract Documents.
- Q4. Specification Section 16461 2.5 B states bearings shall be plate type thrust bearings. Please specify the continuous and momentary thrust loads and direction.

- A4. Per Specification Section 16461,2.5,A.; "Bearings shall conform to specific needs of existing pumps." Contractor shall provide motor bearings that meet the specifications. Per previous project motor upgrade at pump No.3, the previous study used 16,000 lbs of continuous load. Enclosed for reference only is the November 1991 Study, SHAFTING NATURAL FREQUENCY ANALYSIS AND DEFLECTION CALCULATIONS. Even though the pump and shafts exist for pumps number 4 and 5, the Contractor shall still provide their own calculations supporting the installation of the new electric motors and show compliance with Section 01640 Seismic Design of Equipment and Equipment Anchorage, Section 11005 Machine Alignment, Section 11020 Vibration and Critical Speed Limitations, and Section 11175 Pumps, General for a complete and function system. Please refer to Item C Attachments, 2 of this Addendum.
- Q5. Drawing 6P-1 Note 39 states the mop sink shall be provided with an approved back flow prevention device. However, a mop sink is not shown in the Schedule of Fixtures on drawing 6P-2. Please confirm if a mop sink is to be installed
- A5. No, a mop sink is not to be installed.
- Q6. Please clarify if this Contract is subject to Section 7105 of the California Public Contract Code "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.
- A6. Section 7105 of the CPCC applies.
- Q7. According to Spec Section 05120, Paragraph 2.2: the continuous inspection of structural steel welding in an off-site fabrication shop will be waived if the work is done in a shop certified by the International Code Council (ICC) or listed by the International Code Council Evaluation Services (ICC-ESR). a) Is City of Los Angeles certification acceptable in lieu of the ICC certification? b) Note #3 on Dwg S-2 under Special Inspection Notes: "Fabricator must be registered and approved by the City of San Diego, Development Services, for the fabrication of members and assemblies on the premises of the fabricators shop". See also the website from City of San Diego, document of Version 1996. Per para III. A 2, 2.1 and para IV A 2. Can AISC Certified Fabricators, but not a San Diego Registered Fabricator qualify for this based on the referenced sources?
- A7. a) No, City of Los Angeles certification is not acceptable in lieu of the ICC certification.
- b) Refer to City DSD Building newsletter 17-6 as stated.

- Q8. Section 03331 1.6 F 1 states the following "After approval of color(s) per paragraph 1.5.E. of this section, prepare site-cast architectural concrete samples, cast vertically, approximately 24 by 24 by 9 inches of up to 4 different color options as selected by Architect". Paragraph 1.5 E of this same section is a Placement Schedule and does not apply to approval of colors. Please correct Paragraph 1.6 F 1 and tell us what the "approval of color" criteria is.
- A8. Concur, Section 03331,1.6,F.,1. will be corrected to state "paragraph 1.5,F."
- Q9. Section 03331 1.6 F.3 requires a full concrete mock up that is 6' wide by 36'-0" tall. This is a substantial mock up and will require a large amount of space to build it and support it to withstand various loading criteria. (a) Please confirm that the Owner wants this mock up. (b) Will the Owner be providing a design for the foundation for this wall or should the Contractor add money to his estimate to design and build the foundation for the mock up? (c) Due to the tight access, where does the Owner want this located so as to not impact construction?
- A9. a) The Contractor shall provide the foundation of the mockup wall under the direction of the Contractor's licensed engineer.
- b) Same as in "a".
- c) The Contractor shall locate the mockup near the westerly portion of the site while meeting the access requirements of the site per drawings G-5.
- Q10. Section 03331 3.6 FINISHES GENERAL and 3.7 AS CAST FORMED SURFACES go over the surface finish requirements for cast in place concrete. Please provide a schedule as to where these finishes occur.
- A10. See elevations, plans in architectural drawings for finishes requirement.
- Q11. Section 03331 2.5 C describes a "Custom Color as selected by Architect at no additional cost." Please supply a color in order for us to estimate the job. We have no way of estimating the price of a custom color without specific parameters.
- A11. Any color may be selected by Architect.
- Q12. Section 05500 2.1 B. states that miscellaneous metalwork of fabricated steel, which will be used in a corrosive environment or will be submerged shall be stainless steel. Please identify areas that you consider corrosive and there by requiring stainless steel fabrication.

- A12. Refer to Section 16050,1.9 for area designations that are considered corrosive locations.
- Q13. Section 05515 requires the contractor to provide a mock-up ladder. Can the contractor use one of the permanent ladders as the mock-up?
- A13. Yes, Contractor is allowed to use one of the permanent ladders (new approved Contractor furnished) as the mock-up ladder.
- Q14. Please provide information for where the Contractor will be required to perform the work in Section 09800 3.14 TESTING FOR VOLATILE ORGANIC COMPOUNDS IN POTABLE WATER RESERVOIRS. Reference to this work cannot be found in the Contract plans.
- A14. Contractor shall not be required to perform the work in Section 09800,3.14 due to the work not applying to this project.
- Q15. Architectural drawing 6A-3 calls for SS perforated metal panels that appear to have a constant bottom elevation. Structural drawing 6S-5 detail B show a fixed distance of 4'-3 1/2" for the SS perforated metal panel. It is not possible to keep this fixed dimension as the walkway elevation varies therefore the dimension on detail B/6S-5 will also vary. Please confirm this is true.
- A15. Walkway elevations may vary. However the SS perforated metal panel are constant as shown on A/6A-3.
- Q16. Detail 1/6S-5 calls for adhesive anchors installed into an existing CMU/CONC. Wall. Is the CMU wall grouted or hollow block?
- A16. According to record drawings, the CMU wall's vertical cells are grouted.
- Q17. Drawing 7M-9 shows a 2' x 6' grill (Keyed Note 6) located on what appears to be the sound trap (duct silencer). This cannot be done. Where should this grill be installed?
- A17. The Engineer will revise this drawing to relocate this grill to the horizontal run of the same duct and away from the duct silencer.
- Q18. Whitebook 2-11.1 requires a time lapse video robotic camera to be installed. Considering that the scope of work is primarily inside an existing building or will be behind 40'+ high walls of the new facility and that a single camera will not be able to capture much of the work over a 4 year period, is a camera per Whitebook 2-11.1 required?

- A18. Per Whitebook 2-11.1 Remote Control Camera Inspection, "The camera(s) shall be operational during all hours and days when excavation, pipe installation, and backfill is taking place." and "The camera shall be installed at a location where most construction activity shall be captured and remain operational throughout the project.", so this camera system shall be required by the City from the Contractor. Contractor shall provide and install a minimum of 4 cameras for the duration of this project to capture most construction activity and work progress, and selected locations shall be approved by the Engineer prior to installation per the Whitebook 2-11.1.
- Q19. Specification Section 07100 3.2 A states "Waterproofing coating shall be applied to the water side of walls and bottoms of channels or trenches or tanks/ vaults which are common with rooms, tunnels or galleries or trenches to be occupied by equipment, piping, conduit, or personnel." (a) What are you considering the "water side of walls"? (b) Are you referring to the outside of walls which are below grade? (c) Can you provide more specific details as to the exact locations of below grade waterproofing? The above referenced specification is very confusing as the majority of the items it states occur nowhere on this project.
- A19. a), b), c) - See drawing 7S-9, note 3 for clarification.
- Q20. The waterproofing system you require is a multi-stage application with the first stage being a cold fluid applied, single coat, high build, water-based polymer-modified asphalt emulsion. This cannot be applied to the bottom of concrete slabs. Please provide an alternate below grade waterproofing system to be used for concrete slabs.
- A20. Concrete slabs-on-grade shall be underlain by a 6-in layer of clean sand or Class 2 Base and the slab shall also be underlain by a 12Mil visqueen moisture barrier.
- Q21. Supplementary Special Provision 6-8.3 Warranty requires Contractor to warrant the Work against all latent and patent defects for a period of 10 years. Please clarify if this applies to equipment, normally warranted by the manufacturer that is installed as part of the project.
- A21. Equipment installed by the contractor will fall under "materials" as mentioned in this section.
- Q22. a) Please advise the intended location for the generator resistance grounding devices. Was not able to find references on any of the project drawings showing engine room or electrical room.

- b) The cooling system and modifications to the existing heat exchangers are based on preliminary cooling system heat rejections and flows data. If the proposed gas or diesel engines have significant increase or decrease in heat rejection. Will the engineer provided revised drawings and connection details, heat exchanger sizes and pumping requirements to the contractor so that proper cooling of the low temp and high temp circuits is provided?
- c) Per the specification Section 11000... J. Seismic Design: The seismic design of equipment shall be based on the horizontal peak round acceleration indicated in the Geotechnical Report or in accordance with California Building Code 2010 (CBC), whichever is greater. Unless otherwise indicated, Occupancy Category shall be III, and seismic design importance factors shall be $I = 1.25$, $I_p = 1.5$...

The diesel generator set and switchgear can be provided with IBC certifications using appropriate seismic vibration isolators and anchoring. Gas engine generator sets in the size range specified are not available with IBC certification. They will be supplied with seismic rated spring type vibration isolators. This has been acceptable for other installations in southern California.

Will this be acceptable for the gas engine generators for this project?

- A22. a) Refer to Drawing 7E-38, Mid-Level Power and Control Plan, for the location of the generator resistance grounding devices, which are labeled as HRG (high resistance grounding).
 - b) Contractor shall bid the cooling system per plans and specifications.
 - c) Seismic vibration isolators are acceptable, but they should meet IBC/CBC code requirements.
- Q23. Drawing 1S-1; This drawing shows additional reinforcing to be added to the existing framing under the pump motors that are to be replaced. During a site visit it appears that the frame is already reinforced as shown on detail A/1S-1 (unable to confirm size of additional steel). Please confirm intent of the work as shown on 1S-1:
- a. Are the current added steel members acceptable and the work shown on 1S-1 is not necessary?

- b. Is the intent to remove the existing reinforcing steel members and replace as with the members shown on drawing A/1S-1
 - c. Considering the location of the site, are there any restrictions on the use of cranes including limit on boom elevation, required boom down times or any other limitations.
- A23. a) Contractor shall build electric motor support per plans and specifications.
- b) Contractor shall build electric motor support per plans and specifications.
- c) Contractor shall meet all applicable codes and FAA requirements.
- Q24. a. P&ID 7I-7 states that the Urea tanks are 2,500 gallons Specification 01025 states that we are supposed to first fill 3,000 gallons of Urea. Please clarify.
- b. 1500-2.5 cooling system: Does owner provide all required glycol for the new piping that require a water-glycol mixtures for cooling purposes. If so, please provide needed quantity. Generators will be filled.
- A24. a) The tank shall be 2,500 gallons and filled by the contractor.
- b) Contractor shall provide the engine-generator's water-glycol mixture for the cooling system. The mixture shall conform to the manufacturer's requirements (based on the heat loads presented in the contract documents.) and the quantity shall be adequate to completely fill the cooling loop piping system.
- Q25. 1) There are lots of miscellaneous items (switchgear, concrete barrier, crates, etc) near the trailers and within the project footprint that will need to be removed but are not addressed in the plans. Please confirm that these items will be removed by others and not part of this contract.
- 2) There are storage trailers and trash bins on the north side of the project that don't show to be removed. Please confirm these will be removed by others as they are within the footprint of the excavation.
- A25. 1) and 2) - Contractor shall provide 60 days' notice for City to coordinate with others to remove all items indicated.
- Q26. 1) Geotech Report section 5.1.11 calls for grout to be injected only one hole at a time. Grouting one location at a time is cost prohibitive. Please confirm multiple locations may be grouted at one time.

- 2) Reference Geotech Report section 5.1.13: The allowable limits for movement of buildings, facilities or utilities are not provided. Please provide maximum allowable movement for building, facilities, or utilities.
 - 3) Contract Drawings sheet C-6 note 2 calls for the shoring to be "sheet pile" system. Does the Contractor have the option of using a different shoring system?
- A26. 1) We have no objections to the Contractor performing grouting at multiple locations concurrently. It must be noted, that grouting at multiple locations at the same time will increase the potential for damage to existing facilities/utilities in the vicinity of the proposed building.
- 2) As soon as any movement effecting adjacent structures is detected, grouting at that location should be terminated.
- 3) Yes, the Contractor has the option of using different shoring systems.
- Q27. Appendix D, Draft Guidelines and Specifications for Compaction Grouting, Section 4.1.8 states, "Grout with compressive strength of less than 1,000 psi, after 28 days curing shall be considered unacceptable." We recommend the statement be removed or reduce the UCS strength to 500 psi.
- A27. We have no objections to the Contractor using 500 psi compressive strength grout.
- Q28. Appendix D, Draft Guidelines and Specifications for Compaction Grouting, Section 5.1.3 states, "Prior to driving the injection casings, initial probing to check the possible presence of buried utilities shall be performed by using air-jetting techniques." Are other pot-holing methods allowed?
- A28. We have no objections to the Contractor using other potholing methods.
- Q29. Appendix D, Draft Guidelines and Specifications for Compaction Grouting, Section 5.1.8 states, "Compaction grouting shall be terminated at a depth of 4 feet below the ground surface." Due to lack of overburden confinement, the top 5' - 8' are difficult to improve. Please consider revising the termination depth to 8 feet.
- A29. Provided the compaction grouting is performed prior to the excavation for the proposed building, we have no objections to increasing the termination depth to 8 feet below the existing ground surface.

- Q30. Appendix D, Draft Guidelines and Specifications for Compaction Grouting, Section 1.3 states, "The purpose of the work ... is to improve the soil density of the Bay Deposits underlying the proposed pad for the generator building to a minimum of 90% of the maximum dry density..." Section 5.3.1 states, "Sufficient compaction grouting shall be performed to achieve an average corrected post-grouting static Cone Penetrometer Test (CPT) sounding tip resistance of not less than 120 tsf in the Bay Deposits." Please confirm the compaction grouting criteria.
- A30. Either criteria are acceptable. The CPT is anticipated to be the most efficient method of evaluating the post compaction grouting soil condition/bearing capacity at the project site.
- Q31. Appendix D, Draft Guidelines and Specifications for Compaction Grouting, Section 4.1.2 states,
- "The Subcontractor shall maintain the necessary testing apparatus for determining the grout slump, and perform adequate testing to insure quality control of the grout being utilized..." Section 5.4.3 states, "The field inspector will perform slump test of grout and take measurements of grout mix quantities to verify the grouting contractor's grout mix." Please confirm that the field inspector will be performing slump test.
- A31. Both the Contractor and Construction Manager will perform independent slump tests of the grout.
- Q32. 1) Extent of Compaction Grouting: Plan Sheet C-6 states that compaction grouting should be performed "at minimum within the limits of excavation," the Draft Specification states that "confinement grouting shall be performed around the perimeter of the area" and the geotech report recommends "compaction grouting be extended to a lateral distance of 6 feet outside the building or pad perimeters." Please provide clarification regarding the required limits of compaction grouting in relation to the extent of excavation and location of sheet piles.
- 2) Maximum Slump: Draft Specification for Compaction Grouting section 4.1.1 requires grout mix with a slump of 1 inch or less. Grout mixes with slump up to 3 inches are commonly used for compaction grouting and offer improved constructability without sacrificing quality as compared to 1 inch slump mixes. Please consider increasing maximum allowable grout mix slump to 2 or 3 inches.

- A32. 1) The method of construction is left to the Contractor. We assume that compaction grouting will be performed prior to the excavation. Therefore, it should not interfere with installation of the sheet piles.
- 2) We have no objections to the Contractor using grout mix with 3-inch slump provided the subgrade can be compacted to the acceptance criteria.
- Q33. a) 11301, 2.6C states the primary tank is 4,000 gallons? For the 20,000 tank.
- b) 11301, 2.6G will the diesel fuel tank ever be filled more than the 85% alarm signal?
- c) 11301 Are the day tanks required to meet all the testing required as specified by 2.13 A, B, C, D, and E?
Please identify which are applicable, thank you.
- d) Please provide a specification for the manufacturer of the Urea tank. The space indicated on the drawings is a 4 foot diameter tank that will be approx. 26.5 feet tall. Code requires double containment.
- A33. a) This question is misquoting the specification which states "The primary tank shall be constructed of steel plate not less than 1/4" for tanks with a total capacity over 4,000 gallons" which is applicable to 20,000 gal tank.
- b) The tank shall be provided with the alarm and float switch as indicated.
- c) Yes. Both the AST and the day tanks are considered protected tanks and must adhere to these specifications.
Please identify which are applicable.
- d) The two tanks shall each hold 2,500 gal as indicated. The tank height shall be as required to accommodate the tank volume. The tank may be fabricated from steel or FRP so long as the following are satisfied: the tank's construction meets seismic codes and is seismically secure (this will dictate tank construction); the appropriate linings and coatings included for steel. Refer to seismic and coating specification sections within the bid documents. Contractor may use a manufacturer with proven experience in tank construction such as Belco, Snyder, Highland, or other. Double containment is not required in this application.
- Q34. a) Drawing D-1 shows the demolition of existing trailers in the Northwest corner of the jobsite. However, there were no trailers in this location during the site visit. Please clarify the demolition scope for this area of the project.

- b) In addition, there were miscellaneous materials and pallets located in this area. Please confirm that these items will be removed prior to Contractor starting the Work.
- A34. a) b) Contractor shall provide 60 days' notice for City to coordinate with others to remove items indicated.
- Q35. Can the temporary shoring be left in place and not removed upon completion of the project?
- A35. No, temporary shoring shall not be left in place and shall be removed upon completion of the project.
- Q36. Specification section 11000 – 7 2.2 GENERAL REQUIREMENTS
- A. Noise Level: When in operation, no piece of equipment shall exceed the OSHA noise level requirements for a one hour exposure. We have been informed by the generator manufacturers that this cannot be met with the current design of the building. They will be taking exception to this requirement. Is this acceptable to the engineer?
- A36. Yes, this is acceptable to the Engineer.
- Q37. Please provide the following for existing circuit breakers:
Voltage, Current, MVA, Control Voltage, Manufacturers.
- A37. For the information requested for the existing circuit breakers, refer to Contract Drawing G-4, "Reference Documents (Volume V)", item #1; which documents the existing medium voltage switchgear submittal.
- Q38. Note 14 on 8M-1 mentions that all fuel and oil piping within trench is to be double contained (TYP.) however this note appears next to the JWS,JWR,AWS, and AWR lines. Please confirm the mentioned Water Supply lines are not double contained.
- A38. That is correct, the AWS, AWR, JWS, JWR piping is not double-contained, however insulation is required at most locations. Please refer to specifications.
- Q39. Note 14 on 8M-1 mentions that all fuel and oil piping within trench is to be double contained (TYP.), however P&IDs 7I-4, 7I-5, 7I-13, and 7I-14 only make note of the outdoor trench pipe to be double contained. Please confirm whether or not ALL fuel and oil trench piping or only OUTDOOR fuel and oil trench piping is to be double contained.
- A39. Fuel piping near the outdoor fuel tank (within the limits of the containment walls in that area) does not require double-containment. Piping in the trench immediately upon leaving the outdoor fuel containment area must be double contained until it is inside the building.

- Q40. Note 14 on 8M-1 mentions that all fuel and oil piping within trench is to be double contained (TYP.), however there is no specification or detail for this double containment. Please provide specifications or details for the double containment.
- A40. Double containment piping shall be clear PVC such as GF-Contain-It, or equal.
- Q41. The Specifications and Drawings fail to mention any leak detection for the double contained pipe. Please confirm if leak detection is required.
- A41. Leak detection is not required.
- Q42. Specification section 16461 medium voltage motors – 2250 Hp. Please provide the existing pump torque-speed load curve
- A42. See Contract Drawing G-13 for available pump motor information.
- Q43. Contract drawing 7M-2 general notes discuss the schematic nature of the engine exhaust piping system. It also states that the Contractor is expected to follow the general layout and overall intention of the design engineer. We will bid the drawings as shown and include all notations as applicable. If after the generator(s) are submitted for approval and the exhaust system must be revised to meet operational parameters and permits (for example, 30" exhaust pipe must change to 36" for the diesel generators), will these now required changes be at the risk of the contractor?
- A43. Contractor is responsible for a complete functional system that meets all plans and specifications.
- Q44. Can Myers be approved on the Medium Voltage gear lineup? (There is a 10-day minimum requirement before bid time and would like to have another manufacturer approved by the Engineer for this project).
- A44. Products shall meet the plans and specifications.
- Q45. The equipment list and drawing 7I-10 indicate expansion and air separator tanks 761, 762, 763, and 764.
- No other details or requirements have been provided.
- Please provide the type of tanks (bladder?), size, manufacturer, model, inside/outside coating required, pressure rating and mounting details.
- A45. Air-water separators shall include strainers, be fabricated by Taco or equal, and shall be of a make/model capable of servicing the cooling water loops. The separator shall be coated in accordance with the contract documents as required. Internal coatings shall be applied as necessary to ensure performance and corrosion resistance.

Q46. Contract drawing 7I-10 indicates two (2) water softener with 120v power as well as specification 13300 Instrumentation and Control, Appendix D - Equipment tagging list.

No other details or requirements have been provided. Please provide manufacturer, model, capacity, quality of water requirements, and physical location in the building.

A46. The water softens are shown on drawing 8M-1. Water softeners, such as fabricated by Culligan or equal, shall be of a model and capacity sufficient to service the water cooling loops.

Q47. Attachment E Supplementary Special Provisions 2-9.2.3 Payment states that for survey services Work shall be included in the lump sum bid item for "Survey Services". The bid items on Planet Bid do not currently include a bid item for Survey Services. Please confirm that a lump sum bid item for Survey Services will be included.

A47. Lump bid item for Survey services has been added. Please refer to Item F, Additional Changes, included in this Addendum.

Q48. Specification 13300, Appendix A2, 9.1 states "In the CONTRACTOR's bid item in the schedule of values, a line item is reserved for the credit due back to the CITY in case the diesel engines can be permitted without the SCR systems and SDAPCD agrees to the CITY's condition." The bid items on Planet Bid do not currently include a bid item for a credit. Please clarify.

A48. A bid item "DIESEL SCR SYSTEM", which will be a lump sum bid item, will be added to the "Bid Items" paragraph "M" in Section 01025 - Measurement and Payment, and on Planet Bid. Please refer to Item F, Additional Changes, included in this Addendum.

Q49. Specifications 11500 Natural Gas Engine-Generator Set and 11501 Diesel Fuel Engine-Generator Set, in article 2.4.C of each specification, state "The noise as measured from anywhere along the perimeter of the parapet wall roofline shall not exceed 72 dBA. The engine and exhaust manufacture shall provide their anticipated noise levels of the exhaust stack, and if those levels are not anticipated to meet the noise requirements, then the Contractor shall provide an additional exhaust silencer as required to meet this requirement." Please confirm that if an additional exhaust silencer is required it will be considered a change under Section 3 "Changes in Work".

A49. Contractor shall meet specifications.

- Q50. 1) Specification 11000, 2.2 GENERAL REQUIREMENTS, B. Personal Hearing Protection states that "The WORK includes multiple sets of three pairs of high attenuation hearing protectors..."

How many sets of (3 pairs) is required?

- 2) Contract drawing 7S-2 calls out for a davit crane with a 1,500 Lbs capacity model 571BY. Specification 14600, HOISTS AND CANTILEVER JIB CRANES, GENERAL, 1.5 A, 1. States the jib crane is to be designed to lift the combined weight minimum 1,700 pounds with the boom horizontal and 2,200 pounds with the boom at 45 degree from vertical. Model 571BY does not meet spec, please clarify the requirement.

- A50. 1) Contractor shall provide a minimum of 6 sets of 3 pairs of high attenuation hearing protectors meeting the specification.

- 2) Contract Drawing 7S-2 will be revised in the Conformed Set to remove capacity and manufacturer/series of davit crane called out. Drawing will only call out location of davit crane. Refer to Specification 14600 for davit crane requirements.

- Q51. 1) Medium Voltage New Switchgear #3. The gas engine-generator sets SDG&E/ISO Net Metering Cubicles will be 48 inches wide and not 36 inches wide as shown on the plans. This will increase the overall lineup from 45 feet to 47 feet in length.

Will the increased size of the switchgear be acceptable without increase in the size of the electrical room as currently shown?

- 2) There would be additional metering cubicles (not shown on the current plans) for operating the diesel-engine generators in parallel with SDG&E. Provisions for future metering or expansion is not indicated on the drawings for the diesel engine(s) and SWG No. 3.

Is it correct that there is no requirement at this time to provide any SDG&E/CA ISO net metering provisions for the diesel engine in the New SWG No. 3?

- 3) The following equipment is not currently available with IBC Seismic certification based on prior shake table testing. Additional cost to schedule testing or obtain approval is significant/prohibitive in that the manufacturers do not want to invest in the engineering and additional costs to obtain CA-IBC certification. Anchoring per seismic requirements will be provided.

- Gas-Engine Generator Sets
- Exhaust Gas Systems, in this size range, including SCR, Oxidation Catalysts, Particulate Filter, Pumps and Blowers
- High Resistance Grounding (Reactor)
- Plate and Frame Heat Exchangers and Pumps
 - a. Will non IBC equipment be acceptable for the items listed above?
 - b. There are commercially available neutral grounding resistor assemblies, with IBC certification, that appear to be the size indicated in the plan drawings. Will this alternate protection scheme, if acceptable to the generator manufacturer/supplier, be allowed for the basis of bidding the project?

- A51. (1) Switchgear #3 lineup shall be per plans and specifications.
- (2) Contractor shall bid project per plans and specifications.
- (3a) Contractor shall provide IBC Seismic certified equipment if there is an equal IBC Seismic certified equipment available. If there is no equal IBC Seismic certified equipment, then the Contractor shall be allowed to provide non-IBC Seismic certified equipment for the equipment listed above, but the equipment shall be seismic rated and provided/sized with certified structural calculations that meet the seismic requirements per the California Building Code and Specification 01640 - Seismic Design of Equipment and Anchorage.
- (3b) Contractor shall bid project per plans and specifications.

Q52. Engine HT and LT cooling system expansion tanks are shown as wall mounted. Current ASME rated bladder type expansion tanks are available in the required sizes and are intended to be floor mounted. These tanks can be supplied with seismic rated mounting feet intended for floor mounting. The current plans also indicate that the diesel engine HT and LT coolant pumps are floor mounted adjacent to the HT and LT plate and frame heat exchangers. Since the diesel engine-gensets are supplied with engine driven pumps there is adequate space for locating the expansion tanks at floor level which is preferred for servicing.

If space is available can both the gas engine and diesel engine HT and LT expansion tanks be located at ground level? This will provide a direct means of complying with seismic anchoring and is preferred for routine service and inspection.

A52. Location of expansion tanks can be considered during the submittal process. Contractor shall bid the project per plans and specifications.

Q53. 1) Reference section 02100-3.1.B. This paragraph states "Where existing utilities interfere with the WORK of this Section, the CITY'S CONSTRUCTION MANAGER shall be notified of interferences." Will any such conditions, if required to be rectified, be paid for out of the field order allowance fund?

2) Reference section 02100-3.2.A.2. Please define "depth necessary" and "objectionable material".

3) Reference section 02100-3.3.A. This paragraph states "Topsoil shall be salvaged and stored at a location which will not interfere with the WORK." a.) What is to be done with the Topsoil after construction is complete? b.) Is it to become the property of the City? c.) If there is nowhere to store it onsite, who will pay for the cost to store the material offsite and trucking if it is to be brought back to the site?

4) Can the question cutoff be extended from today to Next Friday November 4th? Today was the last day for a site visit and the bid date is now December 6th. In the Solicitation states "Questions received less than 14 days prior to the date for openings of Bids may not be considered"

5) Are the existing overhead cranes in diesel motor room and pump room available for contractors use?

A53. 1) All field changes are per standard practices.

2) Depth necessary is the excavation depth required to remove the objectionable material. Objectionable material is material that is interfering with the project.

3a), 3b), 3c) - Contractor shall properly dispose of any unused topsoil. Refer to Contract Drawing G-5, Keyed Notes in regards to areas that can be used for storage and staging purposes. Contractor is responsible for all storing and transporting of material to meet the plans and specifications.

4) Last day for questions was October 28th.

5) – Yes, the existing overhead cranes in the engine room and pump room will be available for Contractor's use for the installation of the Work if the following conditions/requirements are satisfied and agreed to by the Contractor. All costs shall be borne by the Contractor.

1. Submit a written waiver of liability, signed by a senior manager of the Contractor, taking sole responsibility for the crane and any incidents that may occur while using the crane. Do not use the crane until the Engineer provides written acceptance of the waiver of liability.
2. Keep a daily crane use log that clearly indicates time and frequency of use, including identification of the equipment moved by the crane.
3. Repair the crane to the satisfaction of the Engineer in the event of a break-down during construction activities. If it is not possible to repair the crane, replace it in-kind at no additional cost to the City.
4. Perform an annual inspection and load test by a certified overhead crane inspector at the completion of the Work.

Q54. 1) Please confirm if Square D is acceptable and approved? Please see below:

MV Distribution, 16300 – Westinghouse or equal
LV Motor Control, 16480 - Westinghouse, GE, AB or equal
LV VFD Spec, 16481 – ABB, AB, Eaton, GE, Siemens or equal
MV VFD Spec, 16482 – ABB, AB, Eaton, GE, Siemens or equal

- 2) Will other generator manufacturers (Cummins, Kohler, MTU, etc.) be accepted and approved?
- 3) Is there any on-site material lay down area?
- 4) Is there any on-site employee parking?

A54. 1) The products shall meet the plans and specifications.
2) The generator manufacturers shall meet the plans and specifications.
3) Refer to Contract Drawing G-5, Keyed Notes in regards to areas that can be used for on-site material lay down.
4) Refer to Contract Drawing G-5, Keyed Notes in regards to areas that can be used for on-site employee parking.

Q55. Specification Section 16461 1.1A states the motor manufacturer shall take full responsibility of the existing pump shaft, re-analyze shaft dynamics and make appropriate couplings to the shaft per the standard requirements in Section 11175 Pumps, General.

All motor manufacturers have stated they will not take full responsibility for an existing pump shaft.

Is it your intent to have the manufacturer responsible for ensuring the motors tie into the existing pump shaft, or to be responsible for the entire existing pump shaft? Please clarify the extent of responsibility the motor manufacturer has on the existing pump shaft.

A55. Enclosed for reference only is the November 1991 Study, SHAFTING NATURAL FREQUENCY ANALYSIS AND DEFLECTION CALCULATIONS. Even though the pump and shafts exist for pumps number 4 and 5, the Contractor shall still provide their own calculations supporting the installation of the new electric motors and show compliance with Section 01640 Seismic Design of Equipment and Equipment Anchorage, Section 11005 Machine Alignment, Section 11020 Vibration and Critical Speed Limitations, and Section 11175 Pumps, General for a complete and functional system. Contractor shall examine the existing pumps #4 and #5 shafts and bring to the attention of the City if there are any issues with the shafts before 90 calendar days after the Notice to Proceed. After that time, the Contractor is responsible for the existing pump shafts and to meet the requirements of the plans and specifications.

Q56. Please confirm if the Contractor will be permitted to use the overhead cranes in the Pump Station No. 2 existing engine and pump motor rooms.

A56. See response to A53, 5 of this Addendum.

Q57. Drawing 7M-17 Detail 3 notes a change of material to 1 ½"-W2, however there is no mention of W2 in the specifications or pipe schedule. Please provide specifications for W2.

A57. Revise "W2" to read "W1", material shall be SST as shown in the contract documents. No change in piping material is required except as specified for Hose Bibbs per specification 15400.2.13.E.

Q58. Drawing 7I-9 shows ball valves at the AHU points of connection for AWS and JWS lines, however Drawing 7M-9 does not include them. Please clarify if the ball valves are needed.

A58. Equipment isolating ball valves as shown in 7I-9 are required.

Q59. In Section 7 of Notice Inviting Bids, the subcontracting participation percentage goals for MBE's and WBE's are categorized by Construction, Supplies, Services and Equipment. Is it your intent for the Contractor to meet these subcontracting goal percentages per category, or as a whole?

Are subcontracting participation goals for the Project of 5% MBE and 4% WBE sufficient as a whole regardless of category?

A59. Please refer to the construction fair share objectives in the Notice Inviting Bids on page 5, Section 7.1, Item 1.

Q60. In Section 5 - Certifications and Forms, page 1252 states that the following forms must be submitted in pdf format with bid submission:

- A. Bid Bond
- B. Contractor's Certification of Pending Actions
- C. Equal Benefits Ordinance - Certification of Compliance
- D. Lobby Prohibition, Certification and Disclosure

Please specify if any additional forms are to be submitted with bid submission, and please provide a copy of additional forms if required.

A60. Please refer to contract documents for required submittals at time of bid.

Q61. 1) Noise level measurement for the exhaust stack(s) have not been defined. Manufacturer's published data showing noise level will be provided in the submittal for Engineer / Consultant for information and review.

Will additional measurement criteria be provided prior to bid deadline?

2) The specified noise levels anywhere along the parapet wall is very general. Preliminary designs of the gas and diesel engine exhaust systems with after treatment indicate larger diameter pipe and component sizes than currently shown on the plan drawings without the addition of a supplemental silencer, if needed.

Best information available is that the single engine exhaust stack noise levels will be at or above the 72 dbA levels specified. Operating multiple units or contributions from other noise sources will raise the noise levels. The proposed after-treatment components already impose the maximum full load back exhaust back pressure allowed by the manufacturer. Adding additional silencers may further increase all the component and piping size and require additional space or extension of the exhaust stacks to a higher elevation than indicated in the plan drawings.

- a) Is there a location, such as a property line, other than the parapet wall that defines the maximum noise level?
 - b) Has the Engineer/Consultant considered any alternative in mitigating the noise level?
- 3). Engine room noise levels of 105 dB (OSHA 1 hour limit) will be exceeded by the operating equipment such as a single engine-generator set and possibly other equipment. Data on the equipment noise levels will be submitted for review by the Engineer/Consultant.

Knowing that meeting this requirement would require redesigning and/or expanding the equipment space can the current requirements for proper High Noise placards and Hearing Protection Required be acceptable for the purpose of submitting a bid reflecting the equipment space(s) as indicated in the current plans and specifications.

- A61. 1) Contractor shall meet the requirements of the plans and specifications.
- 2a) Contractor shall meet the requirements of the plans and specifications.
- 2b) Per the plans and specifications, Contractor shall provide size silencers as required to meet the requirements of the plans and specifications.
- 3) Yes, this is acceptable to the Engineer.

C. ATTACHMENTS

- 1. To Attachment D, Item 9, Wage Rates, pages 35 through 60, **DELETE** in its entirety and **SUBSTITUTE** with pages 40 through 66 of this Addendum.
- 2. To Attachment D, **ADD** Shafting Natural Frequency Analysis and Deflection Calculations, pages 67 through 101 of this Addendum.

D. TECHNICALS

- 1. To Technicals, Contract Documents, Volume 01, Table of Contents, pages 104 through 107, **DELETE** in its entirety and **SUBSTITUTE** with pages 34 through 39 of this Addendum.
- 2. To Section 01025, Measurement and Payment, pages 114 through 117, **DELETE** in its entirety and **SUBSTITUTE** with pages 29 through 33 of this Addendum.

3. To Section 13300, Instrumentation and Control, Part 1 General, Item 1.1, Sub-item D, Page 662, **DELETE** in its entirety and **REPLACE** with All ELC programming and configuration shall be provided by the CITY. All network switch configurations shall be provided by the CITY. Any associated third party I/O development hardware addressing shall be supplied by the vendor.
4. To Section 13300, Instrumentation and Control, Part 2 Products, Item 2.1, Sub-item A, New DCS No. 2 – Network Cabinet, Item 7, Page 674, **DELETE** in its entirety PC – Monitor (Shipped Loose) and **REPLACE** with Ovation Engineering Workstation (Shipped Loose).
5. To APPENDIX A2, PROCESS AND CONTROL STRATEGIES AND DESIGN PHILOSOPHY, Section 13300, Instrumentation and Control, Item Process and Control Strategies, Page 701, **ADD** the following as the first paragraph: Upon approval of the product submittals the City's Resident Engineer shall arrange for a meeting between the stakeholders (Contractor, manufacture representatives, City Staff and the Engineer of Record) to discuss details of control strategies and equipment sequencing. The Engineer of Record shall subsequently refine and issue an amended Control Strategies document, according to which the electrical equipment under various operating conditions shall operate in local and remote modes. The DCS programming shall be based on this document.
6. To Section 13400, Distributed Control System (DCS), Part 2 Products, Item 2.14, Sub-item E, No. 12, Page 859, **DELETE** in its entirety and **REPLACE** with Remote Desktop from FIN and DIN.

E. PLANS

1. To Contract Plans, **ADD** Volume IIIA Contract Drawings (Drawing numbers 38027-02-D, 38027-03-D, 38027-04-D, 38027-14-D, 38027-15-D, 38027-18-D, 38027-19-D, 38027-45-D, 38027-46-D, 38027-60-D, 38027-81-D, 38027-86-D, 38027-87-D, 38027-88-D, 38027-89-D, 38027-90-D, 38027-103-D 38027-105-D, 38027-116-D, 38027-117-D, 38027-118-D, 38027-128-D, 38027-155-D, 38027-167-D, 38027-169-D, 38027-229-D, 38027-242-D), New Sheets **38027-292-D (SW-1)**, **38027-293-D (SW-2)**, 38027-222-D (6E-3), 38027-223-D (6E-4) located at the FTP References, <ftp://ftp.sannet.gov/OUT/ECP/AEP/P2/>.

2. To Volume IIIA Contract Drawings, Sheet 38027-02-D and 38027-127-D, **the following changes are as follows:** The northern stairs shall be removed from the Contractor's scope of work. This effects drawing 38027-127-D, and is no longer required. Drawing 38027-127-D is removed from the scope of work, and 38027-02-D table of contents sheet 38027-127-D, the title is changed to, "(NOT USED)".
3. To Volume IIIA Contract Drawings, Sheet 38027-03-D and 38037-14-D, **the following changes are as follows:** Keyed note 1 was moved to drawing 38037-14-D, DSD DEFERRED ITEMS GENERAL NOTES, note 5. In addition, the table of contents was expanded to include VOLUME IIIA, drawing sheets 38027-292-D and 38027-293-D PERMANENT BMP MAP FOR STANDARD PROJECTS.
4. To Volume IIIA Contract Drawings, Sheet 38027-04-D: **the following changes are as follows:** The WATER POLLUTION CONTROL NOTES and the STORM WATER PROTECTION notes have been removed to not conflict with the Contractor's requirement to comply with the storm water requirements per the City's MS4 and Whitebook 2015 version. Project Managers information was revised to David Manela (619) 533-6682. The submittal date was revised to October 2016.
5. To Volume IIIA Contract Drawings, Sheet 38027-14-D: **the following changes are as follows:** DSD DEFERRED ITEMS GENERAL NOTES, note 5 and 6 is added to the scope of work.
6. To Volume IIIA Contract Drawings, Sheet 38027-15-D: **the following changes are as follows:** Note 1 under the EMERGENCY RADIO COVERAGE was modified and the following requirement added, "THE CONTRACTOR SHALL PERFORM AN EMERGENCY RADIO COVERAGE STUDY PER THE REQUIREMENTS OF DSD. IF UPON TESTING IT IS DETERMINED THE SITE DOES NOT MEET EMERGENCY RADIO COVERAGE REQUIREMENTS, THE CONTRACTOR SHALL ENGINEER AND BUILD A SYSTEM TO MEET SUCH REQUIREMENTS." A bid allowance item of \$50,000 is added to the fee schedule (Section 01025 L. EMERGENCY RADIO COVERAGE ENGINEERING AND CONSTRUCTION) in the case the engineering and design of an emergency radio coverage system is required. The initial study shall be included in the Contractor's base bid under MISCELLANEOUS, bid items. **See Section 01025, Measurement and Payment of this Addendum B.**

7. To Volume IIIA Contract Drawings, Sheet 38027-18-D: **the following changes are as follows:** The following requirement was added to the end of the EROSION CONTROL AND CONSTRUCTION BMPs NARRATIVE, "THIS EROSION CONTROL PLAN/CONSTRUCTION BMP PLAN ARE REQUIRED ACCORDING TO COASTAL DEVELOPMENT PERMIT (CDP) NO. 6-14-1548. CONTRACTOR TO COMPLY WITH CDP NO. 6-14-1548 AND CURRENT MS4 STORM WATER PERMIT REQUIREMENTS. CONTRACTOR SHALL SUBMIT THE SWPPP AND CONSTRUCTION BMP PLANS TO THE RESIDENT ENGINEER DURING PRE- CONSTRUCTION MEETING FOR REVIEW/APPROVAL TO ENSURE MOST STRINGENT REQUIREMENTS ARE MET FOR THE APPLICABLE PERMITS."
8. To Volume IIIA Contract Drawings, Sheet 38027-19-D: **the following changes are as follows:** Demolition requirement of the asphalt was shifted to the west 6.6' in front of the building to comply with Volume IIIA contract requirements.
9. To Volume IIIA Contract Drawings, Sheet 38027-45-D: **the following changes are as follows:** The northern stairs shall be removed from the Contractor's scope of work. The plans and details have been modified to reflect this change.
10. To Volume IIIA Contract Drawings, Sheet 38027-46-D: **the following changes are as follows:** The new pavement section (Detail 2/C-4) requirement of the asphalt was shifted to the west 6.6' in front of the building to comply with Volume IIIA contract requirements.
11. To Volume IIIA Contract Drawings, Sheet 38027-60-D: **the following changes are as follows:** Detail F has been revised.
12. To Volume IIIA Contract Drawings, Sheet 38027-81-D: **the following changes are as follows:** ADA requirements have been clarified.
13. To Volume IIIA Contract Drawings, 38027-86-D: **the following changes are as follows:** The northern stairs shall be removed from the Contractor's scope of work. The plans and details have been modified to reflect this change.
14. To Volume IIIA Contract Drawings, Sheet 38027-87-D: **the following changes are as follows:** The northern stairs shall be removed from the Contractor's scope of work. The plans and details have been modified to reflect this change.

15. To Volume IIIA Contract Drawings, Sheet 38027-88-D: **the following changes are as follows:** The northern stairs shall be removed from the Contractor's scope of work. The plans and details have been modified to reflect this change.
16. To Volume IIIA Contract Drawings, Sheet 38027-89-D: **the following changes are as follows:** The northern stairs shall be removed from the Contractor's scope of work. The plans and details have been modified to reflect this change.
17. To Volume IIIA Contract Drawings, Sheet 38027-90-D: **the following changes are as follows:** The northern stairs shall be removed from the Contractor's scope of work. The plans and details have been modified to reflect this change.
18. To Volume IIIA Contract Drawings, Sheet 38027-103-D: **the following changes are as follows:** The drawing was modified to match Volume IIIA Contract Requirements.
19. To Volume IIIA Contract Drawings, Sheet 38027-105-D: **the following changes are as follows:** The drawing was modified to match Volume IIIA Contract Requirements.
20. To Volume IIIA Contract Drawings, Sheet 38027-116-D: **the following changes are as follows:** The northern stairs shall be removed from the Contractor's scope of work. The plans and details have been modified to reflect this change.
21. To Volume IIIA Contract Drawings, Sheet 38027-117-D: **the following changes are as follows:** The northern stairs shall be removed from the Contractor's scope of work. The plans and details have been modified to reflect this change.
22. To Volume IIIA Contract Drawings, Sheet 38027-118-D: **the following changes are as follows:** The northern stairs shall be removed from the Contractor's scope of work. The plans and details have been modified to reflect this change.
23. To Volume IIIA Contract Drawings, Sheet 38027-127-D: **the following changes are as follows:** The northern stairs shall be removed from the Contractor's scope of work. The plans and details have been modified to reflect this change.

24. To Volume IIIA Contract Drawings, Sheet 38027-155-D: **the following changes are as follows:** Note 11 was added, "THE R410A REFRIGERANT SHALL BE LESS THAN 30 LBS TO MEET DSD PERMIT REQUIREMENTS".
25. To Volume IIIA Contract Drawings, Sheet 38027-167-D: **the following changes are as follows:** The registers mounted on the 90-degree silencer has been relocated to the horizontal run of duct.
26. To Volume IIIA Contract Drawings, Sheet 38027-169-D: **the following changes are as follows:** Note 2 was added, "THE R410A REFRIGERANT SHALL BE LESS THAN 30 LBS TO MEET DSD PERMIT REQUIREMENTS".
27. To Volume IIIA Contract Drawings, Sheet 38027-229-D: **the following changes are as follows:** The lights and the corresponding light switch for the stairs on the north side of the building have been removed.
28. To Volume IIIA Contract Drawings, Sheet 38027-242-D: **the following changes are as follows:** The quantity of lights on lighting panel, LP-8, circuit 19, have been reduced from 10 to 7 lights to account for the three lights associated with the northern stair that were removed.
29. To Volume IIIA Contract Drawings, Sheet I-2: **the following changes are as follows:** On left side of page in box, **CHANGE** "(N) PC/MONITOR", to "(N) OVATION ENGINEERING STATION"
30. To Volume IIIA Contract Drawings, Sheet 38027-222-D (Title 24-1): **DELETE** in its entirety and **REPLACE** with the uploaded pages located at the FTP References, <ftp://ftp.sannet.gov/OUT/ECP/AEP/P2/>.
31. To Volume IIIA Contract Drawings, Sheet 38027-223-D (Title 24-1): **DELETE** in its entirety and **REPLACE** with the uploaded pages located at the FTP References, <ftp://ftp.sannet.gov/OUT/ECP/AEP/P2/>.

F. ADDITIONAL CHANGES

The following are changes in the **Line Items Tab** in **PlanetBids**.

For clarity where applicable, **ADDITIONS**, if any, have been **Underlined** and **DELETIONS**, if any, have been **~~Stricken-out~~**.

Section	Item code	Item Description	UOM	QTY	Reference	Unit Price
Main Bid		<u>Emergency radio coverage-Engineering and Design (EOCP Type 1)</u>	<u>AL</u>	<u>1</u>	<u>1025-3.3L</u>	<u>50000</u>
Main Bid	237110	<u>Diesel SCR systems</u>	<u>LS</u>	<u>1</u>	<u>1025-3.3M</u>	
Main Bid	541370	<u>Survey Services</u>	<u>LS</u>	<u>1</u>	<u>2-9.2.3</u>	

James Nagelvoort, Director
Public Works Department

Dated: *November 23, 2016*
San Diego, California

JN/JB/lji

SECTION 01025 – MEASUREMENT AND PAYMENT

PART 1 -- GENERAL (Not Used)

PART 2 -- MATERIALS

2.1 GENERAL (MEASUREMENT)

- A. Measurement for unit price quantities shall be based upon the appropriate bid item in the proposal. The actual quantity of measurement shall be as constructed by the Contractor in place in conformance with the Plans and Specifications.

2.2 LINEAR MEASUREMENTS

- A. Pipeline and related facility measurements shall be made horizontally along the centerline of the pipeline and related facilities through tees, bends, valves, fittings, and as shown on the Plans for its limits or as otherwise specified in the Special Technical Provisions.

2.3 AREA MEASUREMENTS

- A. Measurement for bid items involving area units shall be based upon the surface area measured in acres, square yards, square feet, or as indicated in the bid item.

2.4 VOLUME MEASUREMENTS

- A. Measurement for bid items involving volume units shall be based upon the volume measured in cubic yards, tons, or as indicated in the bid item.

2.5 UNIT MEASUREMENTS

- A. Measurement for bid items involving units of the item shall be based upon the number of units counted as indicated in the bid item.

2.6 LUMP SUM MEASUREMENT

- A. Lump sum items shall include all labor, delivery, materials, equipment and testing services as required by these Specifications for the complete installation of the bid items described in this Section. No separate payment shall be made for items not included by the Contractor in the total contract Bid Price as described in Part 3 herein.

PART 3 -- EXECUTION

3.1 GENERAL

- A. This section covers methods of measurement and payment for items of work under this Contract. The total Bid Price shall cover all work required by the Contract Documents. All costs in connection with the proper and successful completion of the work, including furnishing all materials, equipment, tools and incidentals; and performing all necessary labor and supervision to fully complete the work, shall be included in the unit (linear, area, volume) and lump sum prices bid. All work not specifically set forth as a pay item in the Bid Form shall be considered a subsidiary obligation of Contractor and all costs in connection therewith shall be included in the prices bid.

3.2 ESTIMATED QUANTITIES

- A. All estimated quantities stipulated in the Bid Form or other Contract Documents are approximate and are to be used only (a) as a basis for estimating the probable cost of the work and (b) for the purpose of comparing the bids submitted for the work. The actual amounts of work done and materials furnished under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished. Contractor agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts therefor.

3.3 BID ITEMS

- A. MOBILIZATION/DEMobilIZATION - Lump Sum Bid Item shall include full compensation for mobilization and demobilization including and not limited to furnishing and installing, complete and in place all the necessary site preparatory work and operations, including those necessary for movement of personnel, equipment, supplies, and incidentals to the project site for the establishment and upkeep of temporary facilities, sanitary facilities, permits (unless otherwise specified in other Bid Items), traffic control plans, maintenance of project site including trash and litter pickup, offices, buildings, and other facilities necessary for work on the project, final project close-out and cleanup operations, including, but not limited to, those necessary for the removal of equipment, supplies, incidentals and debris from the project site, cleaning the streets and sidewalks of all soils and construction debris, record drawings, correction of deficiencies in the work, and for all other work required as indicated in the CONTRACT DOCUMENTS.

- B. SHEETING AND SHORING – Lump Sum Bid Item shall full compensation for all equipment, materials, labor to install sheeting and shoring complete and in place as required in contract documents including but not limited to, meeting all OSHA requirements and as required for all construction operations including site improvements, yard piping, drainage piping, site improvements, protection of off-site properties, and preparation and approved sheeting and shoring plan, and any other work as required by the CONTRACT DOCUMENTS.
- C. CIVIL - SITE IMPROVEMENTS - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Civil – Site improvements complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Site Preparation, Storage & Staging, Clearing and Grubbing, Civil Site work demolition, Excavation and Shoring, Hauling soil offsite, Aggregate Base, crushed stone base, Finish Grading, Fine Grading for Over Excavation Subgrade, AC Paving Binder Course, Topping Course, Injection Grouting, and Site Drainage Improvements.
- D. STRUCTURAL - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Structural complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Loading/Unloading Rack Area, Generator Building: wall footings, generator pads & floor Slab- On-Grade, Concrete pipe trench, Concrete walls, Concrete Corbels, Concrete Composite Roof Slab, Runway Beams for Bridge Crane Support, Roof Beams, Roof Metal Decking, and Steel Stairs. Electrical Building: Concrete Wall Footings, Equipment Pads and Floor Slab-on-Grade, Concrete walls, Concrete Elevated slab for Stairway Steps, Concrete Composite Roof Slab, Roof Beams, Roof Metal Decking, Steel Roofing Panels, Trench Cover, and Architectural Finishes.
- E. MECHANICAL - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Mechanical complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Mechanical/HVAC/Equipment Demolition, 4MW diesel generators including exhaust after treatment, 3MW natural gas engines including exhaust after treatment engines & blowers, Engine- Generator Manufacturers Project Management & Engineering, Engine-Generator Manufacturers Startup & Testing, Miscellaneous spare parts (engine/generators), Initial fill lube oil generator/engines reservoirs, Lube Oil Pump + Spare, 20,000 gal horizontal diesel fuel tank including Initial fill, 330 gal diesel fuel day tank including Initial fill, 3,000 gal lube oil tank (diesel gensets), 1,500 gal lube oil tank (natural gas

gensets), Initial fill lube oil tanks, 2,000 gal waste lube oil tanks, 3,000 gal Urea tank with Initial fill, Air Compressor, Air Receiver, Building AHU's, Ductwork, Sewage Heat Exchangers, Pumping, Piping, Valving, Catwalks, & Appurtenances, Main electrical Building AC Units, Control Room AC Units, Existing Engine Room Improvements/Demolition, and Fire Protection Sprinkler System.

- F. INSTRUMENTATION & CONTROL - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Instrumentation & Control complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to EMERSON DCS Equipment (procurement/shipping/delivery and all other costs required to begin installation), DCS Panels Installation and Modifications, Commissioning Team, Field Instruments, Process Smoke and Fire Alarm System, PLC Modifications, and Fiber Optics to Power Generation Building.
- G. ELECTRICAL - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Electrical complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Electrical Demolition & Miscellaneous Modifications, 2,250 HP Electric Motors, Medium Voltage VFDs, Medium Voltage Switchgear No.3, Medium Voltage Switchgear No.1 & No.2 Modifications, USS-1 Modifications and new Controller, Low Voltage Unit Substation, MCCs, UPSs' (Uninterruptible Power Supply), Load Bank, Lighting, Duct Banks, Cable & Conduit, SDG&E ISO Meters & Aux Meters, Miscellaneous Electrical.
- H. ARCHITECTURAL - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Architectural complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Misc. Metal Fabrication: Flashing, downspouts, gutter, and etc., Exterior lighting, Mechanical unit curbs, Splash blocks, Building Signage, Cage ladders, Guard Rails, Metal roofing at Fuel Tank Canopy, Restriping the parking lot and adding proper signage, Fire Extinguishers, Acoustical panels.
- I. FINAL OPERATIONS & MAINTENANCE (O&M) MANUALS - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to complete all approvals of the O&M Manuals as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Final acceptance and approvals of O&M Manuals as described in Section 13350.

- J. MISCELLANEOUS – Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the Miscellaneous complete and in place as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to the Area 6 Miscellaneous Modifications & ADA Improvements, Fuel Polishing System, 10 Ton Bridge Cranes, Rollup Door, Decorative Fence, Motorized Access Gate, Doors, Roof Waterproofing, Painting and Coating, Water Conditioning, Relocation of conflicting fiber optic lines, emergency radio coverage testing requirements, and all remaining items per the CONTRACT DOCUMENTS. SDGE – NEW GAS SERVICE – Preset \$1,000,000 budget by the CITY and is to pay SDG&E for the new gas service. This is a pass through cost to pay for CITY approved SDG&E invoices. The CONTRACTOR shall pass through the invoice with no markups allowed.
- K. EMERGENCY RADIO COVERAGE ENGINEERING AND CONSTRUCTION - Preset \$50,000 budget by the CITY to pay for potential engineering and construction of emergency radio coverage if deemed necessary per the Contract Requirements.
- L. DIESEL SCR SYSTEMS - Lump Sum Bid Item shall full compensation for all equipment, materials, labor to install the diesel SCR systems per Section 13300, Appendix A2, 9.1.

**** END OF SECTION ****

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VOLUME IV – Reference Drawings

FTP References, <ftp://ftp.sannet.gov/OUT/ECP/AEP/P2/>

1. Metro Pump Station No.2 – Additional Pumps Installation of 8th Pump and Engine Drives, 26275-D, 1991
2. Pump Station 1 & Pump Station 2 Electrical Upgrade and New Building at Pump Station 2, 35265-D, 2010
3. Pump Station No. 2, 11053-D, 1960
4. Hawthorne Power Systems Drawing 11090-2E, 1992
5. General Fiber Optic Between PS 1 and PS 2, 30708-D, 2001
6. North Metro Interceptor Fiber Optic Conduit, 30192-D, 2000
7. Pump Station No.2 Instrumentation Upgrade – Comnet Implementation, 31822-D, 2008
8. October 2014 Topographic Survey of a Portion of Pump Station 2.
9. Preliminary Survey from City
10. Pump Station 2 Loop Drawings

VOLUME V – Reference Documents

FTP References, <ftp://ftp.sannet.gov/OUT/ECP/AEP/P2/>

1. Pump Station 1 & 2 San Diego, CA BEC WO#11575 Medium Voltage Switchgear, Submittal No. 16300.001.4
2. Field Revisions to Switchgear No. 1 & 2.
3. Deck/Ramps for Planning Trailers at Pump Station No.2
4. Updated Final Report of Geotechnical Investigation Pump Station No.2 Power Reliability and Surge Protection Dated November 17, 2014.
5. Pump Stations 1 & 2 WO#11575 Unit Substation (Pump Station 2), Submittal #16310.001.4
6. Lead Related construction Specification

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

General Decision Number: CA160001 11/11/2016 CA1

Superseded General Decision Number: CA20150001

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 \$10.15 for calendar year 2016 applies to all contracts subject to the Davis-Bacon Act for which the 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 \$10.15 (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 2016. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/08/2016
1	02/12/2016
2	02/19/2016
3	02/26/2016
4	03/04/2016
5	03/18/2016
6	07/01/2016
7	07/08/2016
8	07/22/2016
9	08/12/2016
10	08/26/2016
11	09/16/2016
12	10/21/2016
13	11/11/2016

ASBE0005-002 07/04/2016

	Rates	Fringes
Asbestos Workers/Insulator (Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems).....	\$ 38.37	20.13
Fire Stop Technician (Application of Firestopping Materials for wall openings and penetrations in walls, floors, ceilings and curtain walls).....	\$ 26.15	17.31

ASBE0005-004 07/04/2016

	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)....	\$ 18.38	10.82

BOIL0092-003 10/01/2012

	Rates	Fringes
BOILERMAKER.....	\$ 41.17	28.27

BRCA0004-008 11/01/2015

	Rates	Fringes
BRICKLAYER; MARBLE SETTER.....	\$ 34.44	17.21

BRCA0018-004 06/01/2016

	Rates	Fringes
MARBLE FINISHER.....	\$ 28.45	11.38
TILE FINISHER.....	\$ 24.53	4.19
TILE LAYER.....	\$ 35.89	8.55

BRCA0018-010 09/01/2013

	Rates	Fringes
TERRAZZO FINISHER.....	\$ 26.59	10.34
TERRAZZO WORKER/SETTER.....	\$ 33.63	11.13

CARP0409-002 07/01/2008

	Rates	Fringes
Diver		
(1) Wet.....	\$ 663.68	9.82
(2) Standby.....	\$ 331.84	9.82
(3) Tender.....	\$ 323.84	9.82
(4) Assistant Tender.....	\$ 299.84	9.82

Amounts in "Rates" column are per day

CARP0409-008 08/01/2010

	Rates	Fringes
Modular Furniture Installer.....	\$ 17.00	7.41

CARP0547-001 07/01/2009

	Rates	Fringes
CARPENTER		
(1) Bridge.....	\$ 37.28	10.58
(2) Commercial Building....	\$ 32.30	10.58
(3) Heavy & Highway.....	\$ 37.15	10.58
(4) Residential Carpenter..	\$ 25.84	10.58
(5) Residential		
Insulation Installer.....	\$ 18.00	8.16
MILLWRIGHT.....	\$ 37.65	10.58
PILEDRIVERMAN.....	\$ 37.28	10.58

CARP0547-002 07/01/2009

	Rates	Fringes
Drywall		
(1) Work on wood framed construction of single family residences, apartments or condominiums under four stories		
Drywall Installer/Lather...\$	21.00	8.58
Drywall Stocker/Scrapper...\$	11.00	6.67
(2) All other work		
Drywall Installer/Lather...\$	27.35	9.58
Drywall Stocker/Scrapper...\$	11.00	6.67

ELEC0569-001 08/31/2015

	Rates	Fringes
Electricians (Tunnel Work)		
Cable Splicer.....	\$ 46.88	13.54
Electrician.....	\$ 46.13	13.51
Electricians: (All Other Work, Including 4 Stories		

	Rates	Fringes
Residential)		
Cable Splicer.....	\$ 41.75	13.38
Electrician.....	\$ 41.00	13.36

ELEC0569-004 06/01/2015

	Rates	Fringes
ELECTRICIAN (Sound & Communications Sound Technician).....	\$ 29.55	11.92
SOUND TECHNICIAN: Terminating, operating and performing final check-out		

ELEC0569-005 06/06/2016

	Rates	Fringes
Sound & Communications Sound Technician.....	\$ 30.22	12.21
SOUND TECHNICIAN: Terminating, operating and performing final check-out		

ELEC0569-006 10/05/2015

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.....	\$ 29.50	8.31
Utility Technician #2.....	\$ 24.65	8.16

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 06/06/2016

	Rates	Fringes
ELECTRICIAN (Residential, 1-3 Stories).....	\$ 31.69	3%+6.61

ELEC1245-001 06/01/2015

	Rates	Fringes
LINE CONSTRUCTION		
(1) Lineman; Cable splicer..	\$ 52.85	15.53
(2) Equipment specialist (operates crawler tractors, commercial motor vehicles, backhoes, trenchers, cranes (50 tons and below), overhead & underground distribution line equipment).....	\$ 42.21	14.32
(3) Groundman.....	\$ 32.28	14.03
(4) Powderman.....	\$ 47.19	14.60

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

ELEV0018-001 01/01/2015

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 49.90	28.38

FOOTNOTE:

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.
PAID HOLIDAYS: New Years Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Friday after Thanksgiving, and Christmas Day.

ENGI0012-003 07/01/2016

	Rates	Fringes
OPERATOR: Power Equipment (All Other Work)		
GROUP 1.....	\$ 39.95	23.35
GROUP 2.....	\$ 40.73	23.35
GROUP 3.....	\$ 41.02	23.35
GROUP 4.....	\$ 42.51	23.35
GROUP 5.....	\$ 41.86	23.35
GROUP 6.....	\$ 41.83	23.35
GROUP 8.....	\$ 42.84	23.35
GROUP 9.....	\$ 42.19	23.35

	Rates	Fringes
GROUP 10.....	\$ 42.96	23.35
GROUP 11.....	\$ 42.31	23.35
GROUP 12.....	\$ 43.13	23.35
GROUP 13.....	\$ 43.23	23.35
GROUP 14.....	\$ 43.26	23.35
GROUP 15.....	\$ 43.34	23.35
GROUP 16.....	\$ 43.46	23.35
GROUP 17.....	\$ 43.63	23.35
GROUP 18.....	\$ 43.73	23.35
GROUP 19.....	\$ 43.84	23.35
GROUP 20.....	\$ 43.96	23.35
GROUP 21.....	\$ 44.13	23.35
GROUP 22.....	\$ 44.23	23.35
GROUP 23.....	\$ 44.34	23.35
GROUP 24.....	\$ 44.46	23.35
GROUP 25.....	\$ 44.63	23.35
OPERATOR: Power Equipment (Cranes, Piledriving & Hoisting)		
GROUP 1.....	\$ 43.20	22.15
GROUP 2.....	\$ 43.98	22.15
GROUP 3.....	\$ 44.27	22.15
GROUP 4.....	\$ 44.41	22.15
GROUP 5.....	\$ 44.63	22.15
GROUP 6.....	\$ 44.74	22.15
GROUP 7.....	\$ 44.86	22.15
GROUP 8.....	\$ 45.03	22.15
GROUP 9.....	\$ 45.20	22.15
GROUP 10.....	\$ 46.20	22.15
GROUP 11.....	\$ 47.20	22.15
GROUP 12.....	\$ 48.20	22.15
GROUP 13.....	\$ 49.20	22.15
OPERATOR: Power Equipment (Tunnel Work)		
GROUP 1.....	\$ 41.80	23.35
GROUP 2.....	\$ 42.58	23.35
GROUP 3.....	\$ 42.87	23.35
GROUP 4.....	\$ 43.01	23.35
GROUP 5.....	\$ 43.23	23.35
GROUP 6.....	\$ 43.34	23.35
GROUP 7.....	\$ 43.46	23.35

PREMIUM PAY:

\$3.75 per hour shall be paid on all Power Equipment Operator work on the following 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 bending 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, PILEDIVING 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, 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, SBM 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 which 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 08/01/2015

	Rates	Fringes
OPERATOR: Power Equipment		
(DREDGING)		
(1) Leverman.....	\$ 49.50	23.60
(2) Dredge dozer.....	\$ 43.53	23.60
(3) Deckmate.....	\$ 43.42	23.60
(4) Winch operator (stern		

	Rates	Fringes
winch on dredge).....	\$ 42.87	23.60
(5) Fireman-Oiler, Deckhand, Bargeman, Leveehand.....	\$ 42.33	23.60
(6) Barge Mate.....	\$ 42.94	23.60

IRON0377-002 07/01/2016

	Rates	Fringes
Ironworkers:		
Fence Erector.....	\$ 28.33	20.64
Ornamental, Reinforcing and Structural.....	\$ 34.75	29.20

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 07/18/2016

	Rates	Fringes
LABORER (BUILDING and all other Residential Construction)		
Group 1.....	\$ 29.42	19.78
Group 2.....	\$ 30.10	19.78
Group 3.....	\$ 30.81	19.78
Group 4.....	\$ 31.61	19.78
Group 5.....	\$ 33.54	19.78
LABORER (RESIDENTIAL CONSTRUCTION - See definition below)		
(1) Laborer.....	\$ 27.32	18.11
(2) Cleanup, Landscape, Fencing (Chain Link & Wood).....	\$ 26.03	18.11

RESIDENTIAL DEFINITION: Wood or metal frame construction of single family residences, apartments and condominiums - 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, asphalt 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 operation, 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 powder 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 11/01/2015

	Rates	Fringes
LABORER (MASON TENDER).....	\$ 29.12	15.39

LABO0089-004 07/03/2016

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
Laborers:		
Group 1.....	\$ 30.54	19.73
Group 2.....	\$ 31.00	19.73
Group 3.....	\$ 31.41	19.73
Group 4.....	\$ 32.25	19.73
Group 5.....	\$ 36.37	19.73

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, Prefabricated 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 tracking, 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 01/01/2016

	Rates	Fringes
Asbestos Removal Laborer.....	\$ 30.43	16.07

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.

LABO1184-001 07/04/2016

	Rates	Fringes
Laborers: (HORIZONTAL DIRECTIONAL DRILLING)		
(1) Drilling Crew Laborer...	\$ 33.65	13.95
(2) Vehicle Operator/Hauler.	\$ 33.82	13.95
(3) Horizontal Directional Drill Operator.....	\$ 35.67	13.95
(4) Electronic Tracking Locator.....	\$ 37.67	13.95
Laborers: (STRIPING/SLURRY SEAL)		
GROUP 1.....	\$ 34.86	17.03

	Rates	Fringes
GROUP 2.....	\$ 36.16	17.03
GROUP 3.....	\$ 38.17	17.03
GROUP 4.....	\$ 39.91	17.03

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

LABO1414-003 08/03/2016

	Rates	Fringes
LABORER		
PLASTER CLEAN-UP LABORER....	\$ 31.60	19.28
PLASTER TENDER.....	\$ 34.15	19.28

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 07/01/2015

	Rates	Fringes
Painters: (Including Lead Abatement)		
(1) Repaint (excludes San Diego County).....	\$ 27.29	12.83
(2) All Other Work.....	\$ 30.72	12.83

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 10/01/2015

	Rates	Fringes
DRYWALL FINISHER/TAPER		
(1) Building & Heavy Construction.....	\$ 27.84	15.20
(2) Residential Construction (Wood frame apartments, single family homes and multi-duplexes up to and including four stories).....	\$ 21.00	13.91

PAIN0036-012 10/01/2016

	Rates	Fringes
GLAZIER.....	\$ 41.55	11.93

PAIN0036-019 01/01/2016

	Rates	Fringes
SOFT FLOOR LAYER.....	\$ 26.77	13.53

PLAS0200-005 08/06/2015

	Rates	Fringes
PLASTERER.....	\$ 38.44	13.77

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

* PLAS0500-001 07/01/2016

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER		
GROUP 1.....	\$ 23.84	21.17
GROUP 2.....	\$ 25.49	21.17
GROUP 3.....	\$ 27.57	21.17

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 07/01/2016

	Rates	Fringes
PLUMBER, PIPEFITTER, STEAMFITTER		
Camp Pendleton.....	\$ 51.69	21.41
Plumber and Pipefitter 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.....	\$ 47.19	21.41
Work ONLY on new additions and remodeling of commercial buildings, bars, restaurants, and stores not to exceed 5,000 sq. ft. of floor space.....	\$ 45.73	20.43
Work ONLY on strip malls, light commercial, tenant improvement and remodel work.....	\$ 35.69	18.76

 PLUM0016-011 07/01/2016

	Rates	Fringes
PLUMBER/PIPEFITTER		
Residential.....	\$ 38.17	17.33

 PLUM0345-001 07/01/2014

	Rates	Fringes
PLUMBER		
Landscape/Irrigation Fitter..\$	29.27	19.75
Sewer & Storm Drain Work....\$	33.24	17.13

 ROOF0045-001 07/01/2012

	Rates	Fringes
ROOFER.....\$	25.08	7.28

 SFCA0669-001 04/01/2016

	Rates	Fringes
SPRINKLER FITTER.....\$	37.67	19.56

 SHEE0206-001 07/01/2015

	Rates	Fringes
SHEET METAL WORKER		
Camp Pendleton.....\$	37.55	23.23
Except Camp Pendleton.....\$	35.33	23.23
Sheet Metal Technician.....\$	25.22	6.69

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

 * TEAM0036-001 07/04/2016

	Rates	Fringes
Truck drivers:		
GROUP 1.....\$	15.90	30.69
GROUP 2.....\$	23.49	30.69
GROUP 3.....\$	23.69	30.69
GROUP 4.....\$	23.89	30.69
GROUP 5.....\$	24.09	30.69
GROUP 6.....\$	24.59	30.69
GROUP 7.....\$	26.09	30.69

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.
=====

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

**SHAFTING
NATURAL FREQUENCY ANALYSIS
and
DEFLECTION CALCULATIONS**

**CITY OF SAN DIEGO
METRO PUMP STATION II
RAW SEWAGE PUMP P-300**

**CUSTOMER ORDER NO. E2047/91
SPECIFICATION SECTION 11340A**

**DRESSER PUMP MODEL 36 NA-57
DRESSER ORDER NO: TP-92281**

**DRESSER PUMP DIVISION
TANEYTOWN, MD**

15 November 1991

SHAFTING
NATURAL FREQUENCY ANALYSIS
and
DEFLECTION CALCULATIONS

CITY OF SAN DIEGO
METRO PUMP STATION II
RAW SEWAGE PUMP P-300

DRESSER PUMP MODEL 36 NA-57
DRESSER ORDER NO: TP-92281

DRESSER PUMP DIVISION
TANEYTOWN, MD

Calculations Performed by:

Richard J. Cronin

Date: 11-15-91

Richard J. Cronin
Product Engineer

Checked by:

David A. House

Date: 11-15-91

David A. House
Product Manager

Certified by:

Meryar Ebrahimi

Date: 11/15/91

Meryar Ebrahimi
Registered Professional Engineer
State of Maryland
License Number 14488

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ABSTRACT

This report documents the Shafting Mass Elastic System and Natural Frequency Analysis and Deflection Calculations required for the Raw Sewage Pump P-300 of the City of San Diego Metro Pump Station II; Contract E2047/91, Specification Section 11340A, Paragraph 1.01E and 2.03.E.

The pump is driven by a 2250 Hp, 514 RPM wound rotor induction motor operating on a liquid rheostat drive. The motor is mounted on a floor above the pump and drives it through three sections of intermediate shafting. A flywheel is mounted to the shaft immediately below the motor floor to provide increased rotational inertia of the drive train.

The system was analyzed for torsional natural frequencies, torsional response, lateral natural frequencies, and shaft deflection. Analysis was performed using Dresser Pump proprietary programs as well as the COSMOS/M Finite Element package developed by the Structural Research and Analysis Corporation.

Output from the analysis consists of system torsional and lateral natural frequencies as well as shaft deflection. The pump rotor response to torque pulsations was developed to check the pump shaft life.

The results indicate:

- 1.) The pump will not dangerously excite shafting torsional and lateral natural frequencies under normal operation.
- 2.) No fatigue failure is expected in the pump shaft under normal operating conditions.
- 3.) There will be no wearing ring contact under normal operating conditions.

INTRODUCTION

The Raw Sewage Pump for the City of San Diego Metro Pump Station II is a Dresser Industries (Worthington) Pump Model 36 NA-57. It is a volute type dry-pit centrifugal pump using a five vane impeller. The pump is driven by a 2250 HP wound rotor induction motor operating on a liquid rheostat drive between 400 and 502 RPM. The motor is mounted on a floor above the pump and drives it through three sections of intermediate shafting. A flywheel is mounted to the shaft immediately below the motor floor to provide increased rotational inertia of the drive train. All bearings are of a journal bearing type.

The motor and liquid rheostat drive are to be relocated from the existing pump position number five. The motor mass elastic diagram was supplied by the original motor vendor, the General Electric Company. The pump and intermediate shafting mass elastic diagram was developed by Dresser Pump.

Specification Section 11340A-1.01E requires that natural frequencies be kept 20% above and 35% below the speed range required by the pump to meet the specified operating conditions. The operating speed range in our case is approximately 400-502 RPM. The restricted range of natural frequencies is therefore 296-602 CPM.

An equivalent mass elastic system was developed (see RY-190057; Appendix A) and the torsional natural frequencies were determined using the Holzer method. Torsional amplification factors were then calculated for the torsional modes which are excitable by either 1X, 2X, or blade pass.

Torque pulsations for 1X, 2X, and blade pass were combined to produce a total alternating torque at each operating point. Alternating torque is calculated by multiplying the amplification factor at the excitation frequency in question by the PU factor and the torque. The amount of torque amplification is dependent on how close the excitation frequency is to a natural frequency. The amplification is 1 at frequencies below the natural frequency; increases to the calculated amplification factor at the natural frequency; and then decreases to 1 after the natural frequency. Pump PU factors are empirical and are based on deviation from BEP GPM. The $PU = .1$ at shutoff and decreases to 0.01 at BEP GPM and increases to .1 at $2 \times$ BEP GPM.

Equivalent pump shaft stresses were calculated for the various operating RPMs by combining the bending, shear, and axial stresses according to the Maximum Distortion Energy Theory. Yield point factors of safety were calculated and shaft life was estimated using the Soderberg relation.

The systems was further analyzed for lateral natural frequencies and shaft deflection using the COSMOS/M finite element package developed by Structural Research and Analysis Corporation.

RESULTS

A. NATURAL FREQUENCIES

Appendix A contains the calculations for determining the system torsional and rotor lateral natural frequencies. The Holzer method was used to determine torsional natural frequencies. Finite Element Analysis was used to determine lateral natural frequencies.

MASS	TORSIONAL NATURAL FREQUENCY (CPM)	LATERAL NATURAL FREQUENCY (CPM)
IMPELLER	653	1743
FLYWHEEL	NA	1768
MOTOR ROTOR	795	2343
LOWER SHAFT	NA	1416
MIDDLE SHAFT	NA	2836
UPPER SHAFT	NA	above 3000

TABLE 1: SYSTEM NATURAL FREQUENCIES

The torsional natural frequencies are all acceptable and fall outside the range required by the specification. Lateral natural frequencies are also acceptable.

B. SHAFT STRESS

Appendix B contains the calculations for determining combined shaft stresses according to the Maximum Distortion Energy Theory. Stresses were calculated for the two shaft sections subject to the highest stresses; the bearing sleeve step; and the shaft sleeve step. The lowest factors of safety based on yield point and shaft life are shown below.

CONDITION of SERVICE	YIELD POINT FACTOR OF SAFETY	ESTIMATED SHAFT LIFE
SHUT OFF 0 GPM, 229' TDH	1.4	FINITE*
OPERATING 53000 GPM, 141.5' TDH	3.6	INFINITE
RUNOUT 55000 GPM, 134' TDH	3.7	INFINITE
REDUCED SPEED (400 RPM) 10000 GPM, 137' TDH	2.3	INFINITE

* Continuous operation at this point is not recommended.

TABLE 2: SHAFT STRESS FACTOR of SAFETY AND LIFE PREDICTION

C. SHAFT DEFLECTION

Appendix C contains a typical Finite Element Analysis shaft deflection plot. The following deflections at the centerline of the impeller were output:

CONDITION of SERVICE	IMPELLER CENTERLINE DEFLECTION (mils)
SHUT OFF 0 GPM, 229' TDH	40.1
OPERATING 53000 GPM, 141.5' TDH	6.7
RUNOUT 55000 GPM, 134' TDH	6.3
REDUCED SPEED (400 RPM) 10000 GPM, 137' TDH	23.8

TABLE 3: SHAFT DEFLECTIONS AT CENTERLINE OF IMPELLER

Specification Section 2.03.E requires a maximum impeller centerline deflection of 6 mils at any continuous operating point. The wearing ring design clearance for the 36 NA-57 is 60 mils per side. Although the calculated shaft deflection at the reduced speed condition exceeds 6 mils, no wearing ring contact or shaft fatigue failure is expected.

CONCLUSIONS

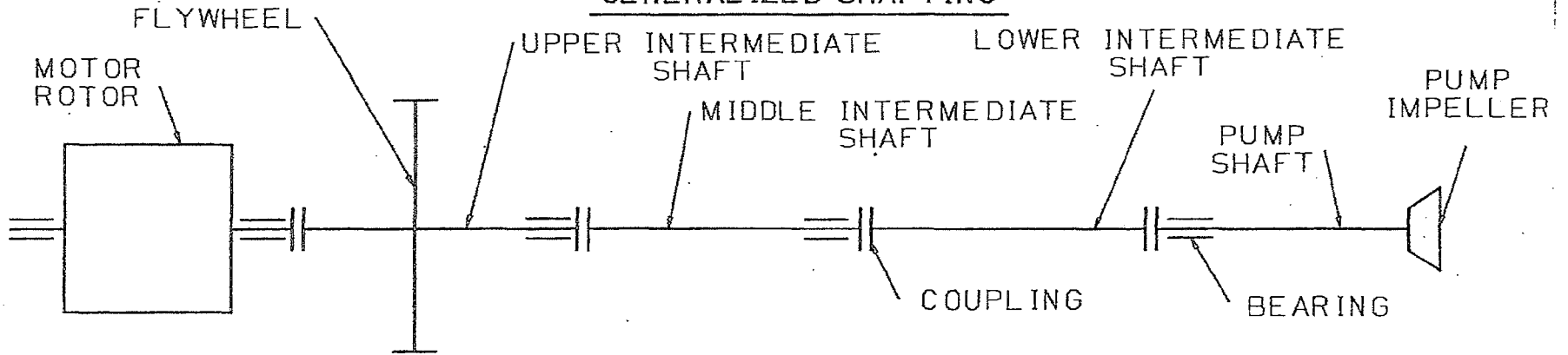
- 1.) Torsional and lateral natural frequencies meet the requirements of Specification Section 11341A-1.01E.
- 2.) The maximum alternating torques will not produce alternating torsional shear stresses exceeding the 3500 psi required in Specification Section 11304A-1.01E.
- 3.) Shaft deflection exceeds the 6 mil requirement of Specification Section 11304A-2.03E at the reduced speed operating point. However, no contact of the wearing rings is expected within the defined operating envelope.

APPENDIX A

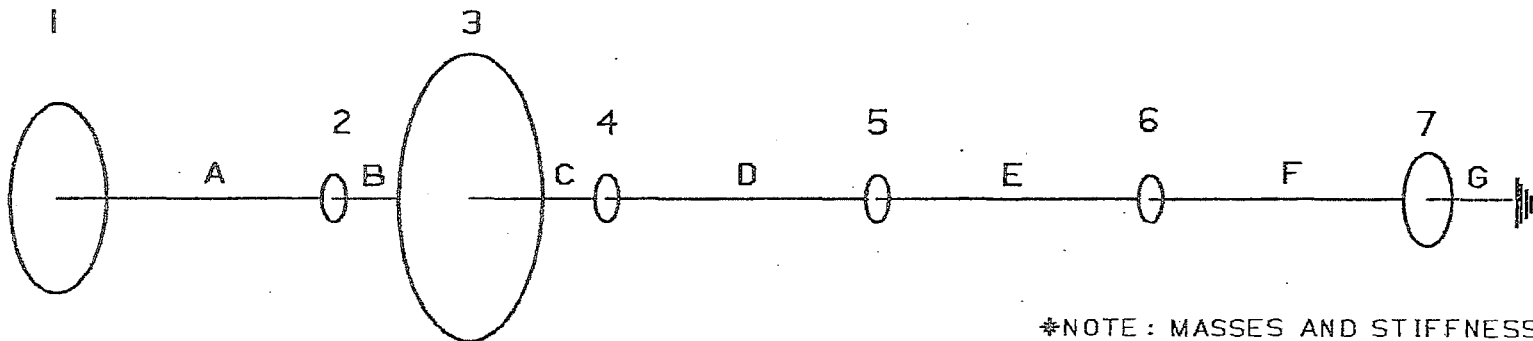
NATURAL FREQUENCY CALCULATIONS
for the
SHAFTING SYSTEM

- Mass Elastic System Diagram
- Torsional Natural Frequencies by the Holzer Method
- Torsional Amplification/PU Factors and Alternating Torque Calculation
- Lateral Natural Frequency Plots from Finite Element Analysis

GENERALIZED SHAFTING



EQUIVALENT MASS/ELASTIC SYSTEM



*NOTE: MASSES AND STIFFNESS WERE DISTRIBUTED TO REPRESENT THE EQUIVALENT SYSTEM.

MASSES	POLAR MOMENT OF INERTIA (LB-FT ²) *	SHAFT TORSIONAL STIFFNESS (IN-LB/RAD) *
1 MOTOR ROTOR	31809	A 1.29E8
2 COUPLING	180	B 9.64E7
3 FLYWHEEL	77743	C 7.03E7
4 COUPLING	200	D 2.17E7
5 COUPLING	298	E 5.48E7
6 COUPLING	188	F 6.39E7
7 IMPELLER	5810	G 0.0

3440

SHAFTING MASS/ELASTIC DIAGRAM
 METRO PUMP STATION II PUMP P-300

DRESSER PUMP DIVISION DRESSER INDUSTRIES, INC.
 TANEBTOWN, MD.

ORDER IP92281 DATE 10-28-91 SCALE N.T.S.

DRAWN	CHECKED	APPROVED	
LMC	MEB	RJC	RY190057 A

METHOD OF ANALYSIS

1. Shafting Torsional Natural Frequencies

When an undamped system is vibrating freely at any one of its natural frequencies, no external force, torque, or moment is necessary to maintain the vibration. Also, the amplitude of the mode shape is immaterial to the vibration. Recognizing these facts, Holzer proposed a method of calculation for the natural frequencies and mode shapes of torsional systems by assuming a frequency and starting with a unit amplitude at one end of the system and progressively calculating the torque and angular displacement to the other end. The frequencies that result in zero external torque or compatible boundary conditions at the other end are the natural frequencies of the system.

Holzer's Procedure for Torsional Systems

Figure 1 shows a torsional system represented by a series of disks connected by shafts. Assuming a frequency ω and amplitude $\Theta_1 = 1$, the inertia torque of the first disk is

$$-J_1\ddot{\Theta}_1 = J_1\omega^2\Theta_1 = J_1\omega^2 \cdot 1$$

where harmonic motion is implied. This torque acts through shaft 1 and twists it by

$$\frac{J_1\omega^2}{K_1} = \Theta_1 - \Theta_2 = 1 - \Theta_2$$

or

$$\Theta_2 = 1 - \frac{J_1\omega^2}{K_1}$$

With Θ_2 known, the inertia torque of the second disk is calculated as $J_2\omega^2\Theta_2$. The sum of the first two inertia torques acts through the shaft K_2 , causing it to twist by

$$\frac{J_1\omega^2 + J_2\omega^2\Theta_2}{K_2} = \Theta_2 - \Theta_3$$

In this manner, the amplitude and torque at every disk can be calculated. The resulting torque at the far end

$$T_{\text{ext}} = \sum_{i=1}^4 J_i\omega^2\Theta_i$$

can then be plotted for the chosen w . By repeating the calculation with other values of w , the natural frequencies are found when $T_{\text{ext}} = 0$.

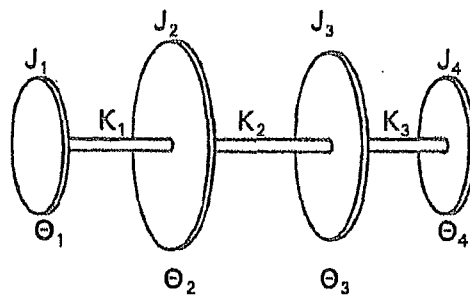


Figure - 1

DRESSER PUMP DIVISION
TANEYTOWN, MD

DRESSER: TP-92281
ORDER NO.

PUMP SIZE: 36 NA-57
CUSTOMER: CITY OF SAN DIEGO
REFERENCE: METRO PUMP STATION II

SHAFT TORSIONAL ANALYSIS
BASED ON HOLZER METHOD

SPAN NO.	POLAR MOMENT OF INERTIA (LB-FT ²)	TORSIONAL STIFFNESS (IN-LB/RAD)
1	31809	1.29E+08
2	180	9.64E+07
3	77743	7.03E+07
4	200	2.17E+07
5	298	5.48E+07
6	188	6.39E+07
7	5810	0

MODE	FREQUENCY (RPM)
1	653
2	795
3	5679

ALL OTHER FREQUENCIES ARE GREATER THAN 10,000 RPM

DRESSER PUMP DIVISION
TANEYTOWN, MD

DRESSER: TP-92281
ORDER NO

PUMP SIZE: 36 NA-57
CUSTOMER: CITY OF SAN DIEGO
VFD VENDOR: NONE
REFERENCE: METRO PUMP STATION II

NO. BLADES 5
BEP GPM 49000

CONDITION POINT DATA

RPM	GPM	TORQUE
502	0	125548
502	53000	277447
502	55000	272329
400	10000	106256

THE FOLLOWING IS TORSIONAL NATURAL FREQUENCY DATA

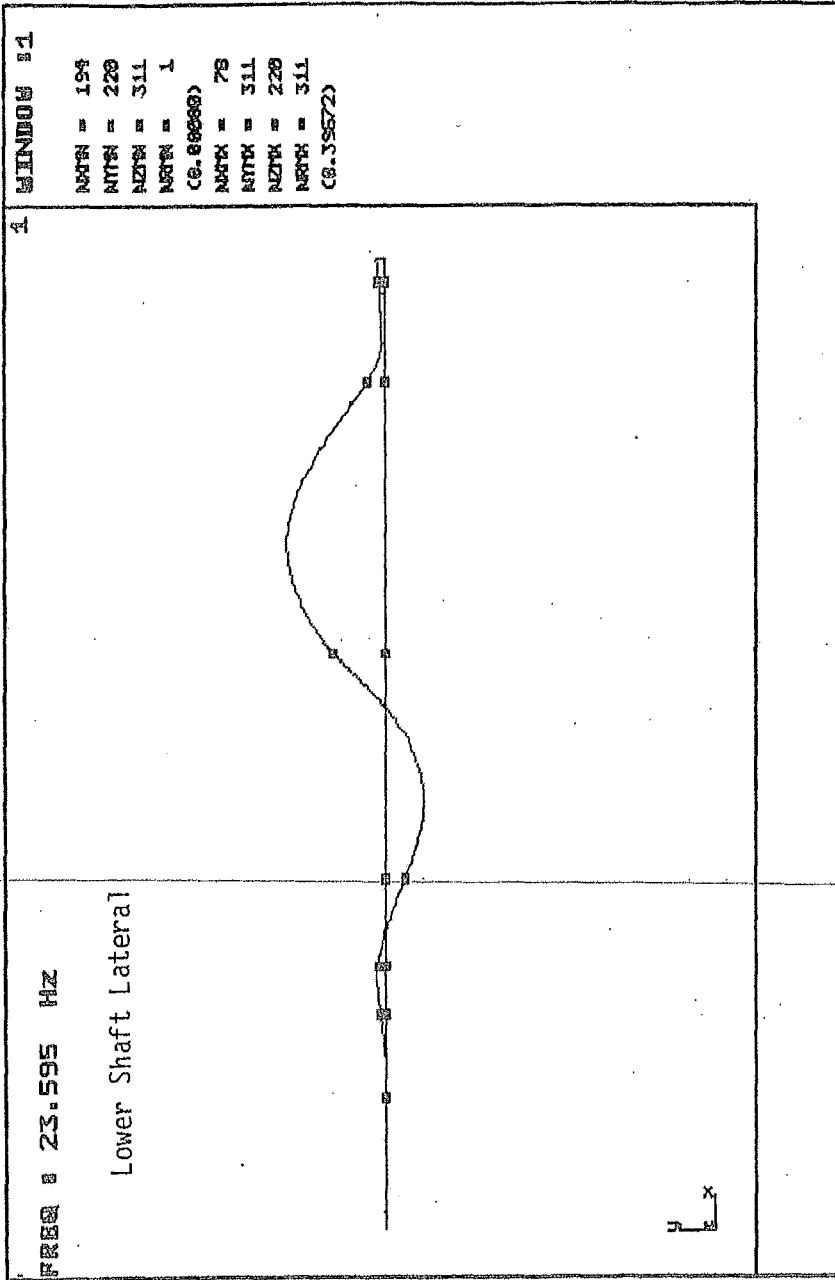
FREQUENCY	AMPLIFICATION FACTOR
653	13.7
795	9.60

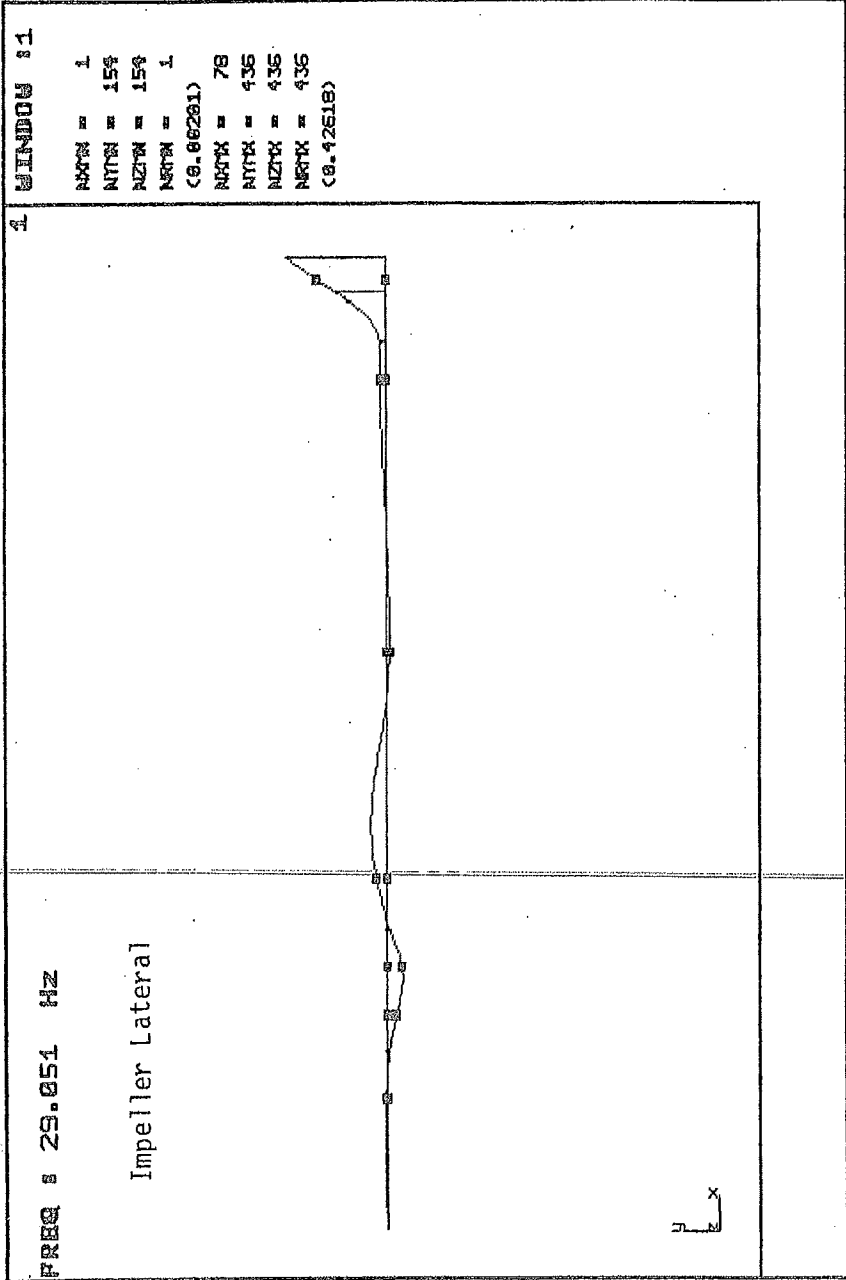
PUMP PU AND AMPLIFICATION FACTORS

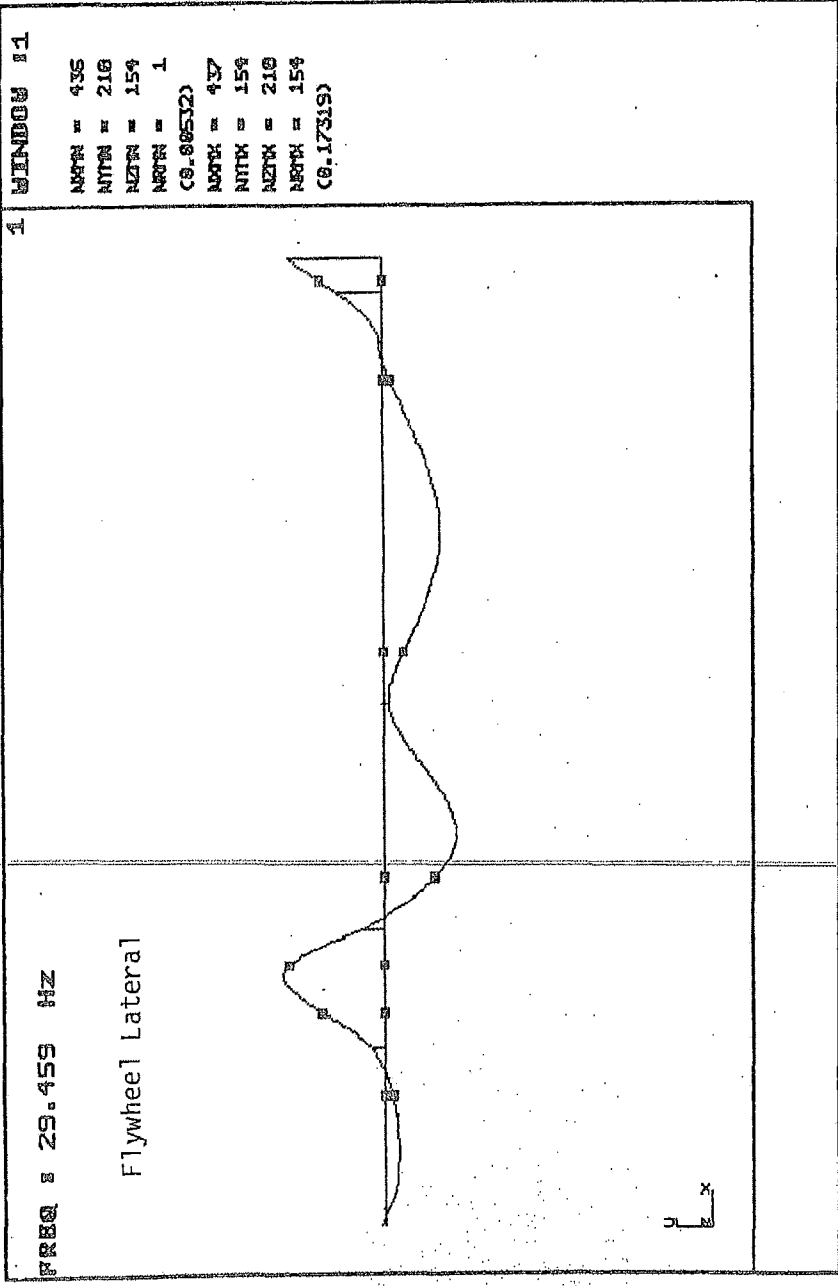
CONDITION	1X		2X		BLADE	
	PU	AMP	PU	AMP	PU	AMP
1	0.100	2.445	0.050	1.681	0.100	1.000
2	0.027	2.445	0.013	1.681	0.027	1.000
3	0.030	2.445	0.015	1.681	0.030	1.000
4	0.080	1.601	0.040	9.600	0.080	1.000

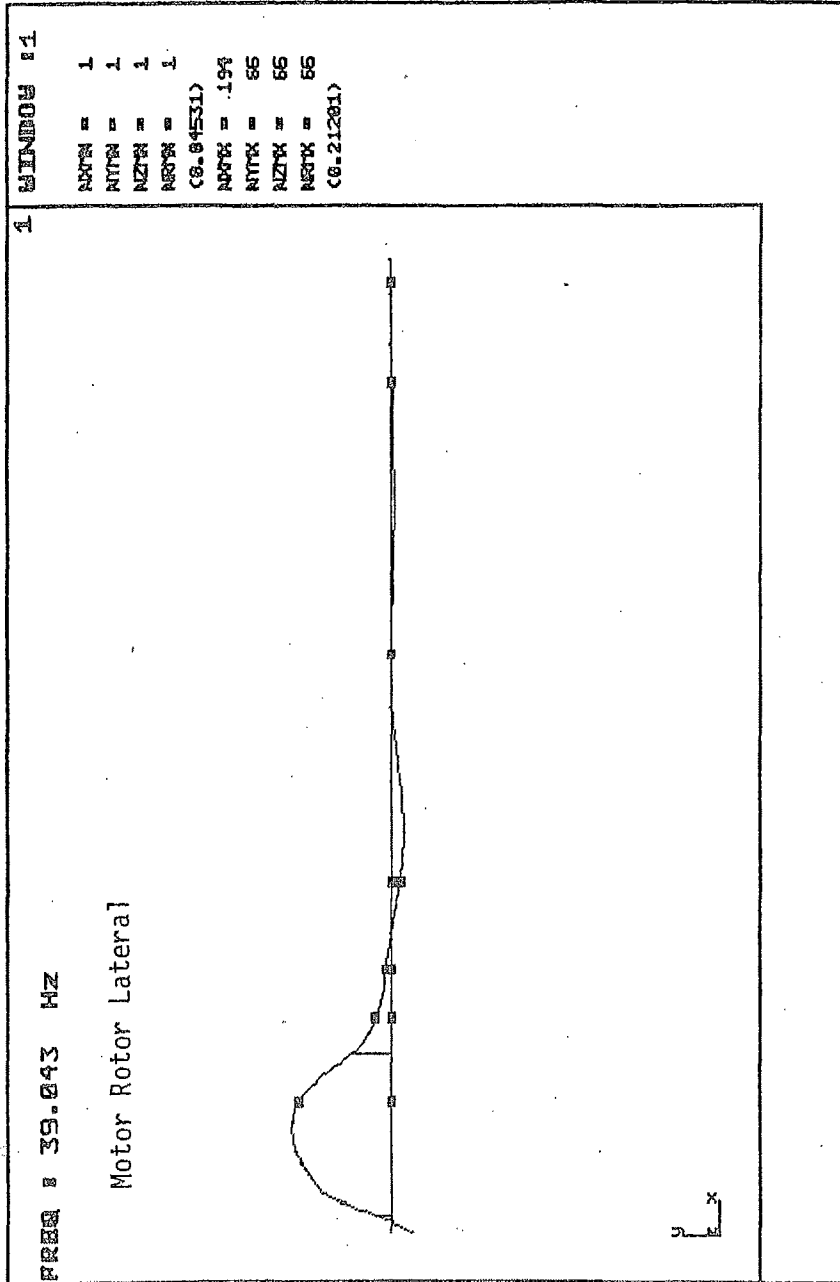
MEAN AND ALTERNATING TORQUE VALUES

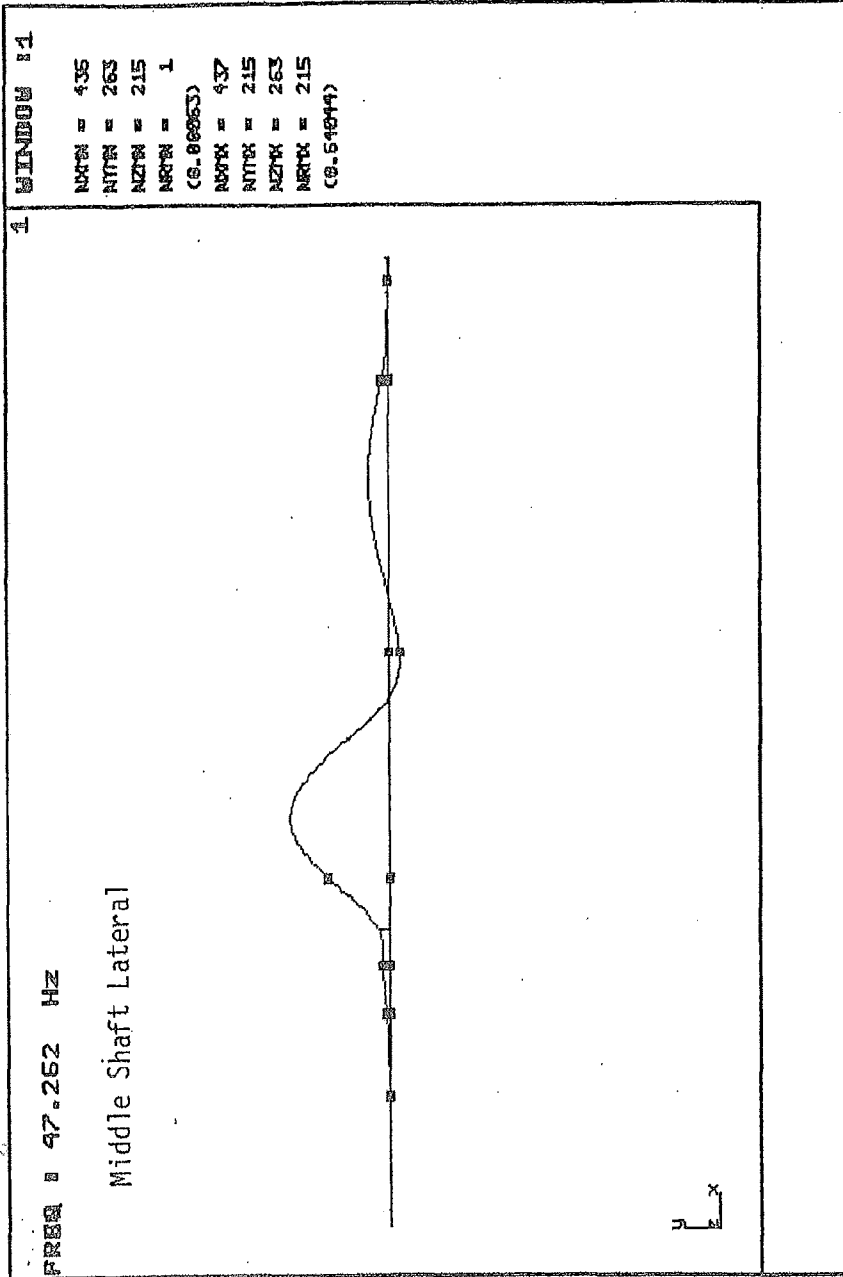
CONDITION	MEAN TORQUE	ALT TORQUE	TOTAL TORQUE
1	125,548.00	49,071.08	174,619.10
2	277,447.00	28,770.23	306,217.20
3	272,329.00	31,715.13	304,044.10
4	106,256.00	61,433.68	167,689.70











APPENDIX B
SHAFT STRESS
and
SHAFT LIFE

- Shaft stress method of calculation
- Shaft life method of calculation
- Shaft stress and shaft life calculation
 - @ Bearing sleeve step
 - @ Shaft sleeve step

SHAFT STRESS

The rotating shaft of a pump is subject both to tensile and shear stresses. The combination of tensile and shear stresses to predict failure by yielding was proposed by M.T. Huber and further developed by R. von Misses and H. Hencky. In this theory, commonly known as the Maximum Distortion Energy Theory, failure by yielding will occur when the distortion energy per unit volume in a state of combined stress is equal to that associated with yielding in a simple tension test. The theory finds experimental support in situations involving ductile materials and plane stress.

For the 2-Dimensional state of stress which exists within the pump shaft the theory reduces to:

σ_C = Combined equivalent stress (psi)

$$= \sqrt{(\sigma_B + \sigma_A)^2 + 3 (\tau_T + \tau_R + \tau_{TALT})^2}$$

σ_M = Combined equivalent mean stress (psi)

$$= \sqrt{\sigma_A^2 + 3 \tau_T^2}$$

σ_{ALT} = Combined equivalent alternating stress (psi)

$$= \sqrt{\sigma_B^2 + 3 (\tau_R + \tau_{TALT})^2}$$

FS = Yield Point Factor of Safety

$$= \frac{\sigma_{YP}}{\sigma_C}$$

where:

σ_B = Axial stress due to bending (psi)

Completely reversed stress through 1 revolution (alternating)

$$= \frac{32 K_B M}{\pi d^3}$$

σ_A = Axial stress due to axial load (psi)

Constant stress through 1 revolution

$$= \frac{4 K_A F_A}{\pi d^2}$$

τ_T = Shear stress due to torque (psi)

Constant stress through 1 revolution

$$= \frac{16 K_T T}{\pi d^3}$$

τ_R = Shear stress due to impeller radial load (psi)

Completely reversed stress through 1 revolution (alternating)

$$= \frac{16 F_R}{3 \pi d^2}$$

τ_{ALT} = Alternating torsional load (psi)

(See Torsional Amplification Factors)

$$= \sqrt{\sum (1.41 P_U A_{MP})^2 \tau_T}$$

F_R = Impeller radial load (lb)

F_A = Axial load (lb)

T = Steady state torque (in-lb)

M = Moment due to impeller radial load (in-lb)

d = Shaft diameter (in)

K_A = Stress concentration factor, axial

K_B = Stress concentration factor, bending

K_T = Stress concentration factor, torsion

SHAFT LIFE

Pump shafts are subject to both mean and alternating stresses. The mean or steady state stresses, those produced by axial loading and torque, have constant direction through each revolution. The alternating stresses, produced by bending and radial loads, completely reverse direction with a maximum period of one revolution. Most pump shaft failures are fatigue failures caused by the repeated loading and unloading of the alternating stresses at a level usually below the yield point. A pump shaft designed to carry a steady state stress with a liberal margin of safety may still fail in fatigue.

The shafting tensile and shear stresses may be broken down into the steady state and alternating stresses and then combined according to the Maximum Distortion Energy Theory; see Shaft Stress. The alternating stress is then plotted against the mean stress and a fatigue failure theory applied. Experience has shown that for steel the Soderberg and Goodman relations are the most reliable for predicting fatigue failure. The relations are:

$$1 = \frac{\sigma_{ALT}}{\sigma_e} + \frac{\sigma_M}{\sigma_U} \quad \text{Goodman}$$

$$1 = \frac{\sigma_{ALT}}{\sigma_e} + \frac{\sigma_M}{\sigma_{YP}} \quad \text{Soderberg}$$

where:

σ_{ALT} = Alternating Stress
(see Shaft Stress)

σ_M = Mean Stress
(see Shaft Stress)

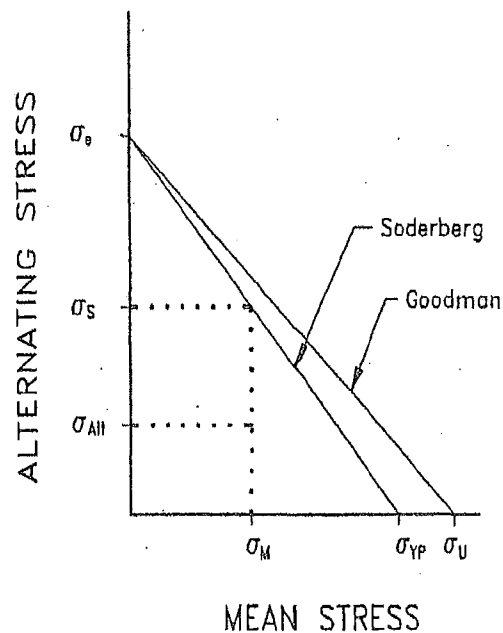
σ_e = Endurance Limit

σ_{YP} = Yield Strength

σ_U = Ultimate Strength

FS = Fatigue Factor of Safety

$$= \frac{\sigma_s}{\sigma_{ALT}} = \frac{\sigma_e}{\sigma_{ALT} \sigma_{YP}} (\sigma_{YP} - \sigma_M)$$



Note that both the Soderberg and Goodman relations define a straight line. Any intersection of σ_{ALT} with σ_M below each line will produce infinite shaft life. The Soderberg relation is based on Yield strength and the Goodman relation is based on Ultimate strength. The Soderberg relation will always yield a more conservative result and we have therefore used the Soderberg relation.

Note that the Fatigue Factor of Safety is the ratio of σ_s to σ_{ALT} and is used to define a measure of confidence. The Soderberg relation is empirical in nature and actual shaft life will vary.

DRESSER PUMP DIVISION
DRESSER INDUSTRIES INCORPORATED

SHAFT STRESS CALCULATIONS
MAXIMUM DISTORTION ENERGY THEORY and SODERBERG CRITERIA

DRESSER ORDER NO : TP-92281
CUSTOMER: CITY OF SAN DIEGO

CALCULATIONS ARE FOR BEARING SLEEVE STEP

SHAFT DIAMETER(in)= 7.37

STRESS CONCENTRATION FACTORS

AXIAL 2
BENDING 2.4
TORSIONAL 1.5

MATERIAL IS ASTM-A668 CLASS E

YIELD STRENGTH(psi)= 43000
ULTIMATE STRENGTH(psi)= 83000
ENDURANCE LIMIT(psi)= 29000

CONDITION	TORQUE (in-lb)	MOMENT (in-lb)	AXIAL (lb)	RADIAL (lb)	ALTERNATING TORQUE (in-lb)
1	125548	495864	15818	13822	49071
2	277447	80647	3844	2248	28770
3	272329	76342	2880	2128	31715
4	106256	288901	10407	8053	61443

CONDITION	BENDING STRESS (psi)	AXIAL STRESS (psi)	TORSIONAL SHEAR STRESS (psi)	RADIAL SHEAR STRESS (psi)	ALTERNATING TORSIONAL SHEAR STRESS (psi)
1	30281	742	2396	432	936
2	4925	180	5295	70	549
3	4662	135	5197	67	605
4	17642	488	2028	252	1173

CONDITION	TOTAL STRESS (psi)	MEAN STRESS (psi)	ALTERNATING STRESS (psi)
1	31700	4216	30374
2	11445	9172	5040
3	11240	9002	4805
4	19091	3546	17814

CONDITION	YIELD FACTOR OF SAFETY	ENDURANCE FACTOR OF SAFETY
1	1.4	.9
2	3.8	4.5
3	3.8	4.8
4	2.3	1.5

DRESSER PUMP DIVISION
DRESSER INDUSTRIES INCORPORATED

SHAFT STRESS CALCULATIONS
MAXIMUM DISTORTION ENERGY THEORY and SODERBERG CRITERIA

DRESSER ORDER NO : TP-92281
CUSTOMER: CITY OF SAN DIEGO

CALCULATIONS ARE FOR SHAFT SLEEVE STEP

SHAFT DIAMETER(in)= 7.19

STRESS CONCENTRATION FACTORS

AXIAL 2.05
BENDING 2.5
TORSIONAL 1.5

MATERIAL IS ASTM-A668 CLASS E

YIELD STRENGTH(psi)= 43000
ULTIMATE STRENGTH(psi)= 83000
ENDURANCE LIMIT(psi)= 29000

CONDITION	TORQUE (in-lb)	MOMENT (in-lb)	AXIAL (lb)	RADIAL (lb)	ALTERNATING TORQUE (in-lb)
1	125548	362966	15818	13822	49071
2	277447	59032	3844	2248	28770
3	272329	55881	2880	2128	31715
4	106256	211472	10407	8053	61443

CONDITION	BENDING STRESS (psi)	AXIAL STRESS (psi)	TORSIONAL SHEAR STRESS (psi)	RADIAL SHEAR STRESS (psi)	ALTERNATING TORSIONAL SHEAR STRESS (psi)
1	24867	799	2580	454	1009
2	4044	194	5702	74	591
3	3828	145	5597	70	652
4	14488	525	2184	264	1263

CONDITION	TOTAL STRESS (psi)	MEAN STRESS (psi)	ALTERNATING STRESS (psi)
1	26604	4540	24995
2	11815	9879	4205
3	11644	9696	4027
4	16332	3819	14727

CONDITION	YIELD FACTOR OF SAFETY	ENDURANCE FACTOR OF SAFETY
1	1.6	1
2	3.6	5.3
3	3.7	5.6
4	2.6	1.8

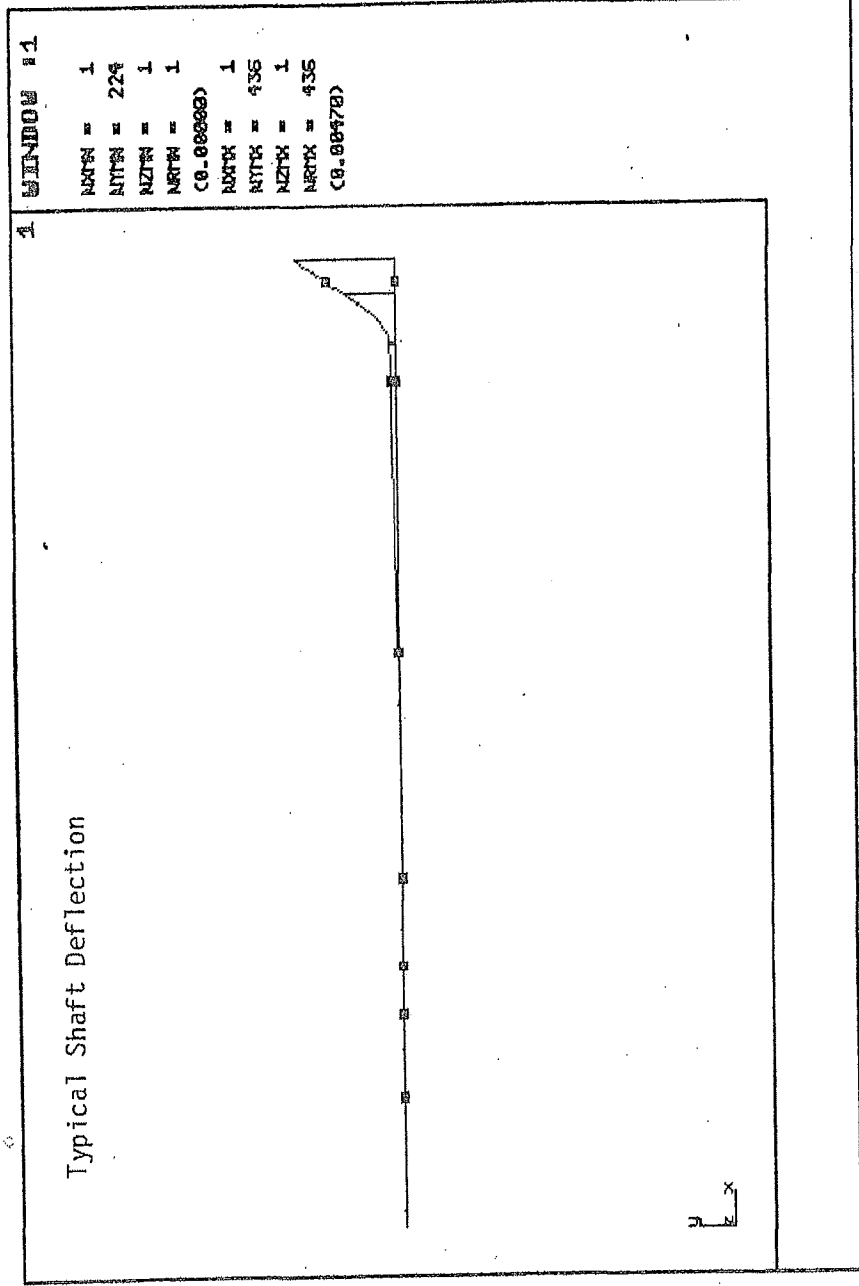
APPENDIX C

SHAFT DEFLECTION CALCULATION

- Shaft deflection plot from FEA
- Impeller centerline deflection

The following was used to simplify the FEA model:

- Bearings were modeled as point support with a radial stiffness of $2.8E6$ lb/in.
- Motor and line bearings were considered self aligning and act as a simple support.
- The pump bearing is rigid and a zero slope was taken through its center.
- Wearing ring stiffness was assumed to be 36000 lb/in.



CONDITION of SERVICE	IMPELLER RADIAL LOAD(lbs)	IMPELLER CENTERLINE DEFLECTION (mils)
SHUT OFF 0 GPM, 229' TDH	13822	40.1
OPERATING 53000 GPM, 141.5' TDH	2248	6.7
RUNOUT 55000 GPM, 134' TDH	2128	6.3
REDUCED SPEED (400 RPM) 10000 GPM, 137' TDH	8053	23.8

SHAFT DEFLECTIONS AT CENTERLINE OF IMPELLER

APPENDIX D

IMPELLER HYDRAULIC LOAD CALCULATIONS

- Impeller Radial load
- Impeller Axial Load
- Torque and Moment

Impeller Radial Load

TP92281
36 NA-57
10-24-91 RAC

$$Fr = \frac{K \cdot H \cdot W \cdot D_E}{2.31}$$

W = width of impeller including shrouds
= 6.78"

D_E = Impeller diameter
= 54.12

H = Total Discharge Head (feet)

$$K = K_{SO} \left[1 - \left(\frac{Q}{Q_n} \right)^x \right]$$

$$\begin{aligned} X &= \frac{N_s}{1154} + .2667 \\ &= \frac{2632}{1154} + .2667 \\ &= 2.55 \end{aligned}$$

Q = GPM

Q_n = GPM @ BEP
= 49000

$$N_s = \frac{502 \cdot 49000^{.75}}{(147)^{.75}} = 2632$$

K_{SO} = .38

Condition	HD	GPM	K	Fr
Shut off	229	0	.38	13822
Design	141.5	53000	.08 (.25)	2248
Element	134	55,000	.08 (.25)	2128
Reduced	137	10000	.37	8053

Impeller Axial Load

TP 92281
36 NA-57
10-22-91 Rykonin

Axial Thrust = Static Weight + Hydraulic Thrust

at Brq Step and Sleeve Step

$$\begin{aligned} \text{Static weight} &= \text{Impeller} + \frac{1}{2} \text{ Pump shaft} \\ &= 2600 + 375 \\ S_w &= 2975 \# \end{aligned}$$

Hydraulic Thrust

$$H_T = (D_r^2 - D_s^2) \frac{\pi}{4} \cdot \frac{HD(z)}{2.31} - \frac{Q^2}{566 D_e^2} \quad \oplus \text{ indicates down thrust}$$

$$\begin{aligned} D_r &= \text{OD Impeller Ring} = 29.88'' \\ D_s &= \text{OD Shaft Sleeve} = 8.25'' \\ D_e &= \text{Impeller Eye Diameter} = 26.50'' \end{aligned}$$

$$H_T = \frac{(29.88^2 - 8.25^2) \pi \cdot HD(z)}{4 (2.31)} - \frac{Q^2}{566 (26.5)^2}$$

$$H_T = 56.083 HD - \frac{Q^2}{397494}$$

Condition	HD	GPM	H _T	S _w	A _T
Shut off	229	0	12843	2975	15818
Design	141.5	53000	869	2975	3844
Run out	134	55000	-95	2975	2880
Reduced	137	70000	7431	2975	10407

Torque & Moment

TP92281
36 NA-57
11-8-91 RyCrown

$$T = \frac{63025 \cdot HP}{RPM}$$

$$HP = \frac{TDH \cdot GPM}{3960 \cdot \eta}$$

Condition	GPM	HD	η	HP	RPM	Torque
Shut off	0	229	0	1000	502	125548
Design	53000	141.5	86	2210	502	277447
Runout	55000	134	85.8	2169	502	272329
Reduced	10000 (12550)	137 (221)	51	674	400	106256

$$M_{Brq \text{ Step}} = R_L * 35.875 \quad \& \text{ Imp to Brq Step} = 35.875$$

$$M_{Sleeve \text{ Step}} = R_L * 25.26 \quad \& \text{ Imp to Slv Step} = 25.26$$

Condition	R_L	M_{Brq}	M_{Sleeve}
Shut off	13822	495864	349144
Design	2248	80647	56784
Run out	2128	76342	53753
Reduced	8053	288901	203419

City of San Diego

CITY CONTACT: Michelle Muñoz, Contract Specialist, Email: MichelleM@sandiego.gov

PHONE No. (619) 533-3482, Fax No. (619) 533-3633

ADDENDUM "A"

e - Bidding FOR



PUMP STATION 2 POWER RELIABILITY AND SURGE PROTECTION

BID NO.:	K-17-1456-DBB-3
SAP NO. (WBS/IO/CC):	S-00312
CLIENT DEPARTMENT:	2012
COUNCIL DISTRICT:	2
PROJECT TYPE:	BP

BID DUE DATE:

**2:00 PM
DECEMBER 6, 2016
CITY OF SAN DIEGO
PUBLIC WORKS CONTRACTS
1010 SECOND AVENUE, 14th FLOOR, MS 614C
SAN DIEGO, CA 92101**

ENGINEER OF WORK

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

Eric Lovering 10/21/2016 Seal:
1) Registered Engineer/Architect Date



[Signature] 10/24/16 Seal
2) For City Engineer 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.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

B. BIDDER'S QUESTIONS

- Q1. The MBE and WBE subcontractor percentages vary between the Notice Inviting Bids, Section 7.1 and Attachment D - Funding Agency Provisions, Section 1.1.
- A1. The Environmental Protection Agency (EPA) has **subcontracting fair share objectives** that are outlined beginning on page 5 Notice Inviting Bids, of Section 7, Subcontracting Participation Percentages, and detailed in sub-section-7.1.
- Q2. Please clarify the correct minimum subcontractor percentages for MBE and WBE participation.
- A2. The minority and female participation goals listed in Section 1 of the Funding Agency Provisions refer to the **contractor's aggregate work force** in each trade on all construction work in the covered area.
- Q3. Which section of the GFE is correct per the bidding documents? Section 11.1 mentions that a minimum of 30 days of solicitation are required before the bid or proposal closing date. Section 11.1.5 states that 15 working days are required before bid date. If 30 days are required, we request a bid extension to meet all GFE requirements.
- A3. Solicitation is 15 Working Days. Refer to this Addendum, Section C - Attachments, Item 1, page 15.
- Q4. Please provide scaled drawing showing maximum dimensions/space available for the 2,500 kW resistive only MV load bank along with adjacent building or fence locations. General location was indicated during the pre-bid meeting.
- A4. Per Specification 16450, 2.3,A,1. "the general arrangement of the equipment is shown on the Drawings. The load bank lineup shall not be greater than the specified dimensions shown on the Drawings." Per scaled contract drawing E-3, the load bank dimensions are approximately 20 feet long by 8 feet wide, and it shows the orientation of the load bank relative to the site. Per contract drawing E-3, the load bank is approximately 6 feet in front of the 3 feet wide door on the west wall of Pump Station No. 2. The load bank is also oriented, so it shall not block access to the roll up door on the west wall of Pump Station No. 2.

- Q5. Looking at the drawings and call outs for CA ISO and or SDG&E Net metering devices to be included in Switchgear #3 (refer to 7E-8 and 7E-9). SDG&E typically has required visible disconnects and standard PT's and CT's in customer supplied metering cubicles. The new lineup appears to call out meter sockets in standard 36 inch cubicles. Has SDG&E approved similar configurations in medium voltage applications using meter sockets without manual and visible disconnects? The standard SDG&E metering section are wider than 36 inch and will increase the overall length of the new switchgear. Drawing E-9 calls out "ISO Net Metering" which is functioning as a gross power meter for the natural gas units. Is it correct that both ISO metering and SDG&E metering standards are required to be met with the proposed equipment.
- A5. Per Specification 16300, 2.3 MAIN SERVICE SWITCHGEAR. C.; "Metering Section: The metering section shall comply with all utility requirements." Per contract drawing 7E-8 keyed note 2, the Contractor shall submit Switchgear No. 3 for approval by the Engineer and SDG&E to comply with Rule 21 for Net Metering. SDG&E's Meter Sections shall meet SDG&E's standards, be fully equipped with all required apparatus, and ready for SDG&E to plug in their meter. Per contract drawing 7E-8 keyed notes 3 and 4 respectively for each SDG&E ISO Meter, City Staff shall provide safety isolation by opening and locking out indicated breakers during SDG&E maintenance of meter sections. The safety isolation by opening and locking out/tagging out the indicated breakers meets the intent of the visible disconnects. The indicated breakers can also be racked out to provide additional visible disconnects. Consultant is not aware of any SDG&E approved similar configurations in medium voltage applications. Consultant had meetings with SDG&E in regards to the ISO metering in Switchgear No. 3. SDG&E required ISO metering at the natural gas units. At the metering sections, both ISO metering and SDG&E metering standards shall be met.
- Q6. We would like the opportunity to bid Florock Resinous Flooring as an equal to the products specified for the above named project (see Subject). Section 09780 - TROWELED EPOXY FLOORING, Please advise where and to whom I can send a submittal packet for approval.
- A6. Submit to the City to provide to the Engineer for review and consideration, Shall follow (SSP) 4-1.6 Trade Names or Equals on Substitutions and will be reviewed for consideration.

- Q7. Ref Appendix A2 5.A1. The specification calls for synchronization controls to be done via data provided over Modbus network from protective relaying at each breaker. Typical protective relaying devices though they operate very quickly to protect equipment can have significant latency time for updating their Modbus register list. Based on our experience this can be as much as 1 second which is not reliable for synchronizing and load controls. Maximum tolerance for latency is 100ms. If 100ms latency cannot be guaranteed then direct connection to the VT, CT, and breaker control circuits for all generator main breakers, tie breakers, and utility main breakers in SWG-1, SWG-2, and SWG-3 is recommended. Please confirm that this approach will be acceptable.
- A7. Per Drawings 7E-10 and 7E-11, synchronization will only be done at the feeder breaker FMR and generator breaker FMR. The command to close the breaker will be sent via the Modbus network to the FMR, but the command via Modbus will only initiate the close sequence of the breaker. The FMR will be the only device to directly control when to close the breaker. Refer to Keyed Note 1 on Drawing 7E-11 for generator control information. Per Drawings I-2, I-3, and I-4; the generator PLCs and breaker FMRs are located on the device-to-device fast baud rate network. In regards to the device-to-device fast baud rate network per Keyed Note 3 on Drawing I-2, the devices have a high baud rate and the communications are required to be guaranteed at less than 50ms.
- Q8. Ref Appendix A2 5.A1. In order to minimize field wiring between SWG-1 and SWG-2 and the generator paralleling controls, the proposed design from Caterpillar will include an option of installing remote I/O modules and power transducers in the existing SWG-1 and SWG-2 switchgear. Please confirm that this approach will be acceptable.
- A8. Installing remote I/O modules and power transducers in existing SWG-1 and SWG-2 is not part of the design. A complete submittal will need to be provided for review and consideration.
- Q9. Ref Appendix A2 General Description, page 13300-A2-7, drawings 7E-8 and 7E-9. Net metering required for natural gas generator sets in the SWG-3 switchgear and provisions required for future net metering of the diesel generator sets. Size of metering sections show in switchgear must be confirmed with SDG&E. This could impact the overall footprint of the switchgear. Please provide SDG&E contact information for coordination of the required net metering cubicle. (previous RFI was submitted)
- A9. The SDG&E contact is Steve Kussman, Senior Customer Project Planner, skussman@semprautilities.com, Office: 858-636-3918.

- Q10. Ref Appendix A2-16.1 and drawing E7-30. 125 VDC control power for the switchgear and controls will be provided from UPS082. Please confirm that separate battery and charger is not required for SWG-3 to provide a redundant 125 VDC source.
- A10. A separate battery and charger is not required for SWG-3 to provide a redundant 125 VDC source
- Q11. Our interpretation of the SOO is the DCS is in control of the transfer to emergency. Once the DCS is in emergency the new closed transition panel will take control and perform the function of the closed transition back to utility. We need to know the status of each of the breakers during the initial transition to verify we have the correct safety components in place. Please send us the sequence of op's for the transition to emergency that includes what controls breakers M-1/M-2/M-T during that transition. Can we get a clarification on the sequence of op's for the transition to emergency during a power outage
- A11. The DCS initiates the sequence of operation for transition to emergency.
- Q12. Is there a plan for the closed transition panel to be used for a closed transition to generator for maintenance and/or testing? If so, what is the preferred sequence of op's for that transition?
- A12. Maintenance and/or testing will be initiated from the DCS.
- Q13. Please confirm that the City of San Diego will sign as generator for disposal of any existing hazardous material encountered on the project, including lead based paint.
- A13. Per Section 02050 Demolition,1.6,A.; "The OWNER is responsible for the removal and disposal of any asbestos found in structures scheduled for demolition, prior to commencement of demolition work by the CONTRACTOR." The City will sign as generator for disposal of any existing hazardous material encountered on the project including lead based paint.
- Q14. The number of bid items in PlanetBids does not match the bid items in specification section 01025 - Measurement and Payment. Please clarify the number of bid items, and provide a bid form. In addition, please provide all other bid documents that are required to be submitted.
- A14. PlanetBids includes the bid items described in Section 01025. Additional bid items are described in City Whitebook or Standard Special provisions (SSP).

- Q15. As per Note 23 on drawing A-2, it is the General Contractor's full responsibility to examine the site and the conditions prior to submitting a bid. As a result, please provide a schedule for optional site visits as needed up to the bid date.
- A15. Dates will be announced for additional site visits.
- Q16. As per specification section 11175, 2.1 (A), pumping equipment shall comply with "the detailed pump specification". There are no detailed pump specifications to be found. Please clarify which specification section this is in reference to.
- A16. Section 11175 consists of 27 pages. All pumps shall meet these specifications.
- Q17. Drawing D-1, Note 21 states that the "Return the generators and all associated apparatus to a location TBD within the City of San Diego,"
- a. Please provide an address for location the generators are to be delivered to.
- b. Will the City of San Diego be able to off load the generators at the location or is the Contractor expected to off load the generators at the location?
- A17. a. Location is TBD.
- b. Contractor shall deliver and off load the generators.
- Q18. On drawing 6A-12, Note 19 states that the facility cannot be shut down during construction and demolition. Please clarify which areas in the facility this is in reference to.
- A18. The entire facility cannot be shutdown.
- Q19. Drawing 6S-3 gives the dimensions for the canopy as either 110'-4 1/2" or 102'-2 1/2". Drawing 6A-3 shows the same canopy as 110'-8". Please provide the correct dimensions for the canopy.
- A19. The Architectural drawing is correct. The Structural drawing will be revised in Addendum B to match the Architectural drawing.
- Q20. Drawing S-1, Note S-4 states that all exposed structural steel be hot dipped galvanized and painted per section 09800. Is this correct?
- A20. Yes, correct.

- Q21. Specification Section 03300 3.3 G states When the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes. This is unreasonable. The contractor will be required to order short loads in order to empty the trucks within this time frame. This will add substantial cost to the job. We ask that the specification be revised to 90 minutes in lieu of the 45 minutes listed.
- A21. The Engineer will consider if the Contractor shows full compliance with ASTM C94.
- Q22. Drawing 1S-1 Note 1 says to remove the existing gear drive support system. Is it your intent to have the support removed and the new members shown shop fabricated? If this is the case it will not be possible for the contractor to install the support onto the existing anchors. Can the work shown be done with the gear drive support system staying in place and the welding done in the field?
- A22. Drawing shows existing (E) members and new (N) members. New (N) members can be welded in the field.
- Q23. Detail 5/7S-10 requires wire mesh be installed in exterior walls with an architectural finish. This will give a poor finished product as the mesh may be exposed in areas with a 3" depressed architectural feature. It is not uncommon to have more than 2' of unsupported concrete when you have architectural finishes such as shown. Please eliminate the wire mesh shown so that the Owner will have a better looking structurally sound product.
- A23. Mesh shall conform and not be exposed.
- Q24. On Drawing D-1, Note 21 points to a curb area and has the tag "(D) Cable Tray on Ground (Temp)" However Note 21 in Keyed Notes references salvaging the existing generators and delivering them to the City of San Diego. Please clarify.
- A24. Per Keyed Note 21, Contractor shall "salvage and disconnect the (2) 2,000 KW emergency diesel generator sets along with ALL APPARATUS. Return the generators and ALL ASSOCIATED APPARATUS to a ..." The cable tray on ground is considered an apparatus of the generators. All conductors for the generators are also considered an apparatus of the generators.

- Q25. Notes on Drawing D-1 reference demolition of lube oil pipe and tank. What will be the status of the lube oil in the lines and tank when it is time to demolish the system? Will the tank be full, partially full or empty? If empty, would the lines and tank already been flushed and decontaminated? For the fuel tanks associated with the generators to be removed, will they be full, partially full or empty? If empty, would the lines and tank already been flushed and decontaminated?
- A25. The lube oil lines and tank system, and fuel lines and tank system will be fully operational just before being turned over to the Contractor for demolition.
- Q26. Detail 2/6A-11 Blocking Details references detail 4/-. However detail 4 on 6A-11 does not show in wall blocking as shown on detail 2. Please confirm that detail 7/A-8.3 is the correct detail for in wall blocking.
- A26. Yes, 7/A-8.3 is the correct detail.
- Q27. Drawing 7S-1 has a note "2-sack cement sand slurry, see note 5". Note 5 states "Roof mechanical equipment not shown, see mechanical drawings." Please clarify.
- A27. See note 6/7S-5.
- Q28. Drawing 6M-3 shows a new HVAC unit on the roof of the new office space. Installation of the new HVAC unit will require demolition and patching back of the existing roofing material. Please provide specifications on the existing roof.
- A28. See specification 02050.
- Q29. Drawing 7M-2 shows RA and SA lines in the Electrical Switchgear Building. On drawing G-12 in the Piping Schedule, the SA line is indicated to be a sample line, and the RA line does not have a designation. Drawing 6M-1 indicates these systems to be HVAC duct. Please provide specifications for these lines, and clarify if they are intended to be round or square duct.
- A29. In Drawing 7M-2, the RA and SA lines are HVAC duct, not piping. Refer to Drawing 7M-12 for the HVAC duct specifications. Per Drawing 7M-2, the Electrical Switchgear Building HVAC duct is indicated as round duct.
- Q30. Specification Section 02090 3.4.1 states that all employees must have taken a "Lead Related Construction Worker" course and have obtained certification from State CDPH as "worker." Please clarify if this requirement is indeed for all employees working on the project, or only for the employees working on lead removal activities.
- A30. Per Specification Section 02090, 3.1, "this portion of the specification describes procedures and protocols for lead hazard control activities.", so the course and certification applies to only employees working on lead removal activities.

- Q31. Please clarify if medical surveillance as per Specification Section 02090 3.10.1.2 is required for all employees working on the project, or only for the employees working on lead removal activities.
- A31. Per Specification Section 02090, 3.1, "this portion of the specification describes procedures and protocols for lead hazard control activities.", so medical surveillance applies to only employees working on lead removal activities.
- Q32. Is it your intent to have the control joints shown on sheets 7A-3 thru 7A-5 match the vertical construction joints or can construction joints be placed at different locations?
- A32. Contractor shall match as shown on drawings.
- Q33. Specification Section 03300 2.5 A gives a maximum aggregate size of either 1" for all work or 1 ½" for walls greater than 12". The contract drawings sheet S-1 note C3 says the maximum aggregate size for foundations and mass concrete work shall be inch and slabs on grade, walls and all other concrete work shall be ¾". Please clarify which aggregate size and location is correct.
- A33. The specification is correct. The drawing will be revised in Addendum B to match the specification.
- Q34. Drawing C-1: General Notes, Note 1 states "If the City Building Inspector determines non-compliance with any accessibility provisions, a complete and detailed revised plan clearly showing all existing non-complying conditions and the proposed modifications to meet current accessibility requirements (including site plan, floor plans, details, etc.) will be submitted to the department for review and approval."
- a. Please confirm that the revised plans will be developed by the Engineer.
 - b. If the revised plans are to be developed by the Contractor, please confirm that this is considered Extra Work for which a Change Order will be issued.
 - c. Also confirm that the rework required by the revised plans is considered Extra Work for which a Change Order will be issued.
- A34. a. The revised plans will be developed by the City.
- b. Contractor shall notify the Resident Engineer for any requests for Extra Work as described in Section 3 of the Standard Special Provisions.
 - c. The rework required by the revised plans is considered extra work.

- Q35. Drawing A-2: General Notes, Note 24. Please confirm that the intent of this note is that the Contractor notifies the Architect immediately of any conflicts or discrepancies the Contractor may find in its review of the Contract documents. This interpretation is consistent with 2-5.1 of the Greenbook which requires the Contractor" upon discovering any error or omission in the Plans or Specifications, immediately call it to the attention of the Engineer."
- A35. The intent of General Note 24 on Drawing A-2 is a more stringent requirement than Greenbook Section 2-5.1, and the Contractor shall take a more proactive approach to comparing and checking all Contract Documents. City requires the Contractor shall first notify the City Resident Engineer of any conflicts/discrepancies, per 2-5.1.
- Q36. Several notes on the drawings (Drawing C-1: General Notes, Note 1; Drawing A-2: Notes 23, 24, and 25; Drawing 6S-2: Notes 3 and 6 are examples) appear to potentially make the Contractor responsible for design even though this is not a design-build job. As this is a remodel of an existing facility and considering the risk for unforeseen issues inherent in a remodel, either in the design or actual site conditions, would the City consider adding an allowance to the bid items to address this risk and uncertainty? This would avoid having the Contractors carry possibly unnecessary contingencies in their bids to cover this risk and uncertainty. By having an allowance the City would only pay the actual costs required to address the unforeseen issues that actually impact the project.
- A36. No allowance bid item will be added to the Bid items list.
- Q37. Supplementary Special Provisions 3-5.2.5 Dispute Resolution Board. How are the costs apportioned for a Dispute Resolution Board? Is it similar to 3-5.2.2 Mandatory Mediation Costs? Please clarify.
- A37. If such costs apply, then would be as stated in 3-5.2.2
- Q38. Bid Item #2 - Special Inspection
- a. Please confirm that Bid Item #2 is the "Inspection Paid For By the Contractor" referenced in Whitebook section 4-1.3.4.1 Payment.
 - b. Please clarify documentation required to be submitted in order for the Contractor to be reimbursed under this bid item.
 - c. Please confirm that this bid item covers all costs for special inspection required to be paid by the Contractor per Drawing S-2 (4-1.3.4.2 Supplementary Special Provisions)
 - d. Please confirm that markups per Whitebook 3-3.2.3 apply to costs incurred for Special Inspection.
-
- A38. a. Special inspection confirmed as stated.
- b. Payment shall be as described in Section 9.
 - c. Bid item covers bid item as required and compensation per allowance provided.
 - d. Markups referenced in 3-3.2.3 are under Section 3 "Changes in work".

- Q39. Bid Item #3 – Permits
- a. Please confirm this allowance is for all permits, other than the permits the City will obtain (7-5.2, Supplementary Special Provisions).
 - b. Please clarify documentation required to be submitted in order for the Contractor to be reimbursed under this bid item.
- A39. a. Allowance only for required permits as described in 7-5 in Appendix E of bidding documents.
- b. Shall follow payment procedures for allowances referenced in section 9 in Whitebook.
- Q40. Bid Item #7 – Field Orders
- a. Please confirm the intent of this bid item. Is it to cover the risk for unforeseen issues inherent in a remodel, either in the design or actual site conditions?
 - b. Please confirm that markups per Whitebook 3-3.2.3 apply to costs incurred under this bid item and will be included in the Field Orders.
- A40. a. Yes, at discretion of the R.E. ease of payment for such applicable under Section 3 "changes in work".
- b. This is an allowance at the R.E. discretion of use of payment methods. Mark up will follow as stated in 3-3.2.3 under Section 3 - "changes in work".
- Q41. Bid Item #18, Specification 01025-3.3K – The bid item is listed as a lump sum with no unit price. The referenced specification (01025-3.3K) states "Preset \$1,000,000 budget by the CITY and is to pay SDG&E for the new gas service." Is this bid item supposed to be an allowance item of \$1,000,000? Please clarify.
- A41. This bid item has been corrected to show allowance, as referenced in 01025-3.3K. Please see Section D Additional Changes as part of this addendum.
- Q42. Specification 02140, 3.1.M states "If the laboratory results of the independent assessment of subsurface conditions show contamination levels above what is acceptable, a treatment system shall be provided under the bid allowances in the Bid Schedule." It does not appear that there is a bid item for this in the Bid Schedule. Please clarify.
- A42. Will be provided for and is included in the bid item for Dewatering.

Q43. Whitebook 6-3.2.2 states "1. Unless specified otherwise in the Contract Documents, you shall retain a qualified archaeologist approved by the City's Environmental Analysis Section (EAS)." Please confirm an archaeologist is required for this project.

A43. None at this time.

Q44. Whitebook 6-3.2.2.1 states "1. The full compensation for the Archaeological and Native American monitoring program and report preparation, as prescribed in Contract Appendices, shall be included in the lump sum or linear foot Bid item for "Archaeological and Native American Monitoring Program". Is a bid item for "Archaeological and Native American Monitoring Program" going to be provided or would the costs be compensated under Bid Item #7?

A44. No bid item will be provided. If a case is encountered, will be per Section 3 "Changes in work".

Q45. Whitebook 6-3.2.3 states "1. Unless specified otherwise in the Contract Documents, you shall retain a qualified paleontologist approved by the City's Environmental Analysis Section (EAS)." Please confirm a paleontologist is required for this project.

A45. None at this time.

Q46. Whitebook 6-3.2.3.1 states "1. The full compensation for the paleontological monitoring program and report preparation, as prescribed in Contract Appendices, shall be included in the lump sum or linear feet Bid item for "Paleontological Monitoring Program". Is a bid item for "Paleontological Monitoring Program" going to be provided or would the costs be compensated under Bid Item #7?

A46. No bid item will be provided. If a case is encountered, will be per Section 3 "Changes in work".

Q47. This is another RFI regarding Instruction to Bidders Item No. 19:

- 1) Only One Bid Per Contractor Shall Be Accepted Can a prequalified bidder who also happen to attend the mandatory Site Meeting bid both as a Prime Contractor and Subcontractor (listed by other GC/s)? This will create advantage to the bidder that decided to bid both as a GC and subcontractor.

A47. A firm can bid as a Prime Contractor and a Subcontractor.

C. ATTACHMENTS

1. To Attachment D, Item 9 Wage Rates, pages 35 through 60, **DELETE** in their entirety and **SUBSTITUTE** with pages 15 through 42 of this Addendum.
2. To Attachment D, Item 11 Agency Specific Provisions, Sub-item 11.1. All EPA Funded Contracts, number 7. c), 2., page 69, **DELETE** in its entirety and **SUBSTITUTE** the following:
 2. 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, whenever possible, posting solicitations for bids or proposals for a minimum of 15 Working Days before the bid or proposal closing date.
3. To Attachment E, Supplementary Special Provisions, Technicals, page 993, Section 15400 – Plumbing, Part 2 – Products, Sub-part 2.13, Valves, Item B., **DELETE** in its entirety and **SUBSTITUTE** the following:
 - B. All shut-off valves: Ball valves 2 inch and smaller with Teflon seats and full port ball, 125# SWP 200# WOG with solder ends. Gate Valves 2 in. and 3 in. bronze, NRS, 125# SWP) 200# WOB with threaded ends.

D. ADDITIONAL CHANGES

The following are changes in the **Line Items Tab** in **PlanetBids**:

For clarity where applicable, **ADDITIONS**, if any, have been **Underlined** and **DELETIONS**, if any, have been **Stricken-out**.

Section	Item Code	Item Description	UOM	QTY	Reference	Unit Price
Main Bid	23821	SDG&E – New Line/Coord (EOC Type I)	LS AL	1	1025-3.3K	<u>\$1,000,000.00</u>

James Nagelvoort, Director
Public Works Department

Dated: *October 24, 2016*
San Diego, California

JN/JB/egz

9. **Wage Rates:** This contract shall be subject to the following Davis-Bacon Wage Decisions:

General Decision Number: CA160001 10/21/2016 CA1

Superseded General Decision Number: CA20150001

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 \$10.15 for calendar year 2016 applies to all contracts subject to the Davis-Bacon Act for which the 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 \$10.15 (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 2016. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/08/2016
1	02/12/2016
2	02/19/2016
3	02/26/2016
4	03/04/2016
5	03/18/2016
6	07/01/2016
7	07/08/2016
8	07/22/2016
9	08/12/2016
10	08/26/2016
11	09/16/2016
12	10/21/2016

* ASBE0005-002 07/04/2016

	Rates	Fringes
Asbestos Workers/Insulator (Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems).....	\$ 38.37	20.13
Fire Stop Technician (Application of Firestopping Materials for wall openings and penetrations in walls, floors, ceilings and curtain walls).....	\$ 26.15	17.31

* ASBE0005-004 07/04/2016

	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)....	\$ 18.38	10.82

BOIL0092-003 10/01/2012

	Rates	Fringes
BOILERMAKER.....	\$ 41.17	28.27

BRCA0004-008 11/01/2015

	Rates	Fringes
BRICKLAYER; MARBLE SETTER.....	\$ 34.44	17.21

* BRCA0018-004 06/01/2016

	Rates	Fringes
MARBLE FINISHER.....	\$ 28.45	11.38
TILE FINISHER.....	\$ 24.53	4.19
TILE LAYER.....	\$ 35.89	8.55

BRCA0018-010 09/01/2013

	Rates	Fringes
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TERRAZZO FINISHER.....	\$ 26.59	10.34
TERRAZZO WORKER/SETTER.....	\$ 33.63	11.13

CARP0409-002 07/01/2008

	Rates	Fringes
Diver		
(1) Wet.....	\$ 663.68	9.82
(2) Standby.....	\$ 331.84	9.82
(3) Tender.....	\$ 323.84	9.82
(4) Assistant Tender.....	\$ 299.84	9.82

Amounts in "Rates" column are per day

CARP0409-008 08/01/2010

	Rates	Fringes
Modular Furniture Installer.....	\$ 17.00	7.41

CARP0547-001 07/01/2009

	Rates	Fringes
CARPENTER		
(1) Bridge.....	\$ 37.28	10.58
(2) Commercial Building....	\$ 32.30	10.58
(3) Heavy & Highway.....	\$ 37.15	10.58
(4) Residential Carpenter..	\$ 25.84	10.58
(5) Residential		
Insulation Installer.....	\$ 18.00	8.16
MILLWRIGHT.....	\$ 37.65	10.58
PILEDRIVERMAN.....	\$ 37.28	10.58

CARP0547-002 07/01/2009

	Rates	Fringes
Drywall		
(1) Work on wood framed construction of single family residences, apartments or condominiums under four stories		
Drywall Installer/Lather...	\$ 21.00	8.58
Drywall Stocker/Scrapper...	\$ 11.00	6.67
(2) All other work		
Drywall Installer/Lather...	\$ 27.35	9.58
Drywall Stocker/Scrapper...	\$ 11.00	6.67

ELEC0569-001 08/31/2015

	Rates	Fringes
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Electricians (Tunnel Work)		
Cable Splicer.....	\$ 46.88	13.54
Electrician.....	\$ 46.13	13.51
Electricians: (All Other Work, Including 4 Stories Residential)		
Cable Splicer.....	\$ 41.75	13.38
Electrician.....	\$ 41.00	13.36

 * ELEC0569-004 06/01/2015

	Rates	Fringes
ELECTRICIAN (Sound & Communications Sound Technician).....	\$ 29.55	11.92
SOUND TECHNICIAN: Terminating, operating and performing final check-out		

 ELEC0569-005 06/06/2016

	Rates	Fringes
Sound & Communications Sound Technician.....	\$ 30.22	12.21
SOUND TECHNICIAN: Terminating, operating and performing final check-out		

 ELEC0569-006 10/05/2015

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.....	\$ 29.50	8.31
Utility Technician #2.....	\$ 24.65	8.16

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 06/06/2016

	Rates	Fringes
ELECTRICIAN (Residential, 1-3 Stories).....	\$ 31.69	3%+6.61

 ELEC1245-001 06/01/2015

	Rates	Fringes
LINE CONSTRUCTION		
(1) Lineman; Cable splicer..	\$ 52.85	15.53
(2) Equipment specialist (operates crawler tractors, commercial motor vehicles, backhoes, trenchers, cranes (50 tons and below), overhead & underground distribution line equipment).....	\$ 42.21	14.32
(3) Groundman.....	\$ 32.28	14.03
(4) Powderman.....	\$ 47.19	14.60

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

 ELEV0018-001 01/01/2015

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 49.90	28.38

FOOTNOTE:

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.
 PAID HOLIDAYS: New Years Day, Memorial Day, Independence Day,
 Labor Day, Veterans Day, Thanksgiving Day, Friday after
 Thanksgiving, and Christmas Day.

 ENGI0012-003 07/01/2016

	Rates	Fringes
OPERATOR: Power Equipment (All Other Work)		

GROUP 1	.....\$ 39.95	23.35
GROUP 2	.....\$ 40.73	23.35
GROUP 3	.....\$ 41.02	23.35
GROUP 4	.....\$ 42.51	23.35
GROUP 5	.....\$ 41.86	23.35
GROUP 6	.....\$ 41.83	23.35
GROUP 8	.....\$ 42.84	23.35
GROUP 9	.....\$ 42.19	23.35
GROUP 10	.....\$ 42.96	23.35
GROUP 11	.....\$ 42.31	23.35
GROUP 12	.....\$ 43.13	23.35
GROUP 13	.....\$ 43.23	23.35
GROUP 14	.....\$ 43.26	23.35
GROUP 15	.....\$ 43.34	23.35
GROUP 16	.....\$ 43.46	23.35
GROUP 17	.....\$ 43.63	23.35
GROUP 18	.....\$ 43.73	23.35
GROUP 19	.....\$ 43.84	23.35
GROUP 20	.....\$ 43.96	23.35
GROUP 21	.....\$ 44.13	23.35
GROUP 22	.....\$ 44.23	23.35
GROUP 23	.....\$ 44.34	23.35
GROUP 24	.....\$ 44.46	23.35
GROUP 25	.....\$ 44.63	23.35

OPERATOR: Power Equipment
(Cranes, Piledriving &
Hoisting)

GROUP 1	.....\$ 43.20	22.15
GROUP 2	.....\$ 43.98	22.15
GROUP 3	.....\$ 44.27	22.15
GROUP 4	.....\$ 44.41	22.15
GROUP 5	.....\$ 44.63	22.15
GROUP 6	.....\$ 44.74	22.15
GROUP 7	.....\$ 44.86	22.15
GROUP 8	.....\$ 45.03	22.15
GROUP 9	.....\$ 45.20	22.15
GROUP 10	.....\$ 46.20	22.15
GROUP 11	.....\$ 47.20	22.15
GROUP 12	.....\$ 48.20	22.15
GROUP 13	.....\$ 49.20	22.15

OPERATOR: Power Equipment
(Tunnel Work)

GROUP 1	.....\$ 41.80	23.35
GROUP 2	.....\$ 42.58	23.35
GROUP 3	.....\$ 42.87	23.35
GROUP 4	.....\$ 43.01	23.35
GROUP 5	.....\$ 43.23	23.35
GROUP 6	.....\$ 43.34	23.35
GROUP 7	.....\$ 43.46	23.35

PREMIUM PAY:

\$3.75 per hour shall be paid on all Power Equipment Operator work on the following 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 bending 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, PILEDIVING 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, 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 which 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 thin 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 08/01/2015

	Rates	Fringes
OPERATOR: Power Equipment		
(DREDGING)		
(1) Leverman.....	\$ 49.50	23.60
(2) Dredge dozer.....	\$ 43.53	23.60
(3) Deckmate.....	\$ 43.42	23.60
(4) Winch operator (stern winch on dredge).....	\$ 42.87	23.60
(5) Fireman-Oiler, Deckhand, Bargeman, Leveehand.....	\$ 42.33	23.60
(6) Barge Mate.....	\$ 42.94	23.60

 IRON0377-002 07/01/2016

	Rates	Fringes
Ironworkers:		
Fence Erector.....	\$ 28.33	20.64
Ornamental, Reinforcing and Structural.....	\$ 34.75	29.20

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 07/18/2016

	Rates	Fringes
LABORER (BUILDING and all other Residential Construction)		
Group 1.....	\$ 29.42	19.78
Group 2.....	\$ 30.10	19.78
Group 3.....	\$ 30.81	19.78
Group 4.....	\$ 31.61	19.78
Group 5.....	\$ 33.54	19.78
LABORER (RESIDENTIAL CONSTRUCTION - See definition below)		
(1) Laborer.....	\$ 27.32	18.11
(2) Cleanup, Landscape, Fencing (Chain Link & Wood).	\$ 26.03	18.11

RESIDENTIAL DEFINITION: Wood or metal frame construction of single family residences, apartments and condominiums - 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 pulling—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 chute 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 (demolition); Guinea chaser; Headboard man-asphalt; 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, multi-plate; Kettlemen, potmen and men 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, vibrating 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 including rubber gasket joints, pointing and any and all other services; Rotary Scarifier or multiple head concrete chipping scarifier; Steel header board man and guideline setter; Tampers, Barko, Wacker and similar type; Trenching machine, handpropelled

GROUP 4: Asphalt raker, luterman, ironer, asphalt 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 operation, 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 powder 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 11/01/2015

	Rates	Fringes
LABORER (MASON TENDER).....	\$ 29.12	15.39

LABO0089-004 07/03/2016

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
Laborers:		
Group 1.....	\$ 30.54	19.73
Group 2.....	\$ 31.00	19.73
Group 3.....	\$ 31.41	19.73
Group 4.....	\$ 32.25	19.73
Group 5.....	\$ 36.37	19.73

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 tracking, 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 01/01/2016

	Rates	Fringes
Asbestos Removal Laborer.....	\$ 30.43	16.07

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.

LABO1184-001 07/04/2016

	Rates	Fringes
Laborers: (HORIZONTAL DIRECTIONAL DRILLING)		
(1) Drilling Crew Laborer...	\$ 33.65	13.95
(2) Vehicle Operator/Hauler.	\$ 33.82	13.95
(3) Horizontal Directional Drill Operator.....	\$ 35.67	13.95
(4) Electronic Tracking Locator.....	\$ 37.67	13.95
Laborers: (STRIPING/SLURRY SEAL)		
GROUP 1.....	\$ 34.86	17.03
GROUP 2.....	\$ 36.16	17.03
GROUP 3.....	\$ 38.17	17.03
GROUP 4.....	\$ 39.91	17.03

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

LABO1414-003 08/03/2016

	Rates	Fringes
LABORER		
PLASTER CLEAN-UP LABORER....	\$ 31.60	19.28
PLASTER TENDER.....	\$ 34.15	19.28

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 07/01/2015

	Rates	Fringes
Painters: (Including Lead Abatement)		
(1) Repaint (excludes San Diego County).....	\$ 27.29	12.83
(2) All Other Work.....	\$ 30.72	12.83

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 10/01/2015

	Rates	Fringes
DRYWALL FINISHER/TAPER		
(1) Building & Heavy Construction.....	\$ 27.84	15.20
(2) Residential Construction (Wood frame apartments, single family homes and multi-duplexes up to and including four stories).....	\$ 21.00	13.91

* PAIN0036-012 10/01/2016

	Rates	Fringes
GLAZIER.....	\$ 41.55	11.93

PAIN0036-019 01/01/2016

	Rates	Fringes
SOFT FLOOR LAYER.....	\$ 26.77	13.53

PLAS0200-005 08/06/2015

	Rates	Fringes
PLASTERER.....	\$ 38.44	13.77

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

PLAS0500-001 07/01/2016

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER		
GROUP 1.....	\$ 23.84	22.85
GROUP 2.....	\$ 25.49	22.85
GROUP 3.....	\$ 27.57	22.85

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 07/01/2016

	Rates	Fringes
PLUMBER, PIPEFITTER, STEAMFITTER		
Camp Pendleton.....	\$ 51.69	21.41
Plumber and Pipefitter 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.....	\$ 47.19	21.41
Work ONLY on new additions and remodeling of commercial buildings, bars, restaurants, and stores not to exceed 5,000 sq. ft. of floor space.....	\$ 45.73	20.43
Work ONLY on strip malls, light commercial, tenant improvement and remodel work.....	\$ 35.69	18.76

 PLUM0016-011 07/01/2016

	Rates	Fringes
PLUMBER/PIPEFITTER		
Residential.....	\$ 38.17	17.33

 PLUM0345-001 07/01/2014

	Rates	Fringes
PLUMBER		
Landscape/Irrigation Fitter..	\$ 29.27	19.75
Sewer & Storm Drain Work....	\$ 33.24	17.13

ROOF0045-001 07/01/2012

	Rates	Fringes
ROOFER.....	\$ 25.08	7.28

SFCA0669-001 04/01/2016

	Rates	Fringes
SPRINKLER FITTER.....	\$ 37.67	19.56

SHEE0206-001 07/01/2015

	Rates	Fringes
SHEET METAL WORKER		
Camp Pendleton.....	\$ 37.55	23.23
Except Camp Pendleton.....	\$ 35.33	23.23
Sheet Metal Technician.....	\$ 25.22	6.69

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

TEAM0036-001 07/06/2015

	Rates	Fringes
Truck drivers:		
GROUP 1.....	\$ 15.40	28.69
GROUP 2.....	\$ 24.99	28.69
GROUP 3.....	\$ 25.19	28.69
GROUP 4.....	\$ 25.39	28.69
GROUP 5.....	\$ 25.59	28.69
GROUP 6.....	\$ 26.09	28.69
GROUP 7.....	\$ 27.59	28.69

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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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

Bid Results for Project Pump Station 2 Power Reliability and Surge Protection (K-17-1456-DBB-3)

Issued on 09/22/2016

Bid Due on December 6, 2016 2:00 PM (Pacific)

Exported on 12/07/2016

VendorID	Company Name	Address	City	ZipCode	Contact	Phone	Fax	Email	Vendor Type
430462	Steve P. Rados, Inc.	2002 E. McFadden Ave., Ste 200	Santa Ana	92705	Sandra Po	714-835-4612	714-835-2186	spo@radoscompanies.com	CAU,CADIR,PQUAL

Respondee	Respondee Title	Respondee Phone	Respondee Email
Jack Olkline	Vice President	714-835-4612 ext. 215	jolkline@radoscompanies.com

Bid Format	Submitted Date	Delivery Method	Responsive	Status	Confirmation #	Ranking
Electronic	December 6, 2016 1:56:37 PM (Pacific)			Submitted	91403	0

Attachments		
File Title	File Name	File Type
Certification of Pending Actions	B-Contractor's Certification of Pending Actions.pdf	General Attachments
Equal Benefits	C Equal Benefits Ordinance-Certificate of Compliance.pdf	General Attachments
Lobby Prohibition Bid Bond	D Lobby Prohibition, Certification and Disclosure.pdf	General Attachments
	A Bid Bond.pdf	Bid Bond

Line Items								
Item Num	Section	Item Code	Description	Unit of Measure	Quantity	Reference	Unit Price	Line Total
1	Main Bid	524126	Bonds (Payment and Performance)	LS	1	2-4.1	\$350,000.00	\$350,000.00
2	Main Bid	541380	Special Inspection (EOC Type I)	AL	1	4-1.3.4.1	\$85,000.00	\$85,000.00
3	Main Bid	236220	Permits (EOC Type I)	AL	1	7-5.3	\$100,000.00	\$100,000.00
4	Main Bid	541330	SWPPP Development	LS	1	7-8.6.3.7	\$13,000.00	\$13,000.00
5	Main Bid	237990	SWPPP Implementation	LS	1	7-8.6.3.7	\$130,000.00	\$130,000.00
6	Main Bid	541330	SWPPP Permit Fee (EOC Type I)	LS	1	7-8.6.3.7	\$3,000.00	\$3,000.00
7	Main Bid		Field Orders (EOC Type II)	AL	1	9-3.1	\$4,000,000.00	\$4,000,000.00
8	Main Bid	238910	Mobilization/Demobilization	LS	1	01025-3.3A	\$1,600,000.00	\$1,600,000.00
9	Main Bid	237110	Shoring, Sheeting and Bracing	LS	1	01025-3.3B	\$300,000.00	\$300,000.00
10	Main Bid	237110	Civil/Site Improvements	LS	1	01025-3.3C	\$3,000,000.00	\$3,000,000.00
11	Main Bid	237110	Structural	LS	1	01025-3.3D	\$9,840,000.00	\$9,840,000.00
12	Main Bid	237110	Mechanical	LS	1	01025-3.3E	\$24,000,000.00	\$24,000,000.00
13	Main Bid	238210	Instrumentation & Controls	LS	1	01025-3.3F	\$1,700,000.00	\$1,700,000.00
14	Main Bid	238210	Electrical	LS	1	01025-3.3G	\$6,800,000.00	\$6,800,000.00
15	Main Bid	238910	Architectural	LS	1	01025-3.3H	\$1,500,000.00	\$1,500,000.00
16	Main Bid	237110	Final Operation & Maintenance (O&M) Manuals	LS	1	01025-3.3I	\$10,000.00	\$10,000.00
17	Main Bid	238990	Miscellaneous	LS	1	01025-3.3J	\$1,500,000.00	\$1,500,000.00
18	Main Bid	238210	SDG&E - New Line/Coord (EOC Type 1)	AL	1	01025-3.3K	\$1,000,000.00	\$1,000,000.00
19	Main Bid	237110	Dewatering	LS	1	02140-1.7A	\$200,000.00	\$200,000.00
20	Main Bid		Emergency Radio Coverage-Engineering and Design (EOC Type 1)	AL	1	01025-3.3L	\$50,000.00	\$50,000.00
21	Main Bid	237110	Diesel SCR Systems	LS	1	01025-3.3M	\$22,000.00	\$22,000.00
22	Main Bid	541370	Survey Services	LS	1	2-9.2.3	\$25,000.00	\$25,000.00
							Subtotal	\$56,228,000.00
							Total	\$56,228,000.00

Bid Results for Project Pump Station 2 Power Reliability and Surge Protection (K-17-1456-DBB-3)

Subcontractors							
Name	Description	License Num	Amount	Type	Address	City	ZipCode
Karcher Insulation	Constructor Insulation	309141	\$625,000.00		2300 E. Orangewood Ave.	Anahelm	92806
Flowsolve US Inc	Supplier Medium Voltage Electric Motors	0	\$820,000.00		5310 Taneytown Pike	Taneytown	21787
Southern Contracting Company	Constructor Electrical	222252	\$6,800,000.00	PQUAL	559 North Twin Oaks Valley Road	San Marcos	92069
National Coating & Lining	Constructor Painting	886430	\$315,000.00		26713 Madison Ave	Murrietta	92562
SAC Inc	Supplier Fabricate Steel Pipe and Supports	0	\$2,450,000.00		206 Ave C	Williston	5495
Superior Ready Mix	Supplier Ready Mix Concrete	0	\$400,000.00		1508 W. Mission Rd	Escondido	92029
Integrity Rebar Placers	Constructor Rebar	533729	\$440,000.00	LAT,MALE	1345 Nandina Avenue	Perris	92571
Hayward Baker, Inc.	Constructor Compaction Grouting	482246	\$310,000.00		10303 Channel Rd	Lakeside	92040
Drake Integrations LLC	Consultant Commissioning Coordinator Services	0	\$425,000.00	CAU,MALE,SLBE,CADIR	2515 Camino Del Rio South, Suite 338	San Diego	92108
Hawthorne Power Systems	Supplier Generators Diesel and Natural Gas	0	\$11,750,000.00		16945 Camino San Bernardo	San Diego	92127
Paramount Metals & Supply Company	Constructor Structural Steel & metals	261180	\$1,990,000.00		8140 E. Rosecrans Ave.	Paramount	90723
WESTERN PAVING CONTRACTORS INC	Constructor Asphalt Paving	639093	\$90,000.00		15533 E ARROW HIGHWAY	IRWINDALE	91706
united mechanical contractors Inc.	Constructor HVAC	759496	\$2,700,000.00		794 E. Los Angeles	Simi Valley	93065
Pacific Sound Control	Constructor Acoustic Panels, Louvers, Doors & Windows	647465	\$700,000.00		2677 N. Main St Ste 230	Santa Ana	92705

Self-Performance
52.31%