# City of San Diego

**CONTRACTOR'S NAME**: AECOM Energy & Construction, Inc.
**ADDRESS**: 16481 Scientific Way, Irvine, CA 92618
**TELEPHONE NO.**: (949) 333-1500 **FAX NO.:** (949) 333-1510
**CITY CONTACT:** Juan E. Espindola, Contract Specialist **Email:** JEEspindola@sandiego.gov
Phone No. (619) 533-4491
A. Van / J.Borja / Lad

# BIDDING DOCUMENTS

e - Bidding

**FINAL**

## FOR

## NORTH CITY WATER RECLAMATION PLANT EXPANSION - EARLY SITE WORK AND OZONE/BAC RELOCATION

BID NO.: **K-19-1724-DBB-3**
SAP NO. (WBS/IO/CC): **B-15142, B-15139**
CLIENT DEPARTMENT: **2000**
COUNCIL DISTRICT: **1**
PROJECT TYPE: **BI**

**THIS CONTRACT WILL BE SUBJECT TO THE FOLLOWING:**

- PHASED-FUNDING
- FEDERAL EQUAL OPPORTUNITY CONTRACTING REQUIREMENTS.
- PREVAILING WAGE RATES: STATE ☒ FEDERAL ☒
- APPRENTICESHIP
- THIS IS AN ENVIRONMENTAL PROTECTION AGENCY AND CLEAN WATER STATE REVOLVING FUND FUNDED CONTRACT THROUGH THE STATE OF CALIFORNIA.

**BID DUE DATE:**

**2:00 PM**

**NOVEMBER 29, 2018**

**CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS**

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

## ENGINEER OF WORK

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

**NCWRP EXPANSION AND NCPWF INFLUENT PUMP STATION AND PIPELINE - PACKAGE 4 NCWRP EARLY SITEWORK AND OZONE/BAC RELOCATION**

**Julian Hoyle**

1) Registered Engineer/Architect


DIGITALLY SIGNED: 09/27/2018

**Amer Barhoumi**

2) For City Engineer

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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 **North City Water Reclamation Plant Expansion – Early Site Work and Ozone/BAC Relocation.** 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 **$14,410,000.**

**4.** **BID DUE DATE AND TIME ARE: November 29, 2018 at 2:00 PM.**

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

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

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

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

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

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

**7.4.** Following are federally subcontracting participation percentages for this contract. For the purpose of achieving the subcontractor participation percentage, Additive or Deductive, and Type II Allowance Bid Items will not be included in the calculation.

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

**7.6. California State Water Resources Control Board - Clean Water State Revolving Fund (CWSRF):**

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

Note: MBEs and WBEs 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.

**7.7.** 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-Bid 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 at (619) 533-3450 at least 5 Working Days prior to the meeting to ensure availability. Failure to attend the Mandatory Pre-Bid Meeting may result in the Bid being deemed non-responsive. The Pre-Bid meeting is scheduled as follows:

**Date:** **October 25, 2018**
**Time:** **10:00 AM**
**Location:** **525 B Street, Suite 700, WADA 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 may not be admitted after the specified start time of the mandatory Pre-Bid Meeting.**

**9.** **PRE-BID SITE VISIT:** All those wishing to submit a bid are **encouraged** to visit the Work Site with the Engineer. The purpose of the 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:** | **1:00 PM** |
| **Date:** | **October 25, 2018** |
| **Location:** | **North City Water Reclamation Plant**<br>**4949 Eastgate Mall, San Diego, CA 92121** |

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

**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 by the City Attorney's Office.

**10.4.** The low Bid will be determined by the Base Bid plus all the Alternates.

**10.5** Once the low bid has been determined, the City may, at its sole discretion, award the contract for the Base Bid plus one or more alternates.

**11.** **SUBMISSION OF QUESTIONS:**

**11.1.** The Director (or designee) of the Public Works Department is the officer responsible for opening, examining, and evaluating the competitive Bids submitted to the City for the acquisition, construction and completion of any public improvement except when otherwise set forth in these documents. Any questions related to this solicitation shall be submitted to:

Public Works Contracts
525 B Street, Suite 750, MS 908A
San Diego, California, 92101
Attention: Contract Specialist, Juan E. Espindola

OR:

JEEspindola@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.

**13. ADDITIVE/DEDUCTIVE ALTERNATES:**

**13.1.** The additive/deductive alternates have been established to allow the City to compare the cost of specific portions of the Work with the Project's budget and enable the City to make a decision whether to incorporate these portions prior to award. The award will be established as described in the Bid. The City reserves the right to award the Contract for the Base Bid only or for the Base Bid plus one or more Alternates.

**13.2.** For water pipeline projects, the Plans typically show all cut and plug and connection work to be performed by City Forces. However, Bidders shall refer to Bidding Documents to see if all or part of this work will be performed by the Contractor.

## 1. PREQUALIFICATION OF CONTRACTORS:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**2.7.1.** Important Note: Submission of the electronic bid into the system may not be

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

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

## 3. ELECTRONIC BID SUBMISSIONS CARRY FULL FORCE AND EFFECT

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

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

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

**3.4.** The Bidder agrees to the construction of the project as described in Attachment "A– Scope of Work" for the City of San Diego, in accordance with the requirements set forth herein for the electronically submitted prices. The Bidder guarantees the Contract Price for a period of 120 days 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 14 Calendar Days after receiving the Contract forms.

**7.** **INSURANCE REQUIREMENTS:**

| Title | Edition | Document Number |
|---|---|---|
| Standard Specifications for Public Works Construction ("The GREENBOOK") http://www.greenbookspecs.org/ | 2015 | PWPI070116-01 |
| City of San Diego Standard Specifications for Public Works Construction ("The WHITEBOOK")* https://www.sandiego.gov/publicworks/edocref/greenbook | 2015 | PWPI070116-02 |
| City of San Diego Standard Drawings* https://www.sandiego.gov/publicworks/edocref/standarddraw | 2016 | PWPI070116-03 |
| Citywide Computer Aided Design and Drafting (CADD) Standards https://www.sandiego.gov/publicworks/edocref/drawings | 2016 | PWPI092816-04 |
| California Department of Transportation (CALTRANS) Standard Specifications – http://www.dot.ca.gov/des/oe/construction-contract-standards.html | 2015 | PWPI092816-05 |
| CALTRANS Standard Plans http://www.dot.ca.gov/des/oe/construction-contract-standards.html | 2015 | PWPI092816-06 |
| California Manual on Uniform Traffic Control Devices Revision 1 (CA MUTCD Rev 1) - http://www.dot.ca.gov/trafficops/camutcd/ | 2014 | PWPIO92816-07 |
| **NOTE**: *Available online under Engineering Documents and References at: http://www.sandiego.gov/publicworks/edocref/index.shtml | | |

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

**7.2.** Refer to sections 7-3, "LIABILITY INSURANCE", and 7-4, "WORKERS' COMPENSATION INSURANCE" of the Supplementary Special Provisions (SSP) for the insurance requirements which must be met.

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

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

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

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

**12. SUBCONTRACTOR INFORMATION:**

**12.1. LISTING OF SUBCONTRACTORS**. In accordance with the requirements provided in the "Subletting and Subcontracting Fair Practices Act" of the California Public Contract Code, the Bidder shall provide the **NAME** and **ADDRESS** of each Subcontractor who will perform work, labor, render services or who specially fabricates and installs a portion [type] of the work or improvement, in an amount in excess of 0.5% of the Contractor's total Bid. The Bidder shall also state within the description, whether the subcontractor is a **CONSTRUCTOR**, **CONSULTANT** or **SUPPLIER**. The Bidder shall state the **DIR REGISTRATION NUMBER** for all subcontractors and shall further state within the description, the **PORTION** of the work which will be performed by each subcontractor under this Contract. The Contractor shall list only one Subcontractor for each portion of the Work. The **DOLLAR VALUE** of the total Bid to be performed shall be stated for all subcontractors listed. Failure to comply with this requirement may result in the Bid being rejected as **non-responsive** and ineligible for award. The Bidder's attention is directed to the Special Provisions - 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.

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

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

**12.3. LISTING OF SUBCONTRACTORS OR SUPPLIERS FOR ALTERNATES.** For subcontractors or suppliers to be used on additive or deductive alternate items, in addition to the above requirements, bidder shall further note "ALTERNATE" and alternate item number within the description.

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

**14. AWARD:**

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

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

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

**15.** **SUBCONTRACT LIMITATIONS**: The Bidder's attention is directed to Standard Specifications for Public Works Construction, Section 2-3, "SUBCONTRACTS" in The GREENBOOK and as amended in the SSP which requires the Contractor to self-perform not less than the specified amount. Failure to comply with this requirement shall render the bid **non-responsive** and ineligible for award.

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

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

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

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

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

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

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

**19.4.** At the time of bid submission, bidders must upload and submit an electronic PDF copy of the aforementioned bid security. Whether in the form of a cashier's check, a properly certified check or an approved corporate surety bond payable to the City of San Diego, the bid security must be uploaded to the City's eBidding system. 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.

**19.5.** 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**.

## 20. AWARD OF CONTRACT OR REJECTION OF BIDS:

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

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

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

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

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

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

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

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

## 21. BID RESULTS:

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

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

## 22. THE CONTRACT:

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

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

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

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

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

## 23. EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE OF WORK:

The Bidder shall examine

carefully the Project Site, the Plans and Specifications, other materials as described in the Special Provisions, Section 2-7, and the proposal forms (e.g., Bidding Documents). The submission of a Bid shall be conclusive evidence that the Bidder has investigated and is satisfied as to the conditions to be encountered, as to the character, quality, and scope of Work, the quantities of materials to be furnished, and as to the requirements of the Bidding Documents Proposal, Plans, and Specifications.

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

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

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

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

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

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

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

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

**25. PRE-AWARD ACTIVITIES:**

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

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

## PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND

### FAITHFUL PERFORMANCE BOND AND LABOR AND MATERIALMEN'S BOND:

**AECOM Energy & Construction, Inc.**, a corporation, as principal, and Federal Insurance Company, a corporation authorized to do business in the State of California, as Surety, hereby obligate themselves, their successors and assigns, jointly and severally, to The City of San Diego a municipal corporation in the sum of **Sixteen Million Four Hundred Three Thousand Three Hundred Dollars and Zero Cents ($16,403,300.00)** for the faithful performance of the annexed contract, and in the sum of **Sixteen Million Four Hundred Three Thousand Three Hundred Dollars and Zero Cents ($16,403,300.00)** for the benefit of laborers and materialmen designated below.

**Conditions:**

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

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

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

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

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

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

Dated January 22, 2019

Approved as to Form

Mara W. Elliott, City Attorney

By _____
Deputy City Attorney

Approved:

By _____
James Nagelvoort
Director
Public Works Department

AECOM Energy & Construction, Inc.
Principal

By _____

Andy Sloane, Vice President
Printed Name of Person Signing for Principal

Federal Insurance Company
Surety

By _____
Kari Davis
Attorney-in-fact

555 S. Flower St., 3rd Floor
Local Address of Surety

Los Angeles, CA 90071
Local Address (City, State) of Surety

(213) 612-5574
Local Telephone No. of Surety

Premium $ 79,564.00

Bond No. 82523565

# 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 Los Angeles

On JAN 22 2019 before me, M. Gonzales, Notary Public, personally appeared Kari Davis 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.

(seal)

Signature M Gonzales

M. Gonzales, Notary Public

M. GONZALES
Notary Public - California
Los Angeles County
Commission # 2213628
My Comm. Expires Oct 5, 2021

CHUBB

# Power of Attorney

## Federal Insurance Company | Vigilant Insurance Company | Pacific Indemnity Company

Know All by These Presents, That FEDERAL INSURANCE COMPANY, an Indiana corporation, VIGILANT INSURANCE COMPANY, a New York corporation, and PACIFIC INDEMNITY COMPANY, a Wisconsin corporation, do each hereby constitute and appoint My Hua, Mechelle Larkin and Kathy R. Mair of Irvine, California; Tenzer V. Cunningham, Karl Davis, Martha Gonzales, Joaquin Perez and Brenda Wong of Los Angeles, California----------

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

In Witness Whereof, said FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY have each executed and attested these presents and affixed their corporate seals on this 10th day of August, 2018.

Dawn M. Chloros, Assistant Secretary

Stephen M. Haney, Vice President

STATE OF NEW JERSEY

County of Hunterdon ss.

On this 10th day of August, 2018, before me, a Notary Public of New Jersey, personally came Dawn M. Chloros, to me known to be Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY, the companies which executed the foregoing Power of Attorney, and the said Dawn M. Chloros, being by me duly sworn, did depose and say that she is Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY and knows the corporate seals thereof, that the seals affixed to the foregoing Power of Attorney are such corporate seals and were thereto affixed by authority of said Companies; and that she signed said Power of Attorney as Assistant Secretary of said Companies by like authority; and that she is acquainted with Stephen M. Haney, and knows him to be Vice President of said Companies; and that the signature of Stephen M. Haney, subscribed to said Power of Attorney is in the genuine handwriting of Stephen M. Haney, and was thereto subscribed by authority of said Companies and in deponent's presence.

Notarial Seal

KATHERINE J. ADELAAR
NOTARY PUBLIC OF NEW JERSEY
No. 2316665
Commission Expires July 16, 2019

Notary Public

## CERTIFICATION

Resolutions adopted by the Boards of Directors of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY on August 30, 2016:

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

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

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

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

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

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

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

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

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

Given under my hand and seals of said Companies at Whitehouse Station, NJ, this JAN 22 2019

Dawn M. Chloros, Assistant Secretary

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

**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 January 24, 2018 *Date* before me, Lori Becker - notary public *Here Insert Name and Title of the Officer*,

personally appeared William Andrew Sloane III *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.

LORI BECKER
Notary Public - California
Orange County
Commission # 2257984
My Comm. Expires Sep 14, 2022

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 Lori Becker
*Signature of Notary Public*

*Place Notary Seal and/or Stamp Above*

**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: See attached

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

**Capacity(ies) Claimed by Signer(s)**

| | |
|---|---|
| Signer's Name: _____ | Signer's Name: _____ |
| ☐ Corporate Officer – Title(s): _____ | ☐ Corporate Officer – Title(s): _____ |
| ☐ Partner – ☐ Limited ☐ General | ☐ Partner – ☐ Limited ☐ General |
| ☐ Individual ☐ Attorney in Fact | ☐ Individual ☐ Attorney in Fact |
| ☐ Trustee ☐ Guardian of Conservator | ☐ Trustee ☐ Guardian of Conservator |
| ☐ Other: _____ | ☐ Other: _____ |
| Signer is Representing: _____ | Signer is Representing: _____ |

# ATTACHMENTS

# ATTACHMENT A

# SCOPE OF WORK

## SCOPE OF WORK

## 1. SCOPE OF WORK

**1.1.** The NCWRP is an active and operational water reclamation facility. It is required that the facility remain in operation at all times, except for City approved planned shutdown intervals during the cutover of new to existing systems.

**1.1.1.** Continuous operation of Owner's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.

**1.1.2.** Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's operations.

**1.1.3.** When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of Owner's facility.

**1.1.4.** See the requirements under Section 01 31 13, Project Coordination.

**1.2.** The Project has specific milestones, constraints, testing periods, and completion requirements. In general, these include:

**1.2.1.** Milestone 1 – Completion of all sitework described in the Early Sitework scope of work (allow for other Contractor to work in area being excavated for the new Secondary Clarifier).

**1.2.2.** Milestone 2 – Completion of all NCPWF Mass Excavation Work.

**1.2.3.** Milestone 3 – Completion of all Ozone/BAC Relocation Work.

**1.2.4.** Milestone 4 - Relocate Power Generator and Appurtenance (Additive/Deductive Alternate).

**1.2.5.** Milestone 5 - Substantial Completion – Occurs after the completion of Milestones 1 through 4 and upon completing the prerequisites for substantial completion.

**1.2.6.** Milestone 6 - Final Completion – After successful completion of substantial completion requirements, and all aspects of the Contract Closeout have been satisfactorily completed.

**1.3.** The Scope of Work is for the Early Sitework, Ozone/BAC Relocation, and NCPWF Mass Excavation in support of the Expansion of the NCWRP from 30 mgd to 52 mgd including the following new facilities and facility modifications, and the associated piping, HVAC, plumbing, instrumentation and controls, electrical, and site work. The scope of work for this package will include the following:

**1.3.1.** Early Sitework:

**1.3.1.1.** Site Civil Work.

**1.3.1.2.** Yard Piping Work.

**1.3.1.3.** Retaining Walls.

**1.3.1.4.** Electrical Work including new service and demolition of existing service.

**1.3.2.** NCPWF Site Mass Excavation.

**1.3.3.** Ozone/BAC Relocation.

**1.3.4.** Relocate Power Generator and Appurtenance (Additive/Deductive Alternate).

**1.4.** The Work shall be performed in accordance with:

**1.4.1.** The Notice Inviting Bids and the North City Water Reclamation Plant (NCWRP) Expansion and Influent Conveyance – Contract 4 Early Sitework and Ozone BAC Relocation Plans:

**1.4.1.1.** NCWRP Expansion Early Sitework - **40381-4001-D through 40381-4124-D,** inclusive.

**1.4.1.2.** CP-1 NCPWF Early Site: **39636-1-D through 39636-18-D,** inclusive.

**1.4.1.3.** Ozone BAC Relocation: **40425-01-D through 40425-88-D**, inclusive.

**2. LOCATION OF WORK:** North City Water Reclamation Plant PK4, at 4949 Eastgate Mall, San Diego CA 92121and NCPWF PK1 Early Site Work at 4940 Eastgate Mall, San Diego CA 92121

**North City Water Reclamation Plant at 5240 Convoy St,**

**3. CONTRACT TIMES:** The Contract Times for completion of the Work including the Plant Establishment Period, shall be as follows:

**3.1. Milestone 1 – Early Sitework:**

**3.1.1.** Completion of all sitework described in the Early Sitework scope of work.

**3.1.2.** This work is required to allow for another Contractor to start work on the new Secondary Clarifiers.

**3.1.3.** Shall be complete within **260 Working Days** from the Notice to Proceed.

**3.2. Milestone 2 – NCPWF Mass Excavation:**

**3.2.1.** Completion of all NCPWF Mass Excavation Work.

**3.2.2.** Shall be complete within **90 Working Days** from the Notice to Proceed.

**3.3. Milestone 3 – Ozone/BAC Relocation:**

**3.3.1.** Completion of all Ozone/BAC Relocation Work.

**3.3.2.** Shall be complete within **200 Working Days** from the Notice to Proceed.

**3.4. Milestone 4 – Relocate Power Generator and Appurtenance (Additive/Deductive Alternate).**

**3.4.1.** Completion of all activities required to relocate the existing generator and appurtenances as shown for the Additive/Deductive Alternate.

**3.4.2.** Shall be complete within **200 Working Days** from the Notice to Proceed.

### 3.5. Milestone 5 - Substantial Completion:

**3.5.1.** Substantial Completion shall be complete within **275 Working Days** from the Notice to Proceed.

### 3.6. Milestone 6 - Final Completion:

**3.6.1.** Final Completion shall be complete within **305 Working Days** from the Notice to Proceed.

# ATTACHMENT B

# PHASED FUNDING PROVISIONS

# PHASED FUNDING PROVISIONS

## 1. PRE-AWARD

**1.1.** Within 10 Working Days after the Bid Opening date, the Apparent Low Bidder must contact the Project Manager to discuss fund availability for each phase and shall also submit the following:

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

**1.2.** Your failure to perform any of the following may result cancelling your award of the Contract:

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

**1.2.2.** Agreeing to a Phased Funding Schedule within thirty Working Days after meeting with the City's Project Manager.

## 2. POST-AWARD

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

**2.2.** If requested, the Engineer may issue the NTP for the next phase before the end of the current approved phase.

## PHASED FUNDING SCHEDULE AGREEMENT

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

**BID NUMBER:** K-19-1724-DBB-3

**CONTRACT OR TASK TITLE: Early Site Work: NCWRP Expansion, NCPWF Influent Pump Station and Pipeline, North City Pure Water Facility, Ozone BAC Relocation, NCWRP Improvements to 30 MGD CONTRACTOR:** AECOM Energy & Construction, Inc.

| Funding Phase | Phase Description | Phase Start | Phase Finish | Not-to-Exceed Amount |
|---|---|---|---|---|
| 1 | Mobilization, Bonds & Submittals, Construction | NTP | 8/31/2019 | $5,977,997.07 |
| 2 | Construction | 9/1/2019 | 8/31/2020 | $10,425,302.93 |
| | | | Contract Total | $ 16,403,300.00 |

Notes:
1) WHITEBOOK section 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 written modifications to the CONTRACT.

**CITY OF SAN DIEGO**

PRINT NAME: Michael Marks
**Construction Manager**

Signature: [signature]

Date: 2/4/19

PRINT NAME: Monika Smoczynski
**Project Manager**

Signature: [signature]

Date: 2/4/19

**CONTRACTOR**

PRINT NAME: Matt Kuzmick

Title: Executive Vice President

Signature: [signature]

Date: February 1, 2019

# ATTACHMENT C

# INTENTIONALLY LEFT BLANK

# ATTACHMENT D

# ENVIRONMENTAL PROTECTION AGENCY (EPA)

# AND

# CLEAN WATER STATE REVOLVING FUND (CWSRF)

# FUNDING AGENCY PROVISIONS

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

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

2. **Bonds.** For construction contracts of $250,000 or more, Contractor shall not begin construction until after it has provided the City with performance and payment bonds each for 100% of the contract value. (SRF Agmt. § 5.3).

3. **Compliance with Laws and Regulations.** Contractor shall, at all times, comply with and require its subcontractors to comply with all applicable federal and state laws, rules, guidelines, regulations, and requirements. Without limitation of the foregoing, to the extent applicable, Contractor shall:

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

   (b) Comply with and require its subcontractors to comply with the list of federal laws in Attachment 1 to this Exhibit. (SRF Agmt. § 5.5).

4. **Indemnification.** Contractor shall defend, indemnify and hold harmless the State Water Quality Control Board, the California Infrastructure and Economic Development Bank (Bank), and any trustee, and their officers, employees, and agents for the Bonds issued by the Bank, if any, to the same extent Contractor is obligated to defend, indemnify, and hold harmless the City under the Agreement. Contractor shall require its subcontractors to similarly defend, indemnify, and hold harmless the State Water Quality Control Board, the Bank, and any trustee, and their officers, employees, and agents for the Bonds issued by the Bank, if any, to the same extent its subcontractors are obligated to defend, indemnify, and hold harmless the Contractor. (SRF Agmt. § 5.11).

5. **Non-Discrimination Requirements.**

(a) During the performance of this Agreement, Contractor and its subcontractors shall not unlawfully discriminate, harass, or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, sexual orientation, physical disability (including HIV and AIDS), mental disability, medical condition (cancer), age (over 40), marital status, denial of family care leave, or genetic information, gender, gender identity, gender expression, or military and veteran status.

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

(c) Contractor and its subcontractors shall comply with the provisions of the Fair Employment and Housing Act and the applicable regulations promulgated thereunder. (Gov. Code, §12990, subds. (a)-(f) et seq.; Cal. Code Regs., tit. 2,

§ 7285 et seq.) Such regulations are incorporated into this Agreement by reference and made a part hereof as if set forth in full.

(d) Contractor and its subcontractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement. (SRF Agmt. § 5.14(e)).

6. **Insurance.** For any policy of general liability insurance concerning the construction of the Project, Contractor will cause, and will require its subcontractors to cause, a certificate of insurance to be issued showing the State Water Quality Control Board, its officers, agents, employees, and servants as additional insured. (SRF Agmt. § 5.16).

7. **Excluded Parties.** Contractor shall not contract with any party who is debarred or suspended or otherwise excluded from or ineligible for participation in any work overseen, directed, funded, or administered by the State Water Board program for which this funding is authorized. For any work related to this Agreement, Contractor shall not contract with any individual or organization on the State Water Board's List of Disqualified Businesses and Persons that is identified as debarred or suspended or otherwise excluded from or ineligible for participation in any work overseen, directed, funded, or administered by the State Water Board program for which funding under this Agreement is authorized. The State Water Board's List of Disqualified Businesses and Persons is located at http://www.waterboards.ca.gov/water_issues/programs/ustcf/dbp.shtml. (SRF Agmt. § 5.17).

8. **Prevailing Wages.** Contractor shall comply with all California State and Federal prevailing wage laws. Contractor shall include in its subcontracts the full the language provided in Attachment 2 to this Exhibit regarding federal prevailing wages. (SRF Agmt. § 5.18; SRF Agmt. Ex. E § A.2).

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

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

The Project sign may include another agency's required promotional information so long as the above logos and disclosure statement are equally prominent on the sign. The sign shall be prepared in a professional manner. (SRF Agmt. Ex. A § 7).

Attachment 1 – Federal Requirements

Contractor shall comply with the following federal conditions:

(A) Federal Award Conditions.

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

(2) Wage Rate Requirements (Davis-Bacon). Contractor shall include in its subcontracts the full the language provided in Attachment 2 to this Exhibit regarding federal prevailing wages.

(3) Contractors, Subcontractors, Debarment and Suspension, Executive Order 12549; 2 CFR Part 180; 2 CFR Part 1532. Contractor shall comply with Subpart C of 2 CFR Part 180 and shall ensure that its subcontracts include compliance. Contractor shall not subcontract with any party who is debarred or suspended or otherwise excluded from or ineligible for participation in federal assistance programs under Executive Order 12549, "Debarment and Suspension". Contractor shall not subcontract with any individual or organization on USEPA's List of Violating Facilities. Contractor shall certify that it and its principals, and shall obtain certifications from its subcontractors that they and their principals:

i. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded by any federal department or agency;

ii. Have not within a three (3) year period preceding this Agreement been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state or local) transaction or contract under a public transaction; violation of federal or state antitrust statutes or

commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

iii. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state or local) with commission of any of the offenses enumerated in paragraph (b) of this certification; and

iv. Have not within a three (3) year period preceding this application/proposal had one or more public transactions (federal, state or local) terminated for cause or default.

v. Suspension and debarment information can be accessed at http://www.sam.gov. Contractor represents and warrants that it has or will include a term or conditions requiring compliance with this provision in all of its subcontracts under this Agreement. Contractor acknowledges that failing to disclose the information as required at

2 CFR 180.335 may result in the termination, delay or negation of this Agreement, or pursuance of legal remedies, including suspension and debarment.

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

(5) Credit. Contractor agrees that any reports, documents, publications or other materials developed for public distribution supported by this Agreement shall contain the following statement:

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

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

(B) Civil Rights Obligations. Contractor shall comply with the following federal non- discrimination requirements:

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

(2) Section 504 of the Rehabilitation Act of 1973, which prohibits discrimination against persons with disabilities. (EPA XC HB).

(3) The Age Discrimination Act of 1975, which prohibits age discrimination. (EPA XC HB).

(4) Section 13 of the Federal Water Pollution Control Act Amendments of 1972, which prohibits discrimination on the basis of sex. (EPA XC HB).

(5) 40 CFR Part 7, as it relates to the foregoing. (EPA XC HB).

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

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

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

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

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

*"(4) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.*

*"(5) The contractor will comply with all provisions of Executive Order No. 11246 of Sept. 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.*

*"(6) The contractor will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of*

*Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.*

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

*"(8) The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States."*

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

(C) Procurement Prohibitions under Section 306 of the Clean Air Act and Section 508 of the Clean Water Act, including Executive Order 11738, Administration of the Clean Air Act and the Federal Water Pollution Control Act with Respect to Federal Contracts, Grants, or Loans; 42 USC § 7606; 33 USC § 1368. Except where the purpose of this Agreement is to remedy the cause of the violation, Contractor may not procure goods, services, or materials from suppliers excluded under the federal System for Award Management: http://www.sam.gov/.

(D) Debarment and Suspension Executive Order No. 12549 (1986). Contractor certifies that it will not knowingly enter into a contract with anyone who is ineligible under the 40 CFR Part 32 to participate in the Project. Contractor shall ensure that subcontractors on the Project must provide the certification prior to the award of any subcontract.

(E) Contractor agrees that if its network or information system is connected to USEPA networks to transfer data using systems other than the Environmental Information Exchange Network

or USEPA's Central Data Exchange, it will ensure that any connections are secure.

(F) Geospatial Data Standards. All geospatial data created pursuant to this Agreement that is submitted to the State Water Board for use by USEPA or that is submitted directly to USEPA must be consistent with Federal Geographic Data Committee endorsed standards. Information on these standards may be found at www.fgdc.gov.

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

**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:

| | | Goal |
|---|---|---|
| 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 action 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 above.

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

10. 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.

11. 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.

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

13. 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.

14. 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.

15. 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.

16. 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.

17. 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. 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 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. This shall be in addition to any other applicable penalties allowed under Labor Code sections 1720 – 1861.

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

**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 contractors and subcontractors of $25 per worker per day for each day the worker works more than 8 hours per day and 40 hours per week in violation of California Labor Code sections1810 through 1815.

**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 Prevailing Wage Unit at 858-627-3200.

**8.9.** **Contractor and Subcontractor Registration Requirements.** This project is subject to compliance monitoring and enforcement by the DIR. A contractor or subcontractor shall not be qualified to bid on, be listed in a bid or proposal, subject to the requirements of section 4104 of the Public Contract Code, or engage in the performance of any contract for public work, unless currently registered and qualified to perform public work pursuant to Labor Code section 1725.5. It is not a violation of this section for an unregistered contractor to submit a bid that is authorized by Section 7029.1 of the Business and Professions code or by Section 10164 or 20103.5 of the Public Contract Code, provided the contractor is registered to perform public work pursuant to Section 1725.5 at the time the contract is awarded.

**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.

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

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

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

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

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

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

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

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

General Decision Number: CA180001 10/05/2018 CA1

Superseded General Decision Number: CA20170001

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 $10.35 for calendar year 2018 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.35 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2018. The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

| Modification Number | Publication Date |
|---|---|
| 0 | 01/05/2018 |
| 1 | 01/12/2018 |
| 2 | 01/19/2018 |
| 3 | 02/09/2018 |
| 4 | 03/02/2018 |
| 5 | 05/04/2018 |
| 6 | 06/29/2018 |
| 7 | 07/06/2018 |
| 8 | 07/13/2018 |
| 9 | 07/20/2018 |
| 10 | 08/17/2018 |
| 11 | 08/24/2018 |
| 12 | 08/31/2018 |
| 13 | 09/07/2018 |
| 14 | 09/28/2018 |
| 15 | 10/05/2018 |

ASBE0005-002 07/01/2018

| | Rates | Fringes |
|---|---|---|
| Asbestos Workers/Insulator (Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems) | $ 39.72 | 20.81 |
| Fire Stop Technician (Application of Firestopping Materials for wall openings and penetrations in walls, floors, ceilings and curtain walls) | $ 27.92 | 18.31 |

ASBE0005-004 07/02/2018

| | 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) | $ 19.93 | 11.72 |

BOIL0092-003 03/01/2018

| | Rates | Fringes |
|---|---|---|
| BOILERMAKER | $ 44.07 | 33.52 |

BRCA0004-008 11/01/2017

| | Rates | Fringes |
|---|---|---|
| BRICKLAYER; MARBLE SETTER | $ 37.46 | 16.69 |

BRCA0018-004 07/01/2017

| | Rates | Fringes |
|---|---|---|
| MARBLE FINISHER | $ 30.93 | 12.95 |
| TILE FINISHER | $ 25.98 | 11.23 |
| TILE LAYER | $ 37.76 | 16.37 |

BRCA0018-010 09/01/2017

| | Rates | Fringes |
|---|---|---|
| TERRAZZO FINISHER | $ 29.75 | 12.91 |
| TERRAZZO WORKER/SETTER | $ 36.75 | 13.82 |

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 CARP0409-002 07/01/2016

                                  Rates          Fringes

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

Amounts in "Rates' column are per day
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 CARP0409-008 08/01/2010

                                  Rates          Fringes

Modular Furniture Installer......$ 17.00            7.41
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 CARP0547-001 07/01/2016

                                  Rates          Fringes

CARPENTER
     (1)  Bridge.................$ 40.33           17.03
     (2)  Commercial Building....$ 35.10           17.03
     (3)  Heavy & Highway........$ 40.20           17.03
     (4)  Residential Carpenter..$ 28.08           17.03
     (5)  Residential
     Insulation Installer........$ 18.00            8.16
MILLWRIGHT.......................$ 46.70           17.03
PILEDRIVERMAN....................$ 40.33           17.03
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 CARP0547-002 07/01/2017

                                  Rates          Fringes

Drywall
     (1) Work on wood framed
     construction of single
     family residences,
     apartments or condominiums
     under four stories
      Drywall Installer/Lather...$ 22.95           18.85
      Drywall Stocker/Scrapper...$ 12.50           12.27
     (2) All other work
      Drywall Installer/Lather...$ 32.00           17.63
      Drywall Stocker/Scrapper...$ 12.50           12.27
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 ELEC0569-001 06/04/2018

                                  Rates          Fringes

Electricians (Tunnel Work)
     Cable Splicer...............$ 50.81         3%+13.63
     Electrician.................$ 50.06         3%+13.63
Electricians: (All Other
Work, Including 4 Stories
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Residential)
     Cable Splicer.....$ 45.25  3%+13.63
     Electrician.....$ 44.50  3%+13.63
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ELEC0569-004 06/04/2018

| | Rates | Fringes |
|---|---|---|
| ELECTRICIAN (Sound & Communications Sound Technician) | $ 31.75 | 3%+11.78 |

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

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ELEC0569-005 06/04/2018

| | Rates | Fringes |
|---|---|---|
| Sound & Communications Sound Technician | $ 31.75 | 3%+11.78 |

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

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

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ELEC0569-006 02/27/2017

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 | $ 30.48 | 3%+7.70 |
| Utility Technician #2 | $ 25.45 | 3%+7.70 |

STREET LIGHT & TRAFFIC SIGNAL WORK:

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

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

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ELEC0569-008 06/04/2018

| | Rates | Fringes |
|---|---|---|
| ELECTRICIAN (Residential, 1-3 Stories) | $ 33.38 | 3%+6.61 |

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ELEC1245-001 06/01/2018

| | Rates | Fringes |
|---|---|---|
| LINE CONSTRUCTION | | |
| (1) Lineman; Cable splicer | $ 56.79 | 17.91 |
| (2) Equipment specialist (operates crawler tractors, commercial motor vehicles, backhoes, trenchers, cranes (50 tons and below), overhead & underground distribution line equipment) | $ 45.36 | 16.74 |
| (3) Groundman | $ 34.68 | 16.36 |
| (4) Powderman | $ 49.55 | 3%+17.65 |

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

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ELEV0018-001 01/01/2018

| | Rates | Fringes |
|---|---|---|
| ELEVATOR MECHANIC | $ 53.85 | 32.645 |

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.

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ENGI0012-003 07/01/2018

| | Rates | Fringes |
|---|---|---|
| OPERATOR: Power Equipment (All Other Work) | | |
| GROUP 1 | $ 45.30 | 25.25 |
| GROUP 2 | $ 46.08 | 25.25 |
| GROUP 3 | $ 46.37 | 25.25 |
| GROUP 4 | $ 47.86 | 25.25 |
| GROUP 5 | $ 48.96 | 25.25 |
| GROUP 6 | $ 48.08 | 25.25 |
| GROUP 8 | $ 48.19 | 25.25 |
| GROUP 9 | $ 49.29 | 25.25 |
| GROUP 10 | $ 48.31 | 25.25 |
| GROUP 11 | $ 49.41 | 25.25 |
| GROUP 12 | $ 48.48 | 25.25 |
| GROUP 13 | $ 48.58 | 25.25 |
| GROUP 14 | $ 48.61 | 25.25 |
| GROUP 15 | $ 48.69 | 25.25 |
| GROUP 16 | $ 48.81 | 25.25 |
| GROUP 17 | $ 48.98 | 25.25 |
| GROUP 18 | $ 49.08 | 25.25 |
| GROUP 19 | $ 49.19 | 25.25 |
| GROUP 20 | $ 49.31 | 25.25 |
| GROUP 21 | $ 49.48 | 25.25 |
| GROUP 22 | $ 49.58 | 25.25 |
| GROUP 23 | $ 49.69 | 25.25 |
| GROUP 24 | $ 49.81 | 25.25 |
| GROUP 25 | $ 49.98 | 25.25 |
| OPERATOR: Power Equipment (Cranes, Piledriving & Hoisting) | | |
| GROUP 1 | $ 46.65 | 25.25 |
| GROUP 2 | $ 47.43 | 25.25 |
| GROUP 3 | $ 47.72 | 25.25 |
| GROUP 4 | $ 47.86 | 25.25 |
| GROUP 5 | $ 48.08 | 25.25 |
| GROUP 6 | $ 48.19 | 25.25 |
| GROUP 7 | $ 48.31 | 25.25 |
| GROUP 8 | $ 48.48 | 25.25 |
| GROUP 9 | $ 48.65 | 25.25 |

GROUP 10.....$ 49.65 25.25
GROUP 11.....$ 50.65 25.25
GROUP 12.....$ 51.65 25.25
GROUP 13.....$ 52.65 25.25

OPERATOR: Power Equipment
(Tunnel Work)

GROUP 1.....$ 47.15 25.25
GROUP 2.....$ 47.93 25.25
GROUP 3.....$ 48.22 25.25
GROUP 4.....$ 48.39 25.25
GROUP 5.....$ 48.58 25.25
GROUP 6.....$ 48.69 25.25
GROUP 7.....$ 48.81 25.25

PREMIUM PAY:

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

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

SEE ZONE DEFINITIONS AFTER CLASSIFICATIONS

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

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

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

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

GROUP 4: Asphalt plant fireman; Backhoe operator (mini-max or similar type); Boring machine operator; Boxman or mixerman (asphalt or concrete); Chip spreading machine operator; Concrete cleaning decontamination machine operator; Concrete Pump Operator (small portable); Drilling machine

operator, small auger types (Texoma super economatic or similar types - Hughes 100 or 200 or similar types - drilling depth of 30' maximum); Equipment greaser (grease truck); Guard rail post driver operator; Highline cableway signalman; Hydra-hammer-aero stomper; Micro Tunneling (above ground tunnel); Power concrete curing machine operator; Power concrete saw operator; Power-driven jumbo form setter operator; Power sweeper operator; Rock Wheel Saw/Trencher; Roller operator (compacting); Screed operator (asphalt or concrete); Trenching machine operator (up to 6 ft.); Vacuum or much truck

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

GROUP 6: Articulating material hauler; Asphalt plant engineer; Batch plant operator; Bit sharpener; Concrete joint machine operator (canal and similar type); Concrete planer operator; Dandy digger; Deck engine operator; Derrickman (oilfield type); Drilling machine operator, bucket or auger types (Calweld 100 bucket or similar types - Watson 1000 auger or similar types - Texoma 330, 500 or 600 auger or similar types - drilling depth of 45' maximum); Drilling machine operator; Hydrographic seeder machine operator (straw, pulp or seed), Jackson track maintainer, or similar type; Kalamazoo Switch tamper, or similar type; Machine tool operator; Maginnis internal full slab vibrator, Mechanical berm, curb or gutter(concrete or asphalt); Mechanical finisher operator (concrete, Clary-Johnson-Bidwell or similar); Micro tunnel system (below ground); Pavement breaker operator (truck mounted); Road oil mixing machine operator; Roller operator (asphalt or finish), rubber-tired earth moving equipment (single engine, up to and including 25 yds. struck); Self-propelled tar pipelining machine operator; Skiploader operator (crawler and wheel type, over 3/4 yd. and up to and including 1-1/2 yds.); Slip form pump operator (power driven hydraulic lifting device for concrete forms); Tractor operator-bulldozer, tamper-scraper (single engine, up to 100 h.p. flywheel and similar types, up to and including D-5 and similar types); Tugger hoist operator (1 drum); Ultra high pressure waterjet cutting tool system operator; Vacuum blasting machine operator

GROUP 8: Asphalt or concrete spreading operator (tamping or finishing); Asphalt paving machine operator (Barber Greene or similar type); Asphalt-rubber distribution operator; Backhoe operator (up to and including 3/4 yd.), small ford, Case or similar; Cast-in-place pipe laying machine operator; Combination mixer and compressor operator (gunite work); Compactor operator (self-propelled); Concrete mixer operator (paving); Crushing plant operator; Drill Doctor; Drilling machine operator, Bucket or auger types (Calweld 150 bucket or similar types - Watson 1500, 2000 2500 auger or similar types - Texoma 700, 800 auger or similar types - drilling depth of 60' maximum); Elevating grader operator; Grade checker; Gradall operator; Grouting machine operator; Heavy-duty repairman; Heavy equipment robotics operator; Kalamazoo balliste regulator or similar type; Kolman belt

loader and similar type; Le Tourneau blob compactor or similar type; Loader operator (Athey, Euclid, Sierra and similar types); Mobark Chipper or similar; Ozzie padder or similar types; P.C. slot saw; Pneumatic concrete placing machine operator (Hackley-Presswell or similar type); Pumpcrete gun operator; Rock Drill or similar types; Rotary drill operator (excluding caisson type); Rubber-tired earth-moving equipment operator (single engine, caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. up to and including 50 cu. yds. struck); Rubber-tired earth-moving equipment operator (multiple engine up to and including 25 yds. struck); Rubber-tired scraper operator (self-loading paddle wheel type-John Deere, 1040 and similar single unit); Self-propelled curb and gutter machine operator; Shuttle buggy; Skiploader operator (crawler and wheel type over 1-1/2 yds. up to and including 6-1/2 yds.); Soil remediation plant operator; Surface heaters and planer operator; Tractor compressor drill combination operator; Tractor operator (any type larger than D-5 - 100 flywheel h.p. and over, or similar-bulldozer, tamper, scraper and push tractor single engine); Tractor operator (boom attachments), Traveling pipe wrapping, cleaning and bendng machine operator; Trenching machine operator (over 6 ft. depth capacity, manufacturer's rating); trenching Machine with Road Miner attachment (over 6 ft depth capacity): Ultra high pressure waterjet cutting tool system mechanic; Water pull (compaction) operator

GROUP 9: Heavy Duty Repairman

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

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

GROUP 12: Auto grader operator; Automatic slip form operator; Drilling machine operator, bucket or auger types (Calweld, auger 200 CA or similar types - Watson, auger 6000 or similar types - Hughes Super Duty, auger 200 or similar types - drilling depth of 175' maximum); Hoe ram or similar

with compressor; Mass excavator operator less tha 750 cu. yards; Mechanical finishing machine operator; Mobile form traveler operator; Motor patrol operator (multi-engine); Pipe mobile machine operator; Rubber-tired earth- moving equipment operator (multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck); Rubber-tired self- loading scraper operator (paddle-wheel-auger type self-loading - two (2) or more units)

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

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

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

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

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

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

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

GROUP 20: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units -

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

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

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

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

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

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

CRANES, PILEDRIVING AND HOISTING EQUIPMENT CLASSIFICATIONS

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

GROUP 2: Truck crane oiler

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

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

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

GROUP 6: Bridge crane operator; Cretor crane operator; Hoist operator (Chicago boom and similar type); Lift mobile operator; Lift slab machine operator (Vagtborg and similar

types); Material hoist and/or manlift operator; Polar gantry crane operator; Self Climbing scaffold (or similar type); Shovel, backhoe, dragline, clamshell operator (over 3/4 yd. and up to 5 cu. yds. mrc); Tugger hoist operator

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

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

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

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

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

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

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

TUNNEL CLASSIFICATIONS

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

GROUP 2: Power-driven jumbo form setter operator

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

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

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

GROUP 6: Heavy Duty Repairman

GROUP 7: Tunnel mole boring machine operator

ENGINEERS ZONES

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

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

T1S, R10E, SBM. Continue S along west boundary of R10E, SBM to Imperial County line at the SW corner of T8S, R10E, SBM. Continue W along Imperial and Riverside county line to NW corner of T9S, R9E, SBM. Continue S along the boundary between Imperial and San Diego Counties, along the west edge of R9E, SBM to the south boundary of Imperial County/California state line. Follow the California state line west to Arizona state line, then north to Nevada state line, then continuing NW back to start at the point which is the NW corner of Section 1, T17N, R14E, SBM

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

That area within the following Boundary: Begin approximately 5 miles north of the community of Cholame, on the Monterey County and San Luis Obispo County boundary at the NW corner of T25S, R16E, Mt. Diablo Meridian. Continue south along the west side of R16E to the SW corner of T30S, R16E, MDM. Continue E to SW corner of T30S, R17E, MDM. Continue S to SW corner of T31S, R17E, MDM. Continue E to SW corner of T31S, R18E, MDM. Continue S along West side of R18E, MDM as it crosses into San Bernardino Meridian numbering area and becomes R30W. Follow the west side of R30W, SBM to the SW corner of T9N, R30W, SBM. Continue E along the south edge of T9N, SBM to the Santa Barbara County and Ventura County boundary at that point whch is the SW corner of Section 34.T9N, R24W, SBM, continue S along the Ventura County line to that point which is the SW corner of the SE quarter of Section 32, T7N, R24W, SBM. Continue E along the south edge of T7N, SBM to the SE corner to T7N, R21W, SBM. Continue N along East side of R21W, SBM to Ventura County and Kern County boundary at the NE corner of T8N, R21W. Continue W along the Ventura County and Kern County boundary to the SE corner of T9N, R21W. Continue North along the East edge of R21W, SBM to the NE corner of T12N, R21W, SBM. Continue West along the north edge of T12N, SBM to the SE corner of T32S, R21E, MDM. [T12N SBM is a think strip between T11N SBM and T32S MDM]. Continue North along the East side of R21E, MDM to the Kings County and Kern County border at the NE corner of T25S, R21E, MDM, continue West along the Kings County and Kern County Boundary until the intersection of San Luis Obispo County. Continue west along the Kings County and San Luis Obispo County boundary until the intersection with Monterey County. Continue West along the Monterey County and San Luis Obispo County boundary to the beginning point at the NW corner of T25S, R16E, MDM.

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

That area within the following Boundary: Begin at the intersection of the northern boundary of Mono County and the California state line at the point which is the center of Section 17, T10N, R22E, Mt. Diablo Meridian. Continue S then SE along the entire western boundary of Mono County, until it reaches Inyo County at the point which is the NE corner of the Western half of the NW quarter of Section 2, T8S, R29E, MDM.

Continue SSE along the entire western boundary of Inyo County, until the intersection with Kern County at the point which is the SW corner of the SE 1/4 of Section 32, T24S, R37E, MDM. Continue E along the Inyo and Kern County boundary until the intersection with San Bernardino County at that point which is the SE corner of section 34, T24S, R40E, MDM. Continue E along the Inyo and San Bernardino County boundary until the point which is the NE corner of the Western half of the NW quarter of Section 6, T25S, R42E, MDM. Continue S to that point which is the SW corner of the NW quarter of Section 6, T27S, R42E, MDM. Continue E in a straight line to the California and Nevada state border at the point which is the NW corner of Section 1, T17N, R14E, San Bernardino Meridian. Then continue NW along the state line to the starting point, which is the center of Section 18, T10N, R22E, MDM.

REMAINING AREA NOT DEFINED ABOVE RECIEVES BASE RATE

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ENGI0012-004 08/01/2015

| | 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 |

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IRON0377-002 07/01/2018

| | Rates | Fringes |
|---|---|---|
| Ironworkers: | | |
| Fence Erector | $ 31.58 | 22.41 |
| Ornamental, Reinforcing and Structural | $ 38.00 | 31.05 |

PREMIUM PAY:

$6.00 additional per hour at the following locations:

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

$4.00 additional per hour at the following locations:

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

$2.00 additional per hour at the following locations:

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

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LABO0089-001 07/01/2018

| | Rates | Fringes |
|---|---|---|
| LABORER (BUILDING and all other Residential Construction) | | |
| Group 1 | $ 31.31 | 19.29 |
| Group 2 | $ 31.99 | 19.29 |
| Group 3 | $ 32.70 | 19.29 |
| Group 4 | $ 33.50 | 19.29 |
| Group 5 | $ 35.43 | 19.29 |
| 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 condominums - excluding (a) projects that exceed three stories over a garage level, (b) any utility work such as telephone, gas, water, sewer and other utilities and (c) any fine grading work, utility work or paving work in the future street and public right-of-way; but including all rough grading work at the job site behind the existing right of way

LABORER CLASSIFICATIONS

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

GROUP 2: Asphalt Shoveler; Cement Dumper (on 1 yard or larger mixer and handling bulk cement); Cesspool digger and

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

GROUP 3: Buggymobile; Concrete cutting torch; Concrete cutting torch; Concrete pile cutter; Driller, jackhammer, 2 1/2 feet drill steel or longer; Dri Pak-it machine; High sealer (including drilling of same); Hydro seeder and similar type; Impact wrench, mult-plate; Kettlemen, potmen and mean applying asphalt, lay-kold, creosote, line caustic and similar type materials (applying  means applying, dipping, brushing or handling of such materials for pipe wrapping and waterproofing); Operators of pneumatic, gas, electric tools, vibratring machines, pavement breakers, air blasting, come-along, and similar mechanical tools not separately classified herein; Pipelayers back up man coating, grouting, making of joints, sealing, caulking, diapering and inclduing rubber gasket joints, pointing and any and all other services; Rotary Scarifier or multiple head concrete chipping scaarifier; Steel header board man and guideline setter; Tampers, Barko, Wacker and similar type; Trenching machine, handpropelled

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

GROUP 5: Blasters Powderman-All work of loading holes, placing and blasting of all pwder and explosives of whatever type, regardless of method used for such loading and placing; Driller-all power drills, excluding jackhammer, whether core, diamond, wagon, track, multiple

unit, and any and all other types of mechanical drills without regard to the form of motive power.

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LABO0089-002 11/01/2017

| | Rates | Fringes |
|---|---|---|
| LABORER (MASON TENDER)..... | $ 30.00 | 16.47 |

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LABO0089-004 07/01/2017

HEAVY AND HIGHWAY CONSTRUCTION

| | Rates | Fringes |
|---|---|---|
| Laborers: | | |
| Group 1..... | $ 31.63 | 18.58 |
| Group 2..... | $ 32.09 | 18.58 |
| Group 3..... | $ 32.50 | 18.58 |
| Group 4..... | $ 33.34 | 18.58 |
| Group 5..... | $ 37.46 | 18.58 |

LABORER CLASSIFICATIONS

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

GROUP 2: Asphalt abatement; Buggymobile; Cement dumper (on 1 yd. or larger mixers and handling bulk cement); Concrete curer, impervious membrane and form oiler; Chute man, pouring concrete; Concrete cutting torch; Concrete pile cutter; driller/Jackhammer, with drill steel 2 1/'2 feet or longer; Dry pak-it machine; Fence erector; Pipeline wrapper, gas, oil, water, pot tender & form man; Grout man; Installation of all asphalt overlay fabric and materials used for reinforcing asphalt; Irrigation laborer; Kettleman-Potman hot mop, includes applying asphalt, lay-klold, creosote, lime caustic and similar tyhpes of materials (dipping, brushing, handling) and waterproofing; Membrane vapor barrier installer; Pipelayer backup man

(coating, grouting, making of joints, sealing caulkiing, diapering including rubber basket joints, pointing); Rotary scarifier, multiple head concrete chipper; Rock slinger; Roto scraper & tiller; Sandblaster pot tender; Septic tank digger/installer; Tamper/wacker operator; Tank scaler & cleaner; Tar man & mortar man; Tree climber/faller, chainb saw operator, Pittsburgh chipper & similar type brush shredders.

GROUP 3: Asphalt, installation of all frabrics; Buggy Mobile Man, Bushing hammer; Compactor (all types), Concrete Curer - Impervious membrane, Form Oiler, Concrete Cutting Torch, Concrete Pile Cutter,Driller/Jackhammer with drill steel 2 1/2 ft or longer, Dry Pak-it machine, Fence erector including manual post hole digging, Gas oil or water Pipeline Wrapper - 6 ft pipe and over, Guradrail erector, Hydro seeder, Impact Wrench man (multi plate), kettleman-Potman Hot Mop includes applying Asphalt, Lay-Kold, Creosote, lime caustic and similar types of materials (dipping, brushing or handling) and waterproofing. Laser Beam in connection with Laborer work. High Scaler, Operators of Pneumatic Gas or Electric Tools, Vibrating Machines, Pavement Breakers, Air Blasting, Come-Alongs and similar mechanical tools, Remote-Controlled Robotic Tools in connection with Laborers work. Pipelayer Backup Man (Coating, grouting,m makeing of joints, sealing, caulking, diapering including rubber gasket joints, pointing and other services). Power Post Hole Digger, Rotary Scarifier (multiple head concrete chipper scarifier), Rock Slinger, Shot Blast equipment (8 to 48 inches), Steel Headerboard Man and Guideline Setter, Tamper/Wacker operator and similar types, Trenching Machine hand propelled.

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

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

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LABO0300-005 01/01/2018

| | Rates | Fringes |
|---|---|---|
| Asbestos Removal Laborer..... | $ 33.19 | 17.78 |

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

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LABO0345-001 07/01/2018

| | Rates | Fringes |
|---|---|---|
| LABORER (GUNITE) | | |
| GROUP 1..... | $ 42.18 | 18.27 |
| GROUP 2..... | $ 41.23 | 18.27 |
| GROUP 3..... | $ 37.69 | 18.27 |

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

GUNITE LABORER CLASSIFICATIONS

GROUP 1: Rodmen, Nozzlemen

GROUP 2: Gunmen

GROUP 3: Reboundmen

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LABO1184-001 07/01/2018

| | Rates | Fringes |
|---|---|---|
| Laborers: (HORIZONTAL DIRECTIONAL DRILLING) | | |
| (1) Drilling Crew Laborer... | $ 35.70 | 14.03 |
| (2) Vehicle Operator/Hauler. | $ 35.87 | 14.03 |
| (3) Horizontal Directional Drill Operator..... | $ 37.72 | 14.03 |
| (4) Electronic Tracking | | |

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     Locator.....................$ 39.72           14.03
Laborers: (STRIPING/SLURRY
SEAL)
     GROUP 1.....................$ 35.86           16.21
     GROUP 2.....................$ 37.16           16.21
     GROUP 3.....................$ 39.17           16.21
     GROUP 4.....................$ 40.91           16.21

LABORERS - STRIPING CLASSIFICATIONS

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

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

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

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

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 LABO1414-003 08/08/2018

                                  Rates          Fringes

LABORER
     PLASTER CLEAN-UP LABORER....$ 33.82           19.40
     PLASTER TENDER..............$ 36.37           19.40

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
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Facility-Seeley, North Island Naval Air Station, Vandenberg AFB.

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PAIN0036-001 07/01/2018

| | Rates | Fringes |
|---|---|---|
| Painters: (Including Lead Abatement) | | |
| (1) Repaint (excludes San Diego County) | $ 27.59 | 14.92 |
| (2) All Other Work | $ 31.12 | 15.04 |

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

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PAIN0036-010 10/01/2017

| | Rates | Fringes |
|---|---|---|
| DRYWALL FINISHER/TAPER | | |
| (1) Building & Heavy Construction | $ 30.24 | 16.95 |
| (2) Residential Construction (Wood frame apartments, single family homes and multi-duplexes up to and including four stories) | $ 23.50 | 15.96 |

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PAIN0036-012 10/01/2017

| | Rates | Fringes |
|---|---|---|
| GLAZIER | $ 42.55 | 18.57 |

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PAIN0036-019 01/01/2018

| | Rates | Fringes |
|---|---|---|
| SOFT FLOOR LAYER | $ 30.02 | 13.68 |

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PLAS0200-005 08/01/2018

| | Rates | Fringes |
|---|---|---|
| PLASTERER | $ 36.86 | 18.00 |

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

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PLAS0500-001 07/01/2018

| | Rates | Fringes |
|---|---|---|
| CEMENT MASON/CONCRETE FINISHER | | |
| GROUP 1 | $ 26.34 | 21.12 |
| GROUP 2 | $ 27.99 | 21.12 |
| GROUP 3 | $ 30.07 | 21.12 |

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

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

GROUP 2: Work classified as type I and II construction

GROUP 3: All other work

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PLUM0016-006 09/01/2018

| | Rates | Fringes |
|---|---|---|
| PLUMBER, PIPEFITTER, STEAMFITTER | | |
| Camp Pendleton | $ 54.63 | 22.16 |
| 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 | $ 50.13 | 22.16 |
| Work ONLY on new additions and remodeling of commercial buildings, bars, restaurants, and stores not to exceed 5,000 sq. ft. of floor space | $ 48.58 | 21.18 |
| Work ONLY on strip malls, light commercial, tenant improvement and remodel work | $ 37.10 | 19.51 |

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PLUM0016-011 09/01/2018

| | Rates | Fringes |
|---|---|---|
| PLUMBER/PIPEFITTER | | |
| Residential | $ 40.23 | 18.08 |

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PLUM0078-001 07/01/2016

| | Rates | Fringes |
|---|---|---|
| PLUMBER | | |
| Landscape/Irrigation Fitter | $ 44.16 | 25.19 |
| Sewer & Storm Drain Work | $ 44.16 | 25.19 |

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ROOF0045-001 07/01/2018

| | Rates | Fringes |
|---|---|---|
| ROOFER | $ 31.00 | 8.62 |

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* SFCA0669-001 04/01/2018

| | Rates | Fringes |
|---|---|---|
| SPRINKLER FITTER | $ 40.57 | 21.18 |

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SHEE0206-001 07/01/2017

| | Rates | Fringes |
|---|---|---|
| SHEET METAL WORKER | | |
| Camp Pendleton | $ 38.88 | 26.52 |
| Except Camp Pendleton | $ 36.88 | 26.52 |
| Sheet Metal Technician | $ 27.70 | 8.43 |

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

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TEAM0166-001 07/03/2017

| | Rates | Fringes |
|---|---|---|
| Truck drivers: | | |
| GROUP 1 | $ 15.90 | 34.69 |
| GROUP 2 | $ 23.49 | 34.69 |
| GROUP 3 | $ 23.69 | 34.69 |
| GROUP 4 | $ 23.89 | 34.69 |
| GROUP 5 | $ 24.09 | 34.69 |
| GROUP 6 | $ 24.59 | 34.69 |
| GROUP 7 | $ 26.09 | 34.69 |

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

TRUCK DRIVER CLASSIFICATIONS

GROUP 1: Fuel Man, Swamper

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

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

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

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

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

GROUP 7: Repairman

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

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

health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

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

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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.

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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:

**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 (Office of the Secretary of Labor 29 CFR 5) are included in this Contract pursuant to the provisions applicable to such Federal assistance.

**SECTION 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 l(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 l(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 l(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 https://www.dol.gov/whd/forms/wh347.pdf 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. Certification of Eligibility.**

**(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.

**SECTION B.** The provisions of this section 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. Contract Work Hours and Safety Standards Act.**

**(i)** **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.

**(ii)** **Violation; Liability For Unpaid Wages; Liquidated Damages.** In the event of any violation of the clause set forth in subparagraph (B)(1)(i) 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)(i) 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 sub paragraph (B)(1)(i) of this section.

**(iii)** **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)(1)(ii) of this section.

**(iv)** **Subcontracts.** The contractor or subcontractor shall insert in any subcontracts the clauses set forth in subparagraphs (B)(1)(i) through (B)(1)(iv) 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)(i) through (B)(1)(iv) of this section.

**2.** In addition to the clauses contained in Section 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 29 CFR 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.

**SECTION C.**

**1. Compliance Verification.**

**(i)** The Recipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. Use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from the funding agency upon request.

**(ii)** The Recipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, the Recipient should conduct interviews with a representative group of covered employees within two weeks of each contractor or subcontractor's submission of its initial weekly payroll data and two weeks prior to the estimated completion date for the contract or subcontract. The Recipient must conduct more frequent interviews if the initial interviews or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. The Recipient shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

**(iii)** The Recipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The Recipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable the Recipient shall spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. The Recipient must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the Recipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

**(iv)** The Recipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in subsection (ii) and (iii) above.

**(v)** The Recipient must immediately report potential violations of the DB prevailing wage requirements to the funding agency DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at http://www.dol.gov/whd/america2.htm.

## 11. AGENCY SPECIFIC PROVISIONS:

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

### 11.1. EPA Requirements:

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

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

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

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

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 Calendar Days (refer to 33 CFR 33.301) 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. Annual DBE Utilization Reporting:**

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

## 11.2. Clean Water State Revolving Fund (CWSRF) Requirements:

**11.2.1.** For contracts subject to CWSRF, refer to Subsection 11.1, "EPA Requirements" above and the following:

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

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

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

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

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

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

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

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

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

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

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

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

## 12. DBE POTENTIAL RESOURCES CENTERS:

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

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

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

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

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

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

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

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

| Name and Address | Web Site |
|---|---|
| **U.S. Small Business Administration** | |
| 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** | |
| Minority Business Development Agency | Bid Notification: |
| 555 Montgomery Street | http://www.mbda.gov/workspace[3] |
| San Francisco, CA 94111 | RE: Business Development Centers |

**12.9.** State Agencies (must be contacted):

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

Notes:

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

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

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

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

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

## 13. GOOD FAITH EFFORT DOCUMENTATION SUBMITTALS:

**13.1.** The affirmative GFE steps documentation shall be submitted **within 4 Working Days 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
525 B STREET, SUITE 750, MS 908A
SAN DIEGO, CA 92101

SUBJECT: AFFIRMATIVE GOOD FAITH EFFORT DOCUMENTATION

BID NO. **K-19-1724-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.** The Contractor shall demonstrate that efforts were made to attract DBEs on this contract. The Contractor and Subcontractors shall take the steps listed in these specifications to assure that DBEs are used whenever possible as sources of supplies, construction, equipment, or services. In addition to the specified GFE documentation, the Bidder shall submit the following forms.

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

1. Form 4500-3: DBE Subcontractor Performance Form
2. Form 4500-4: DBE Subcontractor Utilization Form

**14.1.1.2** The following forms shall be completed and submitted within **4 Working Days 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. Form AA62: Summary of Bids Received
3. Form AA63: Good Faith Effort List of Subcontractors Solicited

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

1. EPA Form 5700 52A: MBE/WBE Utilization Forms
2. Form UR-334: California State Revolving Funds (CASRF)

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

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

## FUNDING AGENCY PROVISIONS

## FORMS

CALIFORNIA Water Boards

## *Disadvantaged Business Enterprise (DBE) Program*

## *DBE Subcontractor Utilization Form*

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

| Prime Contractor Name | | Project Name |
|---|---|---|
| AECOM Energy & Construction, Inc. | | North City Water Reclamation Plant Expansion |
| Bid / Proposal No. | Assistance Agreement ID No. (if known) | Point of Contact |
| K-19-1724-DBB-3 | N/A | Matt Kuzmick |
| Address | | |
| 16481 Scientific Way Irvine, CA 92618 | | |
| Telephone No. | | Email Address |
| 949-333-1500 | | matt.kuzmick@aecom.com |
| Issuing/Funding Entity | | |
| EPA/CWSRF | | |

I have identified potential DBE certified subcontractors. ✓ YES NO

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

| Subcontractor Name/ Company Name | Company Address / Phone / Email | Estimated Dollar Amount | Currently DBE Certified? |
|---|---|---|---|
| Alcon Fence Company | 9901 Glenoaks Blvd. Sun Valley, CA 91352<br>Ph 323-875-1342, maric@alcornfence.com | $35,283 | Yes |
| | | | |
| | | | |

*--Continue on back if needed--*

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

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

***FORM 4500-4 (DBE Subcontractor Utilization Form)***

CALIFORNIA
Water Boards

## *Disadvantaged Business Enterprise (DBE) Program*

## *DBE Subcontractor Utilization Form*

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

| Prime Contractor Name | | Project Name |
|---|---|---|
| AECOM Energy & Construction, Inc. | | North City Water Reclamation Plant Expansion |
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| K-19-1724-DBB-3 | N/A | Matt Kuzmick |
| Address | | |
| 16481 Scientific Way Irvine, CA 92618 | | |
| Telephone No. | | Email Address |
| 949-333-1500 | | matt.kuzmick@aecom.com |
| Issuing/Funding Entity | | |
| EPA/CWSRF | | |

I have identified potential DBE certified subcontractors. ✓ YES NO

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

| Subcontractor Name/ Company Name | Company Address / Phone / Email | Estimated Dollar Amount | Currently DBE Certified? |
|---|---|---|---|
| 3531 Trucking, Inc. | P.O. Box 1062 Glendora, CA 91740<br>Ph 626-644-6221, miguel@3531truckinginc.com | $10,000 | Yes |
| | | | |
| | | | |

*--Continue on back if needed--*

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***FORM 4500-4 (DBE Subcontractor Utilization Form)***

CALIFORNIA Water Boards

## *Disadvantaged Business Enterprise (DBE) Program*

## *DBE Subcontractor Utilization Form*

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

| Prime Contractor Name | | Project Name |
|---|---|---|
| AECOM Energy & Construction, Inc. | | North City Water Reclamation Plant Expansion |
| Bid / Proposal No. | Assistance Agreement ID No. (if known) | Point of Contact |
| K-19-1724-DBB-3 | N/A | Matt Kuzmick |
| Address | | |
| 16481 Scientific Way Irvine, CA 92618 | | |
| Telephone No. | | Email Address |
| 949-333-1500 | | matt.kuzmick@aecom.com |
| Issuing/Funding Entity | | |
| EPA/CWSRF | | |

I have identified potential DBE certified subcontractors. ✓ YES NO

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

| Subcontractor Name/ Company Name | Company Address / Phone / Email | Estimated Dollar Amount | Currently DBE Certified? |
|---|---|---|---|
| Sampo Engineering, Inc. | 171 Saxony Rd, Suite 213 Encintas, CA 92024<br>Ph 760-436-0660x110, vince@sampoengineering.com | $30,000 T&M | Yes |
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*--Continue on back if needed--*

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***FORM 4500-4 (DBE Subcontractor Utilization Form)***

CALIFORNIA
Water Boards

## *Disadvantaged Business Enterprise (DBE) Program*

## *DBE Subcontractor Utilization Form*

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

| Prime Contractor Name | | Project Name |
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| Address | | |
| 16481 Scientific Way Irvine, CA 92618 | | |
| Telephone No. | | Email Address |
| 949-333-1500 | | matt.kuzmick@aecom.com |
| Issuing/Funding Entity | | |
| EPA/CWSRF | | |

I have identified potential DBE certified subcontractors. ✓ YES NO

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

| Subcontractor Name/ Company Name | Company Address / Phone / Email | Estimated Dollar Amount | Currently DBE Certified? |
|---|---|---|---|
| Nickolas Steel, Inc. | 816 S. Cucamonga Ave., Ontario, CA 91767<br>Ph 714-738-4647, elan@nicksteel.com | $210,116 | Yes |
| | | | |
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*--Continue on back if needed--*

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***FORM 4500-4 (DBE Subcontractor Utilization Form)***

CALIFORNIA Water Boards

## *Disadvantaged Business Enterprise (DBE) Program*

## *DBE Subcontractor Utilization Form*

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

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| 16481 Scientific Way Irvine, CA 92618 | | |
| Telephone No. | | Email Address |
| 949-333-1500 | | matt.kuzmick@aecom.com |
| Issuing/Funding Entity | | |
| EPA/CWSRF | | |

I have identified potential DBE certified subcontractors. ✓ YES NO

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

| Subcontractor Name/ Company Name | Company Address / Phone / Email | Estimated Dollar Amount | Currently DBE Certified? |
|---|---|---|---|
| SoCal Stormwater Runoff Solution Services Inc | 14930 Ventura Blvd Suite #310, Sherman Oaks, CA 91403 Ph 310-343-8313, mary@socalstormwatersolutions.com | $3,445 | Yes |
| | | | |
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*--Continue on back if needed--*

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

***FORM 4500-4 (DBE Subcontractor Utilization Form)***

**LIST OF WORK MADE AVAILABLE**

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

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

| Company Name | NAICS CODES | Scope of Work | Selected (Y/N) | Bid Amount | DBE | Non-DBE | Explanation for not Selecting |
|---|---|---|---|---|---|---|---|
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**USE ADDITIONAL FORMS AS NECESSARY**

**DISADVANTAGE BUSINESS ENTERPRISE (DBE)**

**GOOD FAITH EFFORT LIST OF SUBCONTRACTORS SOLICITED**

| Contractor Name | Contractor Address | How Located | Date of Contact | Contact Method | Scope of Work | Bidding (Yes/No) |
|---|---|---|---|---|---|---|
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**USE ADDITIONAL FORMS AS NECESSARY**

OMB CONTROL NO. 2030-0020
APPROVED: 04/06/2018
APPROVAL EXPIRES: 04/30/2021

# U.S. ENVIRONMENTAL PROTECTION AGENCY
# MBE/WBE UTILIZATION UNDER FEDERAL GRANTS AND COOPERATIVE AGREEMENTS

**FOR COOPERATIVE AGREEMENTS OR OTHER FEDERAL FINANCIAL ASSISTANCE WHERE THE COMBINED TOTAL OF FUNDS BUDGETED FOR PROCURING SUPPLIES, EQUIPMENT, CONSTRUCTION OR SERVICES EXCEED $150,000.**

**PART 1: PLEASE REVIEW INSTRUCTIONS BEFORE COMPLETING**

| 1A. FEDERAL FISCAL YEAR (Oct 1- Sep 30) | 1B. REPORT TYPE |
|---|---|
| 20_____ | ☐ Annual ☐ Last Report (Project completed) |

1C: REVISION OF A PRIOR YEAR REPORT? ◯ No ◯ Yes, Year_____

IF YES, BRIEFLY DESCRIBE THE REVISIONS YOU ARE MAKING:

| 2A. EPA FINANCIAL ASSISTANCE OFFICE ADDRESS (ATTN: DBE COORDINATOR) | 3A. RECIPIENT NAME AND ADDRESS |
|---|---|
| 2B. EPA DBE COORDINATOR<br>Name:<br>Email:<br>Phone:<br>Fax: | 3B. RECIPIENT REPORTING CONTACT<br>Name:<br>Address:<br>Phone:<br>Email: |
| 4A. FINANCIAL ASSISTANCE AGREEMENT ID NUMBER<br>(SRF State Recipients, refer to Instructions for Completion of blocks 4A, 5A and 5C) | 4B. FEDERAL FINANCIAL ASSISTANCE PROGRAM TITLE OR CFDA NUMBER: |
| 5A. TOTAL ASSISTANCE AGREEMENT AMOUNT<br>EPA Share: $ _____<br>Recipient Share: $ _____<br>☐ N/A (SRF Recipient) | 5B. If NO procurements and NO accomplishments were made this reporting period (by the recipients, sub-recipients, loan recipients, and prime contractors), **CHECK and SKIP to Block No. 7**. (Procurements are all expenditures through contract, order, purchase, lease or barter of supplies, equipment, construction, or services needed to complete Federal assistance programs. Accomplishments, in this context, are procurements made with MBEs and/or WBEs.) ☐ |

5C. Total Procurements This Reporting Period (Only include amount not reported in any prior reporting period)

Total Procurement Amount $_____

(Include total dollar values awarded by recipient, sub-recipients and SRF loan recipients, including MBE/WBE expenditures.)

5D. Were sub-awards issued under this assistance agreement? Yes ◯ No ◯

Were contracts issued under this assistance agreement? Yes ◯ No ◯

5E. MBE/WBE Accomplishments This Reporting Period

Actual MBE/WBE Procurement Accomplished (Include total dollar values awarded by recipient, sub-recipients, SRF loan recipients and Prime Contractors.)

| | Construction | Equipment | Services | Supplies | Total |
|---|---|---|---|---|---|
| $MBE: | _____ | _____ | _____ | _____ | 0.00 |
| $WBE: | _____ | _____ | _____ | _____ | 0.00 |

6. COMMENTS: (If no MBE/WBE procurements, please summarize how certified MBEs/WBEs were notified of the opportunities to compete for the procurement dollars entered in Block 5C and why certified MBEs /WBEs were not awarded any procurements during this reporting period.)

| 7. NAME OF RECIPIENT'S AUTHORIZED REPRESENTATIVE | TITLE |
|---|---|
| 8. SIGNATURE OF RECIPIENT'S AUTHORIZED REPRESENTATIVE | DATE |

EPA FORM 5700-52A available electronically at http://www.epa.gov/osbp/pdfs/5700_52a.pdf

OMB CONTROL NO. 2030-0020
APPROVED: 04/06/2018
APPROVAL EXPIRES: 04/30/2021

## PART II.

## MBE/WBE PROCUREMENTS MADE DURING REPORTING PERIOD

## EPA Financial Assistance Agreement Number: _____

| 1. Procurement Made By | | | 2. Business Enterprise | | 3. $ Value of Procurement | 4. Date of Procurement MM/DD/YY | 5. Type of Product or Service (Enter Code) | 6. Name/Address/Phone Number of MBE/WBE Contractor or Vendor |
|---|---|---|---|---|---|---|---|---|
| Recipient | Sub-Recipient and/or SRF Loan Recipient | Prime | Minority | Women | | | | |
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Type of Product or Service Codes: 1 = Construction 2 = Supplies 3 = Services 4 = Equipment

Note: Recipients are required to submit MBE/WBE reports to EPA beginning with the Federal fiscal year the recipients receive the award, continuing until the project is completed.

**Instructions:**

**A. General Instructions:**

MBE/WBE utilization is based on 40 CFR Part 33. The reporting requirement reflects the class deviation issued on November 8, 2013, clarified on January 9, 2014 and modified on December 2, 2014. EPA Form 5700-52A must be completed annually by recipients of financial assistance agreements where the combined total of funds budgeted for procuring supplies, equipment, construction or services exceeds $150,000.This reporting requirement applies to all new and existing awards and voids all previous reporting requirements.

In determining whether the $150,000 threshold is exceeded for a particular assistance agreement, the analysis must focus on funds budgeted for procurement under the supplies, equipment, construction, services or "other" categories, and include funds budgeted for procurement under sub-awards or loans

Reporting will also be required in cases where the details of the budgets of sub-awards/loans are not clear at the time of the grant awards and the combined total of the procurement and sub-awards and/or loans exceeds the $150,000 threshold.

When reporting is required, all procurement actions are reportable, not just the portion which exceeds $150,000.

If at the time of award the budgeted funds exceed $150,000 but actual expenditures fall below, a report is still required.

If at the time of award, the combined total of funds budgeted for procurements in any category is less than or equal to $150,000 and is maintained below the threshold, no DBE report is required to be submitted.

Recipients are required to report 30 days after the end of each federal year, per the terms and conditions of the financial assistance agreement.

Last reports are due October 30th or 90 days after the end of the project period, whichever comes first.

MBE/WBE program requirements, including reporting, are material terms and conditions of the financial assistance agreement.

**B. Definitions:**

***Procurement*** is the acquisition through contract, order, purchase, lease or barter of supplies, equipment, construction or services needed to accomplish Federal assistance programs.

*A* ***contract*** is a written agreement between an EPA recipient and another party (also considered "prime contracts") and any lower tier agreement (also considered "subcontracts") for equipment, services, supplies, or construction necessary to complete the project. This definition excludes written agreements with another public agency. This definition includes personal and professional services, agreements with consultants, and purchase orders.

*A* ***minority business enterprise*** **(MBE)** is a business concern that is (1) at least 51 percent owned by one or more minority individuals, or, in the case of a publicly owned business, at least 51 percent of the stock is owned by one or more minority

individuals; and (2) whose daily business operations are managed and directed by one or more of the minority owners. In order to qualify and participate as an MBE prime or subcontractor for EPA recipients under EPA's DBE Program, an entity must be properly certified as required by 40 CFR Part 33, Subpart B.

U.S. citizenship is required. Recipients shall presume that minority individuals include Black Americans, Hispanic Americans, Native Americans, Asian Pacific Americans, or other groups whose members are found to be disadvantaged by the Small Business Act or by the Secretary of Commerce under section 5 of Executive order 11625. The reporting contact at EPA can provide additional information.

*A **woman business enterprise*** **(WBE)** is a business concern that is, (1) at least 51 percent owned by one or more women, or, in the case of a publicly owned business, at least 51 percent of the stock is owned by one or more women and (2) whose daily business operations are managed and directed by one or more of the women owners. In order to qualify and participate as a WBE prime or subcontractor for EPA recipients under EPA's DBE Program, an entity must be properly certified as required by 40 CFR Part 33, Subpart B.

Business firms which are 51 percent owned by minorities or women, but are in fact not managed and operated by minorities or females do not qualify for meeting MBE/WBE procurement goals. U.S. Citizenship is required.

**Good Faith Efforts**

A recipient is required to make the following good faith efforts whenever procuring construction, equipment, services, and supplies under an EPA financial assistance agreement. These good faith efforts for utilizing MBEs and WBEs must be documented. Such documentation is subject to EPA review upon request:

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 calendar 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.

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 SBA and the Minority Business Development Agency of the Department of Commerce.

6. If the prime contractor awards subcontracts, require the prime contractor to take the steps in paragraphs (a) through (e) of this section.

**C. Instructions for Part I:**

1A. Specify Federal fiscal year this report covers. The Federal fiscal year runs from October 1st through September 30th (**e.g. November 29, 2014 falls within Federal fiscal year 2015**)

1B. Specify report type. Check the annual reporting box. Also indicate if the project is completed.

1C. Indicate if this is a revision to a previous year and provide a brief description of the revision you are making.

2A-B. Please refer to your financial assistance agreement for the mailing address of the EPA financial assistance office for your agreement.

The "EPA DBE Reporting Contact" is the DBE Coordinator for the EPA Region from which your financial assistance agreement was originated. For a list of DBE Coordinators please refer to the EPA OSBP website at http://epa.gov/osbp/dbe_cord.

3A-B. Identify the agency, state authority, university or other organization which is the recipient of the Federal financial assistance and the person to contact concerning this report.

4A. Provide the Assistance Agreement number assigned by EPA. A separate report must be submitted for each Assistance Agreement.

***For SRF recipients**: In box 4a list numbers for ALL OPEN Assistance Agreements being reported on this form.

4B. Refer back to Assistance Agreement document for this information.

5A. Provide the total amount of the Assistance Agreement which includes Federal funds plus recipient matching funds and funds from other sources.

***For SRF recipients only**: SRF recipients will not enter an amount in 5a. SRF recipients should check the "N/A" box.

5B. Self-explanatory.

5C. Provide the total dollar amount of **ALL** procurements awarded this reporting period by the recipient, sub-recipients, and SRF loan recipients, **including** MBE/WBE expenditures, not just the portion which exceeds $150,000. For example: Actual dollars for procurement from the procuring office; actual contracts let from the contracts office; actual goods, services, supplies, etc., from other sources including the central purchasing/ procurement centers).

***NOTE**: To prevent double counting on line 5C, if any amount on 5E is for a subcontract and the prime contract has already been included on Line 5C in a prior reporting period, then report the amount going to MBE or WBE subcontractor on line 5E, but exclude the amount from Line 5C. To include the amount on 5C again would result in double counting because the prime contract, which includes the subcontract, would have already been reported.

***For SRF recipients only**: In 5c please enter the total annual procurement amount under all of your SRF Assistance Agreements. The figure reported in this section is **not** directly tied to an individual Assistance Agreement identification number. **(SRF state recipients report state procurements in this section)**

5D. State whether or not sub-awards and/or subcontracts have been issued under the financial assistance agreements by indicating “yes” or “no”.

5E. Where requested, also provide the total dollar amount of all MBE/WBE procurement awarded during this reporting period by the recipient, sub-recipients, SRF loan recipients, and prime contractors in the categories of construction, equipment, services and supplies. These amounts include Federal funds plus recipient matching funds and funds from other sources.

6. If there were no MBE/WBE accomplishments this reporting period, please briefly how certified MBEs/WBEs were notified of the opportunities to compete for the procurement dollars entered in Block 5C and why certified MBEs /WBEs were not awarded any procurements during this reporting period.

7. Name and title of official administrator or designated reporting official.

8. Signature, month, day, and year report submitted.

**D. Instructions for Part II:**

For each MBE/WBE procurement made under this financial assistance agreements during the reporting period, provide the following information:

1. Check whether this procurement was made by the recipient, sub-recipient/SRF loan recipient, or the prime contractor.

2. Check either the MBE or WBE column. If a firm is both an MBE and WBE, the recipient may choose to count the entire procurement towards EITHER its MBE or WBE accomplishments. The recipient may also divide the total amount of the procurement (using any ratio it so chooses) and count those divided amounts toward its MBE and WBE accomplishments. If the recipient chooses to divide the procurement amount and count portions toward its MBE and WBE accomplishments, please state the appropriate amounts under the MBE and WBE columns on the form. **The combined MBE and WBE amounts for that MBE/WBE contractor must not exceed the “Value of the Procurement” reported in column #3**

3. Dollar value of procurement.

4. Date of procurement, shown as month, day, year. Date of procurement is defined as the date the contract or procurement was awarded, **not** the date the contractor received payment under the awarded contract or procurement, unless payment occurred on the date of award. **(Where direct purchasing is the procurement method, the date of procurement is the date the purchase was made)**

5. Using codes at the bottom of the form, identify type of product or service acquired through this procurement (e.g., enter 1 if construction, 2 if supplies, etc.).

6. Name, address, and telephone number of MBE/WBE firm.

**This data is requested to comply with provisions mandated by: statute or regulations (40 CFR Parts 30, 31, and 33 and/or 2 CFR Parts 200 and 1500); OMB Circulars; or added by EPA to ensure sound and effective assistance management. Accurate, complete data are required to obtain funding, while no pledge of confidentiality is provided.

The public reporting and recording burden for this collection of information is estimated to average l hour per response annually. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclosure or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, OPPE Regulatory Information Division, U.S. Environmental Protection Agency (2136), 1200 Pennsylvania Avenue, NW, Washington, D.C. 20460. Include the OMB Control number in any correspondence. Do not send the completed form to this address.

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

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

| Payment or Purchase Paid by Recipient or Prime Contractor | Amount Paid to Any DBE Contractor or Sub-Contractor For Service Provided to Recipient | | Date of Payment (MM/DD/YY) | Procurement Type Code** (see below) | Name and Address of DBE Contractor of Sub-Contractor or Vendor |
|---|---|---|---|---|---|
| | **MBE** | **WBE** | | | |
| | | | | | |
| | | | | | |
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| |
|---|
| **8. Initial here if no DBE contractors or sub-contractors paid during current reporting period:** |
| **9. Initial here if all procurements for this contract are completed:** |
| **10. Comments:** |

| **11. Signature and Title of Recipient's Authorized Representative** | **12. Date** |
|---|---|
| | |

**Email Form UR-334 to:**

DrinkingWaterSRF@waterboards.ca.gov OR CleanWaterSRF@waterboards.ca.gov

**Questions may be directed to:**

Barbara August, SWRCB
Barbara.August@waterboards.ca.gov
Phone: (916) 341-6952
Fax: (916) 327-7469

****Procurement Type:**
1. Construction
2. Supplies
3. Services (includes business services; professional services; repair services and personnel services)
4. Equipment

## *Disadvantaged Business Enterprise (DBE) Program*

## *DBE Subcontractor Participation Form*

A Financial Assistance Agreement Recipient must require its prime contractors to provide this form to its DBE subcontractors. This form gives a DBE[1] subcontractor[2] the opportunity to describe work received and/or report any concerns regarding the funded project (e.g., in areas such as termination by prime contractor, late payments, etc.). The DBE subcontractor can, as an option, complete and submit this form to the DBE Coordinator at any time during the project period of performance.

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

| **Contract Item Number** | **Description of Work Received from the Prime Contractor Involving Construction, Services, Equipment or Supplies** | **Amount Received by Prime Contractor** |
|---|---|---|
| | | |

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

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

***FORM 4500-2 (DBE Subcontractor Participation Form)***

Please use the space below to report any concerns regarding the above funded project:

| Subcontractor Signature | Print Name |
|---|---|
| | |
| Title | Date |
| | |

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

**Send completed Form 4500-2 to:**
Mr. Joe Ochab, DBE Coordinator
US EPA, Region 9
75 Hawthorne Street
San Francisco, CA 94105

***FORM 4500-2 (DBE Subcontractor Participation Form)***

# ATTACHMENT E

# SUPPLEMENTARY SPECIAL PROVISIONS

# SUPPLEMENTARY SPECIAL PROVISIONS

The following Supplementary Special Provisions (SSP) modifies the following documents:

1. The **2015 Edition** of the Standard Specifications for Public Works Construction (The "GREENBOOK").
2. The **2015 Edition** of the City of San Diego Standard Specifications for Public Works Construction (The "WHITEBOOK"), including the following:
   a) General Provisions (A) for all Contracts.

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

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

The **Normal Working Hours** are **6:30 p.m**. to **3:30 p.m**. **working hours** for second and or third shift work shall be coordinated with the Construction Manager.

To the "WHITEBOOK", ADD the following:

ITEM 10A – "Beneficial Use" to read the following:

The time at which the Work for a specific area or unit process has progressed to the point where, in the opinion of Owner and Construction Manager, the Work for the specific area or unit process is sufficiently complete, in accordance with the Contract Documents, so that for the specific area or unit process can be utilized for the purposes for which it is intended.

To the "WHITEBOOK", ADD the following:

ITEM 24A – "Construction Manager" to read the following:

The authorized representative of the Owner, also referred to as the Owner's Representative, who may be assigned to the site or any part thereof. All communication from the Contractor shall be through the Construction Manager. The responsibilities, authority, and limitations of the Construction Manager shall be as shown in the Contract Documents.

To the "WHITEBOOK", ADD the following:

ITEM 35A – "Design Engineer" to read the following:

Design Engineer: The person, firm(s) or corporation(s) named as such below:

CH2M HILL Engineers, Inc.
Kleinfelder, Inc.
Marum Partnership.
Manuel Oncina Architects.

Lopez Engineering, Inc.
Kennedy Jenks Consultants, Inc.
O'Day Consultants, Inc.
PW Engineering, Inc.
RF Yeager Engineering, Inc.

The authorized Engineer of Record hired by the Owner. The Design Engineer is also the individual(s) or entity(ies) named as such in the Agreement and established as the Engineer of Record.

To the "WHITEBOOK", ADD the following:

Item 42A – "Final Completion" to read the following:

Once Substantial Completion has been achieved, the following items are planned to be completed by the Owner prior to the Final Completion by the Contractor:

- The Contractor shall complete punch list fix-up as approved by the Construction Manager prior to being provided with Final Completion.
- All Work required under Section 01 77 00, Closeout Procedures shall have been completed.

Following Final Completion, the Owner shall provide acceptance of the facilities and take over operation of the facilities.

To the "WHITEBOOK", ADD the following:

Item 97A – "Substantial Completion" to read the following:

The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Owner and Construction Manager, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

Substantial completion is further defined as:

Project's operating facilities or systems sufficient to provide Owner the full time, uninterrupted, and continuous beneficial operation of the Work; and (ii) all required functional, performance and acceptance or startup testing, and commissioning has been successfully demonstrated for all components, devices, equipment, and instrumentation and control to the satisfaction of the Owner and Construction Manager in accordance with the requirements of the Specifications. For Substantial Completion, the Contractor shall have completed all interior finish work, electrical, instrumentation and control, mechanical, HVAC, lighting, plumbing, civil, and final grading and paving is completed, and in the opinion of the Construction Manager and the Owner, the plant is essentially complete and ready for operation.

## SECTION 2 - SCOPE AND CONTROL OF WORK

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

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

**2-7** **SUBSURFACE DATA.** To the "WHITEBOOK", ADD the following:

4. In preparation of the Contract Documents, the designer has relied upon the following reports of explorations and tests of subsurface conditions at the Work Site:

   a. Final Report of Geotechnical Investigation North City Water Reclamation Plant Expansion (AGE Project No. 44F1) dated January 17, 2018 by Allied Geotechnical Engineer's Inc.

   b. North City Reclamation Plant Expansion Potholing Report No. X170059, dated June 9, 2017 by AirX Utility Surveyors Inc.

5. The reports listed above are available for review by contacting the Contract Specialist or visiting:

   https://filecloud.sandiego.gov/url/b3miekz7ft9ssgyb

**2-9.1** **Permanent Survey Markers.** To the "WHITEBOOK", item 3, DELETE in its entirety and SUBSTITUTE with the following:

3. You shall submit to the Engineer a minimum of 7 Days prior to the start of the Work a list of controlling survey monuments which may be disturbed. CMFS (or the private owner for Permit Work) shall perform the following:

   a) Set survey points outside the affected Work area that reference and locate each controlling survey monument that may be disturbed.

   b) File a Corner Record or Record of Survey with the County Surveyor after setting the survey points to be used for re-establishment of the disturbed controlling survey monuments.

   c) File a Corner Record or Record of Survey with the County Surveyor after re-establishment of the disturbed controlling survey monuments.

**ADD:**

**2-10** **AUTHORITY OF THE BOARD AND THE ENGINEER.** To the "GREENBOOK", Paragraph (2), DELETE in its entirety and SUBSTITUTE with the following:

The decision of the Engineer is final and binding on all questions relating to: quantities; acceptability of material, equipment, or work; execution, progress or sequence of work; requests for information (RFI), and interpretation of the Plans, Specifications, or other Contract Documents. This shall be precedent to any payment under the

Contract. The Engineer shall be the single point of contact and shall be included in all communications.

**2-14.3 Coordination.** To the "WHITEBOOK", ADD the following:

2. Other adjacent City projects are scheduled for construction for the same time period in the vicinity of the NCWRP Expansion Project. See **Appendix D** for the approximate location. Coordinate the Work with the adjacent projects as listed below:

   a) Morena Pump Station and Conveyance, Laila Nasrawi, Phone 619-533-5321.

   b) North City Pure Water Facility and Pump Station, Anthony Van, Phone 858-292-6492 and Jeff Soriano, Phone (858) 292-6336.

   c) Renewable Energy, Lubna Arikat, Phone858-292-6419.

   d) North City Water Reclamation Plant Expansion – Bid Packages 1, 2, and 3, Monika Smoczynski, Phone (858) 292-6455.

**2-16 CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM.** To the "WHITEBOOK", item 1, DELETE in its entirety.

## SECTION 3 – CHANGES IN WORK

**3-3.2.3 Markup.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. Work paid under Allowance Bid items for permits, governmental fees, or direct payments specified in the Contract Documents shall not be subject to any markups.

2. The allowance for overhead and profit shall not exceed the values listed in the table below:

| Component | Overhead | Profit |
|---|---|---|
| Labor | 10% | 10% |
| Material | 10% | 5% |
| Equipment | 10% | 5% |

3. Markups for materials shall be applied to the actual cost of the material before applying the sales tax.

4. When a Subcontractor is performing Extra Work, the allowance for overhead and profit shall be applied to the labor, materials, and equipment costs of the Subcontractor as follows:

   a) Regardless of the number of Subcontractor tasks for Extra Work, you may only apply 10% for the first $50,000 of the Subcontractor's portion of accumulated total cost.

b) If the accumulated costs of single or subsequent tasks exceed the $50,000 threshold, you shall instead only apply 5% to any amounts in excess of the $50,000.

c) You shall not apply 10% to any costs after the first $50,000 of accumulated total costs from performing Extra Work.

d) Regardless of the number of hierarchical tiers of Subcontractors, you may only markup a Subcontractor's Work once.

**3-5.1 Claims.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

**ADD:**

**3-5.1 Claims.**

1. A Claim is a written demand by you that seeks an adjustment in the Contract Price, Contract Time, or other relief associated with a dispute arising under or relating to the Contract, including a breach of any provision thereof. A voucher, invoice, or other routine request for payment is not a Claim.

2. A Claim shall conform to these specifications and may be considered after the City has previously denied a request by you for a Change Order seeking the demanded relief.

3. You shall submit a Claim to the Engineer if a dispute occurs that arises from or relates to the Contract. The Claim shall seek all relief to which you assert you are entitled as a result of the event(s) giving rise to the dispute. Your failure to process a Claim in accordance with these specifications shall constitute a waiver of all relief associated with the dispute. Claims are subject to 6-11, "Right to Audit".

4. You shall continue to perform the Services and Work and shall maintain the Schedule during any dispute proceedings. The Engineer will continue to make payments for undisputed Services and Work.

5. The City's Claims process specified herein shall not relieve you of your statutory obligations to present claims prior to any action under the California Government Code.

**3-5.1.1 Initiation of Claim.**

1. You shall promptly, but no later than 30 Days after the event(s) giving rise to the Claim, deliver the Claim to the Engineer.

2. You shall not process a Claim unless the Engineer has previously denied a request by you for a Change Order that sought the relief to be pursued in the claim.

**3-5.1.1.1.1 Claim Certification Submittal.**

1. If your Claim seeks an increase in the Contract Price, the Contract Time, or both, submit with the Claim an affidavit certifying the following:

    a) The Claim is made in good faith and covers all costs and delays to which you are entitled as a result of the event(s) giving rise to the Claim.

    b) The amount claimed accurately reflects the adjustments in the Contract Price, the Contract Time, or both to which you believe you are entitled.

    c) All supporting costs and pricing data are current, accurate, and complete to the best of your knowledge. The cost breakdown per item of Work shall be supplied.

    d) You shall ensure that the affidavit is executed by an official who has the authority to legally bind you.

**3-5.1.2 Initial Determination.**

1. The Engineer will respond in writing to your Claim within 30 Days of receipt of the Claim.

**3-5.1.3 Settlement Meeting.**

1. If you disagree with the Initial Determination, you shall request a Settlement Meeting within 30 Days. Upon receipt of this request, the Engineer will schedule the Settlement Meeting within 15 Working Days.

**3-5.1.7 City's Final Determination.**

1. If a settle agreement is not reached, the City shall make a written Final Determination within 10 Working Days after the Settlement Meeting.
2. If you disagree with the City's Final Determination, notify the Engineer in writing of your objection within 15 Working Days after receipt of the written determination and file a "Request for Mediation" in accordance with 3-5.2, "Dispute Resolution Process".
3. Failure to give notice of objection within the 15 Working Days period shall waive your right to pursue the Claim.

**3-5.1.8 Mandatory Assistance.**

1. If a third party dispute, litigation, or both arises out of or relates in any way to the Services provided under the Contract, upon the City's request, you shall agree to assist in resolving the dispute or litigation. Your assistance includes, but is not limited to the following:

    a) Providing professional consultations.

    b) Attending mediations, arbitrations, depositions, trials, or any event related to the dispute resolution and litigation.

**3-5.1.8.1 Compensation for Mandatory Assistance.**

1. The City will reimburse you for reasonable fees and expenses incurred by you for any required assistance rendered in accordance with 3-5.1.8, "Mandatory Assistance" as Extra Work.
2. The Engineer will determine whether these fees and expenses were necessary due to your conduct or failure to act.
3. If the Engineer determines that the basis of the dispute or litigation in which these fees and expenses were incurred were the result of your conduct or your failure to act in part or in whole, you shall reimburse the City for any payments made for these fees and expenses.
4. Reimbursement may be through any legal means necessary, including the City's withholding of your payment.

**3-5.2.3 Selection of Mediator.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. A single mediator, knowledgeable in construction aspects and acceptable to both parties, shall be used to mediate the dispute.
2. To initiate mediation, the initiating party shall serve a Request for Mediation at the American Arbitration Association (AAA) on the opposing party.
3. If AAA is used, the initiating party shall concurrently file with AAA a "Request for Mediation" along with the appropriate fees, a copy of requested mediators marked in preference order, and a preference for available dates.
4. If AAA is selected to coordinate the mediation (Administrator), within 10 Working Days from the receipt of the initiating party's Request for Mediation, the opposing party shall file the following:
   a) A copy of the list of the preferred mediators listed in preference order after striking any mediators to which they have any objection.
   b) A preference for available dates.
   c) Appropriate fees.
5. If the parties cannot agree on a mediator, then each party shall select a mediator and those mediators shall select the neutral third party to mediate the matter.

**3-5.3 Forum of Litigation.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. It is the express intention that all legal actions and proceedings related to the Contract or Agreement with the City or to any rights or any relationship between the parties arising therefrom shall be solely and exclusively initiated and maintained in courts of the State of California for the County of San Diego.

**3-5.4 Pre-judgment Interest.**

1. The parties stipulate that if a judgment is entered against a party for breaching this Contract, the pre-judgment interest shall be two percent (2%) per annum.

## SECTION 4 - CONTROL OF MATERIALS

**ADD:**

**4-1.1.1 American Iron and Steel (AIS).**

1. The Consolidated Appropriations Act, 2014, includes an "American Iron and Steel (AIS)" requirement in section 436 that requires this project, funded via the Clean Water State Revolving Loan Fund (CWSRF) to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system.

2. You acknowledge to and for the benefit of the City of San Diego and the State Water Resource Control Board that you understand the Work under this Contract is being funded with monies made available by the Clean Water State Revolving Fund that have statutory requirements commonly known as "American Iron and Steel" that requires all of the iron and steel products used for construction to be produced in the United States including iron and steel products to be provided by you. You hereby warrant to and for the benefit of the City and the State that:

   a) You have reviewed and understand the American Iron and Steel Requirement,

   b) All of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement with required certification, 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.

**4-1.3.1 General.** To the "WHITEBOOK", ADD the following:

1. Steel pipe in sizes larger than 18 inches shall require inspection at the source of production.
2. City lab staff or a qualified inspection agency approved by the Engineer shall witness all welding, lining, coating, and testing. You shall incur additional inspection costs outlined in 4-1.3.3, "Inspection of Items Not Locally Produced".
3. All parts of production (including but not limited to product fabrication, welding, testing, lining, and coating of straight pieces and specials) shall be performed or produced in the United States.
4. Welding and all testing shall be performed by certified welders and testing staff with credentials traceable in the United States.

**4-1.3.2 Inspection by the Agency.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. The City will provide inspection and testing laboratory services within the continental United States within a 200-mile radius of the geographical limits of the City.

**4-1.3.3 Inspection of Items Not Locally Produced.** To the "WHITEBOOK", DELETE in its entirety.

**ADD:**

**4-1.3.3 Inspection of Items Not Locally Produced.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. When you intend to purchase materials, fabricated products, or equipment from sources located more than 200 miles (321.9 km) outside the geographical limits of the City, City Lab staff or a qualified inspection agency approved by the Engineer, shall be engaged at your expense to inspect the materials, equipment, or process.
2. This approval shall be obtained before producing any material or equipment. City Lab staff or inspector shall evaluate the materials for conformance with the requirements of the Plans and Specifications. You shall forward reports required by the Engineer. No materials or equipment shall be shipped nor

shall any processing, fabrication or treatment of such materials be done without proper inspection by City Lab staff or the approved agent. Approval by said agent shall not relieve you of responsibility for complying with the requirements of the Contract Documents.

3. The Engineer may elect City Lab staff to perform inspection of an out-of-town manufacturer. You shall incur additional inspection costs of the Engineer including lodging, meals, and incidental expenses based on Federal Per Diem Rates, along with travel and car rental expenses. If the manufacturing plant operates a double shift, a double shift shall be figured in the inspection costs.

   a) At the option of the Engineer, full time inspection shall continue for the length of the manufacturing period. If the manufacturing period will exceed 3 consecutive weeks, you shall incur additional inspection expenses of the Engineer's supervisor for a trip of 2 Days to the site per month.

   b) When the Engineer elects City Lab staff to perform out-of-town inspections, the wages of staff employed by the City shall not be part of the additional inspection expenses paid by you.

   c) Federal Per Diem Rates can be determined at the location below:

      https://www.gsa.gov/portal/content/104877

4. The Engineer will perform inspections of out-of-town manufacturers for the items of Work specified here:

   a) Section 26 13 13, Medium Voltage Circuit Breaker Switchgear.

**4-1.3.4** **Inspection Paid For By the Contractor.** To the "WHITEBOOK", ADD the following:

No special inspection shall be paid for or performed by the Contractor. The City shall employ and pay for the services of qualified inspection entities to perform specialty inspection services

**4-1.3.5** **Special Inspection**. To the "WHITEBOOK", ADD the following:

No special inspection shall be paid for or performed by the Contractor. The City shall employ and pay for the services of qualified inspection entities to perform specialty inspection services

**4-1.3.6** **Preapproved Materials.** To the "WHITEBOOK", ADD the following:

3. You shall submit in writing a list of all products to be incorporated in the Work that are on the AML.

**4-1.6** **Trade Names or Equals.** To the "WHITEBOOK", ADD the following:

11. You shall submit your list of proposed substitutions for an "equal" item **no less than 15 Working Days prior to the Bid due date** 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 "WHITEBOOK", item 2, ADD the following:

g) Refer to **Appendix K** for more information on the protection of AMI devices.

**5-6** **COOPERATION.** To the "GREENBOOK", **ADD the following:**

1. **Notify SDG&E at least 10 Working Days prior to excavating within 10 feet of SDG&E Underground High Voltage Transmission Power Lines (69 KV and higher).**

## SECTION 6 - PROSECUTION, PROGRESS AND ACCEPTANCE OF WORK

**6-1.1** **Construction Schedule.** To the "WHITEBOOK", item 5, 9, 20 and 22, DELETE in their entirety and SUBSTITUTE with the following:

5. Monthly progress payments are contingent upon the submittal of an updated Schedule and cash flow forecast as discussed in item 22 of 6-1.1, "Construction Schedule" to the Engineer. The Engineer may refuse to recommend the whole or part of any monthly payment if, in the Engineer's opinion, your failure or refusal to provide the required Schedule and cash flow forecast information precludes a proper evaluation of your ability to complete the Project within the Contract Time and amount.

9. Inclusive to the Contract Time, include 15 Working Days to the Schedule for the generation of the Punchlist. You shall Work diligently to complete all Punchlist items within 30 Working Days after the Engineer provides the Punchlist.

20. To the "WHITEBOOK", item 20, ADD the following:

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

22. With every pay request, submit the following:

a) An updated cash flow forecast showing periodic and cumulative construction billing amounts for the duration of the Contract Time. If there has been any Extra Work since the last update, include only the approved amounts.

b) A curve value percentage comparison between the Contract Price and the updated cash flow forecast for each Project ID included in the Contract Documents. Curve values shall be set on a scale from 0% to 100% in intervals of 5% of the Contract Time. Refer to the Sample City Invoice materials in **Appendix D – Sample City Invoice with Spend Curve** and use the format shown. Your invoice amounts shall be

supported by this curve value percentage. For previous periods, use the actual values and percentages and update the curve value percentages accordingly. See "Cash Flow Curve Fitting Example" at the location below:

https://www.sandiego.gov/publicworks/edocref

**6-2.1** **Moratoriums.** To the "WHITEBOOK", ADD the following:

3. Do not Work in the areas where there is currently a moratorium issued by the City. The areas subject to moratorium are listed here:

   a) Holiday Shopping Moratorium. Any work that would impact on-street parking, vehicle travel lanes and pedestrian sidewalks along Eastgate Mall is prohibited between Thanksgiving Day and New Year's Day (inclusive).

   b) Activities that disrupt plant operations are prohibited during the summer, unless otherwise approved in writing by the Owner.

**ADD:**

**6-3.2.1.1** **Environmental Document.**

1. The City of San Diego has prepared an **EIR/EIS NORTH CITY PROJECT PURE WATER SAN DIEGO PROGRAM** for **Early Site Work: NCWRP Expansion, NCPWF Influent Pump Station and Pipeline North City Pure Water Facility, Ozone BAC Relocation, NCWRP Improvements to 30 MGD** as referenced in the Contract Appendix. You shall comply with all requirements of the **Mitigation, Monitoring, and Reporting Program (MMRP)** as set forth in the file cloud below:

https://filecloud.sandiego.gov/ui/core/index.html?mode=public#expl-tabl./SHARED/rnovencido/9cX6Nts0I9ih65Zt.

2. Compliance with the City's environmental document shall be included in the Contract Price, unless separate bid items have been provided.

**6-3.2.2** **Archaeological and Native American Monitoring Program.** To the "WHITEBOOK", ADD the following:

4. The City will retain a qualified archaeologist for this Contract. You shall coordinate your activities and Schedule with the activities and schedules of the archaeologist monitor. Notify the Engineer before noon of the Working Day before monitoring is required. See 2-11, "INSPECTION" for details.

**6-3.2.2.1** **Payment.** To the "WHITEBOOK", item 1, DELETE in its entirety and SUBSTITUTE with the following:

1. The full compensation for the Archaeological and Native American monitoring program and report preparation, as described in the Contract Appendices, shall be included in the Lump Sum or Linear Foot Bid item for "**Archaeological and Native American Monitoring Program**" and shall include the payment

for Work performed on laterals and other services, such as potholing and other trenching. No payment shall be made unless the qualified archaeologist is present to verify during the performance of the Work.

**6-3.2.3 Paleontological Monitoring Program.** To the "WHITEBOOK", ADD the following:

3. The City will retain a qualified paleontologist for this Contract. You shall coordinate your activities and Schedule with the activities and schedules of the paleontologist monitor. Notify the Engineer before noon of the Working Day before monitoring is required. See 2-11, "INSPECTION" for details.

**6-3.2.3.1 Payment.** To the "WHITEBOOK", item 1, DELETE in its entirety and SUBSTITUTE with the following:

1. The full compensation for the Paleontological monitoring program and report preparation, as described in the Contract Appendices, shall be included in the Lump Sum or Linear Foot Bid item for "**Paleontological Monitoring Program**" and shall include the payment for Work performed on laterals and other services, such as potholing and other trenching. No payment shall be made unless the qualified paleontologist is present to verify during the performance of the Work.

**6-8.1.1 Requirements Preparatory to Requesting a Walk-through.** To the "WHITEBOOK", ADD the following:

2. You shall notify the Engineer to arrange a final inspection of permanent BMPs installed and shall obtain the completed, signed, and stamped DS-563 Form 30 Days prior to the issuance of the Notice of Completion**.**

**6-9 Liquidated Damages.** To the "WHITEBOOK", add the following Item 3:

3. Contractor and Owner recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in Contract Times in the Scope of Work. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as penalty), the Contractor shall pay the following amounts for each Milestone for each day that expires after the time specified herein until the Work is substantially complete.

| Milestone No. | Milestone Description | Required Completion Date or Calendar Days | Amount of Liquidated Damages |
|---|---|---|---|
| Milestone 1 | Early Sitework | 260 Working Days after Notice to Proceed | $4,000/day |
| Milestone 2 | NCPWF Mass Excavation | 90 Working Days after Notice to Proceed | $4,000/day |
| Milestone 3 | Ozone/BAC Relocation | 200 Working Days after Notice to Proceed | $4,000/day |
| Milestone 4 | Generator and Appurtenance Relocation | 200 Working Days after Notice to Proceed | $4,000/day |
| Milestone 5 | Substantial Completion | 275 Working Days after Notice to Proceed | $4,000/day |
| Milestone 6 | Final Completion | 305 Working Days after Notice to Proceed | $4,000/day |

## SECTION 7 - RESPONSIBILITIES OF THE CONTRACTOR

**7-3** **INSURANCE.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

**7-3** **INSURANCE.**

1. 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:

| General Annual Aggregate Limit | Limits of Liability |
|---|---|
| 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 $**2,000,000** 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.** To the "GREENBOOK", 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:

| Workers' Compensation | Statutory Employers Liability |
|---|---|
| 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 "WHITEBOOK", ADD the following:

2. The City will obtain, at no cost to you, the following permits:

   a) Building Permit

   b) Grading Permit

   c) Site Development Permit

**ADD:**

**7-6** **THE CONTRACTORS REPRESENTATIVE.** To the "GREENBOOK", ADD the following:

1. Both the representative and alternative representative shall be employees of the Contractor and shall not be assigned to a Subcontractor unless otherwise approved by the City in writing.

**7-8.6** **Water Pollution Control.** To the "WHITEBOOK", ADD the following:

6. Based on a preliminary assessment by the City, this Contract is subject to SWPPP Risk Level 2.

**7-8.6.5** **Payment.** DELETE in its entirety.

**7-13.4** **Contractor Standards and Pledge of Compliance.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. The Contract is subject to City's Municipal Code §22.3004 as amended 10/29/13 by ordinance O-20316.

2. You shall complete a Pledge of Compliance attesting under penalty of perjury that you complied with the requirements of this section.

3. You shall ensure that all Subcontractors complete a Pledge of Compliance attesting under penalty of perjury that they complied with the requirements of this section.

4. You shall require in each subcontract that the Subcontractor shall abide by the provisions of the City's Municipal Code §22.3004. A sample provision is as follows:

   "Compliance with San Diego Municipal Code §22.3004. The Subcontractor acknowledges that it is familiar with the requirements of San Diego Municipal Code §22.3004 ("Contractor Standards"), and agrees to comply with requirements of that section. The Subcontractor further agrees to complete the Pledge of Compliance, incorporated herein by reference."

**ADD:**

**7-13.8 Equal Pay Ordinance.**

1. You shall comply with the Equal Pay Ordinance (EPO) codified in the San Diego Municipal Code (SDMC) in section 22.4801 through 22.4809, unless compliance is not required based on an exception listed in SDMC section 22.4804.

2. You shall require all of your Subcontractors to certify compliance with the EPO in their written subcontracts.

3. You shall post a notice informing your employees of their rights under the EPO in the workplace or job site.

4. By signing this Contract with the City of San Diego, you acknowledge the EPO requirements and pledge ongoing compliance with the requirements of SDMC Division 48, section 22.4801 et seq., throughout the duration of this Contract.

**7-20 ELECTRONIC COMMUNICATION.** To the "WHITEBOOK", ADD the following:

1. PM Web shall be used on this Contract.

2. You shall post all communications addressed to the Engineer concerning construction including RFIs, submittals, daily logs, and transmittals through PM Web. Review and act on all communications addressed to you in PM Web. A user's guide to PM Web will be provided at the Pre-construction meeting and demonstration will be provided.

**7-21.1 General.** To the "WHITEBOOK", item 3, DELETE in its entirety and SUBSTITUTE with the following:

2. 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 8 - FACILITIES FOR AGENCY PERSONNEL

**8-2 FIELD OFFICE FACILITIES.** To the "WHITEBOOK", ADD the following.

1. Provide a as described in Section 01 50 00, Temporary Facilities and Controls.

## SECTION 209 – PRESSURE PIPE

**209 PRESSURE PIPE.** To the "WHITEBOOK", ADD the following:

2. PVC products, specifically type C900 and C905, as manufactured or distributed by J-M Manufacturing Company or JM Eagle shall not be used on the Contract for pressurized pipe.

## SECTION 306 – OPEN TRENCH CONDUIT CONSTRUCTION

**306-3.3 Removal and Abandonment of Existing Conduits and Structures.** To the "GREENBOOK", ADD the following:

1. For 16 inch (406.4 mm) and larger conduits, abandoned pipe shall be filled with sand or CLSM in accordance with 201-6, "Controlled Low Strength Material (CLSM)".

**306-3.3.4.1 Non-Friable Asbestos Cement Pipe (ACP).** To the "WHITEBOOK", item 2, subsection "i", DELETE in its entirety and SUBSTITUTE with the following:

i) A minimum of 5 Working Days prior to the transportation of the ACP disposal bins or friable asbestos waste, you shall provide notice to and assist the Resident Engineer in completing the Inspection Work Request Form for the Asbestos, Lead, and Mold Program. The form is located below:

https://forms.sandiego.gov/f/gs2064

**306-6.5.1 General. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:**

1. For PVC water pipes:

   a) Bedding material shall:

      i. Either be sand, crushed aggregate, or native free-draining granular material.

      ii. 100% of the bedding material shall pass the no. 4 sieve and shall have an expansion when saturated with water of not more than 0.5%.

      iii. Have a sand equivalent of SE 50. SE 30 or higher may be substituted for SE 50 as bedding material if all of the following requirements are met:

         - The top of the pipe and haunch areas are mechanically compacted by means of tamping, vibrating roller, or other mechanical tamper.

- Equipment is of size and type approved by the Engineer.
- 90% relative compaction or better is achieved.

b) When jetting, care shall be exercised to avoid floating of the pipe.

2. PVC sewer pipes shall be bedded in 3/8 inch (9.5 mm) or 1/2 inch (12.5 mm) crushed rock in accordance with 200-1.2, "Crushed Rock and Rock Dust". Crushed rock for PVC sewer pipes may contain recycled Portland Cement Concrete and shall conform to gradation requirements for 3/8 inch or1/2 inch nominal size as shown in Table 200-1.2.1 (A).

3. Storm drains and all types of non-PVC sewer mains shall be bedded in 3/4 inch (19 mm) crushed rock in accordance with 200-1.2, "Crushed Rock and Rock Dust". Crushed rock for storm drains may contain recycled Portland Cement Concrete and shall conform to gradation requirements for 3/4 inch nominal size as shown in Table 200-1.2.1 (A). Bedding shall be placed to a depth of 4 inches (101.6 mm) below the outside diameter of the pipe or 1 inch (25.4 mm) below the bell of the pipe, whichever is greater.

## SECTION 601- TEMPORARY TRAFFIC CONTROL FOR CONSTRUCTION AND MAINTENANCE WORK ZONES

**601-2.1.2 Engineered Traffic Control Plans (TCP).** To the "GREENBOOK", ADD the following:

6. Engineered TCP (2 foot x 3 foot size) shall be required for the following areas:

a) Eastgate Mall

## SECTION 802 - NATIVE HABITAT PROTECTION, INSTALLATION, MAINTENANCE, AND MONITORING

**802-2.1 Project Biologist.** To the "WHITEBOOK", ADD the following:

5. The City will retain a qualified Project Biologist to perform biological monitoring work for this Contract. You shall coordinate your activities and Schedule with the activities and schedules of the Project Biologist.

## EQUAL OPPORTUNITY CONTRACTING PROGRAM (EOCP) SECTION A – GENERAL REQUIREMENTS

**4.1 Nondiscrimination in Contracting Ordinance.** To the "WHITEBOOK", subsection 4.1.1, paragraph (2), sentence (1), DELETE in its entirety and SUBSTITUTE with the following:

You shall not discriminate on the basis of race, gender, gender expression, gender identity, religion, national origin, ethnicity, sexual orientation, age, or disability in the solicitation, selection, hiring, or treatment of subcontractors, vendors, or suppliers.

## END OF SUPPLEMENTARY SPECIAL PROVISIONS (SSP)

# TECHNICALS

# TABLE OF CONTENTS

Pages

## VOLUME 1

SPECIFICATIONS

**END OF SECTION**

# SECTION 01 26 00
# CONTRACT MODIFICATION PROCEDURES

## PART 1 GENERAL

### 1. PROPOSAL REQUESTS

A. Owner may, in anticipation of ordering an addition, deletion, or revision to the Work, request Contractor to prepare a detailed proposal of cost and times to perform contemplated change.

B. Proposal request will include reference number for tracking purposes and detailed description of and reason for proposed change, and such additional information as appropriate and as may be required for Contractor to accurately estimate cost and time impact on Project.

C. Proposal request is for information only; Contractor is neither authorized to execute proposed change nor to stop Work in progress as result of such request.

D. Contractor's written proposal shall be transmitted to Construction Manager promptly, but not later than 14 days after Contractor's receipt of Owner's written request. Proposal shall remain firm for a maximum period of 45 days after receipt by Construction Manager.

E. Owner's request for proposal or Contractor's failure to submit such proposal within the required time period will not justify a Claim for an adjustment in Contract Price or Contract Times (or Milestones).

### 2. CLAIMS

A. Include, at a minimum:

1. Specific references including (i) Drawing numbers, (ii) Specification section and article/paragraph number, and (iii) Submittal type, Submittal number, date reviewed, Construction Manager's comment, as applicable, with appropriate attachments.
2. Stipulated facts and pertinent documents, including photographs and statements.
3. Interpretations relied upon.
4. Description of (i) nature and extent of Claim, (ii) who or what caused the situation, (iii) impact to the Work and work of others, and (iv) discussion of claimant's justification for requesting a change to price or times or both.
5. Estimated adjustment in price claimant believes it is entitled to with full documentation and justification.
6. Requested Change in Contract Times: Include at least (i) Progress Schedule documentation showing logic diagram for request, (ii) documentation that float times available for Work have been used,

and (iii) revised activity logic with durations including sub-network logic revisions, duration changes, and other interrelated schedule impacts, as appropriate.

7. Documentation as may be necessary as set forth below for Work Change Directive, and as Construction Manager may otherwise require.

3. WORK CHANGE DIRECTIVEs

A. Procedures:

1. Construction Manager will:
   a. Initiate, including a description of the Work involved and any attachments.
   b. Affix signature, demonstrating Engineer's recommendation.
   c. Transmit five copies to Owner for authorization.
2. Owner will:
   a. Affix signature, demonstrating approval of the changes involved.
   b. Return four copies to Construction Manager, who will retain one copy, send one copy to the Design Engineer, and forward two copies to Contractor.
3. Upon completion of Work covered by the Work Change Directive or when final Contract Times and Contract Price are determined, Contractor shall submit documentation for inclusion in a Change Order.
4. Contractor's documentation shall include but not be limited to:
   a. Appropriately detailed records of Work performed to enable determination of value of the Work.
   b. Full information required to substantiate resulting change in Contract Times and Contract Price for Work. On request of Construction Manager, provide additional data necessary to support documentation.
   c. Support data for Work performed on a unit price or Cost of the Work basis with additional information such as:
      1) Dates Work was performed, and by whom.
      2) Time records, wage rates paid, and equipment rental rates.
      3) Invoices and receipts for materials, equipment, and subcontracts, all similarly documented.

B. Effective Date of Work Change Directive: Date of signature by Owner, unless otherwise indicated thereon.

4. CHANGE ORDERS

A. Procedure:

1. Construction Manager will prepare six copies of proposed Change Order and transmit such with Construction Manager's written recommendation and request to Contractor for signature.

2. Contractor shall, upon receipt, either: (i) promptly sign copies, retaining one for its file, and return remaining five copies to Construction Manager for Owner's signature, or (ii) return unsigned five copies with written justification for not executing Change Order.
3. Construction Manager will, upon receipt of Contractor signed copies, promptly forward Construction Manager's written recommendation and partially executed five copies for Owner's signature, or if Contractor fails to execute the Change Order, Construction Manager will promptly so notify Owner and transmit Contractor's justification to Owner.
4. Upon receipt of Contractor-executed Change Order, Owner will promptly either:
   a. Execute Change Order, retaining one copy for its file and returning four copies to Construction Manager; or
   b. Return to Construction Manager unsigned copies with written justification for not executing Change Order.
5. Upon receipt of Owner-executed Change Order, Construction Manager will transmit two copies to Contractor, one copy to Design Engineer, and retain one copy, or if Owner fails to execute the Change Order, Construction Manager will promptly so notify Contractor and transmit Owner's justification to Contractor.
6. Upon receipt of Owner-executed Change Order, Contractor shall:
   a. Perform Work covered by Change Order.
   b. Revise Schedule of Values to adjust Contract Price and submit with next Application for Payment.
   c. Revise Progress Schedule to reflect changes in Contract Times, if any, and to adjust times for other items of Work affected by change.
   d. Enter changes in Project record documents after completion of change related Work.

B. In signing a Change Order, Owner and Contractor acknowledge and agree that:

1. Stipulated compensation (Contract Price or Contract Times, or both) set forth includes payment for (i) the Cost of the Work covered by the Change Order, (ii) Contractor's fee for overhead and profit, (iii) interruption of Progress Schedule, (iv) delay and impact, including cumulative impact, on other Work under the Contract Documents, and (v) extended overheads.
2. Change Order constitutes full mutual accord and satisfaction for the change to the Work.
3. Unless otherwise stated in the Change Order, all requirements of the original Contract Documents apply to the Work covered by the Change Order.

## 5. COST OF THE WORK

A. In determining the supplemental costs for rental equipment and machinery,

the following will apply.

B. Rental of construction equipment and machinery and the parts thereof having a replacement value in excess of $1,000, whether owned by Contractor or rented or leased from others, shall meet the following requirements:

1. Full rental costs for leased equipment shall not exceed rates listed in the Rental Rate Blue Book published by Equipment Watch, as adjusted to the regional area of the Project. Owned equipment costs shall not exceed the single shift rates established in the Cost Reference Guide (CRG) published by Equipment Watch. The most recent published edition in effect at commencement of actual equipment use shall be used.
2. Rates shall apply to equipment in good working condition. Equipment not in good condition, or larger than required, may be rejected by Construction Manager or accepted at reduced rates.
3. Leased Equipment: For equipment leased or rented in arm's length transactions from outside vendors, maximum rates shall be determined by the following actual usage/Payment Category:
   a. Less than 8 hours: Hourly rate.
   b. 8 or more hours but less than 7 days: Daily rate.
   c. 7 or more days but less than 30 days: Weekly rate.
   d. 30 days or more: Monthly rate.
4. Arm's length rental and lease transactions are those in which the firm involved in the rental or lease of equipment is not associated with, owned by, have common management, directorship, facilities and/or stockholders with the firm renting the equipment.
5. Financial arrangements associated with rental and lease transactions that provide Contractor remuneration or discounts not visible to the Owner must be disclosed and integrated with charged rates.
6. Leased Equipment in Use: Actual equipment use time documented by Construction Manager shall be the basis that equipment was on and utilized at the Project Site. In addition to the leasing rate above, equipment operational costs shall be paid at the estimated hourly operating cost rate set forth in the Rental Rate Blue Book if not already included in the lease rate. Hours of operation shall be based upon actual equipment usage to the nearest quarter hour, as recorded by Construction Manager.
7. Leased Equipment, When Idle (Standby): Idle or standby equipment is equipment onsite or in transit to and from the Work Site and necessary to perform the Work under the modification, but not in actual use. Idle equipment time, as documented by Construction Manager, shall be paid at the leasing rate determined above, excluding operational costs.
8. Owned and Other Equipment in Use: Equipment rates for owned equipment or equipment provided in other than arm's length transaction shall not exceed the single shift total hourly costs rate developed in accordance with the CRG and as modified herein for multiple shifts. This total hourly rate will be paid for each hour the equipment actually performs work. Hours of operation shall be based upon actual

equipment usage as recorded by Construction Manager. This rate shall represent payment in full for Contractor's direct costs.

9. Owned and Other Equipment, When Idle (Standby): Equipment necessary to be onsite to perform the Work on single shift operations, but not utilized, shall be paid for at the ownership hourly expense rate developed in accordance with the CRG, provided its presence and necessity onsite has been documented by the Construction Manager. Payment for idle time of portions of a normal workday, in conjunction with original contract Work, will not be allowed. In no event shall idle time claimed in a day for a particular piece of equipment exceed the normal Work or shift schedule established for the Project. It is agreed that this rate shall represent payment in full for Contractor's direct costs. When Construction Manager determines that the equipment is not needed to continuously remain at the Work Site, payment will be limited to actual hours in use.
10. Owned and Other Equipment, Multiple Shifts: For multiple shift operations, the CRG single shift total hourly costs rate shall apply to the operating equipment during the first shift. For subsequent shifts, up to two in a 24-hour day, operating rate shall be the sum of the total hourly CRG operating cost and 60 percent of the CRG ownership and overhaul expense. Payment for idle or standby time for second and third shifts shall be 20 percent of the CRG ownership and overhaul expense.
11. When necessary to obtain owned equipment from sources beyond the Project limits, the actual cost to transfer equipment to the Site and return it to its original location will be allowed as an additional item of expense. Move-in and move-out allowances will not be made for equipment brought to the Project if the equipment is also used on original Contract or related Work.
12. If the move-out destination is not to the original location, payment for move-out will not exceed payment for move-in.
13. If move is made by common carrier, the allowance will be the amount paid for the freight. If equipment is hauled with Contractor's own forces, rental will be allowed for the hauling unit plus the hauling unit operator's wage. If equipment is transferred under its own power, the rental will be 75 percent of the appropriate total hourly costs for the equipment, without attachments, plus the equipment operator's wage.
14. Charges for time utilized in servicing equipment to ready it for use prior to moving and similar charges will not be allowed.
15. When a breakdown occurs on any piece of owned equipment, payment shall cease for that equipment and any other owned equipment idled by the breakdown.
16. If any part of the Work is shut down by Owner, standby time will be paid during nonoperating hours if diversion of equipment to other Work is not practicable. Construction Manager reserves the right to cease standby time payment when an extended shutdown is anticipated.
17. If a rate has not been established in the CRG for owned equipment, Contractor may:

a. If approved by Construction Manager, use the rate of the most similar model found, considering such characteristics as manufacturer, capacity, horsepower, age, and fuel type, or
b. Request Equipment Watch to furnish a written response for a rate on the equipment, which shall be presented to Construction Manager for approval; or
c. Request Construction Manager to establish a rate.

6. FIELD ORDER

A. Construction Manager will issue Field Orders, with three copies to Contractor.

B. Effective date of the Field Order shall be the date of signature by Construction Manager, unless otherwise indicated thereon.

C. Contractor shall acknowledge receipt by signing and returning one copy to Construction Manager.

D. Field Orders will be incorporated into subsequent Change Orders, as a no-cost change to the Contract.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

# SECTION 01 29 00
# PAYMENT PROCEDURES

## PART 1 GENERAL

### 1. WORK REQUIRED OF THIS SECTION

A. Payment for the various items of the Bid Schedule, as further specified herein, shall include all compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor and services, operations, and incidentals appurtenant to the items of Work being described here and within the plans, specifications, and Contract Documents, as necessary to complete the various items of the Work all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of permits and cost of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the California Division of Industrial Safety and the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). No separate payment will be made for any item that is not specifically set forth in the Bid Schedule, and all costs therefore shall be included in the Contract Price.

B. Work shall include all electrical, mechanical, HVAC, plumbing, instrumentation and control, structural, coatings, and architectural work required to support each Bid Item.

### 2. related sections

A. The Work of the following Section applies to Work of this Section. Other Sections of the Work not referenced below shall also apply to the extent required for proper performance of the Work.

1. Bid Schedule.
2. Section 01 32 00, Construction Progress Documentation.

### 3. SUBMITTALS

A. Informational Submittals:

1. Schedule of Values: Submit on Owner’s form.
2. Schedule of Estimated Progress Payments: Submit with initially acceptable Schedule of Values.
3. Application for Payment.
4. Final Application for Payment.

### 4. CASH ALLOWANCES

A. Cash allowances will be administered in accordance with the Contract

requirements.

B. Submit, with application for payment, invoice showing the date of purchase, labor costs, expenses, and the total price for all allowance items.

C. Cash allowances shall be paid based on actual work performed up to the amount listed in the Bid Schedule. The Owner shall authorize the use of the cash allowances on an as needed basis.

D. Cash allowances are further described as:

1. Storm Water Pollution Prevention Plan Permit Fee.
2. Field Orders.
3. Security Guard Allowance.

5. SCHEDULE OF VALUES

A. Prepare a separate Schedule of Values for each schedule of the Work under the Agreement.

B. Upon request of Construction Manager, provide documentation to support the accuracy of the Schedule of Values.

C. Lump Sum Work:

1. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.
   a. Mobilization includes, at minimum, items identified in Section 01 50 00, Temporary Facilities and Controls.
   b. Include item(s) for monthly progress schedule update.
2. Break down by WBS number and then by Divisions 02 through 49 with appropriate subdivision of each specification for each Bid Item.

D. An unbalanced or front-end loaded schedule will not be acceptable.

E. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.

6. APPLICATION FOR PAYMENT

A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.

B. Use detailed Application for Payment Form provided by Owner.

C. Provide separate form for each schedule as applicable.

D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.

E. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Construction Manager.

F. Preparation:

1. Round values to nearest dollar.
2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Construction Manager.

7. PAYMENT

A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

B. Payment for Materials and Equipment on Hand:

1. The Owner may accept and pay for materials and equipment on hand with specific required documentation provisions. These include:
   a. Providing the request for payment for materials and equipment on hand with the Application for Payment.
   b. The request shall include the following documentation:
      1) Item description and identifier from the Schedule of Values.
      2) Quantity.
      3) Value from Schedule of Values.
      4) Evidence substantiating purchase.
      5) Location where it is stored.
      6) Affidavit stating that the materials have been purchased exclusively for the project and that the materials are stored separated from other like materials and are physically identified as the Owner’s property for use on this Contract.
2. The Construction Manager and owner shall have the sole discretion for payment of materials and equipment on hand.

C. Payment for Lump Sum Work covers all Work shown on Drawings and

in Specification section(s).

8. NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by Owner.
6. Material remaining on hand after completion of Work.

9. BONDS (PAYMENT AND PERFORMANCE NOT TO EXCEED 2.5 PERCENT) (BID ITEM NO. 1) LUMP SUM

A. No measurement shall be made for this Item.

B. Payment is made for this item for the Bonds required under this Contract and shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 1 and shall constitute the actual cost for bonds, up to, but not more than 2.5 percent of the total Contract price.

10. MOBILIZATION AND DEMOBILIZATION (BID ITEM NO. 2) LUMP SUM

A. No measurement shall be made for this Item.

B. Payment is made for this item to include, but not limited to, office trailers, temporary sheds, temporary utilities, all temporary facilities, and all preparatory work prior to the commencement of productive work at the site required under this Contract. Payment for this item also includes demobilization, removal of said temporary facilities and return of the North City Water Reclamation Plant (NCWRP) to the conditions and requirements of the Contract Documents. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 2. The total amount listed under Bid Item No. 2 shall not exceed 3 percent of the total amount proposed for the project.

11. SHEETING, SHORING, AND BRACING (BID ITEM NO. 3) LUMP SUM

A. No measurement shall be made for this Item.

B. Payment is made for this Item for temporary sheeting, shoring, and bracing or equivalent method and shall be made at the lump sum price named in the Bid Schedule under Bid Item No. 3, which price shall constitute full compensation for completion of all planning, design, engineering fees, furnishing and constructing, and removal and disposal

of such temporary sheeting, shoring, and bracing as a lump sum item, complete, as required for the prosecution of the Work, required for temporary or permanent support of any structures, pipelines or utilities and required under the provisions of any permits, and in accordance with the requirements of OSHA and the Construction Safety Orders of the State of California, pursuant to the provisions of Section 6707 of the California Labor Code.

12. SITE CIVIL GRADING, excavation and stormwater piping (BID ITEM NO. 4) LUMP SUM

A. No measurement shall be made for this Item.

B. General: All site civil grading and stormwater piping.

C. Payment is made for this item for the following:

1. Civil demolition work and grading as shown on Drawings and as specified.
2. Stormwater piping as shown on Drawings and as specified.
3. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 4.

13. YARD PIPING (BID ITEM NO. 5) LUMP SUM

A. No measurement shall be made for this Item.

B. General: All yard piping.

C. Payment is made for this item for the following:

1. All yard piping shown on Drawings and as specified.
2. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 5.

14. RELOCATED, DEMOLITION AND ABANDONMENT OF UTILITIES (BID ITEM NO. 6) LUMP SUM

A. No measurement shall be made for this Item.

B. General: Relocation, demolition, and abandonment of Utilities.

C. Payment is made for this item for all Work required for all demolition, relocation and abandonment of utilities for the excavation are of the future Secondary Clarifiers. This also includes the protection of the 60-inch storm drain line. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 6.

15. SITE ELECTRICAL (BID ITEM NO. 7) LUMP SUM

A. No measurement shall be made for this Item.

B. General: The Work shall include all site electrical, including panels, duct banks and cabling.

C. Payment is made for this item include power and site electrical including pullboxes, ductbanks, panelboards, switchboards, concrete, conduit, conductors and equipment and as required for the site and facility electrical such that facilities and equipment is complete and operational. This Work shall include the demolition of the existing electrical service conductors and raceways. The Work shall include all required coordination with SDG&E for the new electrical service. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 7.

16. RETAINING WALL EAST OF PROPOSED SECONDARY CLARIFIERS FACILITY 23 (BID iTEM NO. 8) LUMP SUM

A. Includes all structural, civil, and geotechnical interface for construction of concrete retaining wall. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 8.

17. fencing, security and site civil access road (BID ITEM NO. 9) LUMP SUM

A. Includes the concrete pad, fencing, gate, security, site grading and access road. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 9.

18. electro-dialysis reversal facility 27 (BID ITEM NO. 10) LUMP SUM

A. Includes all civil, structural, mechanical, electrical, instrumentation and controls for modifications to the Electro-Dialysis Reversal Facility. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 10.

19. ozone and bac filter facility 29 (BID ITEM NO. 11) LUMP SUM

A. Includes relocation of the Ozone and BAC Filter Facility. Includes all demolition, civil, structural, mechanical, electrical, instrumentation and controls for modifications and relocation of the facilities. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 11.

20. STORM WATER POLLUTION PREVENTION PLAN (SWPPP) – IMPLEMENTATION (BID ITEM NO. 12) LUMP SUM

A. No measurement shall be made for this Item.

B. Payment is made for this item for the implementation of the SWPPP measures required under this Contract and shall be made as the lump

sum price named in the Bid Schedule under Bid Item No. 12. Payment for this item shall include the implementation of the 100 percent SWPPP based on the draft SWPPP and shall include all necessary additional BMP's as required for compliance with the permitting agency. Payment shall include implementation, monitoring, upkeep and removal of all necessary BMP's as required in the approved SWPPP.

21. STORM WATER POLLUTION PREVENTION PLAN (SWPPP) – PERMIT FEE (BID ITEM NO. 13) ALLOWANCE

A. No measurement shall be made for this Item.

B. Payment is made for this item as an allowance towards the SWPPP Permit Fee to the NCWRP Expansion. Payment for this item shall be made as the allowance amount named in the Bid Schedule under Bid Item No. 13.

22. TRAFFIC CONTROL (BID ITEM NO. 14) LUMP SUM

A. No measurement shall be made for this Item.

B. Payment is made for this item for the all work required for traffic control measures, preparation of traffic control plans, submittal of plans, approvals from the City of San Diego including, but not limited to all measures required within the Contract Documents under this Contract and conforming to City of San Diego standards and requirements and shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 14.

23. temporary road with relocated water line and storm drain (BID ITEM NO. 15) LUMP SUM

A. Includes stormwater piping, curb and gutter, pavement, relocated water line, associated valves, grading, retaining wall. Payment for this item shall be made as the allowance amount named in the Bid Schedule under Bid Item No. 15.

24. BIORETENTION BASINS AND APPURTENANCES (BID ITEM NO. 16) LUMP SUM

A. No measurement shall be made for this Item.

B. Payment is made for this item for the all necessary components of the bioretention basins, inlet/outlet piping, soils, filter materials, geotextiles necessary to meet the final drainage requirements of the NCWRP Expansion site shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 16.

25. CP-1 NORTH CITY PURE WATER FACILITY MASS GRADING (BID ITEM NO. 17) LUMP SUM

A. No measurement shall be made for this Item.

B. General: All North City Pure Water Facility (NCPWF) site civil grading.

C. Payment is made for this item for the following:

1. Clearing, grubbing, and mass grading as shown on Drawings and as specified for the NCPWF site.
2. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 17.

26. FIELD SURVEYS (BID ITEM NO. 18) LUMP SUM

A. No measurement shall be made for this Item.

B. Payment is made for this item for meeting and performing survey and staking requirements in accordance with the Contract Documents. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 18.

27. FIELD ORDERS (BID ITEM NO. 19) ALLOWANCE

A. No measurement shall be made for this Item.

B. Payment is made for this item as an allowance towards field orders and contingencies that may occur during the course of the Work. Payment for this item shall be made as an allowance amount named in the Bid Schedule under Bid Item No. 19. Field Order limits shall conform to Whitebook 9-3.5.

28. SECURITY GUARD ALLOWANCE (BID ITEM NO. 20) ALLOWANCE

A. No measurement shall be made for this Item.

B. Payment is made for this item as an allowance towards security guard services under the terms of the Contract Documents. Payment for this item shall be made as an allowance amount named in the Bid Schedule under Bid Item No. 20.

29. relocation of power generation and prep for future power generation pad (additive alternate a - BID ITEM NO. 1) ADDITIVE/DEDUCTIVE alternate LUMP SUM

A. Includes relocation of existing power generation, storage container, all equipment associated with this facility. All wiring, utilities, grading, stormwater, structural, electrical and I&C interface. This also includes all grading and preparation for the future pad Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Additive Alternate A, Bid Item No. 1.

B. This Bid Item shall be an additive/deductive alternate.

30. RETENTION

A. The Owner shall retain a percentage of each progress payment in accordance with Section 9-3 Partial and Final Payment of Part 1 Special Provisions – General of the Contract Documents. The retained amount is available for the protection and payment of the person(s), mechanics, subcontractors, or materialmen who perform labor upon the Contract or Work thereunder, and the persons who supply such person(s), or subcontractors with components and supplies for carrying on such Work.

B. Pursuant to Section 22300 of the Public Contract Code of the State of California, the Contractor has the option, at its expense, to deposit securities with an Escrow Agent as a substitute for retention earnings required to be withheld by the City. Securities eligible for such substitution are bank or savings and loans certificates of deposit or such securities which are eligible for investment pursuant to Government Code Section 16430. As to any such security or securities so substituted for monies withheld, the Contractor shall be the beneficial owner of same and shall receive any interest thereon. Such security shall, at the request and expense of the Contractor, be deposited with the City or with a State or Federally Chartered bank as the escrow agent who shall pay such monies to the Contractor upon notification by the City that payment can be made. Such notification will be given at the expiration of 35 days from the date of acceptance of the work, or as prescribed by law, provided however, that there will be a continued retention of the necessary securities to cover such amounts as are required by law to be withheld by properly executed and filed notices to stop payment, or as may be authorized by the Contract to be further retained.

31. PHASE FUNDING

A. The Contract conditions and requirements for Phase Funding are contained in Section 6-1 Construction Schedule and Commencement of Work, and Section 9-3 Phase Funding of Part 1 Special Provisions - General of the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

# SECTION 01 31 13
# PROJECT COORDINATION

## PART 1 GENERAL

### 1. SUBMITTALS

A. Informational:

1. Statement of Qualification (SOQ) for land surveyor or civil engineer.
2. Photographs:
   a. Digital Images: Submit one copy of DVD disc containing images within 5 days of being taken. Each image is to have a minimum file size of 1.4 Mb (1,400 Kb) so viewed resolution is high quality. The production of larger file sizes with higher resolution is encouraged.
3. Video Recordings: Submit one copy, including updated copy of Project video log, within 5 days of being taken.

### 2. RELATED WORK AT SITE

A. General:

1. Other work that is either directly or indirectly related to scheduled performance of the Work under these Contract Documents, listed henceforth, is anticipated to be performed at Site by others.
   a. Contract 1 – Flow Equalization.
   b. Contract 2 – North City Water Reclamation Plant Expansion.
   c. Contract 3 – North City Pure Water Facility Influent Pump Station and Conveyance.
   d. NCWRP Renewable Energy Project.
   e. Morena Pump Station and Conveyance Project.
2. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions.
3. Include sequencing constraints specified herein as a part of Progress Schedule.
4. Coordinate work with environmental mitigation measures that are outlined in the North City EIR/EIS document.
5. Facility Operations: Contractor to ensure plant access and deliveries are maintained operational during Construction. Confirm with Owner operational hours and deliveries prior to Construction.

B. Power:

1. Electric Relocations:
   a. Contact Person: John Marshall, Governmental Liaison Planner.
   b. Telephone: (858) 547-3086.
   c. Email: jsmarshall@semprautilities.com

2. Eastgate New Services:
   a. Contact Person: Cathy Cavaletto, Senior Customer Project Planner.
   b. Telephone: (858) 636-5786.
   c. Email: CCavaletto@semprautilities.com

3. UTILITY NOTIFICATION AND COORDINATION

A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during the Work.

1. Electricity/Gas Company: San Diego Gas and Electric (SDG&E).
   a. Emergencies: (800) 411-7343.
   b. Mark-Out: 811 or www.call811.com
   c. Website: https://www.sdge.com/more-information/safety/gas-safety/dial-811-you-dig
2. Electric Relocations:
   a. Contact: John Marshall, Governmental Liaison Planner.
   b. Telephone: (858) 547-3086.
   c. Email: jsmarshall@semprautilities.com
3. Eastgate New Services:
   a. Contact Person: Cathy Cavaletto, Senior Customer Project Planner.
   b. Telephone: (858) 636-5786.
   c. Email: CCavaletto@semprautilities.com
4. Gas Relocations:
   a. Contact Person: Joseph Dator, Senior Field Utility Specialist.
   b. Telephone: (619) 517-8085.
   c. Email: JDator@semprautilities.com
5. Telephone Company: City of San Diego – Information Technology Department.
   a. Contact Person: IT Support.
   b. Telephone: (877) 796-5999.
6. Water/Sewer Department: Public Utilities Department.
   a. Contact Person: Emergency Hotline.
   b. Telephone: (619) 515-3525.
7. Public Works Department: City of San Diego.
   a. Contact Person: General Services.
   b. Telephone: (619) 533-4207.

4. SDG&E COORDINATION

A. Contractor shall abide by SDG&E standards, CPUC General Order 95, and OSHA requirements at all times. Work restrictions include (but are not limited to) the following:

1. Provide a clear route free of obstructions that would inhibit construction of overhead service facilities per SDG&E Standard SG 103.1.

2. Provide a “CAUTION OVERHEAD” signage under powerlines per CPUC General Order 95, Rule 39, Table 2-A.
3. Maintain accessibility at all times to existing 20-feet easement to SDG&E substation per SDG&E Standards SG 004.5 and SG 015.
    a. Proved H20 load bearing plating over any trenching for new storm drain.
    b. Workers or objects not supported by boom-type equipment must maintain 6-feet horizontal and 12-feet vertical clearance from medium-voltage (600V-50KV) conductors per SDG&E Standard OH 228.1.
    c. Boom-type lifting or hoisting equipment, including load, must maintain 20-feet horizontal clearance from medium-voltage (600-50KV) conductors per SDG&E Standard OH 228.2.
        1) To reduce minimum distance to 10-feet, refer to OSHA Requirements 1926.1408.
    d. All energized overhead facilities of any voltage classification shall have a minimum clearance of 10-feet measured horizontally and at a radium of 25-feet from an exposed tank, vent or fill tube containing flammable or explosive mixtures per SDG&E Standard SG 019.
    e. Install vehicle impact cushion around each power pole per SDG&E Standard OH 218.
    f. Maintain the most restrictive minimum vertical clearance of wires about thoroughfares per SDG&E Standard OH 224 or CPUC General Order 95, Rule 37, Table 1.
    g. Identify the work zone per OSHA Requirements 1926.1408(A)(1).
    h. Contractor shall review the following to confirm the above list complies with the latest requirements and any additional that may apply:
        1) SDG&E Standards: https://www.sdge.com/builderservices/standards-manuals
        2) CPUC General Order 95: http://docs.cpuc.ca.gov/publisheddocs/published/g000/m146/k646/146646565.pdf
        3) OSHA: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=19

5. PROJECT MILESTONES

A. Project Milestones:

1. Generally described in the General Requirements. The following is a detailed description of each:
    a. Milestone 1 – Completion of all sitework described below.
        1) Site Civil:
            a) All demolition as shown and detailed in the Contract Documents.

b) Type D concrete ditch.
c) New retaining walls A through D including retaining wall special over the existing 60-inch pipe.
d) New aluminum handrail on the top of all retaining walls as shown.
e) Construction of the new BMP #5 complete.
f) Mass excavation to the lines and grades shown on the Contract Documents.
g) Paving of the temporary road.
h) Chain link fence, gate, and bollards.

2) Yard Piping:
a) Install 18-inch casing for future use.
b) 16-inch casing with 10-inch gas carrier pipe.
c) 10-inch gas piping and gas meter relocate.
d) 12-inch FPW piping.
e) 10-inch SD piping and manholes.
f) 8-inch PW piping.
g) 4-inch gas piping.
h) 18-inch storm drain, inlets, and cleanouts.

3) Relocate Power Generator and Appurtenance (Additive/Deductive Alternate):
a) Demolition of piping at original location.
b) Construction of new generator pad.
c) Construct new control building pad.
d) Tank containment pad.
e) Relocate generator and equipment.
f) Grading of generator site and furnish DG lot for future use.
g) Provide piping as shown.
h) Electrical connections as required.

4) Electrical:
a) Electrical site work as shown.
b) Communications site work as shown.
c) Electrical demolition at Substation 63.
d) Electrical Work at Substation 64.
e) Electrical Work at Substation 69.
f) Electrical Work at Substation 72.

b. Milestone 2 – Completion of all NCPWF Mass Excavation Work: Clearing, grubbing, and mass excavation including construction of temporary silt basins and stormwater management facilities.

c. Milestone 3 – Completion of all Ozone/BAC Relocation Work:
1) 27 - EDR - Modifications to the EDR piping.
2) 29 - BAC Filters and Ozone: Relocation of the BAC Filters and Ozone processes to the Chlorine Contact Basin, rerouting of buried utilities in the area, and demolition of the concrete pad.

d. Milestone 4 - Substantial Completion: Occurs after the

completion of Milestones 1 through 3 and upon completing the prerequisites for substantial completion.

e. Milestone 5 - Final Completion: After successful completion of substantial completion requirements, and all aspects of the Contract Closeout have been satisfactorily completed.

6. GENERAL CONSTRAINTS ON SEQUENCE AND SCHEDULING OF WORK

A. Wastewater Projects:

1. The North City Water Reclamation Plant (NCWRP) treats wastewater generated by northern San Diego communities to produce reclaimed water produced for a variety of downstream users. Impairing the operational capabilities of this treatment plant will result in serious environmental damage and monetary fines.
2. Conduct work in a manner that will not impair the operational capabilities of essential elements of the treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quality of raw wastewater to the water quality limitations specified in the discharge permit.
3. The status of the treatment plant shall be defined as “operational” when it is capable of treating the entire quantity of wastewater received to the water quality limits specified in the discharge permit.
4. Include costs for compliance with specific sequencing limitations and constraints and the related general factors pertaining to such compliance including, but not limited to:
   a. Reduced construction efficiency and productivity.
   b. Location of site at which Work shall be performed.
   c. Overtime costs for performing work outside of normal work hours, if required.
   d. Escalation of costs.
   e. Work related to temporary facilities needed to maintain plant operations.
   f. Preparation and revision of schedule and planned Sequence of Work.
   g. Numerous requests for clarification of details related to compliance with this Section.
   h. Design and construction of temporary bracing, underpinning, or special sequencing necessary to support or brace existing structures.
   i. Design, construction, and provision of temporary, new, or relocated piping, conduit, and associated supports necessary to maintain plant operations.

B. Work Sequence and Constraints:

1. Utilize description of critical events in work sequence in this Section as a guideline for scheduling and undertaking the Work.
2. Work sequence and constraints presented do not include all items

affecting completion of the Work, but are intended to describe critical events necessary to minimize disruption of the existing facilities and to ensure compliance with a Waste Discharge Requirement Order.

3. Work sequence and constraints represent one possible way of executing the Work, but the Contractor is expected to undertake the Work in whatever manner they believe to be best and is expected to submit proposed changes to work sequence for review.

7. COORDINATION OF WORK

A. Maintain overall coordination of the Work.

B. Obtain construction schedules from subcontractors and suppliers, and assume responsibility for correctness.

C. Incorporate schedules from subcontractors and suppliers into Progress Schedule to plan for and comply with sequencing constraints.

8. WORK SEQUENCING/CONSTRAINTS

A. The purpose of this Article is to present pertinent information that will assist the Contractor in preparing their approach to Work. Concurrent activities are not identified. This Work sequence described herein is provided only as a guide to how the Work may be performed; the Contractor is ultimately responsible for how the Work is performed, and it is expected that the Contractor may have approaches different than described herein. However, the Contractor shall comply with all work restrictions and constraints identified.

B. In all instances, the Contractor shall hold a preconstruction meeting prior to each shutdown, each bypass pumping, or the beginning of any shoring activity.

C. Ozone/BAC Relocation Work Sequencing/Constraints:

1. The North City Water Reclamation Plant (NCWRP) treats wastewater generated by northern San Diego communities to produce reclaimed water produced for a variety of downstream users. Impairing the operational capabilities of this treatment plant will result in serious environmental damage and monetary fines.
2. Conduct work in a manner that will not impair the operational capabilities of essential elements of the treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quality of raw wastewater to the water quality limitations specified in the discharge permit.
3. The status of the treatment plant shall be defined as “operational” when it is capable of treating the entire quantity of wastewater received to the water quality limits specified in the discharge

permit.

4. Include costs for compliance with specific sequencing limitations and constraints and the related general factors pertaining to such compliance including, but not limited to:
   a. Reduced construction efficiency and productivity.
   b. Location of site at which Work shall be performed.
   c. Overtime costs for performing work outside of normal work hours, if required.
   d. Escalation of costs.
   e. Work related to temporary facilities needed to maintain plant operations.
   f. Preparation and revision of schedule and planned Sequence of Work.
   g. Numerous requests for clarification of details related to compliance with this Section.
   h. Design and construction of temporary bracing, underpinning, or special sequencing necessary to support or brace existing structures.
   i. Design, construction, and provision of temporary, new, or relocated piping, conduit, and associated supports necessary to maintain plant operations.
5. Work Sequence and Constraints:
   a. Utilize description of critical events in work sequence in this Section as a guideline for scheduling and undertaking the Work.
   b. Work sequence and constraints presented do not include all items affecting completion of the Work, but are intended to describe critical events necessary to minimize disruption of the existing facilities and to ensure compliance with a Waste Discharge Requirement Order.
   c. Work sequence and constraints represent one possible way of executing the Work, but the Contractor is expected to undertake the Work in whatever manner they believe to be best and is expected to submit proposed changes to work sequence for review.
6. General Shutdown Constraints:
   a. Execute the Work while the existing facility is in operation.
   b. Some activities may be accomplished without a shutdown.
   c. Apply to activities of construction regardless of process or work area.
   d. Activities that disrupt plant or utilities operations must comply with these shutdown constraints.
   e. Organize work to be completed in a minimum number of shutdowns.
   f. Have required equipment, materials, and labor on hand at time of shutdown.
   g. Provide thorough advanced planning, including timeline having required equipment, materials, and labor on hand at time of shutdown. Shutdown plan shall be submitted a

minimum of 42 days in advance of the work and must be approved a minimum of 21 days in advance of the work. In the absence of an approved work plan, scheduled shutdown date will be pushed back in order to provide a minimum 4-week advance notice of the Work.

h. Shutdown plans shall include hourly schedule of work events to take place.
i. When multiple shifts occur, Contractor will need to describe the transition and maintenance of quality control of the Work from one crew to the next crew.
j. Initiation (start) of shutdowns are limited to Tuesdays, Wednesdays, and Thursdays.
k. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.
l. Twenty-four hours in advance of the scheduled shutdown, the Owner's Representative will confirm that all required equipment and materials are on site before the shutdown is scheduled to begin. Should required materials and equipment not be onsite 24 hours in advance of the scheduled shutdown, the Owner reserves the right to postpone the shutdown.
m. Final determination of the permitting of shutdowns will be the sole judgment of the Owner.
n. Owner maintains the ability to abort on the day of the scheduled shutdown.

7. General Seasonal Plant Flow Work Limitations: Activities that disrupt plant operations are prohibited during the summer, unless otherwise approved in writing by the Owner.
8. Unit Process Availability Work Limitations: Shutdowns and tie-ins or other activities that disrupt plant operations are prohibited unless otherwise approved in writing by the Owner.
9. Shutdown Activities:
   a. Scheduling: Perform between the hours of 2:00 a.m. and 6:00 a.m. or as directed or approved by Construction Manager or Owner.
   b. Unplanned shutdowns due to emergencies are not indicated in this Section.
   c. Planned shutdowns are summarized in the table below.

| Number | Description | Impacted Processes | Maximum Allowable Shutdown Duration |
|---|---|---|---|
| 1 | Install EDRP piping in the chlorine contact tank inlet channel at the effluent pump | Chlorine Contact Tank & Recycled Water | 21 days(1) |

| Number | Description | Impacted Processes | Maximum Allowable Shutdown Duration |
|---|---|---|---|
| | station. | Production | |
| 2 | Tie-in PD/BWE piping from EDR-6 and DPWF MF/UF to new manhole. | EDR-6 & DPWF | 4 hours(2) |
| 3 | Install PD bypass pump from manhole. | EDR-6 & DPWF | 4 hours(2) |
| 4 | Remove PD bypass pump from manhole. | EDR-6 & DPWF | 4 hours(2) |
| 5 | Tie-in EDRF at EDRF pump 27-P-104 and at EDR-6. | EDR-6 | 4 hours(2) |
| 6 | Tie-in EDRP at EDR-6. | EDR-6 | 4 hours(2) |
| 7 | Tie-in EDRP at EDR 1-3 Product Tank. | EDR 1-3 | 4 hours(2) |
| 8 | Tie in CIPF and ECIP piping at EDR-6 and at chemical piping gallery adjacent to EDR 1-3. | EDR CIP System | 4 hours |
| 9 | Tie in SHC piping at EDR-6 at chemical piping gallery adjacent to ED 1-3. | SHC System | 4 hours |
| 10 | Tie-in SDR upstream of existing SDR pipe adjacent to EDR 1-3 and at proposed catch basin location. | SDR | 4 hours(2) |
| 11 | Install temporary OZI piping to DPWF MF/UF from EDRF pumps 27-P-104, 27-P-105, and 27-P-106. | DPWF MF/UF, RO, and UV AOP | 4 hours(2) |
| 12 | Remove temporary OZI piping and connect new piping to ozone and BAF with bypass to DWPF MF/UF processes. | DPWF MF/UF, RO, and UV AOP | 4 hours(2) |
| 13 | Tie-in to existing potable water (PW) system. | Potable Water System | 4 hours(2) |

Notes:
(1) Seasonal restriction on this shutdown such that it coincides with winter months January through March.
(2) Provide for adequate low total dissolved solids (TDS) product from the EDR and DPWF systems at all times. Where possible, EDR shutdowns shall not occur simultaneously with DPWF shutdowns.

10. Dewatering of Existing Process and Disposal of Residue:
    a. Before Owner turns process unit over to Contractor for modification or temporary use, Owner shall have dewatered and disposed of liquid and solids in the process unit.
        1) Drainage and disposal of process unit liquids, solids, etc. into another treatment process unit on the plant site may be allowed if approved in advance by the Construction Manager and Owner, and is conducted in accordance with Owner's requirements.
        2) Costs for any dewatering, disposal of solids and residuals, and preparation of surfaces for the Work are Contractor's responsibility.
            a) Includes tipping fees for the removal and disposal of the grit/debris.
        3) Grit debris may include biological wastewater material that may not be accepted at certain landfills due to its nature.
        4) Dewatering of grit/debris as a result of any additional cleaning to accommodate modifications to meet landfill requirements is the responsibility of the Contractor.
        5) Contractor shall provide adequate time in schedules for draining and cleanup of pipelines and basins.
        6) Owner will remove standing liquids and broom clean the floor.
11. Gas Purging Requirements:
    a. References:
        1) American Gas Association (AGA): Purging Principles and Practice, 2001 Edition.
        2) National Fire Protection Association (NFPA):
            a) NFPA 54 – National Fuel Gas Code.
            b) NFPA 69 – Standard on Explosion Prevention Systems.
    b. Ozone system components and piping could accumulate significant amounts of combustible mixtures must be purged in strict accordance with AGA and NFPA purging principles when being drawn down or taken out of service and before being started up or returned to service. The Contractor shall purge such system components with nitrogen in accordance with NFPA 54, NFPA 69, and AGA Purging Principles and Practice. The Contractor shall provide evidence of satisfactory completion of the inert gas purge prior to starting up or beginning work on the ozone system relocation. The Contractor shall be responsible for instrumentation and monitoring required to prove satisfactory completion of the inert gas purge.
12. Complete relocation of buried utilities shown in Volume 5 before relocating the BAC Filter and Ozone Processes.
    a. This includes process drain (PD), storm drain (SDR), ozone generator influent (OZI), DPWF feed (PDR), EDR product

(EDRP), EDR feed (EDRF), and chemical piping.

b. Install bypass pumping of the inbound PD flows upstream of improvement manhole adjacent to EDR-6 as necessary for removal and installation of the large diameter PD piping and modification/installation of PD manholes.

13. Install temporary piping as needed from EDRF Pumps 27-P-104, 27-P-105, and 27-P-106 so that the MF/UF, RO, and UV AOP DPWF processes can remain in service during the BAC Filter and Ozone Process relocation.
    a. The two tie-in points shall be located as follows:
        1) Immediately downstream of the 2-inch air release valve (ARV), which is located downstream of the isolation valves for EDRF Pumps 27-P-104, 27-P-105, and 27-P-106 on the common header. Refer to Photo 2 on Drawing No. 27-M-001 for a view of this location.
        2) Immediately downstream of existing isolation valve to DPWF MF/UF processes, which is located upstream of the sodium hypochlorite and ammonium hydroxide injection points and static mixer. Refer to Photo 3 on Drawing No. 27-M-003 for a view of this location.
    b. Route temporary piping such that access to existing processes remains unencumbered.

D. Early Sitework:

1. The ductbank crossing at the existing project entrance from Eastgate Mall shall be completed in a manner that allows for continuous access by the plant staff and deliveries during business hours.
2. The temporary access road west of the O&M building shall be fully operational prior to the demolition of the entry road east of the O&M building. This includes:
    a. Provide temporary parking to replace any stalls impacted by construction of the temporary road.
    b. Relocate utilities impacted by the construction of the temporary access road.
3. The existing power generation facilities shall be relocated and operational (with access) prior to the grading of the pad for the new secondary clarifiers. This includes:
    a. Relocate the storm drain.
    b. Build the retaining wall, access, and grading for the new power generation location.
    c. Relocate the power generation facilities.
4. The maximum allowable shutdown duration for relocation of City 1.6 MW engine shall be coordinated with the City prior to any construction. The existing facility operations includes but is not limited to:
    a. Existing facility operations includes privately-operated power generation facility that is to remain in continuous operation,

coordinate site access and utility connections through City.

9. GENERAL SEQUENCING REQUIREMENTS

A. Electrical installed before functional testing of any facility requiring electrical.

B. Drainage functional before facility requiring drainage.

C. Buried utility relocation and temporary DPWF MF/UF feed piping installed before ozone and BAC filter relocation.

D. New piping installed and tested up to tie-in point(s) before shutdown(s).

10. FACILITY OPERATIONS

A. Continuous operation of Owner's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.

B. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's operations.

C. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of Owner's facility.

D. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after authorization by Owner and Construction Manager. Such authorization will be considered within 48 hours after receipt of Contractor's written request.

E. Process or Facility Shutdown and Operating Requirements:

1. The following describes operating requirements and facilities which may be shutdown at some time during the Work:
   a. Provide 21 days advance written request for approval of need to shut down a process or facility to Owner and Construction Manager.
   b. Maintain one main electrical service in operation at all times.
2. Power outages will be considered upon 48 hours written request to Owner and Construction Manager. Describe the reason, anticipated length of time, and areas affected by the outage. Provide temporary provisions for continuous power supply to critical facility components.

F. Do not remove or demolish existing facilities required to keep the existing plant operational at the capacities specified until the existing facilities are replaced by temporary, new, or upgraded facilities or

equipment.

1. Test replacement facilities to demonstrate operational success prior to removing or demolishing existing facilities.

G. Provide safe, continuous access to process control equipment for plant operations personnel.

H. Maintain safe operation and maintenance access for all operating equipment at all times.

1. For all operating equipment, reserve a minimum of 3 feet unencumbered workspace around equipment.
   a. Areas reserved for operations and maintenance access for all operating equipment shall be separated from Contractor's working area with temporary orange plastic fencing or similar means.
   b. Storage of Contractor's equipment or materials in access area is prohibited.

I. Provide access on 1 hour advance notice to process control equipment for plant maintenance personnel and associated maintenance equipment.

J. Install and maintain bypass facilities and temporary connections required to keep Owner's wastewater treatment operations on line. Sequences other than those specified will be considered upon written request to Owner and Construction Manager, provided they afford equivalent continuity of operations.

K. Do not proceed with Work affecting a facility's operation without obtaining Owner's and Construction Manager's advance approval of the need for and duration of such Work.

L. Relocation of Existing Facilities:

1. During construction, it is expected that minor relocations of Work will be necessary.
2. Provide complete relocation of existing structures and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct bank, and other necessary items.
3. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
4. Perform relocations to minimize downtime of existing facilities.
5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Construction Manager.

## 11. COMPLIANCE WITH DISCHARGE PERMITS

A. The existing facility is operating under the terms of a Waste Discharge Requirement Order and a permit issued by the Regional Water Quality Control Board. This permit specifies the water quality limits that the plant must meet prior to discharge of effluent. A copy of the existing permit is on file for review at the plant.

B. Perform work in a manner that will not prevent the existing facility from achieving the finished water quality requirements established by regulations.

12. ADJACENT FACILITIES AND PROPERTIES

A. Examination:

1. After Effective Date of the Agreement and before Work at Site is started, Contractor, Construction Manager, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.
2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.

B. Documentation:

1. Record and submit documentation of observations made on examination inspections in accordance with Article Construction Photographs and Article Audio-Video Recordings.
2. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor's operations, and is for the protection of adjacent property owners, Contractor, and Owner.

13. CONSTRUCTION PHOTOGRAPHS

A. General:

1. Photographically document all phases of the Project including preconstruction, construction progress, and post-construction.
2. Construction Manager shall have right to select subject matter and vantage point from which photographs are to be taken.

B. Preconstruction and Post-Construction:

1. After Effective Date of the Agreement and before Work at Site is started, and again upon issuance of Substantial Completion, take a minimum of 60 photographs of Site and property adjacent to perimeter of Site.
2. Particular emphasis shall be directed to structures both inside and outside the Site.

3. Format: Digital, minimum resolution of 20 megapixel.

C. Construction Progress Photos:

1. Photographically demonstrate progress of construction, showing every aspect of Site and adjacent properties as well as interior and exterior of new or impacted structures.
2. Weekly: Take 50 photographs using digital, minimum resolution of 20 megapixel.

D. Documentation:

1. Digital Images:
   a. Electronic image shall have date taken embedded into image.
   b. Archive using a commercially available photo management system that provides listing of photographs including date, keyword description, and direction of photograph.
   c. Label file folders or database records with Project and Owner's name, and month and year images were produced.

14. AUDIO-VIDEO RECORDINGS

A. Prior to beginning the Work on Site or of a particular area of the Work, video Site and property adjacent to Site.

B. In the case of preconstruction recording, no work shall begin in the area prior to Construction Manager's review and approval of content and quality of video for that area.

C. Particular emphasis shall be directed to physical condition of existing vegetation, structures, and pavements within Site and areas adjacent to and within the right-of-way or easement, and on Contractor storage and staging areas.

D. The Contractor shall provide a continuous time lapsed construction video for the overall Site depicting the continuous construction progress. This video shall be provided to the Owner on a monthly basis, with the final version covering the entire construction period being provided as part of the closeout documents.

E. Construction Manager shall have right to select subject matter and vantage point from which videos are to be taken.

F. Video recording shall be by a professional commercial videographer, experienced in shooting exterior and interior construction videos. Video Format and Quality:

1. DVD format, with sound.
2. Video:
   a. Produce bright, sharp, and clear images with accurate colors,

free of distortion and other forms of picture imperfections.

b. Electronically, and accurately display the month, day, year, and time of day of the recording.

3. Audio:
   a. Audio documentation shall be done clearly, precisely, and at a moderate pace.
   b. Indicate date, project name, and a brief description of the location of recording, including:
      1) Facility name.
      2) Street names or easements.
      3) Addresses of private property.
      4) Direction of coverage, including engineering stationing, if applicable.

G. Documentation:

1. DVD Label:
   a. DVD number (numbered sequentially, beginning with 001).
   b. Project name.
   c. Applicable location.
   d. Date and time of coverage.
2. Project Video Log: Maintain an ongoing log that incorporates above noted label information for DVDs on Project.

15. REFERENCE POINTS AND SURVEYS

A. Location and elevation of bench marks are shown on Drawings.

B. Contractor's Responsibilities:

1. Provide additional survey and layout required to layout the Work.
2. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
3. In event of discrepancy in data or staking provided by Owner, request clarification before proceeding with Work.
4. Retain professional land surveyor or civil engineer registered in California who shall perform or supervise engineering surveying necessary for construction staking and layout.
5. Maintain complete accurate log of survey work as it progresses as a Record Document.
6. On request of Construction Manager, submit documentation.
7. Provide competent employee(s), tools, stakes, and other equipment and materials as Construction Manager may require to:
   a. Establish control points, lines, and easement boundaries.
   b. Check layout, survey, and measurement work performed by others.
   c. Measure quantities for payment purposes.

PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 1. SALVAGE OF MATERIALS

A. Salvage materials for Owner's use where shown:

1. Remove material with extreme care so as not to damage for future use.
2. Promptly remove salvaged materials from Work area.
3. Store materials where instructed by Owner onsite.

B. Meet with Construction Manager prior to starting to dismantle equipment or piping designated to be salvaged.

C. Meet with Construction Manager and Owner prior to salvaging of equipment to ascertain the condition of the equipment being salvaged. Provide new or repair damaged equipment or material specified or indicated to be salvaged should condition vary from the condition prior to salvage. Clean and protect equipment from dust, dirt, natural elements, and store as directed.

END OF SECTION

# SECTION 01 31 19
# PROJECT MEETINGS

## PART 1 GENERAL

### 1. GENERAL

A. Contractor shall schedule physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 5 days after each meeting to participants and parties affected by meeting decisions.

### 2. PRECONSTRUCTION CONFERENCE

A. Contractor shall be prepared to discuss the following subjects, as a minimum:

1. Required schedules.
2. Status of Bonds and insurance.
3. Sequencing of critical path work items.
4. Progress payment procedures.
5. Project changes and clarification procedures.
6. Use of Site, access, office and storage areas, security and temporary facilities.
7. Major product delivery and priorities.
8. Contractor’s safety plan and representative.

B. Attendees will include:

1. Owner’s representatives.
2. Construction Manager’s representatives.
3. Contractor’s office representative.
4. Contractor’s resident superintendent.
5. Contractor’s quality control representative.
6. Subcontractors’ representatives whom Contractor may desire or Construction Manager may request to attend.
7. Design Engineer’s representatives.
8. Others as appropriate.

### 3. ENVIRONMENTAL MITIGATION MONITORING AND REPORTING PROGRAM PRECONSTRUCTION CONFERENCE

A. The Contractor shall be required to discuss the following:

1. Discuss the Environmental Mitigation Monitoring and Reporting Program.

B. Attendees will include:

1. City's Mitigation Monitoring Coordination Section Construction Manager.
2. Owner's representatives.
3. Construction Manager's representatives.
4. Contractor's representatives.
5. Contractor's quality control representative.
6. Others as appropriate.

4. PRELIMINARY SCHEDULES REVIEW MEETING

A. As set forth in General Conditions and Section 01 32 00, Construction Progress Documentation.

B. Provide weekly look-ahead schedules for Progress Meetings (show 1-week past, current week, and 4 weeks in advance).

5. PROGRESS MEETINGS

A. Construction Manager will schedule regular progress meetings at Site, conducted weekly to review the Work progress, Progress Schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.

B. Attendees will include:

1. Owner's representative(s), as appropriate.
2. Construction Manager's representative (s), as appropriate.
3. Contractor, Subcontractors, and Suppliers, as appropriate.
4. Design Engineer's representative(s).
5. Others as appropriate.

6. QUALITY CONTROL MEETINGS

A. Scheduled by Construction Manager on regular basis and as necessary to review test and inspection reports, and other matters relating to quality control of the Work and work of other Contractors.

B. Attendees will include:

1. Contractor.
2. Contractor's designated quality control representative.
3. Subcontractors and Suppliers, as necessary.
4. Construction Manager's representatives.
5. Design Engineer's representatives, as necessary.

7. PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS) COORDINATION MEETINGS

A. Construction Manager will schedule as needed meetings at Site to

review specific requirements of PICS work.

B. Attendees will include:

1. Contractor.
2. Owner.
3. Construction Manager.
4. PICS Subcontractor/Installer.
5. Distributed Control System Provider.
6. Design Engineer's representatives, as required.

8. PREINSTALLATION MEETINGS

A. When required in individual Specification sections, convene at Site prior to commencing the Work of that section.

B. Require attendance of entities directly affecting, or affected by, the Work of that section.

C. Notify Construction Manager 5 days in advance of meeting date.

D. Provide suggested agenda to Construction Manager to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

9. FACILITY STARTUP MEETINGS

A. Schedule and attend a minimum of twenty facility startup meetings. The first of such meetings shall be held prior to submitting Facility Startup Plan, as specified in Section 01 91 14, Testing, Integration, and Startup, and shall include preliminary discussions regarding such plan.

B. Agenda items shall include, but not be limited to, content of Facility Startup Plan, coordination needed between various parties in attendance, and potential problems associated with startup.

C. Attendees will include:

1. Contractor.
2. Contractor's designated quality control representative.
3. Subcontractors and equipment manufacturer's representatives whom Contractor deems to be directly involved in facility startup.
4. Construction Manager.
5. Design Engineer's representatives.
6. Owner's operations personnel.
7. Others as required by Contract Documents or as deemed necessary by Contractor or City.

10. OTHER MEETINGS

A. In accordance with Contract Documents and as may be required by Owner and Construction Manager.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (NOT Used)

END OF SECTION

# SECTION 01 32 00
# CONSTRUCTION PROGRESS DOCUMENTATION

## part 1 GENERAL

### 1. SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit within 14 days after Notice to Proceed.
2. Detailed Baseline Schedule:
   a. Submit final Baseline Schedule within 60 working days after Notice to Proceed.
   b. Submit an Updated Progress Schedules monthly in accordance with Article Progress of the Work.
3. Submit with Each Progress Schedule Submission:
   a. Contractor's certification that Progress Schedule submission is actual schedule being utilized for execution of the Work.

   b. Disk file compatible with latest version of Project Planner (P6) by Primavera Systems, Inc.
   b. Progress Schedule: Four legible 11-inch by 17-inch hard copies.
   c. Narrative Progress Report: Same number of copies as specified for Progress Schedule.
4. Prior to final payment, submit a final Updated Progress Schedule.

### 2. RESPONSIBLE PERSON

A. Designate, in writing at Preconstruction Conference, the Contractor's person responsible for preparation, maintenance, updating, and revision of all schedules.

B. Qualifications of Responsible Person:

1. Authority to act on behalf of Contractor.
2. Experience in preparation of complex construction schedules for projects of similar value, size, and complexity.
3. Knowledge of CPM scheduling utilizing the latest version of Project Planner (P6) by Primavera Systems, Inc.

C. Construction Manager reserves the right to disapprove Scheduler when submitted by Contractor if not qualified. Construction Manager reserves the right to remove Scheduler from the Project if found to be incompetent.

### 3. SCHEDULING FORMAT AND SOFTWARE

A. Schedule Format: Utilize critical path method (CPM) format.

B. Prepare computerized cost and resource loaded schedule utilizing the latest version of Project Planner (P6) by Primavera Systems, Inc. Contractor shall provide two licensed copies of the scheduling software to the Construction Manager, registered in the Construction Manager's name, for the duration of the Project.

4. PRECONSTRUCTION SCHEDULING MEETING

A. Construction Manager will conduct a Preconstruction Scheduling Meeting with Contractor's Project Manager, General Superintendent and Scheduler to take place within 7 calendar days after Notice to Proceed. This meeting is separate from the Preconstruction Conference meeting and is intended to cover schedule issues exclusively.

B. At the meeting, scheduling requirements shall be reviewed with Contractor. These include schedule preparation, reporting requirement, updates, revisions, and schedule delay analysis. Contractor shall present their schedule methodology, planned sequence of operations, and present their proposed activity coding structure.

C. Naming Convention: Name schedule files with the year, month, and day of the data date, revision identifier, and a description of the schedule.

1. Example 1: 2014_07_30 rev 1 draft baseline schedule.xer.
2. Example 2: 2014_09_30 rev 2 sep final update.xer.

D. Coding Structure: Contractor shall submit proposed coding structure, identifying the code fields and the associated code values it intends to use in the Project schedule. The coding structure shall, at a minimum, include code fields for the following:

1. Submit proposed coding structure, identifying the code fields and the associated code values Contractor intends to use in the Project schedule.
2. At a minimum, include code fields for Project Segment or Phase, Area of Work, and Type of Work.
3. Submittal/Procurement/Construction and Responsibility/Subcontractor. Refer to NETWORK DETAILS AND GRAPHICAL OUTPUT for listing of activity categories to be included in the schedule.
4. Phase: A value shall be defined for each phase or segment of Work.
5. Responsibility Code: A value shall be defined for the Contractor (GC), each Subcontractor, and for each third party.
6. Area Code: A value shall be defined for each area where Work will be performed.
7. Bid Item Code: A value shall be defined for each bid item.
8. Work Type: A value shall be defined for each of the following types of Work:
   a. Sitework.

b. Civil.
c. Structural.
d. Mechanical.
e. Electrical.
f. Instrumentation and Controls.

f. Critical submittals that impact the critical path (including preparation, review, and procurement).

5. PRELIMINARY PROGRESS SCHEDULE

A. In addition to basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 120 days, and a summary of balance of Project through Final Completion.

B. Show activities including, but not limited to the following:

1. Notice to Proceed.
2. Permits.
3. Mobilization and other preliminary activities.
4. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01 33 00, Submittal Procedures.
5. Early procurement activities for long lead equipment and materials.
6. Initial Site work.
7. Earthwork.
8. Specified Work sequences and construction constraints.
9. Contract Milestone and Completion Dates.
10. Owner-furnished products delivery dates or ranges of dates.
11. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.
12. System startup summary.
13. Project close-out summary.
14. Demobilization summary.

C. Update Preliminary Progress Schedule within 7 days of receipt of Construction Manager's review comments and resubmit. Continue updating the Preliminary Progress Schedule until approved by the Construction Manager. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Construction Manager.

D. Format: In accordance with Article Progress Schedule—Critical Path Network.

6. BASELINE SCHEDULE

A. These requirements are in addition to those provided in the General Conditions and Special Provisions.

B. No more than 60 working days after Notice to Proceed, Contractor shall submit the Final Baseline Schedule. Baseline Schedule shall show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor beginning with the date of Notice to Proceed and concluding with date of Final Completion of Contract.

C. Format: In accordance with Article Progress Schedule—Critical Path Network.

D. Baseline Schedule Submittals: The Contractor shall submit the following Baseline Schedule components in accordance with the times provided in the "Baseline Schedule Development – Submittal Schedule."

| Baseline Schedule Development – Submittal Schedule | | |
|---|---|---|
| Baseline Schedule Component Description | Submittal Deadline | Construction Manager's Review Deadline |
| Project Coding, Resource Definitions, Calendars, Milestone | 5 Working Days After Award of Contract | 5 Working Days After Receipt of Submittal |
| Submittal, Submittal Review and Material Fabrication and Delivery Schedule | 20 Working Days After Award of Contract | 5 Working Days After Receipt of Submittal |
| Construction Activities and Schedule Logic | 30 Working Days After Award of Contract | 10 Working Days After Receipt of Submittal |
| Baseline Schedule with Cost Loading | 45 Working Days After Award of Contract | 10 Working Days After Receipt of Submittal |
| Final Baseline Schedule adjust for Construction Manager's comments and Actual NTP | 60 Working Days After Award of Contract | 5 Working Days After Receipt of Submittal |

E. No physical work by the Contractor at the construction site shall be allowed until the Final Baseline Schedule is accepted by the Owner.

F. Acceptance of the Baseline Schedule by the Owner is a condition precedent to making payments for Work other than bonds and insurance.

G. Early Completion:

1. The Contractor may show early completion of the original CPM Submittal if that is its plan and the schedule satisfies all

requirements of the Contract Documents.

2. Where the Contractor submits a Baseline Schedule, reflecting a plan to complete the Project earlier than the Contract Completion Date, it is agreed that a change to the Contract will be issued to revise Contract Milestone date(s) to the early completion date(s) shown in the Baseline Schedule. Physical work at the Project site shall not commence prior to execution of this Change Order.

H. Baseline Schedule Submittal shall include as a minimum the following components:

1. Tabular listing of all activities including activity data.
2. Time scaled bar chart.
3. Predecessor/successor report.
4. Budgeted cost assigned to each construction activity.
5. Phase, responsibility, area, and work type coding of activities.
6. The Baseline Schedule narrative shall explain the schedule logic and construction sequencing.
7. Read-only CD containing the schedule file, narrative, and all reports.

I. In no event shall the Baseline Schedule be accepted if it fails to meet any of the following criteria:

1. The sum of all dollar values shall equal the Contract Price.
2. Activity costs shall not be front-end loaded.
3. The Contract Milestones and special construction requirements specified in these Special Provisions shall be accurately represented. The Baseline Schedule shall show the timely completion of each Contract Milestone. All activities shall have a percent complete of zero, total float greater than or equal to zero, and there shall be no actual start or actual finish dates.
4. Every activity, except the NTP and Contract Completion Milestones, shall have a minimum of one predecessor and one successor. Activity predecessors and successors shall be included in the Project schedule as necessary to show the Work flow and resource limitations. Redundant logic and extraneous logic ties shall not be included.
5. Errors in activity coding shall not occur in more than 1 percent of the total number of activities or 50 activities, whichever is less.
6. Submittal components shall be complete and in accordance with their specified format.

J. Update monthly to reflect actual progress and occurrences to date, including weather delays.

7. SCHEDULE COORDINATION

A. Project is divided into multiple prime contracts with each contract awarded separately. Construction Manager will be responsible for

developing and maintaining a master Progress Schedule using individual Progress Schedules prepared by each Contractor as submitted to Construction Manager under this section.

B. Construction Manager shall prepare and transmit to Design Engineer one hard copy of master Progress Schedule for each designated Contractor and one hard copy for Design Engineer.

C. Where Contractor is referred to in the singular, it shall refer to each of separate Contractors as applicable.

8. SCHEDULE PREPARATION

A. General: Comprehensive computer-generated schedule using CPM, generally as outlined in Associated General Contractors of America (AGC) 580, “Construction Project Planning and Scheduling Guidelines.” If a conflict occurs between the AGC publication and this Specification, this Specification shall govern.

B. Prepare schedule utilizing activity durations in terms of working days. Do not exceed 15-working-day duration on activities except concrete curing, Submittal review and equipment fabrication and deliveries. Where duration of continuous work exceeds 15 working days, subdivide activities by location, stationing, or other sub-element of the Work.

C. Activity duration for Submittal review shall not be less than review time specified unless clearly identified and prior written acceptance has been obtained from Construction Manager.

D. Contractor shall coordinate holidays to be observed with the Owner and incorporate them into the schedule.

E. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified times and at price specified in Agreement. Failure of Contractor to include required schedule constraints, sequences or milestones in schedule shall not relieve Contractor of obligation to conform to requirements of Contract. Acceptance of schedule shall not waive Contract requirements. In event of conflict between accepted schedule and Contract requirements, terms of Contract shall govern at all times, unless requirements are waived in writing by the Owner.

F. Reference schedule to calendar days with beginning of Contract Time as Day “1”.

G. Interim Milestone Dates, Operational Constraints: In event there are interim milestone dates and/or operational constraints set forth in Contract, Contractor shall show them on schedule as specified in Contract. Contractor shall not use Zero Total Float constraint or Mandatory Finish Date on such Contract requirements.

H. Schedule Windows for Owner–furnished, Contractor–installed Equipment or Materials: Immediately after Notice to Proceed, Contractor shall obtain from Construction Manager anticipated delivery dates of Owner–furnished equipment or materials. These dates shall be shown on schedule in same manner indicated by Construction Manager.

I. Contents:

1. Schedule shall begin with the date of Notice to Proceed and conclude with the date of Final Completion.
2. Identify Work calendar basis using days as a unit of measure.
3. Show complete interdependence and sequence of construction and Project-related activities reasonably required to complete the Work.
4. Identify the Work of separate stages and other logically grouped activities, and clearly identify critical path of activities.
5. Reflect sequences of the Work, constraints, delivery windows, review times, Contract Times and Project Milestones set forth in the Agreement and Section 01 31 13, Project Coordination.
6. Activities shall be broken out as follows:
   a. Early Sitework.
   b. NCPWF Mass Excavation.
   c. Ozone/BAC Relocation.
7. Include as applicable, at a minimum:
   a. Obtaining permits, Submittals for early product procurement, and long lead time items.
   b. Mobilization and other preliminary activities.
   c. Initial sitework.
   d. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s) for Subcontract Work.
   e. Major equipment design, fabrication, factory testing, and delivery dates.
   f. Sitework.
   g. Concrete work.
   h. Structural steel work.
   i. Architectural features work.
   j. Conveying systems work.
   k. Equipment work.
   l. Mechanical work.
   m. Electrical work.
   n. Instrumentation and control work.
   o. Interfaces with Owner-furnished equipment.
   p. Other important work for each major facility.
   q. Equipment and system startup and test activities.
   r. Project closeout and cleanup.
   s. Demobilization.

J. Network Graphical Display:

1. Plot or print on paper not greater than 30 inches by 42 inches or smaller than 22 inches by 34 inches, unless otherwise approved.
2. Title Block: Show name of Project, Owner, date submitted, revision or update number, and the name of the Scheduler. Updated schedules shall indicate data date.
3. Identify horizontally across top of schedule the time frame by year, month, and day.
4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
5. Indicate the critical path.
6. Show, at a minimum, the controlling relationships between activities.
7. Plot activities on a time-scaled basis, with the length of each activity proportional to the current estimate of the duration.
8. Plot activities on an early start basis unless otherwise requested by Construction Manager.
9. Provide a legend to describe standard and special symbols used.

K. Schedule Report:

1. On 8-1/2-inch by 11-inch white paper, unless otherwise approved.
2. List information for each activity in tabular format, including, at a minimum:
   a. Activity Identification Number.
   b. Activity Name.
   c. Predecessors and Successors.
   d. Original Duration.
   e. Remaining Duration.
   f. Early Start Date (Actual start on Updated Progress Schedules).
   g. Early Finish Date (Actual finish on Updated Progress Schedules).
   h. Late Start Date.
   i. Late Finish Date.
   j. Total Float.
3. Sort reports, in ascending order, as listed below: Activity number sequence with predecessor and successor activity.

L. Cost-Loading:

1. Note the estimated cost to perform each Work activity, with the exception of Submittals or Submittal reviews, in the network in a tabular listing.
2. The sum of all activity costs shall equal the Contract Price. An unbalanced or front-end-loaded schedule will not be accepted.
3. One activity representing the cost of insurance, bonds, permits, and licenses required by the Contract Documents. Total budgeted cost of activity shall not exceed actual cost documented with paid invoices.

4. One activity representing submission of a completed and detailed as-built drawing and a corresponding review activity with a minimum budgeted cost of $200,000, payable based on percent complete.
4. One activity representing submission of the as-built schedule (the final monthly update) and a corresponding review activity.
5. Activities representing Submittal preparation and review shall not be cost loaded.
6. The accepted cost-loaded Progress Schedule shall constitute the Schedule of Values specified in Section 01 29 00, Payment Procedures.
7. Cost shall be broken down by the funding sources. The following are the breakdown requirements:
   a. B-15142 NCWRP Expansion:
      1) Early Sitework: All Work required to provide the early sitework.
   b. S-17012 NCWRP Improvements to 30 mgd:
      1) Electrical Service: All Work required for the new electrical service.
   c. 700010 NCPWF Mass Excavation:
      1) NCPWF Mass Excavation: All Work required for the Mass Excavation at the NCPWF site.
   d. 700011 Ozone/BAC Relocation:
      1) Ozone/BAC Relocation: All Work required for the Ozone/BAC relocation.

9. PROGRESS OF THE WORK

A. The Contractor shall update the Project schedule monthly. In the update, the Contractor shall accurately document the progress of the Work to date and adjust the schedule to accurately reflect the Contractor's current plan for the timely completion of the Work.

B. Submittal activities shall be updated by adding separate activities to represent each resubmittal and the corresponding review.

C. Schedule updates shall include a written narrative that explains all changes to the schedule logic and describes all delays that occurred during the update period.

D. The Project schedule shall be updated through the last day of the month and be submitted no later than the second working day of the following month. The Owner review period is 5 working days.

E. The monthly schedule update Submittal will be reviewed with the Contractor during a monthly construction progress meeting held on the eighth day of each month. The goal of these meetings is to enable the Contractor and the Construction Manager to initiate appropriate remedial action to minimize any known or foreseen delay in the completion of the Work and to determine the amount of Work completed

since the last schedule update. The status of Work will be determined by the percent complete of each activity in the updated CPM schedule. These meetings are considered a critical component of the overall monthly schedule update Submittal, and the Contractor shall have appropriate personnel attend. As a minimum, the Contractor's Project Manager, Superintendent, and Scheduler shall attend these meetings. Within 5 days after the monthly progress meeting, the Contractor shall submit the revised CPM schedule, the schedule Update Narrative as defined herein, and the Contractor's Application for Payment. Within 5 days of receipt of the update, the Construction Manager will either accept or reject the Monthly Schedule Update Submittal.

F. The Construction Manager decision shall be final regarding the Monthly Update. If the Contractor disagrees with the Owner's review comments, the Contractor shall record its objection both in an explanatory letter and in accompanying schedule file that represents the update the Contractor believes is correct. The letter and schedule file containing the Contractor's objection shall be submitted with the Monthly Update that has been corrected per the Owner's comments.

G. Any changes to the record schedule logic and remaining durations are subject to the review and possible rejection by the Construction Manager.

H. Since the Monthly Schedule Update, is part of the application for progress payment, Submittal and acceptance of the Monthly Schedule Update are a condition precedent to the making of any progress payments.

I. Update schedule shall reflect:

1. Actual start and finish dates.
2. Percent complete and remaining duration.
3. Approved changes in Work scope and activities modified since submission.
4. Delays in Submittals or resubmittals, deliveries, or Work.
5. Adjusted or modified sequences of Work.
6. Other identifiable changes.
7. Revised projections of progress and completion.
8. Report of changed logic.

J. Update Submittal Scope:

1. Each monthly update shall contain the following information as a minimum:
   a. A narrative explaining each change to the record schedule.
   b. Three sets of tabular listings of all activities including the following activity data:
      1) Activity identifier, description, remaining duration, percent complete, total float, activity dates.

c. Three sets of time-scaled bar charts (as specified by the Owner).
d. Predecessor/successor report.
e. Activity earned value for the update period and total activity earned values to date (pay request).
f. Two sets of read-only CD's containing the schedule file and all required reports.

K. Produce detailed subschedules and/or fragnets to further define critical portions of the Work such as facility shutdowns. Examples of such subschedules and fragnets include those associated with extensions/modifications of existing flow channels, cutovers from existing to temporary flow or bypass pumping, etc, as shown on Drawings or as requested by the Owner or Design Engineer.

L. If Contractor fails to complete an activity by its latest scheduled completion date and this Failure is anticipated to extend Contract Times (or Milestones), Contractor shall, within 7 days of such failure, submit a written statement as to how Contractor intends to correct nonperformance and return to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.

M. Owner may order Contractor to increase plant, equipment, labor force or working hours if Contractor fails to:

1. Complete a milestone activity by its completion date.
2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

N. Project Status Narrative Report: The Contractor shall submit monthly Project status narrative reports in conjunction with the revised CPM schedule as indicated above.

1. Format: Organize same as Progress Schedule. Identify, on a cover letter, reporting period, date submitted, and name of author of report.
2. Contents:
   a. Number of days worked over the period, work force on hand, construction equipment on hand (including utility vehicles such as pickup trucks, maintenance vehicles, stake trucks).
   b. General progress of Work, including a listing of activities started and completed over the reporting period, mobilization/ demobilization of Subcontractors, and major milestones achieved.
   c. Critical Path Analysis: The progress made on critical activities indicated on the CPM schedule. Explanations for lack of Work on critical path activities planned for the last month. Changes to the critical path.

d. A list of the critical activities schedule to be performed in the next 2 months.
e. The status of major material and equipment procurement.
f. The value of materials and equipment properly stored on the Site but not yet incorporated into the Work.
g. Explanation of key constraints affecting the Contractor's approach to the Work.
h. Description of anticipated plant shutdowns or other potential impacts to operations.
i. Contractor's plan for management of site (e.g., lay down and staging areas, construction traffic), utilization of construction equipment, buildup of trade labor, and identification of potential Contract changes.
j. Identification of new activities and sequences as a result of executed Contract changes.
k. Documentation of weather conditions over the reporting period, and any resulting impacts to the Work.
l. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
m. Explanations for any schedule changes to activity logic and to activity durations.
n. Identification of, and accompanying reason for, any activities added or deleted since the last report.
o. Steps taken to recover the schedule from Contractor-caused delays.
p. The Contractor may include any other information pertinent to the status of the Work. The Contractor shall include additional status information requested by the Construction Manager.

10. REVISIONS TO SCHEDULE

A. Submit revised schedule within 5 calendar days.

1. When delay in completion of any activity or group of activities indicates an overrun of the Contract time or milestone dates by 20 calendar days or 5 percent of the remaining duration, whichever is less.
2. When delays in Submittal, deliveries or work stoppages are encountered making necessary the replanning or rescheduling of activities.
3. When the schedule does not represent the actual progress of activities.
4. When any change to the sequence of activities, the completion date for major portions of the Work, or when changes occur which affect the critical path.
5. When Contract modification necessitates schedule revision, submit schedule analysis of Change Order work with cost proposal.

B. Submit revised schedule and materials as specified under Article Progress of the Work.

C. Make revisions on most recently accepted version of schedule.

D. Schedule Revisions shall not be prepared or submitted with Schedule Updates. They shall be separate Submittals and shall be noted as Schedule Revisions.

E. Only upon acceptance of a revision by the Owner shall it be reflected in the next monthly Schedule Update.

11. SCHEDULE ACCEPTANCE

A. Construction Manager's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
   a. Contract Times, including Final Completion and all intermediate Milestones, are within the specified times.
   b. Specified Work sequences and constraints are shown as specified.
   c. Specified Owner-furnished Equipment or Material arrival dates, or range of dates, are included.
   d. Access restrictions are accurately reflected.
   e. Startup and testing times are as specified.
   f. Submittal review times are as specified.
   g. Startup testing duration is as specified and timing is acceptable.
2. In all other respects, Construction Manager's acceptance of Contractor's schedule indicates that, in Construction Manager's judgment, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Construction Manager's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Construction Manager's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

B. Unacceptable Preliminary Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Construction Manager as Baseline Progress Schedule, continue review and revision process, including updating schedule including updating schedule to reflect actual progress and occurrences to date.

C. Unacceptable Detailed Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Construction Manager as Baseline Progress Schedule, continue review and revision process.

D. Narrative Report: All changes to activity duration and sequences, including addition or deletion of activities subsequent to Construction Manager's acceptance of Baseline Progress Schedule, shall be delineated in Narrative Report current with proposed Updated Progress Schedule.

12. WEEKLY SCHEDULE

A. Submit to Construction Manager, on the last calendar day of every week or on the day of the week when the Progress Meeting is held, if acceptable to Construction Manager, a progress schedule, generated from Primavera, showing the activities completed during the previous week and the Contractor's schedule of activities for the following 8 weeks.

B. The Weekly Schedule shall be a CPM generated bar chart utilizing the logic and conforming to the Contractor's plan reflected in the current progress schedule. In the event that the Weekly Schedule no longer conforms to the current schedule, Contractor may be required to revise the schedule in accordance with Article Revisions to Schedule.

C. The activity designations used in the Weekly Schedule shall be consistent with those used in the Baseline Schedule and the Monthly Schedule Updates.

D. The format of the Weekly Schedule shall be as agreed upon between the Contractor and the Construction Manager.

E. Upon request the Contractor shall provide to the Construction Manager the Primavera file used to generate the Weekly Schedule.

13. ADJUSTMENT OF CONTRACT TIMES

A. Reference General Conditions and Section 01 26 00, Contract Modification Procedures.

B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.

C. If the Contractor believes that the Owner has impacted its Work, such that the Project completion date will be delayed, the Contractor must submit proof demonstrating the delay to the critical path. This proof, in the form of a Time Impact Analysis, may entitle the Contractor to an adjustment of Contract Time.

D. The Time Impact Analysis:

1. The Time Impact Analysis submitted by the Contractor shall utilize the accepted schedule update that is current relative to the time frame of the delay event (Change Order, third party delay, or other Owner-caused delay). The Contractor shall represent the delay event in the schedule by 1) inserting new activities associated with the delay event into the schedule, 2) revising activity logic, or 3) revising activity durations.
2. If the Project schedule's critical path and completion date are impacted as a result of adding this delay event to the schedule, a time extension equal to the magnitude of the impact may be warranted.
3. The Time Impact Analysis Submittal shall consist of 1) a fragment of the portion of the schedule affected by the delay event, 2) a narrative explanation of the delay issue and how it impacted the schedule, and 3) a CD containing the schedule file used to perform the Time Impact Analysis.

E. When a delay to the Project as a whole can be avoided by revising preferential sequencing or logic, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.

F. Indicate clearly that the Contractor has used, in full, all Project float available for the Work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date. Utilize the latest version of the Schedule Update accepted at the time of the alleged delay, and all other relevant information to determine the adjustment of the Contract Time.

G. Float:

1. Float time is a Project resource available to both parties to meet Contract Milestones and Contract Times.
2. Use of float suppression techniques such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity times are prohibited and use of float time disclosed or implied by use of alternate float-suppression techniques shall be shared to proportionate benefit of Owner and Contractor.
3. Pursuant to above float-sharing requirement, no time extensions will be granted nor delay damages paid until a delay occurs which (i) impacts Project's critical path, (ii) consumes available float or contingency time, and (iii) extends Work beyond Contract completion date.
4. If early completion (Completion prior to the Contract's identified Interim and Final Completion Milestones) is shown in the Contractor's schedules, the Owner reserves the right to adjust the Interim or Final Completion Milestones to the Contractor's dates. Liquidated Damages are also adjusted accordingly. If the Owner

chooses to accept early completion of the Interim and Final Completion Milestones, without modifications to the Interim and Final Completion Milestones, the Contractor must agree in writing that the duration from the Contractor's early completion date to the Interim and Final Completion Milestones shall be considered as float to be shared equally between the Owner and Contractor.

H. Notify Construction Manager of a request for Contract Time adjustment. Submit request in accordance with the General Conditions. In cases where the Contractor does not submit a request for Contract Time adjustment for a specific Change Order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular Change Order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.

I. The Construction Manager will, within 30 calendar days after receipt of a Contract Time adjustment, request any supporting evidence, review the fact and advise the Contractor in writing.

J. The new Progress Schedule data, if accepted by the Owner, shall be included in the next monthly Schedule Update.

K. Claims Based on Contract Times:

1. Where Construction Manager has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, Contractor shall reflect an interim adjustment in the Progress Schedule as acceptable to Construction Manager.
2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
3. Contractor shall revise Progress Schedule prepared thereafter in accordance with Construction Manager's formal decision.

14. FINAL SCHEDULE SUBMITTAL

A. As a condition precedent to the release of retainage, the final Schedule Update shall be identified by the Contractor as the As-Built Schedule.

B. The As-Built Schedule shall reflect the exact manner in which the Project was constructed by reflecting actual start and completion dates for all activities accomplished on the Project.

C. The As-Built Schedule shall be signed and certified by the Contractor's Project Manager and Scheduler as being an accurate record of the way

in which the Project was actually constructed.

part 2 PRODUCTS (NOT USED)

part 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

## PART 1 GENERAL

### 1. DEFINITIONS

A. Action Submittal: Written and graphic information submitted by Contractor that requires Design Engineer's approval.

B. Deferred Submittal: Information submitted by Contractor for portions of design that are to be submitted to permitting agency for approval prior to installation of that portion of the Work, along with Design Engineer's review documentation that submittal has been found to be in general conformance with Project's design.

C. Informational Submittal: Information submitted by Contractor that requires Design Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

### 2. PROCEDURES

A. Direct submittals as described in Section 01 33 22, Web Based Construction Document Management, unless specified otherwise.

1. Via Construction Manager.

B. Electronic Submittals: Submittals shall, unless specifically accepted, be made in electronic format.

1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
3. PDF files shall be set to open "Bookmarks and Page" view.
4. Add general information to each PDF file, including title, subject, author, and keywords.
5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
6. Submit new electronic files for each resubmittal.
7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
8. Provide Construction Manager with authorization to reproduce and distribute each file as many times as necessary for Project documentation.
9. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference and shall be as

required by Section 01 33 22, Web Based Construction Document Management.

C. Transmittal of Submittal:

1. Contractor shall:
   a. Review each submittal and check for compliance with Contract Documents.
   b. Stamp each submittal with uniform approval stamp before submitting to Construction Manager.
      1) Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
      2) Construction Manager will not review submittals that do not bear Contractor's approval stamp and will return them without action.
2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form in format approved by Construction Manager.
3. Identify each submittal with the following:
   a. Numbering and Tracking System:
      1) Sequentially number each submittal.
      2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
   b. Specification section and paragraph to which submittal applies.
   c. Project title and Owner's project number.
   d. Date of transmittal.
   e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.

D. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.
2. Package submittal information by individual specification section. Do not combine different specification sections together in submittal package, unless otherwise directed in specification.
3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
4. Index with labeled tab dividers in orderly manner.

E. Timeliness: Schedule and submit in accordance Schedule of Submittals, and requirements of individual specification sections.

F. Processing Time:

1. Time for review shall commence on Construction Manager's receipt of submittal.
2. Construction Manager will act upon Contractor's submittal and transmit response to Contractor not later than 20 working days after receipt, unless otherwise specified.
3. Resubmittals will be subject to same review time.
4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.

G. Resubmittals: Clearly identify each correction or change made.

H. Incomplete Submittals:

1. Construction Manager will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
2. When any of the following are missing, submittal will be deemed incomplete:
   a. Contractor's review stamp; completed and signed.
   b. Transmittal of Contractor's Submittal; completed and signed.
   c. Insufficient number of copies.

I. Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped "Not Subject to Review."
2. Construction Manager will keep one copy and return submittal to Contractor.

3. ACTION SUBMITTALS

A. Prepare and submit Action Submittals required by individual specification sections.

B. Shop Drawings:

1. Copies: Five copies of closed submittals as required under Section 01 33 22, Web Based Construction Document Management.
2. Identify and Indicate:
   a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
   b. Equipment and Component Title: Identical to title shown on Drawings.
   c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
   d. Project-specific information drawn accurately to scale.

3. Manufacturer's standard schematic drawings and diagrams as follows:
   a. Modify to delete information that is not applicable to the Work.
   b. Supplement standard information to provide information specifically applicable to the Work.
4. Product Data: Provide as specified in individual specifications.
5. Deferred Submittal: See Drawings for list of deferred submittals.
   a. Contractor-design drawings and product data related to permanent construction.
      1) Written and graphic information.
      2) Drawings.
      3) Cut sheets.
      4) Data sheets.
      5) Action item submittals requested in individual specification section.
   b. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit required supporting data and drawings for review and acceptance by Design Engineer. Documentation of review and approval provided on Design Engineer's comment form, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.
6. Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.

C. Samples:

1. Copies: Two, unless otherwise specified in individual specifications.
2. Preparation:
   a. Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
      1) Manufacturer name.
      2) Model number.
      3) Material.
      4) Sample source.
3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
4. Full-size Samples:
   a. Size as indicated in individual specification section.
   b. Prepared from same materials to be used for the Work.
   c. Cured and finished in manner specified.
   d. Physically identical with product proposed for use.

D. Action Submittal Dispositions: Design Engineer will review, comment, stamp, and distribute as noted:

1. Approved:
   a. Contractor may incorporate product(s) or implement Work covered by submittal.
   b. Distribution: Electronic.
      1) One copy of closed submittal furnished to the Construction Manager.
2. Approved as Noted:
   a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Design Engineer's notations.
   b. Distribution: Electronic.
3. Partial Approval, Resubmit as Noted:
   a. Make corrections or obtain missing portions, and resubmit.
   b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Design Engineer's notations.
   c. Distribution: Electronic.
4. Revise and Resubmit:
   a. Contractor may not incorporate product(s) or implement Work covered by submittal.
   b. Distribution: Electronic.

4. INFORMATIONAL SUBMITTALS

A. General:

1. Copies: Electronic.
2. Refer to individual specification sections for specific submittal requirements.
3. Construction Manager will review each submittal. If submittal meets conditions of the Contract, Construction Manager will forward copy to appropriate parties. If Construction Manager determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Construction Manager will provide review comments to Contractor, and require that submittal be corrected and resubmitted.

B. Certificates:

1. General:
   a. Provide notarized statement that includes signature of entity responsible for preparing certification.
   b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual specification section.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of

material for compliance with requirements.

5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual specification sections.
6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
7. Manufacturer's Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers' Field Services.

C. Construction Photographs and Video: In accordance with Section 01 31 13, Project Coordination, and as may otherwise be required in Contract Documents.

D. Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.

E. Contractor-design Data (related to temporary construction):

1. Written and graphic information.
2. List of assumptions.
3. List of performance and design criteria.
4. Summary of loads or load diagram, if applicable.
5. Calculations.
6. List of applicable codes and regulations.
7. Name and version of software.
8. Information requested in individual specification section.

F. Deferred Submittals: See Drawings for list of deferred submittals.

1. Contractor-design data related to permanent construction:
   a. List of assumptions.
   b. List of performance and design criteria.
   c. Summary of loads or load diagram, if applicable.
   d. Calculations.
   e. List of applicable codes and regulations.
   f. Name and version of design software.
   g. Factory test results.
   h. Informational submittals requested in individual specification section.
2. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit calculations and test results of Contractor-designed components for review by Design Engineer. Documentation of review and indication of compliance with general design intent and project criteria provided on Design Engineer's comment form as meets conditions of the Contract, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.

G. Manufacturer's Instructions: Written or published information that

documents manufacturer's recommendations, guidelines, and procedures in accordance with individual specification section.

H. Operation and Maintenance Data: As required in Section 01 78 23, Operation and Maintenance Data.

I. Schedules:

1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
   a. Show for each, at a minimum, the following:
      1) Specification section number.
      2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
      3) Estimated date of submission to Construction Manager, including reviewing and processing time.
   b. On a monthly basis, submit updated Schedule of Submittals to Construction Manager if changes have occurred or resubmittals are required.
2. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.

J. Special Guarantee: Supplier's written guarantee as required in individual specification sections.

K. Statement of Qualification:

1. Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals. Submittals Required by Laws, Regulations, and Governing Agencies:
   a. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
   b. Transmit to Construction Manager for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

L. Test, Evaluation, and Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.
2. Factory:
   a. Identification of product and specification section, type of inspection or test with referenced standard or code.

b. Date of test, Project title and number, and name and signature of authorized person.
c. Test results.
d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
e. Provide interpretation of test results, when requested by Construction Manager.
f. Other items as identified in individual specification sections.

3. Field:
   a. As a minimum, include the following:
      1) Project title and number.
      2) Date and time.
      3) Record of temperature and weather conditions.
      4) Identification of product and specification section.
      5) Type and location of test, Sample, or inspection, including referenced standard or code.
      6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
      7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
      8) Provide interpretation of test results, when requested by Construction Manager.
      9) Other items as identified in individual specification sections.

M. Testing and Startup Data: In accordance with Section 01 91 14, Testing, Integration, and Startup.

N. Training Data: In accordance with Section 01 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 22
WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT

## part 1 GENERAL

### 1. summary

A. The Owner, Construction Manager, Engineer, and Contractor shall utilize PMWeb (PMWeb is a registered trademark of PMWeb, Inc.), for submission of all data and documents (unless specified otherwise herein) throughout the duration of the Contract.

1. PMWeb is a web-based electronic media site.
2. PMWeb is paid for by the Owner.
3. PMWeb will be made available to all Contractor's personnel, subcontractor personnel, suppliers, consultants, Construction Manager, and Engineer.
4. The joint use of this system is to facilitate electronic exchange of information, automation of key processes, and overall management of Construction Phase Documentation.
5. PMWeb shall be the primary official means of project information submission and management.

B. User Access Limitations: The Construction Manager will initially manage the Contractor's access to PMWeb by allowing access and assigning user profiles to accepted Contractor personnel. User profiles will define levels of access into the system; determine assigned function based authorizations and user privileges. Subcontractors and suppliers will be given access to PMWeb by and through the Contractor. Entry of information exchanged and transferred between the Contractor and its subcontractors and suppliers on PMWeb shall be the responsibility of the Contractor.

C. Joint Ownership of Data: Data entered in a collaborative mode (entered with the intent to share as determined by permissions and workflows within the PMWeb system) by the Owner, Construction Manager, Engineer, and Contractor will be jointly owned.

D. Automated System Notification and Audit Log Tracking: Review comments made (or lack thereof) by the Owner on Contractor submitted documentation shall not relieve the Contractor from compliance with requirements of the Contract Documents. The Contractor is responsible for managing, tracking, and documenting the Work to comply with the requirements of the Contract Documents. Owner's acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation

of the Contractor's submitted information.

E. Submittals:

1. See Section 01 33 00, Submittal Procedures.
2. Preconstruction Submittals List of Contractor's key PMWeb personnel. Include descriptions of key personnel's roles and responsibilities for this Project. Contractor should also identify their organizations administrator on the list.

F. Computer Requirements:

1. The Contractor shall use computer hardware and software that meets the requirements of the PMWeb system as required to access and utilize PMWeb. As recommendations are modified by PMWeb, the Contractor will upgrade their system(s) to meet or exceed the recommendations. Upgrading of the Contractor's computer systems will not be justification for a cost or time modification to the Contract.
2. The Contractor shall ensure that connectivity to the PMWeb system is accomplished through DSL, cable, T-1, or wireless communications systems. The minimum bandwidth requirements for using the system is 128kb/s. It is recommended a faster connection be used when uploading pictures and files into the system.
3. PMWeb currently supports Mozilla's Firefox v3.0-3.5, Apple's Safari v3.0-3.5, and Microsoft's Internet Explorer v7.0 web browsers for accessing the application.

G. Contractor Responsibility:

1. The Contractor shall be responsible for the validity of their information placed in PMWeb and for the abilities of their personnel.
2. Accepted users shall be knowledgeable in the use of computers, including Internet Browsers, email programs, CAD drawing applications, and Adobe Portable Document Format (PDF) document distribution program.
3. The Contractor shall utilize the existing forms in PMWeb to the maximum extent possible. If a form does not exist in PMWeb, the Contractor must include a form of their own or provided by the Construction Manager as an attachment to a submittal.
4. Adobe PDF documents will be created through electronic conversion rather than optically scanned whenever possible. The Contractor is responsible for the training of their personnel in the use of PMWeb (outside what is provided by the Owner) and the other programs indicated above as needed.

H. Connectivity Problems: Provide a list of Contractor's key PMWeb personnel for the Construction Manager's acceptance. Contractor is responsible for adding and removing users from the system. The Construction Manager reserves the right to perform a security check on all potential users. The Contractor will be allowed to add additional personnel and subcontractors to PMWeb after clearance by security check.

I. Training:

1. The Owner has arranged and paid for training to be provided to the Contractor.
2. Training consists of web-based seminars in conjunction with a conference call.
3. Contractor shall arrange and pay for the facilities and hardware/software required to facilitate their own training.

part 2 PRODUCTS

1. DESCRIPTION

A. PMWeb project management application (no equal).

part 3 EXECUTION

1. PMWeb Utilization

A. PMWeb shall be utilized in connection with all document and information management required by these Contract Documents.

2. submittals

A. Shop Drawings:

1. Shop Drawing and design data documents shall be submitted PDF attachments to the PMWeb submittal work flow process and form. Examples of Shop Drawings include, but are not limited to:
   a. Standard manufacturer installation drawings.
   b. Drawings prepared to illustrate portions of the work designed or developed by the Contractor.
   c. Steel fabrication, piece, and erection drawings.

B. See Section 01 33 00, Submittal Procedures.

3. PRODUCT DATA

A. Product catalog data and manufacturer's instructions shall be submitted as PDF attachments to the PMWeb submittal work flow process and

form. Examples of product data include, but are not limited to:

1. Manufacturer's printed literature.
2. Preprinted product specification data and installation instructions.

4. Administrative or informational Submittals

A. All correspondence and preconstruction submittals shall be submitted using PMWeb. Examples of administrative submittals include, but are not limited to:

1. Permits.
2. Requests for substitutions (RFS).
3. List of contact personnel.
4. Requests for Information (RFI).

B. Network Analysis Schedules and associated reports and updates. Each schedule submittal specified in these Contract Documents shall be submitted as a native backed-up file (.PRX or .STX) of the scheduling program being used. The schedule shall also be posted as a PDF file in the format specified in these Contract Documents.

C. Plans for safety, demolition, environmental protection, and similar activities.

D. Quality Control Plan(s), Testing Plan and Log, Quality Control Reports, Production Reports, Quality Control Specialist Reports, Preparatory Phase Checklist, Initial Phase Checklist, Field Test reports, Summary reports, Rework Items List, etc.

E. Meeting minutes for quality control meetings, progress meetings, pre-installation meetings, etc.

F. Any general correspondence submitted.

G. Project Photos: Project photos shall be posted monthly to PMWeb.

5. Compliance Submittals

A. Test reports, certificates, and manufacture field report submittals shall be submitted on PMWeb as PDF attachments. Examples of compliance submittals include, but are not limited to:

1. Field test reports.
2. Quality Control certifications.
3. Manufacturer's documentation and certifications for quality of products and materials provided.

6. Record and Closeout Submittals

A. Operation and maintenance data and closeout submittals shall be submitted on PMWeb as PDF documents during the approval and review stage as specified, with actual set of documents submitted for final. Examples of record submittals include, but are not limited to:

1. Operation and Maintenance Manuals: Final documents shall be submitted as specified.
2. Extra materials, spare stock, etc., submittal forms shall indicate when actual materials are submitted.

7. Financial Submittals

A. Schedule of Value, Pay Estimates, and Change Request Proposals shall be submitted on PMWeb. Supporting material for Pay Estimates and Change Requests shall be submitted on PMWeb as PDF attachments. Examples of compliance submittals include, but are not limited to:

1. Contractor's Schedule of Values.
2. Contractor's Monthly Progress Payment Requests.
3. Contract Change proposals requested by the Owner.

8. SUBMITTAL PAPER COPIES

A. Contractor shall deliver bound and tabbed paper copies of every closed submittal to the Construction Manager within 1 week of the Construction Manager closing a submittal with any disposition as follows:

1. Each copy shall have the closed PMWeb cover page including the disposition and any comments.
2. Final copies of submittals returned with comments, but not requiring resubmittal shall incorporate revisions per the Design Engineer's comments.
3. Number of Paper Copies:
   a. Final O&M Manuals: Three copies as specified in the Section 01 78 23, Operation and Maintenance Data.
   b. All Other Submittals: Five copies as specified in Section 01 33 00, Submittal Procedures.
   c. For submittals with attachments over 30 megabytes in size, provide one CD of the submittal for each required paper copy.

END OF SECTION

# SECTION 01 42 13
# ABBREVIATIONS AND ACRONYMS

## PART 1 GENERAL

### 1. REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

A. Reference to standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided in Article 3 of the General Conditions, and as may otherwise be required herein and in the individual Specification sections.

B. Work specified by reference to published standard or specification of government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet requirements or surpass minimum standards of quality for materials and workmanship established by designated standard or specification.

C. Where so specified, products or workmanship shall also meet or exceed additional prescriptive or performance requirements included within Contract Documents to establish a higher or more stringent standard of quality than required by referenced standard.

D. Where two or more standards are specified to establish quality, product and workmanship shall meet or exceed requirements of most stringent.

E. Where both a standard and a brand name are specified for a product in Contract Documents, proprietary product named shall meet or exceed requirements of specified reference standard.

F. Copies of standards and specifications of technical societies:

1. Copies of applicable referenced standards have not been bound in these Contract Documents.
2. Where copies of standards are needed by Contractor, obtain a copy or copies directly from publication source and maintain in an orderly manner at the Site as Work Site records, available to Contractor’s personnel, Subcontractors, Owner, and Construction Manager.

### 2. ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used.

1. AA Aluminum Association
2. AABC Associated Air Balance Council
3. AAMA American Architectural Manufacturers Association
4. AASHTO American Association of State Highway and Transportation Officials
5. ABMA American Bearing Manufacturers' Association
6. ACI American Concrete Institute
7. AEIC Association of Edison Illuminating Companies
8. AGA American Gas Association
9. AGMA American Gear Manufacturers' Association
10. AI Asphalt Institute
11. AISC American Institute of Steel Construction
12. AISI American Iron and Steel Institute
13. AITC American Institute of Timber Construction
14. ALS American Lumber Standards
15. AMCA Air Movement and Control Association
16. ANSI American National Standards Institute
17. APA APA – The Engineered Wood Association
18. API American Petroleum Institute
19. APWA American Public Works Association
20. AHRIAir-Conditioning, Heating, and Refrigeration Institute
21. ASA Acoustical Society of America
22. ASABE American Society of Agricultural and Biological Engineers
23. ASCE American Society of Civil Engineers
24. ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
25. ASME American Society of Mechanical Engineers
26. ASNT American Society for Nondestructive Testing
27. ASSE American Society of Sanitary Engineering
28. ASTM ASTM International
29. AWI Architectural Woodwork Institute
30. AWPA American Wood Preservers' Association
31. AWPI American Wood Preservers' Institute
32. AWS American Welding Society
33. AWWA American Water Works Association
34. BHMA Builders Hardware Manufacturers' Association
35. CBM Certified Ballast Manufacturer
36. CDA Copper Development Association
37. CGA Compressed Gas Association
38. CISPI Cast Iron Soil Pipe Institute

39. CMAA Crane Manufacturers' Association of America
40. CRSI Concrete Reinforcing Steel Institute
41. CS Commercial Standard
42. CSA Canadian Standards Association
43. CSI Construction Specifications Institute
44. DIN Deutsches Institut für Normung e.V.
45. DIPRA Ductile Iron Pipe Research Association
46. EIA Electronic Industries Alliance
47. EJCDC Engineers Joint Contract Documents' Committee
48. ETL Electrical Test Laboratories
49. FAA Federal Aviation Administration
50. FCC Federal Communications Commission
51. FDA Food and Drug Administration
52. FEMA Federal Emergency Management Agency
53. FIPS Federal Information Processing Standards
54. FM FM Global
55. Fed. Spec. Federal Specifications (FAA Specifications)
56. FS Federal Specifications and Standards (Technical Specifications)
57. GA Gypsum Association
58. GANA Glass Association of North America
59. HI Hydraulic Institute
60. HMI Hoist Manufacturers' Institute
61. IBC International Building Code
62. ICBO International Conference of Building Officials
63. ICC International Code Council
64. ICEA Insulated Cable Engineers' Association
65. IFC International Fire Code
66. IEEE Institute of Electrical and Electronics Engineers, Inc.
67. IESNA Illuminating Engineering Society of North America
68. IFI Industrial Fasteners Institute
69. IGMA Insulating Glass Manufacturer's Alliance
70. IMC International Mechanical Code
71. INDAAssociation of the Nonwoven Fabrics Industry
72. IPC International Plumbing Code
73. ISA International Society of Automation
74. ISO International Organization for Standardization
75. ITL Independent Testing Laboratory
76. JIC Joint Industry Conferences of Hydraulic Manufacturers
77. MIA Marble Institute of America

78. MIL Military Specifications
79. MMAMonorail Manufacturers' Association
80. MSS Manufacturer's Standardization Society
81. NAAMM National Association of Architectural Metal Manufacturers
82. NACE NACE International
83. NBGQA National Building Granite Quarries Association
84. NEBB National Environmental Balancing Bureau
85. NEC National Electrical Code
86. NECA National Electrical Contractor's Association
87. NEMA National Electrical Manufacturers' Association
88. NESC National Electrical Safety Code
89. NETA InterNational Electrical Testing Association
90. NFPA National Fire Protection Association
91. NHLA National Hardwood Lumber Association
92. NICET National Institute for Certification in Engineering Technologies
93. NIST National Institute of Standards and Technology
94. NRCA National Roofing Contractors Association
95. NRTL Nationally Recognized Testing Laboratories
96. NSF NSF International
97. NSPE National Society of Professional Engineers
98. NTMA National Terrazzo and Mosaic Association
99. NWWDA National Wood Window and Door Association
100. OSHA Occupational Safety and Health Act (both Federal and State)
101. PCI Precast/Prestressed Concrete Institute
102. PEI Porcelain Enamel Institute
103. PPI Plastic Pipe Institute
104. PS Product Standards Section- U.S. Department of Commerce
105. RMA Rubber Manufacturers' Association
106. RUS Rural Utilities Service
107. SAE SAE International
108. SDI Steel Deck Institute
109. SDI Steel Door Institute
110. SJI Steel Joist Institute
111. SMACNA Sheet Metal and Air Conditioning Contractors National Association
112. SPI Society of the Plastics Industry
113. SSPC The Society for Protective Coatings

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|---|---|---|
| 114. | STI/SPFA | Steel Tank Institute/Steel Plate Fabricators Association |
| 115. | SWI | Steel Window Institute |
| 116. | TEMA | Tubular Exchanger Manufacturers' Association |
| 117. | TCA | Tile Council of North America |
| 118. | TIA | Telecommunications Industry Association |
| 119. | UBC | Uniform Building Code |
| 120. | UFC | Uniform Fire Code |
| 121. | UL | Underwriters Laboratories Inc. |
| 122. | UMC | Uniform Mechanical Code |
| 123. | USBR | U.S. Bureau of Reclamation |
| 124. | WCLIB | West Coast Lumber Inspection Bureau |
| 125. | WI | Wood Institute |
| 126. | WWPA | Western Wood Products Association |

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

# SECTION 01 43 33
# MANUFACTURERS' FIELD SERVICES

## part 1 GENERAL

### 1. DEFINITIONS

A. Person-Day: One person for 8 hours within regular Contractor working hours.

### 2. SUBMITTALS

A. Informational Submittals:

1. Training Schedule: Submit, in accordance with requirements of this Specification, not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.
2. Lesson Plan: Submit, in accordance with requirements of this Specification, proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.
3. Training Session Recordings: Furnish Owner with two complete sets of recordings fully indexed and cataloged with printed label stating session and date recorded.

### 3. QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual specification section.

B. Representative subject to acceptance by Owner, Construction Manager, and Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

## part 2 PRODUCTS (NOT USED)

## part 3 EXECUTION

### 1. FULFILLMENT OF SPECIFIED MINIMUM SERVICES

A. Furnish manufacturers' services, when required by an individual specification section, to meet the requirements of this section.

B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified,

time required to perform specified services shall be considered incidental.

C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.

D. Determine, before scheduling services, that conditions necessary to allow successful testing have been met.

E. Only those days of service approved by Construction Manager will be credited to fulfill specified minimum services.

F. When specified in individual specification sections, manufacturer's onsite services shall include:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
3. Providing, on a daily basis, copies of manufacturers' representatives field notes and data to Engineer and Construction Manager.
4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Construction Manager.
5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer's products and systems.
6. Assistance during functional and performance testing, and facility startup and evaluation.
7. Training of Owner's personnel in the operation and maintenance of respective product as required.

2. MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

A. A Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by equipment manufacturer's representative.

B. Such form shall certify signing party is a duly authorized representative of manufacturer, is empowered by manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to ensure equipment is complete and operational.

3. TRAINING

A. General:

1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Section 01 78 23, Operation and Maintenance Data.
3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

B. Training Schedule:

1. List specified equipment and systems that require training services and show:
   a. Respective manufacturer.
   b. Estimated dates for installation completion.
   c. Estimated training dates.
2. Allow for multiple sessions when several shifts are involved.
3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
4. Coordinate with Section 01 32 00, Construction Progress Documentation, and Section 01 91 14, Testing, Integration, Facility Startup.

C. Lesson Plan:

1. When manufacturer or vendor training of Owner personnel is specified, prepare a lesson plan for each required course containing the following minimum information:
   a. Title and objectives.
   b. Recommended attendees (such as, managers, engineers, operators, maintenance).
   c. Course description, outline of course content, and estimated class duration.
   d. Format (such as, lecture, self-study, demonstration, hands-on).
   e. Instruction materials and equipment requirements.
   f. Resumes of instructors providing training.

D. Prestartup Training:

1. Coordinate training sessions with Owner's operating personnel and manufacturers' representatives and with submission of operation and maintenance manuals in accordance with Section 01 78 23, Operation and Maintenance Data.
2. Complete at least 14 days prior to beginning of facility startup.

E. Post-startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

F. Recording of Training Sessions:

1. Furnish video recording of prestartup and post-startup instruction sessions, including manufacturers' representatives' hands-on equipment instruction and classroom sessions.
2. Video training materials shall be produced by a qualified, professional video production company.
3. Use DVD format suitable for playback on standard equipment available commercially in the United States. Blu-ray® DVD format is not acceptable without Construction Manager's prior approval.
4. DVD may contain multiple training sessions. If multiple training sessions included on a DVD, provide with on-screen menu for playback selection.

4. SUPPLEMENT

A. The supplement listed below, following "End of Section," is part of this Specification.

1. Manufacturer's Certificate of Proper Installation.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER _____ EQPT SERIAL NO: _____

EQPT TAG NO: _____ EQPT/SYSTEM: _____

PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

☐ Installed in accordance with Manufacturer's recommendations.

☐ Inspected, checked, and adjusted.

☐ Serviced with proper initial lubricants.

☐ Electrical and mechanical connections meet quality and safety standards.

☐ All applicable safety equipment has been properly installed.

☐ Functional tests.

☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments: _____

_____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate their equipment and (iii) authorized to make recommendations required to ensure equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20___

Manufacturer:_____

By Manufacturer's Authorized Representative: _____

(Authorized Signature)

# SECTION 01 45 16.13
# CONTRACTOR QUALITY CONTROL

## PART 1 GENERAL

### 1. REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
   b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

### 2. DEFINITIONS

A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

### 3. SUBMITTALS

A. Informational Submittals:

1. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
2. CQC Report: Submit, weekly, an original and one copy in report form.

### 4. OWNER'S QUALITY ASSURANCE

A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.

B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:

1. Relieve Contractor of responsibility for providing adequate quality control measures.
2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance.
3. Constitute or imply acceptance.
4. Affect the continuing rights of Owner after acceptance of the completed Work.

C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.

D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Construction Manager.

E. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 1. GENERAL

A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.

B. Maintain complete inspection records and make them available at all times to Owner and Construction Manager.

C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

### 2. COORDINATION MEETING

A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Construction Manager and Owner to discuss the quality control system.

B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor’s management and control with the Owner’s Quality Assurance.

C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

### 3. QUALITY CONTROL ORGANIZATION

A. CQC System Manager:

1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
2. CQC System Manager may not perform other duties on the Project.
3. CQC System Manager shall be an experienced construction person, with construction experience on similar type Work.
4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
5. CQC System Manager shall be onsite during construction; periods of absence may not exceed 2 weeks at any one time.
6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.

B. CQC Staff:

1. Designate a CQC staff, available at the Site at all times during progress, with complete authority to take any action necessary to ensure compliance with the Contract. CQC staff members shall be subject to acceptance by Construction Manager.
2. CQC staff shall take direction from CQC System Manager in matters pertaining to QC.
3. CQC staff must be of sufficient size to ensure adequate QC coverage of Work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities.
4. The actual strength of the CQC staff may vary during any specific Work period to cover the needs of the Project. Add additional staff when necessary for a proper CQC organization.

C. Organizational Changes: Obtain Construction Manager's acceptance before replacing any member of the CQC staff. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

4. QUALITY CONTROL PHASING

A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:

1. Preparatory Phase:

a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.
b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.
c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.
d. Perform prior to beginning Work on each definable feature of Work:
    1) Review applicable Contract Specifications.
    2) Review applicable Contract Drawings.
    3) Verify that all materials and/or equipment have been tested, submitted, and approved.
    4) Verify that provisions have been made to provide required control inspection and testing.
    5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
    6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
    7) Review the appropriate activity hazard analysis to verify safety requirements are met.
    8) Review procedures for constructing the Work, including repetitive deficiencies.
    9) Document construction tolerances and workmanship standards for that phase of the Work.
    10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Construction Manager.

2. Initial Phase:
    a. Accomplish at the beginning of a definable feature of Work:
        1) Notify Owner at least 48 hours in advance of beginning the initial phase.
        2) Perform prior to beginning Work on each definable feature of Work:
            a) Review minutes of the preparatory meeting.
            b) Check preliminary Work to verify compliance with Contract requirements.
            c) Verify required control inspection and testing.
            d) Establish level of workmanship and verify that it meets minimum acceptable workmanship

standards. Comparison with sample panels is appropriate.

e) Resolve all differences.

f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

3) Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3. Follow-up Phase:

a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.

b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.

c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.

4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

5. CONTRACTOR QUALITY CONTROL PLAN

A. General:

1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
2. An interim plan for the first 30 days of operation will be considered.
3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.

B. Content:

1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:
   a. Organization: Description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three-phase control system (see Paragraph QC Phasing) for all aspects of the Work specified.
   b. CQC Staff: The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
   c. Letters of Authority: A copy of a letter to the CQC System Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop Work which is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to Owner.
   d. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.
   e. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.
   f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
   g. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.
   h. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.

C. Acceptance of Plans: Acceptance of the Contractor’s basic and addendum CQC plans is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Owner reserves the right to require Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.

D. Notification of Changes: After acceptance of the CQC plan, Contractor shall notify Construction Manager, in writing, a minimum of 7 calendar

days prior to any proposed change. Proposed changes are subject to acceptance by Construction Manager.

6. CONTRACTOR QUALITY CONTROL REPORT

A. As a minimum, prepare a CQC report for every 7 calendar days. Account for all days throughout the life of the Contract. Reports shall be signed and dated by CQC System Manager. Include copies of test reports and copies of reports prepared by QC staff.

B. Maintain current records of quality control operations, activities, and tests performed, including the Work of subcontractors and suppliers.

C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items, including but not limited to the following:

1. Contractor/subcontractor and their areas of responsibility.
2. Operating plant/equipment with hours worked, idle, or down for repair.
3. Work performed today, giving location, description, and by whom. When a network schedule is used, identify each phase of Work performed each day by activity number.
4. Test and/or control activities performed with results and references to specifications/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
5. Material received with statement as to its acceptability and storage.
6. Identify submittals reviewed, with Contract reference, by whom, and action taken.
7. Offsite surveillance activities, including actions taken.
8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. List instructions given/received and conflicts in Drawings and/or Specifications.
10. Contractor’s verification statement.
11. Indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered.
12. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in file work and workmanship comply with the Contract.

7. SUBMITTAL QUALITY CONTROL

A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures. The CQC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements.

Owner will furnish copies of test report forms upon request by Contractor. Contractor may use other forms as approved.

8. TESTING QUALITY CONTROL

A. Testing Procedure:

1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Perform the following activities and record the following data:
   a. Verify testing procedures comply with contract requirements.
   b. Verify facilities and testing equipment are available and comply with testing standards.
   c. Check test instrument calibration data against certified standards.
   d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
   e. Documentation:
      1) Record results of all tests taken, both passing and failing, on the CQC report for the date taken.
      2) Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.
      3) Actual test reports may be submitted later, if approved by Construction Manager, with a reference to the test number and date taken.
      4) Provide directly to Construction Manager an information copy of tests performed by an offsite or commercial test facility. Test results shall be signed by an engineer registered in the state where the tests are performed.
      5) Failure to submit timely test reports, as stated, may result in nonpayment for related Work performed and disapproval of the test facility for this Contract.

B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

9. COMPLETION INSPECTION

A. CQC System Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.

B. Punchlist:

1. CQC System Manager shall develop a punchlist of items which do not conform to the Contract requirements.
2. Include punchlist in the CQC report, indicating the estimated date by which the deficiencies will be corrected.
3. CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

END OF SECTION

# SECTION 01 45 33
# SPECIAL INSPECTION, OBSERVATION, AND TESTING

## PART 1 GENERAL

### 1. SUMMARY

A. This section covers requirements for Special Inspection, Observation, and Testing required in accordance with Chapter 17 of the 2016 CBC and is in addition to and supplements requirements included in Statement of Special Inspections shown on Drawings.

### 2. REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
2. 2016 California Building Code (CBC) by California Building Standards Commission.
3. International Code Council (ICC):
   a. International Building Code (IBC).
   b. Evaluation Service (ICC-ES) Reports and Legacy Reports.

### 3. DEFINITIONS

A. Agencies and Personnel:

1. Agency Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.
2. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.
3. Registered Design Professional in Responsible Charge: An individual who is registered or licensed to practice their respective design profession as defined by statutory requirements of professional registration laws of state or jurisdiction in which Project is to be constructed.
4. Special Inspector: Qualified person employed by Owner who will demonstrate competence to the satisfaction of AHJ for inspection of a particular type of construction or operation requiring Special Inspection.

B. Statement of Special Inspections: Detailed written procedure contained on Drawings establishing systems and components subject to Special Inspection, Observation, and Testing during construction, type and frequency of testing, extent and duration of Special Inspection, and reports to be completed and distributed by Special Inspector.

C. Special Inspection:

1. Special Inspection: Inspection required of materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved Contract Documents and referenced standards.
2. Special Inspection, Continuous: Full-time observation of work requiring Special Inspection by an approved Special Inspector who is present in area where the Work is being performed.
3. Special Inspection, Periodic: Part-time or intermittent observation of the Work requiring Special Inspection by an approved Special Inspector who is present in area where the Work has been or is being performed, and at completion of the Work.

D. Structural Systems and Components:

1. Diaphragm: Component of structural lateral load resisting system consisting of roof, floor, or other membrane or bracing system acting to transfer lateral forces to vertical resisting elements of structure.
2. Drag Strut or Collector: Component of structural lateral load resisting system consisting of diaphragm or shear wall element that collects and transfers diaphragm shear forces to vertical force-resisting elements or distributes forces within diaphragm or shear wall.
3. Seismic-Force-Resisting System: That part of structural lateral load resisting system that has been considered in the design to provide required resistance to seismic forces identified on Drawings.
4. Shear Wall: Component of structural lateral load resisting system consisting of a wall designed to resist lateral forces parallel to plane of the wall. Unless noted otherwise on Drawings, load-bearing walls with direct in-plane connections to roof and floors shall be considered to be shear walls.
5. Wind Force Resisting System: That part of the structural system that has been considered in the design to provide required resistance to wind forces identified on Drawings.

E. Nonstructural Components:

1. Architectural Component Supports: Structural members or assemblies of members which transmit loads and forces from architectural systems or components to structure, including

braces, frames, struts, and attachments.

2. Electrical Component Supports: Structural members or assemblies which transmit loads and forces from electrical equipment to structure, including braces, frames, legs, pedestals, and tethers, as well as elements forged or cast as part of component for anchorage.
3. Mechanical and Plumbing Component Supports: Structural members or assemblies which transmit loads and forces from mechanical or plumbing equipment to structure, including braces, frames, skirts, legs, saddles, pedestals, snubbers, and tethers, as well as elements forged or cast as part of component for anchorage.

F. Professional Observation:

1. Does not include or waive responsibility for required Special Inspection or inspections by building official.
2. Requirements are indicated on Statement of Special Inspections provided on Drawings.
3. Geotechnical Observation: Visual observation of selected subgrade bearing surfaces and installation of deep foundation elements by a registered design professional for general conformance to Contract Documents.
4. Structural Observation: Visual observation of structural system(s) by a registered design professional for general conformance to Contract Documents.

4. SUBMITTALS

A. Informational Submittals:

1. Contractor's Statement of Responsibility: Form shall be completed by entity responsible for construction of and main seismic-force-resisting system, seismic-resisting component listed in Statement of Special Inspections. Refer to Article Supplements located at end of section.
2. Fabricator's Certificate of Compliance: Form shall be completed by entity responsible for shop fabrication of structural load-bearing members and assemblies. Refer to Article Supplements located at end of section.

5. STATEMENT OF SPECIAL INSPECTIONS REQUIREMENTS

A. Designated Systems for Inspection:

1. Seismic-force-resisting systems designated under CBC Section 1705 and subject to Special Inspection under Section 1705: See Drawings for basic lateral load resisting systems for each structure and other designated seismic systems.

2. Wind-force-resisting systems designated under CBC Section 1705: None required.
3. Architectural, plumbing, mechanical, and electrical components subject to Special Inspection under CBC Section 1705.12.5 and 1705.12.6 for Seismic Resistance.

B. Statement of Special Inspections:

1. As included on Drawings and in support of building permit application, Project-specific requirements were prepared by Registered Design Professional in Responsible Charge. The following identifies elements of inspection, observation, and testing program to be followed in construction of the Work:
   a. Designated seismic systems and main seismic force resisting systems and components that are subject to Special Inspection and Structural Observation for lateral load resistance.
   b. Special Inspection and testing required by CBC Section 1705 and other applicable sections and referenced standards therein.
   c. Type and frequency of Special Inspection required.
   d. Type and frequency of testing required.
   e. Required frequency and distribution of testing and Special Inspection reports to be distributed by Special Inspector to Construction Manager, Contractor, building official, and Owner.
   f. Geotechnical Observation to be Performed: Required frequency and distribution of Geotechnical Observation reports by registered design professional to Contractor, building official, and Owner.
   g. Structural Observations to be Performed: Required frequency and distribution of Structural Observation reports by registered design professional to Contractor, building official, and Owner.

C. Special Inspection and associated testing of shop fabrication and field construction will be performed by an approved accredited independent agency or by Authority Having Jurisdiction's (AHJ) approved, qualified inspection staff. Owner will secure and pay for services of agency to perform Special Inspection and associated testing.

D. Code required Special Inspection with associated testing and Professional Observation, as provided in Statement of Special Inspections on Drawings and further provided in this section, is for benefit of Owner and does not:

1. Relieve Contractor of responsibility for providing adequate quality control measures.
2. Relieve Contractor of responsibility for damage to or loss of

material before acceptance.

3. Constitute or imply acceptance.
4. Affect continuing rights of Owner after acceptance of completed Work.

E. The presence or absence of code required Special Inspector and Professional Observer does not relieve Contractor from Contract requirements.

F. Contractor is responsible for additional costs associated with Special Inspection and Testing and Observation when Work is not ready at time identified by Contractor and Special Inspectors and Professional Observer are onsite, but not able to provide contracted services.

G. Contractor is responsible for associated costs for additional Special Inspection and Testing and Professional Observation by Special Inspectors and Professional Observers required because of rejection of materials of in place Work that cannot be made compliant to Contract Document without additional inspections and observation and testing.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 1. GENERAL

A. Requirements of the Statement of Special Inspections are provided by the Owner. All other testing and inspections, unless noted otherwise, are provided by Contractor.

B. Provide access to shop or Site for Special Inspection and Testing and Professional Observation requirements.

C. Notify Construction Manager in advance of required Special Inspection and Professional Observation no later than 48 hours prior to date of Special Inspection and Professional Observation.

D. Provide access for Special Inspector to construction documents.

E. Retain special inspection records onsite to be readily available for review.

F. Cooperate with Special Inspector and provide safe access to the Work to be inspected.

G. Submit Fabricator's Certificates of Compliance for approved fabricators.

H. Provide reasonable auxiliary services as requested by the Special Inspector. Auxiliary services required include, but not limited to:

1. Providing access to the Work and furnishing incidental labor and

facilities necessary to facilitate inspections and tests to assist the Special Inspector in performing test/inspections.

2. Providing storage space for the Special Inspector's exclusive use, such as for storing and curing concrete test samples and delivery of samples to testing laboratories.
3. Providing the Special Inspector with access to all approved submittals.
4. Providing security and protection of samples and test equipment at the Project Site.
5. Provide samples of materials to be tested in required quantities.

I. When required by Registered Design Professional in Responsible Charge, provide access for plumbing, mechanical, and electrical component inspections for those items requiring certification.

J. Materials and systems shall be inspected during placement where Continuous Special Inspection is required.

K. Where Periodic Special Inspection is indicated in the Statement of Special Inspections:

1. Schedule inspections for either during or at completion of their placement or a combination or both.
2. Schedule periodically inspected Work (either inspected during or after its placement) so that corrections can be completed and re-inspected before Work is inaccessible.
3. Sampling a portion of the Work is not allowed. Schedules shall provide for inspection of all Work requiring periodic inspection.

2. SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this specification:

1. Contractor's Statement of Responsibility.
2. Fabricator's Certificate of Compliance.

END OF SECTION

CONTRACTOR'S STATEMENT OF RESPONSIBILITY

_____

(Project)

_____

(Name of Contracting Company)

_____

(Business Address)

(_____) _____ (_____) _____

(Telephone) (Fax)

I, (We) hereby certify that I am (we are) aware of the Special Inspection and Testing and Professional Observation requirements contained in Contract Documents for this Project for seismic force-resisting systems and for components including architectural, mechanical, and electrical components as listed in Statement of Special Inspections on Drawings, and that:

1. I, (We) aware of the systems and the requirements of the special inspection and acknowledge our responsibility in the implementation of the Statement of Special Inspections for the construction of the following systems:

| Facility | Specification | Lateral Force-Resisting System |
|---|---|---|
| Retaining Walls | | Cantilevered Retaining Wall |

2. Control of this Work will be exercised to obtain conformance with Contract Documents approved by building official.
4. Procedures within the Contractor's organization to be used for exercising control of the Work, method and frequency of reporting, and distribution of reports required under Statement of Special Inspections for Project are attached to this statement.
5. I, (We) will provide 48-hour notification to Construction Manager and approved inspection agency as required for structural tests and Special Inspection for Project.
6. The following person is hereby identified as exercising control over requirements of this section for the Work designated above:
   Name: _____
   Qualifications: _____
   _____
   _____
   (Print name and official title of person signing this form)
   Signed by: __
   Date: _
   Project Name: _____

FABRICATOR'S CERTIFICATE OF COMPLIANCE

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per Section 2016 CBC must submit Fabricator's Certificate of Compliance at the completion of fabrication.

(Project)

(Fabricator's Name)

(Business Address)

(Certification or Approval Agency)

(Certification Number)

(Date of Last Audit or Approval)

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with approved construction documents.

(Name and Title) type or print

(Signature and Date)

Attach copies of fabricator's certification or building code evaluation service report and fabricator's quality control manual.

# SECTION 01 50 00
# TEMPORARY FACILITIES AND CONTROLS

## PART 1 GENERAL

### 1. REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of Nurserymen (AAN): American Standards for Nursery Stock.
2. Federal Emergency Management Agency (FEMA).
3. National Fire Prevention Association (NFPA): 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
4. Telecommunications Industry Association (TIA); Electronic Industries Alliance (EIA): 568B, Commercial Building Telecommunications Cabling Standard.
5. U.S. Department of Agriculture (USDA): Urban Hydrology for Small Watersheds.
6. U.S. Weather Bureau: Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years.

### 2. SUBMITTALS

A. Informational Submittals:

1. Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.
2. Temporary Construction Submittals:
   a. Access Roads: Routes, cross-sections, and drainage facilities.
   b. Contractor’s field office, storage yard, and storage building plans, including gravel surfaced area.
   c. Fencing and protective barrier locations and details.
   d. Construction Manager’s field office plans.
      1) Seismic restraint design.
      2) Communication (data) and electrical wiring plan (data).
      3) Fire detection and alarm.
      4) Catalog cuts for flooring, trim, counters, partitions, kitchen appliances, etc.
      5) Construction details for all decks, handrails, ramps and stairs. Handrail and main ramp to be ADA compliant.
   e. Staging area location plan.
   f. Traffic and Pedestrian Control and Routing Plans: As specified herein, and proposed revisions thereto.

g. Plan for maintenance of existing plant operations.

3. Temporary Control Submittals:
   a. Noise control plan.
   b. Dust control plan.
   c. Submittals required as part of the Environmental Mitigation Monitoring and Reporting Program in Supplement 1 – Environmental Monitoring and Reporting Program.
   d. SWPPP submittals required under Section 01 57 13, Temporary Erosion and Sediment Control.
   e. Plan for disposal of waste materials and intended haul routes.
   f. Preconstruction and post construction condition assessment report performed by a licensed professional engineer registered in the State of California.

## 3. MOBILIZATION

A. Mobilization includes, but is not limited to, these principal items:

1. Obtaining required permits.
2. Moving Contractor's field office and equipment required for first month operations onto Site.
3. Installing temporary construction power, wiring, and lighting facilities.
4. Providing onsite Internet service and telephones.
5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
6. Arranging for and erection of Contractor's work and storage yard.
7. Posting OSHA required notices and establishing safety programs and procedures.
8. Having Contractor's superintendent at Site full time.
9. Providing Construction Manager's facilities.

B. Use area designated for Contractor's temporary facilities as shown on Drawings.

## 4. PROTECTION OF WORK AND PROPERTY

A. Comply with Owner's safety rules while on Owner's property.

B. Keep Owner informed of serious onsite accidents and related claims.

C. Use of Explosives: No blasting or use of explosives will be allowed onsite.

## 5. VEHICULAR TRAFFIC

A. Traffic Control Plan: Adhere to traffic control plan reviewed and accepted

by the Construction Manager. Changes to this plan shall be made only by written approval of the Construction Manager. Secure approvals for necessary changes so as not to delay progress of the Work.

B. Traffic Routing Plan: Show sequences of construction affecting use of roadways, time required for each phase of the Work, provisions for decking over excavations and phasing of operations to provide necessary access, and plans for signing, barricading, and striping to provide passages for pedestrians and vehicles.

## PART 2 PRODUCTS

### 1. CONSTRUCTION MANAGER FIELD OFFICES

A. Furnish equipment specified for exclusive use of Construction Manager and their representatives.

B. A general arrangement of the temporary construction facilities as shown for reference in Supplement Temporary Construction Facilities General Arrangement. The Contractor shall be responsible for providing facilities in an arrangement determined by the Contractor meeting the requirements for all Contractor and Subcontractor personnel as well as the Construction Manager.

C. Ownership of equipment furnished under this article will remain, unless otherwise specified, that of Contractor. The lease for the Construction Manager's trailers shall be transferable at the conclusion of the Project. It is the intent to keep the trailer onsite for a minimum of 3 additional years.

D. Equipment furnished shall be new or like new in appearance and function.

E. Minimum Features: See Figure 1 (Office Layout) and Figure 2 (Furniture Layout) in the Supplements for specific requirements.

1. 110-volt lighting and wall plugs.
2. Fluorescent ceiling lights.
3. Electric heating and self-contained air conditioning unit, properly sized for Project locale and conditions. Provide ample electric power to operate installed systems.
4. Provide railed stairways and landings, and exterior lighting at entrances. Provide an ADA accessible ramp and 8-foot full trailer width deck at the main entrance of the trailer.
5. Sign on entrance door reading Construction Manager, letter height 4 inches minimum.
6. Exterior Door(s):
   a. Number: Three.

b. Type: Solid core.
c. Lock(s): Cylindrical; keyed alike.

7. Number of Windows: Fifteen.
8. Minimum Interior Height: 8 feet.

F. Trailer Type Mobile Structure: Quad (Four 14 feet by 60 feet).

G. Floor Space: Minimum 1,680 square feet.

H. All-metal frame; all-metal exterior, sides, and roof; and insulated double walls, floor, and roof.

I. Security guard screens on windows.

J. Men's and Women's restroom with hot and cold water and drains.

K. Kitchen Appliances:

1. GE Profile™ Energy Star® 21.7 Cubic Foot Top-Freezer Refrigerator, or approved equal.
2. Amana commercial grade countertop microwave, or approved equal.
3. One horsepower stainless Waste King, or approved equal, disposer.
4. Bunnomatic commercial type coffeemaker, or approved equal.
5. Faberware toaster, or approved equal.
6. Hamilton Beach toaster oven with convection cooking, or approved equal.

L. Number of Private Offices: Six, variable sizes.

M. Blinds or drapes on windows.

N. Office Equipment:

1. See Figure 2 - Furniture Layout and Table 1- Furniture List:
   a. Bottled Water Service: One, with cooler capable of producing hot water and cold water.
   b. Paper Cup Dispenser with Cups: One.
   c. Paper Towel Dispenser with Towels: One.
   d. Furniture and Paneling System: See Supplement Table 1 for item list.
   e. Telecommunications: See Article Construction Manager's Field Office.
   f. Wastepaper Basket: Eighteen.
   g. Blue Recycling Basket: Eighteen.
   h. Clothes Rack: Two.
   i. First-Aid Kit: One.

j. Tri-Class (ABC), Dry Chemical Fire Extinguisher, 10-Pound: Two.
k. Telephone: Per layout with one intercom line and two incoming/outgoing lines, Touch-Tone, with conference speaker, and 12-foot coiled handset cord.
l. Digital Answering Machine: Model as approved by Engineer. Must have capability to retrieve messages remotely.
m. Provide and install 55-inch Samsung Smart TV.

O. Computer Hardware:

1. Accessories:
a. Free Standing Document Holder: 11 inches by 17 inches.
b. Adjustable keyboard tray, large enough to accommodate standard keyboard and mouse.
c. Wrist rest for keyboard.
d. Wrist rest and pad for mouse.
e. Foot rest, slanted and small enough to fit under desk.
f. Monitor arm.
g. Monitor risers.
h. Laptop Accessories:
1) External Mouse: Three-button.
2) External keyboard.
3) Riser.
2. Power Supply Surge Protector: One each per computer; rated at 15 amps.

2. PROJECT SIGN

A. Refer to Whitebook Section 7-10.6.2 for requirements for City-furnished project signs and the Funding Agency provisions for required signage.

PART 3 EXECUTION

1. Construction Manager's FIELD OFFICE

A. Make available for Construction Manager's use prior to start of the Work at Site and to remain on Site for minimum of 60 days after substantial completion of the Work. Trailer lease to be transferable from that portion there-on.

B. Locate where directed by Construction Manager; level, block, tie down, skirt, provide stairways, and relocate when necessary and approved. Construct on proper foundations, and provide proper surface drainage and connections for utility services.

C. Provide minimum 100 square feet of gravel or crushed rock base, minimum depth of 4 inches, at each entrance.

D. Locate where directed by Construction Manager; level, block, tie down (seismic restraint), skirt, provide stairways, ADA accessible ramp, 8-foot-wide decking at entrance for the entire width of the trailer and relocate when necessary and approved. Construct on proper foundations, and provide proper surface drainage and connections for utility services.

E. Provide minimum 100 square feet of gravel or crushed rock base, minimum depth of 4 inches, at each entrance.

F. Raise grade under field office, as necessary, to elevation adequate to avoid flooding.

G. Provide sanitary facilities in compliance with state and local health authorities.

H. Exterior Door Keys: Furnish two sets of keys.

I. Telephone:

1. Provide and install Voice over Internet Protocol (VOIP) phones for the number of incoming lines equal to that specified.
2. Provide and install appropriate jacks; locate as directed by Construction Manager.

J. Computer:

1. Provide and install ten HP Pro Compaq 6300 Computers with 24-inch Elite Display monitor (E241i), including required connecting cables and plugs.
2. Provide four Microsoft Surface Pro Fours with docking station.

K. Local Area Network (LAN):

1. Provide Ethernet network prewired in compliance with EIA/TIA 568B.
2. LAN shall be designed and installed by personnel experienced in similar LAN systems.

L. Telecommunications:

1. Provide and install the following:
    a. Cisco 2960-24 port 10/100 Switch:
        1) WS-C2960-24TT-L; Catalyst 2960 24 10/100 + 2 1000BT LAN Base Image, one each.
        2) CAB-AC; Power Cord, 110V, one each.
        3) CON-OS-C29602TT, ONSITE 8X5XNBD Catalyst 2960 24 10/100 + 2 1000BT LAN, three each.
        4) Cisco 1941 Router.

5) CISCO1941-SEC/K9; Cisco 1941 Security Bundle w/SEC license PAK, one each.
6) S19UK9-15001M; Cisco 1941 IOS UNIVERSAL, one each.
7) SL-19-DATA-K9; Data License for Cisco 1900, one each.
8) MEM-CF-256U512MB; 256MB to 512MB CF Upgrade for Cisco 1900,2900,3900 ISR, one each.
9) AC Power Cord (North America), C13, NEMA 5-15P, CAB-AC; 2.1m, one each.
10) PWR-1941-AC; Cisco 1941 AC Power Supply, one each.
11) ISR-CCP-EXP; Cisco Config Pro Express on Router Flash, one each.
12) MEM-1900-512MB-DEF; 512MB Default DRAM for Cisco 1941 ISR, one each.
13) SL-19-IPB-K9; IP Base License for Cisco 1900, one each.
14) SL-19-SEC-K9; Security License for Cisco 1900, one each.
15) CON-SNT-1941SEC; SMARTNET 8X5XNBD Cisco 1941 Security Bundle w/SEC license, three each.

b. AIR-AP1142N-A-K9:
1) AIR-AP1131AG-A-K9; 802.11a, .11g AP, Int Radios, Ants, FCC Cnfg, one each.
2) AIR-AP1142N-A-K9; AIR Line Cord North America, one each.
3) S114W7K9-12421JA; Cisco 1140 Series IOS WIRELESS LAN, one each.
4) AIR-PWRINJ4=; Power Injector - 1140 / 1250 Series; Spare, one each.
5) CON-SNT-1142NAK; SMARTNET 8X5XNBD 802.11a/g/n Fixed Unified AP; Int Ant, three each.

c. Riverbed for WAN Optimization:
1) SHA-00550-H; Steelhead 550 with 2 onboard GbE bypass ports (600 conn/2Mbps), one each.
2) MNT-GLD-SHA-00550; Gold level annual support for Steelhead Appliance 550 Series, one each.
3) MEM-002; 2 GB Memory, one each.
4) RMK-001; Rack Mount Kit for Steelhead SH250/550 , one each.
5) RSP-PCK-02; RSP Multi-Package License, one each.
6) MNT-RSP-PCK-0 2; RSP Multi-Package License Support, one each.

d. UPS:
1) SUA750; APC Smart-UPS 750VA USB & Serial 120V, one each.

2) AP9617; Network Management Card EX, one each.

e. Network Printer:
   1) Sharp MX Network Printer or greater capable of 11-inch by 17-inch printing and network accessible.
   2) Contract for immediate site service, one each.

f. Multi-Function Device (MFD):
   1) Konica BizHub or greater capable of color printing, 11-inch by 17-inch printing, scan to email and fax capabilities.
   2) Contract for immediate site service, one each.

g. The Contractor shall provide an Internet, T1 line or greater. The internet circuit shall be provided for the duration of the Project to the Construction Manager with an Ethernet handoff. Provide a public routable IP address scheme with a subnet mask of /29 for routable addresses. The Contractor shall provide LAN Line telephone service and voicemail and will perform maintenance including move, add, and changes for the duration of the Project. Each network component and UPS device will carry the stated maintenance types until 30 days after Final Acceptance.

h. Contractor shall provide all consumable supplies necessary for complete operation of the equipment specified under this section shall be furnished by Contractor until 30 days after Final Acceptance. These supplies include, but are not limited to, ink and toner cartridges, plain paper, first-aid supplies, and fire extinguisher certification.

i. Provide appropriate jacks, wiring, and equipment required for a complete telecommunications system.

j. Arrange and provide for telecommunication service for use during construction. Pay costs of installation, maintenance, and monthly service of internet connection.

k. Maintain in good repair and appearance, and provide weekly cleaning service and replenishment, as required, of paper towels, paper cups, hand soap, toilet paper, first-aid kit supplies, and bottled water.

## 2. TEMPORARY UTILITIES

### A. Power:

1. Electric power will be available at or near Site. Determine type and amount available and make arrangements for obtaining temporary electric power service, metering equipment, and pay costs for electric power used during Contract period, except for portions of the Work designated in writing by Construction Manager as substantially complete.
2. Where grid power is unavailable or impractical, provide diesel

fueled standby generators and temporary distribution circuit breaker equipment to maintain continuous power to process facilities as required.

B. Lighting: Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.

C. Heating, Cooling, and Ventilating:

1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for installation of materials, and to protect materials, equipment, and finishes from damage because of temperature or humidity. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
2. Pay costs of installation, maintenance, operation, removal, and fuel consumed.
3. Provide portable unit heaters, complete with controls, oil- or gas-fired, and suitably vented to outside as required for protection of health and property.
4. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.

D. Water:

1. Hydrant Water:
   a. Is available from nearby hydrants. Secure written permission for connection and use from water department and meet requirements for use. Notify fire department before obtaining water from fire hydrants.
   b. Use only special hydrant-operating wrenches to open hydrants. Make certain hydrant valve is open full, since cracking valve causes damage to hydrant. Repair damaged hydrants and notify appropriate agency as quickly as possible. Hydrants shall be completely accessible to fire department at all times.
   c. Include costs to connect and transport water to construction areas in Contract Price.
2. Owner will provide a place of temporary connection for construction and drinking water at Site. Contractor to provide temporary facilities and piping required to bring water to point of use and remove when no longer needed. Install an acceptable metering device and pay for water used at Owner's current rate.
3. Provide and bear costs of necessary water in excess of 100 gpm

required for testing equipment, tanks or basins, and piping prior to Substantial Completion, unless otherwise specifically stated in Specifications for equipment, systems, or facilities to be tested.

4. Provide means to prevent water used for testing from flowing back into source pipeline.

E. Sanitary and Personnel Facilities:

1. Provide and maintain facilities for Contractor's employees, Subcontractors, and other onsite employers' employees. Service, clean, and maintain facilities and enclosures.
2. Use of Owner's existing sanitary facilities by construction personnel will not be allowed.

F. Telephone Service:

1. Contractor: Arrange and provide onsite telephone service for use during construction. Pay costs of installation and monthly bills.

G. Fire Protection: Furnish and maintain on Site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of NFPA 241.

3. PROTECTION OF WORK AND PROPERTY

A. General:

1. Perform Work within right-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
2. No business shall be cut off from vehicular traffic. Contractor shall phase work to allow ingress/egress at all times, unless special arrangements have been made.
3. Maintain in continuous service existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.
4. Where completion of the Work requires temporary or permanent removal or relocation of existing utility, coordinate activities with owner of said utility and perform work to their satisfaction.
5. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
6. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
7. In areas where Contractor's operations are adjacent to or near a

utility, such as gas, telephone, television, electric power, water, sewer, or irrigation system, and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection have been made by Contractor.

8. Notify property owners and utility offices that may be affected by construction operation at least 2 days in advance. Before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to Contractor's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.
9. Do not impair operation of existing sewer system. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures.
10. Maintain original Site drainage wherever possible.

B. Site Security:

1. Maintain existing security at plant entrance security guard shack and security gate. Maintain access for plant personnel and deliveries. Relocation of guard shack, gate, and associated utilities is part of NCWRP Expansion (Package 2).
2. Provide and maintain additional temporary security fences as necessary to protect the Work and Contractor-furnished products not yet installed.

C. Barricades and Lights:

1. Provide as required by the CalTrans, OSHA Title 8, California Manual on Uniform Traffic Control Devices (CAMUTCD), or other required Vehicle Code and in sufficient quantity to safeguard public and the Work.
2. Provide as necessary to prevent unauthorized entry to construction areas and affected roads, streets, and alleyways, inside and outside of fenced area, and as required to ensure public safety and the safety of Contractor's employees, other employer's employees, and others who may be affected by the Work.
3. Provide to protect existing facilities and adjacent properties from potential damage.
4. Locate to enable access by facility operators and property owners.
5. Protect streets, roads, highways, and other public thoroughfares that are closed to traffic by effective barricades with acceptable warning signs.
6. Locate barricades at the nearest intersecting public thoroughfare on each side of blocked section.
7. Illuminate barricades and obstructions with warning lights from sunset to sunrise.

D. Signs and Equipment:

1. Conform to requirements of CAMUTCD.
2. Portable TOW-AWAY-NO STOPPING Signs: Place where approved by police department and Owner.
3. Traffic Cones: Provide to delineate traffic lanes to guide and separate traffic movements.
4. High-Level Warning Flag Units: Provide two in advance of traffic approaching the Work, each displaying three flags mounted at a height of 9 feet.
5. DETOUR Signs: Provide two, right arrow or left arrow, placed as approved by Construction Manager.
6. RIGHT or LEFT LANE CLOSED AHEAD Signs: Provide two, place in advance of lane to be closed.
7. Provide at obstructions, such as material piles and equipment.
8. Use to alert general public of construction hazards, which would include surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.

E. Trees and Plantings:

1. Protect from damage and preserve trees, shrubs, and other plants outside limits of the Work and within limits of the Work, which are designated on Drawings to remain undisturbed.
   a. Where practical, tunnel beneath trees when on or near line of trench.
   b. Employ hand excavation as necessary to prevent tree injury.
   c. Do not stockpile materials or permit traffic within drip lines of trees.
   d. Provide and maintain temporary barricades around trees.
   e. Water vegetation as necessary to maintain health.
   f. Cover temporarily exposed roots with wet burlap, and keep burlap moist until soil is replaced around roots.
   g. No trees, except those specifically shown on Drawings to be removed, shall be removed without written approval of Engineer.
   h. Dispose of removed trees in a legal manner off the Site.
2. Balling and burlapping of trees indicated for replacement shall conform to recommended specifications set forth in the American Standards for Nursery Stock, published by American Association of Nurserymen. Balls shall be firm and intact and made-balls will not be accepted. Handle ball and burlap trees by ball and not by top.
3. In event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint,

and other accepted horticultural and tree surgery practices.

4. Replace each plant that dies as a result of construction activities.

F. Existing Structures:

1. Where Contractor contemplates removal of small structures such as mailboxes, signposts, and culverts that interfere with Contractor's operations, obtain approval of property owner and Construction Manager.
2. Move mailboxes to temporary locations accessible to postal service.
3. Replace items removed in their original location and a condition equal to or better than original.

G. Finished Construction: Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing.

H. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.

4. TEMPORARY CONTROLS

A. Air Pollution Control:

1. Minimize air pollution from construction operations.
2. Burning of waste materials, rubbish, or other debris will not be permitted on or adjacent to Site.
3. Conduct operations of dumping rock and of carrying rock away in trucks to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in construction area a dust-preventive treatment or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.
4. Provide and maintain temporary dust-tight partitions, bulkheads, or other protective devices during construction to permit normal operation of existing facilities. Construct partitions of plywood, insulating board, plastic sheets, or similar material. Construct partitions in such a manner that dust and dirt from demolition and cutting will not enter other parts of existing building or facilities. Remove temporary partitions as soon as need no longer exists.

B. Noise Control:

1. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
2. Noise Control Ordinance: San Diego Municipal Code, Section 59.5.01.
3. Noise Control Plan: Propose plan to mitigate construction noise

and to comply with noise control ordinances, including method of construction, equipment to be used, and acoustical treatments.

C. Erosion, Sediment, and Flood Control: Provide, maintain, and operate temporary facilities as required by the Storm Water Pollution Prevention Plan (SWPPP), provided as part of the Contract Documents, to control erosion and sediment releases, and to protect the Work and existing facilities from flooding during construction period.

D. Requirements for the Federal Aviation Administration and Marine Corps Air Station.

1. The Contractor shall comply with all requirements provided in the Environment Impact Report (EIR).
2. Cranes shall have a maximum height limit as required by the ALUC Air Space Obstruction Criteria defined in the EIR. This limit is 200 feet aboveground level.
3. All Work shall be provided in accordance with the Compatibility Plan provided within the EIR.

E. Provide all requirements as required to comply with the Mitigation Monitoring and reporting Program shown on Drawings.

5. STORAGE YARDS AND BUILDINGS

A. Coordinate requirements with Section 01 61 00, Common Product Requirements.

B. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.

C. Temporary Storage Buildings:

1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
3. Store combustible materials (paints, solvents, fuels) in a well-ventilated and remote building meeting safety standards.

6. ACCESS ROADS AND DETOURS

A. Alignments for alternative routes to that provided on Drawings shall be approved by the Construction Manager.

B. Maintain drainage ways. Install and maintain culverts to allow water to flow beneath access roads. Provide corrosion-resistant culvert pipe of

adequate strength to resist construction loads.

C. Provide gravel, crushed rock, or other stabilization material to permit access by all motor vehicles at all times.

D. Maintain road grade and crown to eliminate potholes, rutting, and other irregularities that restrict access.

E. Coordinate detours and other operations affecting traffic and access with the Construction Manager. Provide at least 72 hours' notice to Construction Manager of operations that will alter access to Site.

F. Where access road crosses existing fences, install and maintain gates.

G. Upon completion of construction, restore ground surface disturbed by access road construction to original grade. Replace damaged or broken culverts with new culvert pipe of same diameter and material.

7. PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

B. If equipment staging and parking facilities are not identified in the Contract Documents, the Contractor's proposed locations for these purposes is subject to City approval.

C. Provide parking facilities for personnel working on Project. No employee or equipment parking will be permitted on Owner's existing paved areas.

D. Use area designated on Drawings for parking of Contractor's and Contractor's employees' vehicles.

E. For Staging Area 1 parking area, provide 3-inch asphalt on 95 percent compacted subgrade.

8. supplements

A. The supplements listed below, following "End of Section," are part of this Specification.

1. Environmental Mitigation Monitoring and Reporting Program.
2. Figure 1 – Office Layout.
3. Figure 2 – Furniture Layout.
4. Table 1 – Furniture and Paneling.

END OF SECTION

# CHAPTER 10 MITIGATION MONITORING AND REPORTING PROGRAM

Section 21081.6 of the California Environmental Quality Act (CEQA) requires that a mitigation, monitoring, and reporting program (MMRP) be adopted upon certification of an Environmental Impact Report (EIR) to ensure that the mitigation measures are enforceable and implemented. It stipulates that "the public agency shall adopt a reporting or monitoring program for the changes made to the project or conditions of project approval, adopted in order to mitigate or avoid significant effects on the environment. The reporting or monitoring program shall be designed to ensure compliance during project implementation."

This MMRP has been developed in compliance with Section 21081.6 of CEQA and identifies (1) mitigation measures to be implemented prior to, during, and after construction of the North City Project; (2) the individual/agency responsible for that implementation; and (3) criteria for completion or monitoring of the specific measures.

The Environmental Impact Report/Environmental Impact Statement (EIR/EIS), incorporated herein as referenced, focused on issues determined to be potentially significant by the City. Public Resources Code Section 21081.6 requires mitigation of only those impacts identified as significant or potentially significant. The environmental analysis resulted in the identification of mitigation measures that would reduce potentially significant impacts for the following issue areas: air quality; biological resources; health and safety/hazards; historical resources; noise; paleontological resources; public utilities; and transportation, circulation, and parking.

## 10.1 GENERAL

1. Prior to issuance of a Notice to Proceed (NTP) or any construction permits, including but not limited to, the first Demolition Plans/Permits, and Building Plans/Permits, the Assistant Deputy Director (ADD) Environmental Designee of the Land Development Review Division shall verify that all mitigation measures listed in this EIR/EIS have been included in entirety on the submitted construction documents and contract specifications, and included under the heading, "Environmental Mitigation Requirements." In addition, the requirements for a Preconstruction Meeting shall be noted on all construction documents.

2. Prior to the commencement of work, a Preconstruction Meeting (Pre-con) shall be conducted and include the City of San Diego's Mitigation Monitoring Coordination (MMC) Section, Construction Manager (CM), Resident Engineer, Building Inspector, Project Consultant, Applicant and other parties of interest.

3. Evidence of compliance with other permitting authorities is required, if applicable. Evidence shall include either copies of permits issued, letters of resolution issued by the Responsible Agency documenting compliance, or other evidence documenting compliance and deemed acceptable by the ADD Environmental Designee.

4. Pursuant to Section 1600 et seq. of the State of California Fish & Game Code, evidence of compliance with Section 1602 is required, if applicable. Evidence shall include either copies of permits issued, letters of resolution issued by the Responsible Agency documenting compliance, or other evidence documenting compliance and deemed acceptable by the ADD Environmental Designee.

## 10.2 SPECIFIC MMRP ISSUE AREA CONDITIONS/REQUIREMENTS

### 10.2.1 AIR QUALITY Miramar Reservoir Alternative

The following mitigation measures outline the steps necessary to reduce the construction emissions from all components of the Miramar Reservoir Alternative.

**MM-AQ-1** The following best management practices shall be implemented during construction to comply with applicable San Diego Air Pollution Control District (SDAPCD) rules and regulations and to further reduce daily construction emissions:

- Best management practices that could be implemented during construction to reduce particulate emissions and reduce soil erosion and trackout include the following:
  - Cover or water, as needed, any on-site stockpiles of debris, dirt, or other dusty material.
  - Use adequate water and/or other dust palliatives on all disturbed areas in order to avoid particle blow-off. Due to current drought conditions, the contractor shall consider use of a SDAPCD-approved dust suppressant where feasible to reduce the amount of water to be used for dust control. Use of recycled water in place of potable water shall also be considered provided that the use is approved by the City of San Diego and other applicable regulatory agencies prior to initiation of construction activity.[1] Use of recycled water shall be in compliance with all applicable City of San Diego Rules and Regulation for Recycled Water (City of San Diego 2016a), particularly for the protection of public health per the California Code of Regulations, Title 22, Division 4.



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- Wash down or sweep paved streets as necessary to control trackout or fugitive dust.
- Cover or tarp all vehicles hauling dirt or spoils on public roads if sufficient freeboard is not available to prevent material blow-off during transport.
- Use gravel bags and catch basins during ground- disturbing operations.
- Maintain appropriate soil moisture, apply soil binders, and plant stabilizing vegetation.

**MM-AQ-2** The following measures shall be adhered to during construction activities associated with the North City Project to reduce oxides of nitrogen ($NO_X$):

a. All diesel-fueled construction equipment shall be equipped with Tier 3 or better (i.e., Tier 4 Interim or Tier 4 Final) diesel engines.

b. ~~The engine size~~ of construction equipment shall be the minimum size suitable for the required job.

[1] The use of recycled water for construction purposes requires approval of the City and other regulatory agencies on a case-by-case basis. The permit shall be obtained prior to beginning construction. Recycled water used for construction purposes may only be used for soil compaction during grading operations, dust control, and consolidation and compaction of backfill in trenches for non-potable water, sanitary sewer, storm drain, gas and electric pipelines. Equipment operators shall be instructed about the requirements contained herein and the potential health hazards involved with the use of recycled water. Water trucks, hoses, drop tanks, etc. shall be identified as containing non-potable water and not suitable for drinking. Determinations as to specific uses to be allowed shall be in accordance with the standards set forth in Title 22, Division 4 of the California Code of Regulations and with the intent of this ordinance to preserve the public health. The City may, at its discretion, set forth specific requirements as conditions to providing such services and/or require specific approval from the appropriate regulatory agencies (City of San Diego 2016a).

c. Construction equipment shall be maintained in accordance with the manufacturer's specifications.

Mitigation measure MM-AQ-3 is provided to reduce odor impacts for the Miramar Reservoir Alternative.

**MM-AQ-3** The City shall implement odor control systems at the NCWRP Expansion, Morena Pump Station, and Morena Wastewater Forcemain specifically designed to abate the potential odors of the facility. Odor control systems would be similar to those currently employed at City of San Diego wastewater treatment facilities to reduce odor impacts. The following odor control systems or equivalent measures shall be implemented to mitigate nuisance odors:

a. North City Water Reclamation Plant Expansion and the Morena Pump Station: NaOCl/NaOH Wet Scrubber plus carbon or Biofilter plus carbon.

b. Air/vacuum relief valves at high points along the wastewater forcemain: ferric chloride and/or High Purity Oxygen injection.

Alternatively, odors could be abated through the addition of chemicals such as iron chloride, nitrate, hydrogen peroxide, sodium hypochlorite, high purity oxygen, magnesium hydroxide, and/or caustic solutions to reduce the liquid phase concentration and thus, reduce the amount volatilized into the gas phase.

### 10.2.2 BIOLOGICAL RESOURCES Miramar Reservoir Alternative

Refer to Section 6.4, Biological Resources, for specific impact summary tables for the Miramar Reservoir Alternative.

**MM-BIO-3 Nesting Birds.** To avoid any direct impacts any species identified as a candidate, sensitive, or special status species in the MSCP or other local or regional plans, policies or regulations, or by CDFW or USFWS, removal of habitat that supports active nests in the proposed area of disturbance should occur outside of the breeding season for these species (February 1 to September 15). If removal of habitat in the proposed area of disturbance must occur during the breeding season, the Qualified Biologist shall conduct a pre- construction survey to determine the presence or absence of nesting birds on the proposed area of disturbance. The pre- construction survey shall be conducted within 10 calendar days prior to the start of construction activities (including removal of vegetation). The applicant shall submit the results of the pre- construction survey to the City's Development Services Department for review and approval prior to initiating any construction activities. If nesting birds are detected, a letter report or mitigation plan in conformance with the City's Biology Guidelines and applicable State and Federal Law (i.e. appropriate follow up surveys, monitoring schedules, and construction barriers/buffers, etc.) shall be prepared and include proposed measures to be implemented to ensure that take of birds or eggs is avoided. The report or mitigation plan shall be submitted to the City for review and approval and implemented to the satisfaction of the City. The City's MMC Section and Biologist shall verify and approve that all measures identified in the report or mitigation plan are in place prior to and/or during construction.

**MM-BIO-4a Coastal California Gnatcatcher.** Prior to the preconstruction meeting, the Assistant Deputy Director (ADD) or MMC shall verify that the MHPA boundaries and the Project requirements regarding the coastal California gnatcatcher, as specified below, are shown on the construction plans.

No clearing, grubbing, grading, or other construction activities shall occur during the coastal California gnatcatcher breeding season (March 1 to August 15), until the following requirements have been met to the satisfaction of the ADD/MMC:

1. A Qualified Biologist (possessing a valid Endangered Species Act Section 10(a)(1)(a) Recovery Permit) shall survey those habitat areas within the MHPA that would be subject to construction noise levels exceeding 60 decibels [dB(A)] hourly average for the presence of the coastal California gnatcatcher. Surveys for coastal California gnatcatcher shall be conducted pursuant to the protocol survey guidelines established by the USFWS within the breeding season prior to the commencement of any construction. If coastal California gnatcatchers are present, then the following conditions must be met:

   a. Between March 1 and August 15, no clearing, grubbing, or grading of occupied coastal California gnatcatcher habitat shall be permitted. Areas restricted from such activities shall be staked or fenced under the supervision of a Qualified Biologist; and

   b. Between March 1 and August 15, no construction activities shall occur within any portion of the site where construction activities would result in noise levels exceeding 60 dB(A) hourly average at the edge of occupied coastal California gnatcatcher habitat. An analysis showing that noise generated by construction activities would not exceed 60 dB(A) hourly average at the edge of occupied habitat must be completed by a Qualified Acoustician (possessing current noise engineer license or registration with monitoring noise level experience with listed animal species) and approved by the ADD/MMC at least 2 weeks prior to the commencement of construction activities. Prior to the commencement of construction activities during the breeding season, areas restricted from such activities shall be staked or fenced under the supervision of a Qualified Biologist; or

   c. At least 2 weeks prior to the commencement of construction activities, under the direction of a Qualified Acoustician, noise attenuation measures (e.g., berms, walls) shall be implemented to ensure that noise levels resulting from construction activities would not exceed 60 dB(A) hourly average at the edge of habitat occupied by the coastal California gnatcatcher. Concurrent with the commencement of construction activities and the construction of necessary noise attenuation facilities, noise monitoring shall be conducted at the edge of the occupied habitat area to ensure that noise levels do not exceed 60 dB(A) hourly average. If the noise attenuation techniques implemented are determined to be inadequate by the Qualified Acoustician or Biologist, then the associated construction activities shall cease until such time that adequate noise attenuation is achieved or until the end of the breeding season (August 16). Construction noise monitoring shall continue to be monitored at least twice weekly on varying days, or more frequently depending on the construction activity, to verify that noise levels at the edge of occupied habitat are maintained below 60 dB(A) hourly average or to the ambient noise level if it already exceeds 60 dB(A) hourly average. If not, other measures shall be implemented in consultation with the biologist and the ADD/MMC, as necessary, to reduce noise levels to below 60 dB(A) hourly average or to the ambient noise level if it already exceeds 60 dB(A) hourly average. Such measures may include, but are not limited to, limitations on the placement of construction equipment and the simultaneous use of equipment.

2. If coastal California gnatcatchers are not detected during the protocol survey, the Qualified Biologist shall submit substantial evidence to the ADD/MMC and applicable resource agencies which demonstrates whether or not mitigation measures such as noise walls are necessary between March 1 and August 15 as follows:

   a. If this evidence indicates that the potential is high for coastal California gnatcatcher to be present based on historical records or site conditions, then Condition 1(a) shall be adhered to as specified above.

   b. If this evidence concludes that no impacts to this species are anticipated, no mitigation measures would be necessary.

**MM-BIO-4b Coastal California Gnatcatcher.** Ambient noise levels on MCAS Miramar, in particular in the vicinity of the airfield, exceed typical construction noise level. On MCAS Miramar, construction noise levels are not anticipated to exceed ambient noise levels. Potential impacts associated with construction activities on MCAS Miramar would be mitigated through the following:

1. Qualified Biologist (possessing a valid federal Endangered Species Act (FESA) Section 10(a)(1)(a) Recovery Permit) shall conduct a pre- construction survey within suitable habitat. Between February 15 and August 31, no clearing, grubbing, or grading of occupied coastal California gnatcatcher habitat shall be permitted. Areas restricted from such activities shall be staked or fenced under the supervision of a Qualified Biologist; and

2. For potential impacts associated with construction noise, presence or absence of coastal California gnatcatcher would be determined by pre-construction surveys conducted by a Qualified Biologist adjacent to the Project area. Coastal sage scrub outside of the impact area

would be flagged to protect it from construction equipment as directed by the Project Biologist. Between February 15 and August 31, no noise-generating construction activities that exceed ambient noise levels would occur in close proximity to occupied habitat. If necessary, other measures shall be implemented in consultation with the Project Biologist as necessary, to reduce noise levels. Measures may include, but are not limited to, limitations on the placement of construction equipment and the simultaneous use of equipment.

**Introduction to MM-BIO-10**

Mitigation measure MM-BIO-10 will be included in the design and construction documents for each Project component and will reduce the potential for short-term and long-term indirect impacts to sensitive vegetation communities. A biological monitor will be present during construction within or adjacent to sensitive resources and would ensure that the Project adheres to and implements the appropriate measures to protect sensitive resources.

**MM-BIO-10** The following measures will be included in the design and construction documents for each Project component to reduce potential impacts to sensitive resources:

a. **Qualified Biologist.** The owner/permittee shall provide a letter to the City's Mitigation Monitoring Coordination (MMC) section stating that a Project Biologist (Qualified Biologist) as defined in the City of San Diego Municipal Code, Land Development Code—Biology Guidelines (City of San Diego 2012), has been retained to implement the Project's biological monitoring program. The letter shall include the names and contact information of all persons involved in the biological monitoring of the Project.

b. **Preconstruction Meeting.** The Qualified Biologist shall attend the preconstruction meeting, discuss the Project's biological monitoring program, and arrange to perform any follow up mitigation measures and reporting including site-specific monitoring, restoration or revegetation, and additional fauna/flora surveys/salvage.

c. **Documentation.** The Qualified Biologist shall submit all required documentation to MMC verifying that any special mitigation reports including but not limited to, maps, plans, surveys, survey timelines, or buffers are completed or scheduled per City Biology Guidelines, Multiple Species Conservation Program (MSCP), Environmentally Sensitive Lands Ordinance, project permit conditions; California Environmental Quality Act (CEQA); National Environmental Policy Act (NEPA); endangered species acts (federal Endangered Species Act and California Endangered Species Act); and/or other local, state or federal requirements.

d. **Biological Construction Mitigation/Monitoring Exhibit.** The Qualified Biologist shall present a Biological Construction Mitigation/Monitoring Exhibit (BCME), which includes the biological documents above. In addition, the BCME would include restoration/revegetation plans, plant salvage/relocation requirements (e.g., burrowing owl exclusions, etc.), avian or other wildlife surveys/survey schedules (including general avian nesting and U.S. Fish and Wildlife (USFWS) protocol), timing of surveys, wetland buffers, avian construction avoidance areas/noise buffers/barriers, other impact avoidance areas, and any subsequent requirements determined by the Qualified Biologist and the City Assistant Deputy Director (ADD)/MMC. The BCME shall include a site plan, written and graphic depiction of the Project's biological mitigation/monitoring program, and a schedule. The BCME shall be approved by MMC and referenced in the construction documents.

e. **Construction Fencing.** Prior to construction activities, the Qualified Biologist shall supervise the placement of orange construction fencing or equivalent along the limits of disturbance adjacent to sensitive biological habitats and verify compliance with any other project conditions as shown on the BCME. This phase shall include flagging plant specimens and delineating buffers to protect sensitive biological resources (e.g., habitats/flora & fauna species, including nesting birds) during construction. Appropriate steps/care should be taken to minimize attraction of nest predators to the site.

f. **On-site Education.** Prior to commencement of construction activities, the Qualified Biologist shall meet with the owner/permittee or designee and the construction crew and conduct an on-site educational session regarding the need to avoid impacts outside of the approved construction area and to protect sensitive flora and fauna (e.g., explain the avian and wetland buffers, flag system for removal of invasive species or retention of sensitive plants, and clarify acceptable access routes/methods and staging areas).

g. **Biological Monitoring.** During construction, a Qualified Biologist would be present to assist in the avoidance of impacts to native vegetation, jurisdictional aquatic resources, sensitive plants and wildlife, and nesting birds. Specific biological monitoring and or mitigation measures for sensitive wildlife, sensitive vegetation communities, and jurisdictional aquatic resources are described further in the mitigation measures.

h. **Cover Trenches.** General biological monitoring shall include verifying that the contractor has covered all steep-walled trenches or excavations over night or after shift. If trenches or excavations cannot be covered, the monitor would verify that the contractor has installed



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exclusionary fencing (e.g., silt fence) around the trenches or excavation areas or installed ramps to prevent entrapment of wildlife (e.g., reptiles and mammals). If animals are encountered within any trenches or excavated areas, they would be removed by the biological monitor, if possible, or provided with a means of escape (e.g., a ramp or sloped surface) and allowed to disperse. In addition, the biological monitor would provide training to construction personnel to increase awareness of the possible presence of wildlife beneath vehicles and equipment and to use best judgment to avoid killing or injuring wildlife. The biological monitor would be available to assist with moving wildlife, if necessary.

i. **Nighttime Construction.** To reduce impacts to nocturnal species in those areas where they have a potential to occur, nighttime construction activity within undeveloped areas containing sensitive biological resources would be minimized whenever feasible and shielded lights would be utilized when necessary. Construction nighttime lighting would be subject to City Outdoor Lighting Regulations per San Diego Land Development Code (LDC) Section 142.0740.

j. **Best Management Practices/Erosion/Runoff.** The City will incorporate methods to control runoff, including a Stormwater Pollution Prevention Plan (SWPPP) to meet National Pollutant Discharge Elimination System (NPDES) regulations or batch discharge permit from the City. Implementation of stormwater regulations are expected to substantially control adverse edge effects (e.g., erosion, sedimentation, habitat conversion) during and following construction both adjacent and downstream from the study area. Typical construction Best Management Practices (BMPs) specifically related to reducing impacts from dust, erosion, and runoff generated by construction activities would be implemented.

During construction, material stockpiles shall be placed such that they cause minimal interference with on-site drainage patterns. This will protect sensitive vegetation from being inundated with sediment-laden runoff. Dewatering shall be conducted in accordance with standard regulations of the Regional Water Quality Control Board (RWQCB). An NPDES permit, issued by RWQCB to discharge water from dewatering activities, shall be required prior to start of dewatering. This will minimize erosion, siltation, and pollution within sensitive communities. Design of drainage facilities shall incorporate long-term control of pollutants and stormwater flow to minimize pollution and hydrologic changes.

k. **Toxics/Project Staging Areas/Equipment Storage.** Projects that use chemicals or generate by-products such as pesticides, herbicides, and animal waste, and other substances that are potentially toxic or impactive to native habitats/flora/fauna (including water) shall incorporate measures to reduce impacts caused by the application and/or drainage of such materials into the MHPA. No trash, oil, parking, or other construction/development-related material/activities shall be allowed outside any approved construction limits. Where applicable, this requirement shall be incorporated into leases on publicly owned property when applications for renewal occur. Provide a note in/on the CDs that states: "All construction-related activity that may have potential for leakage or intrusion shall be monitored by the Qualified Biologist/Owners Representative or Resident Engineer to ensure there is no impact to the MHPA."

### 10.2.3 HEALTH AND SAFETY/HAZARDS Miramar Reservoir Alternative

Potential impacts due to fire hazards would be reduced with implementation of the following mitigation measure:

**MM-HAZ-2** A Hazardous Materials Reporting Form shall be prepared, as determined necessary by the City of San Diego, and a Hazardous Materials Review conducted by the Development Services Department for each North City Project component in compliance with the City of San Diego's Information Bulletin 116.

**MM-HAZ-3** A Spill Prevention and Emergency Response Plan shall be completed, as determined necessary by the City of San Diego, for each North City Project component which includes on-site storage of hazardous materials (i.e., Morena Pump Station, NCWRP Expansion, North City Renewable Energy Facility, NCPWF, and Dechlorination Facility) prior to the commencement of operation. Other safety programs, including a worker safety program, fire response program, a plant safety program, and the facility's standard operating procedures, shall be developed addressing hazardous materials storage locations, emergency response procedures, employee training requirements, hazard recognition, fire safety, first aid/emergency medical procedures, hazard communication training, and release reporting requirements.

### 10.2.4 HISTORICAL RESOURCES Miramar Reservoir Alternative

The mitigation measures (MMs) provided in this section have been designed to fulfill the requirements of Section 106 of the National Historic Preservation Act, the CEQA Guidelines, and the City of San Diego Historic Resource Guidelines. The City of San Diego will be the lead agency implementing cultural resource mitigation measures and will provide information to the Bureau of Reclamation for their ongoing Section 106 oversight and consultation obligations.

**MM-HIS-3** To reduce potential impacts to unknown archaeological resources and/or grave sites during construction of all Project components (i.e., Components Common to the Project Alternatives, Miramar Reservoir Alternative, and San Vicente Reservoir Alternative) the following measures shall be implemented:

I. Prior to Permit Issuance or Bid Opening/Bid Award

A. Entitlements Plan Check

1. Prior to permit issuance or bid opening/bid award, whichever is applicable, the Assistant Deputy Director (ADD) environmental designee shall verify that the requirements for archaeological monitoring and Native American̄ monitoring have been noted on the applicable construction documents through the plan check process.

B. Letters of Qualification have been submitted to ADD

1. Prior to bid award, the applicant shall submit a letter of verification to Mitigation Monitoring Coordinator (MMC) identifying the Principal Investigator (PI) for the Project and the names of all persons involved in the archaeological monitoring program, as defined in the City Historical Resources Guidelines (HRG). If applicable, individuals involved in the archaeological monitoring program must have completed the 40-hour HAZWOPER training with certification documentation.

2. MMC will provide a letter to the applicant confirming the qualifications of the PI and all persons involved in the archaeological monitoring of the Project meet the qualifications established in the City Historical Resources Guidelines.

3. Prior to the start of work, the applicant must obtain written approval from MMC for any personnel changes associated with the monitoring program.

II. Prior to Start of Construction

A. Verification of Records Search

1. The PI shall provide verification to MMC that a site-specific records search (0.25-mile radius) has been completed. Verification includes, but is not limited to a copy of a confirmation letter from South Coastal Information Center, or, if the search was in-house, a letter of verification from the PI stating that the search was completed.

2. The letter shall introduce any pertinent information concerning expectations and probabilities of discovery during trenching and/or grading activities.

3. The PI may submit a detailed letter to MMC requesting a reduction to the 0.25-mile radius.

B. PI Shall Attend Preconstruction Meetings

1. Prior to beginning any work that requires monitoring, the applicant shall arrange a Preconstruction Meeting that shall include the PI, Native American consultant/monitor (where Native American resources may be impacted), Construction Manager (CM), Grading Contractor, Resident Engineer (RE), Building Inspector (BI), if appropriate, and MMC. The qualified archaeologist and Native American monitor shall attend any grading/excavation related Preconstruction Meetings to make comments and/or suggestions concerning the archaeological monitoring program with the CM and/or Grading Contractor.

a. If the PI is unable to attend the Preconstruction Meeting, the applicant shall schedule a focused Preconstruction Meeting with MMC, the PI, RE, CM, if appropriate, prior to the start of any work that requires monitoring.

2. Acknowledgment of Responsibility for Curation (Capital Improvement Program or Other Public Projects)

The applicant shall submit a letter to MMC acknowledging their responsibility for the cost of curation associated with all phases of the archaeological monitoring program.

3. Identify Areas to be Monitored

a. Prior to the start of any work that requires monitoring, the PI shall submit an Archaeological Monitoring Exhibit (AME) (with verification that the AME has been reviewed and approved by the Native American consultant/monitor when Native American resources may be impacted) based on the appropriate construction documents (reduced to 11×17) to MMC identifying the areas to be monitored, including the delineation of grading/excavation limits.



b. The AME shall be based on the results of a site-specific records search as well as information

regarding the age of existing pipelines, laterals and associated appurtenances, and/or any known soil conditions (native or formation).

c. MMC shall notify the PI that the AME has been approved.

4. When Monitoring Will Occur

a. Prior to the start of any work, the PI shall also submit a construction schedule to MMC through the RE indicating when and where monitoring will occur.

b. The PI may submit a detailed letter to MMC prior to the start of work or during construction requesting a modification to the monitoring program. This request shall be based on relevant information such as review of final construction documents which indicate conditions such as age of existing pipe to be replaced, depth of excavation and/or site graded to bedrock, etc., which may reduce or increase the potential for resources to be present.

5. Approval of AME and Construction Schedule

After approval of the AME by MMC, the PI shall submit to MMC written authorization of the AME and Construction Schedule from the CM.

III. <u>During Construction</u>

A. Monitor Shall be Present During Grading/Excavation/Trenching

1. The Archaeological Monitor shall be present full-time during all soil-disturbing and grading/excavation/trenching activities that could result in impacts to archaeological resources as identified on the AME. **The CM is responsible for notifying** the RE, PI, and MMC of changes to any construction activities such as in the case of a potential safety concern within the area being monitored. In certain circumstances, Occupational Safety and Health Administration safety requirements may necessitate modification of the AME.

2. The Native American consultant/monitor shall determine the extent of their presence during soil-disturbing and grading/excavation/trenching activities based on the AME and provide that information to the PI and MMC. If prehistoric resources are encountered during the Native American consultant/monitor's absence, work shall stop, and the Discovery Notification Process detailed in Section III.B–

III.C and IV.A–IV.D shall commence.

3. The PI may submit a detailed letter to MMC during construction requesting a modification to the monitoring program when a field condition such as modern disturbance post-dating the previous grading/trenching activities, presence of fossil formations, or when native soils are encountered that may reduce or increase the potential for resources to be present.

4. The archaeological and Native American consultant/monitor shall document field activity via the Consultant Site Visit Records. The Consultant Site Visit Records shall be emailed by the CM to the RE the first day of monitoring, the last day of monitoring, monthly (Notification of Monitoring

Completion), and in the case of ANY discoveries. The RE shall forward copies to MMC.

B. Discovery Notification Process

1. In the event of a discovery, the Archaeological Monitor shall direct the contractor to temporarily divert all soil-disturbing activities, including but not limited to digging, trenching, excavating, or grading activities in the area of discovery and in the area reasonably suspected to overlay adjacent resources and immediately notify the RE or CM, as appropriate.

2. The Archaeological Monitor shall immediately notify the PI (unless monitor is the PI) of the discovery.

3. The PI shall immediately notify MMC by phone of the discovery, and shall also submit written documentation to MMC within 24 hours by email with photos of the resource in context, if possible.

4. No soil shall be exported off site until a determination can be made regarding the significance of the resource specifically if Native American resources are encountered.

C. Determination of Significance

1. The PI and Native American consultant/monitor, where Native American resources are discovered shall evaluate the significance of the resource. If Human Remains are involved, follow protocol in Section IV below.

a. The PI shall immediately notify MMC by phone to discuss significance determination and shall also submit a letter to MMC indicating whether additional mitigation is required.

**b.** If the resource is significant, the PI shall submit an Archaeological Data Recovery Program (ADRP) and obtain written approval of the program from MMC, CM, and RE. The ADRP and any mitigation must be approved by MMC, RE, and/or CM before ground-disturbing activities in the area of discovery will be allowed to resume. **Note: If a unique** archaeological site is also an historical resource as defined in CEQA Guidelines Section 15064.5, then the **limits on the amount(s) that a Project applicant may be required to pay to cover mitigation costs as indicated in CEQA Section 21083.2 shall not apply.**

(1) Note: For pipeline trenching and other linear projects in the public Right-of-Way, the PI shall implement the Discovery Process for Pipeline Trenching projects identified below under "D."

c. If the resource is not significant, the PI shall submit a letter to MMC indicating that artifacts will be collected, curated, and documented in the Final Monitoring Report. The letter shall also indicate that that no further work is required.

(1) Note: For pipeline trenching and other linear projects in the public right-of-way, if the deposit is limited in size, both in length and depth; the information value is limited and is not associated with any other resource; and there are no unique features/artifacts associated with the deposit, the discovery should be considered not significant.

(2) Note: For pipeline trenching and other linear projects in the public right-of-way, if significance cannot be determined, the Final Monitoring Report and Site Record (DPR Form 523A/B) shall identify the discovery as potentially significant.

D. Discovery Process for Significant Resources – Pipeline Trenching and Other Linear Projects in the Public Right-of-Way

The following procedure constitutes adequate mitigation of a significant discovery encountered during pipeline trenching activities or for other linear project types within the public right- of-way, including but not limited to excavation for jacking pits, receiving pits, laterals, and manholes to reduce impacts to below a level of significance:

1. Procedures for documentation, curation, and reporting

a. One hundred percent (100%) of the artifacts within the trench alignment and width shall be documented in situ,

to include photographic records, plan view of the trench and profiles of side walls, recovered, photographed after cleaning and analyzed and curated. The remainder of the deposit within the limits of excavation (trench walls) shall be left intact.

b. The PI shall prepare a Draft Monitoring Report and submit to MMC via the RE as indicated in Section VI-A.

c. The PI shall be responsible for recording (on the appropriate State of California Department of Parks and Recreation forms DPR 523 A/B) the resource(s) encountered during the Archaeological Monitoring Program in accordance with the City's HRG. The DPR forms shall be submitted to the South Coastal Information Center for either a Primary Record or SDI Number and included in the Final Monitoring Report.

d. The Final Monitoring Report shall include a recommendation for monitoring of any future work in the vicinity of the resource.

IV. <u>Discovery of Human Remains</u>

If human remains are discovered, work shall halt in that area, and no soil shall be exported off-site until a determination can be made regarding the provenance of the human remains; and the following procedures as set forth in CEQA Guidelines Section 15064.5(e), the California Public Resources Code Section 5097.98, and the California Health and Safety Code Section 7050.5, shall be undertaken:

A. Notification

1. Archaeological Monitor shall notify the RE or CM as appropriate, MMC, and the PI, if the monitor is not qualified as a PI. MMC will notify the appropriate Senior Planner in the Environmental Analysis Section of the Development Services Department to assist with the discovery notification process.

2. The PI shall notify the Medical Examiner after consultation with the RE, either in person or via telephone.

B. Isolate discovery site

1. Work shall be directed away from the location of the discovery and any nearby area reasonably suspected to overlay adjacent human remains until a determination can be made by the Medical Examiner in consultation with the PI concerning the provenience of the remains.

2. The Medical Examiner, in consultation with the PI, will determine the need for a field examination to determine the provenience.

3. If a field examination is not warranted, the Medical Examiner will determine with input from the PI, if the remains are or are most likely to be of Native American origin.

C. If human remains are determined to be Native American

1. The Medical Examiner will notify the Native American Heritage Commission (NAHC) within 24 hours. By law, only the Medical Examiner can make this call.

2. NAHC will immediately identify the person or persons determined to be the Most Likely Descendant (MLD) and provide contact information.

3. The MLD will contact the PI within 24 hours or sooner after the Medical Examiner has completed coordination, to begin the consultation process in accordance with CEQA Guidelines Section 15064.5(e) and the California Public Resources and Health and Safety Codes.

4. The MLD will have 48 hours to make recommendations to the property owner or representative, for the treatment or disposition with proper dignity, of the human remains and associated grave goods.

5. Disposition of Native American human remains will be determined between the MLD and the PI, and, if:

a. The NAHC is unable to identify the MLD, OR the MLD failed to make a recommendation within 48 hours after being notified by the Commission, OR

b. The landowner or authorized representative rejects the recommendation of the MLD and mediation in accordance with California Public Resources Code Section 5097.94(k), by the NAHC fails to provide measures acceptable to the landowner, THEN

c. To protect these sites, the landowner shall do one or more of the following:

(1) Record the site with the NAHC,

(2) Record an open space or conservation easement, or

(3) Record a document with the County.

d. Upon the discovery of multiple Native American human remains during a ground-disturbing land development activity, the landowner may agree that additional conferral with descendants is necessary to consider culturally appropriate treatment of multiple Native American human remains. Culturally appropriate treatment of such a discovery may be ascertained from review of the site utilizing cultural and archaeological standards. Where the parties are unable to agree on the appropriate treatment measures, the human remains and items associated and buried with Native American human remains shall be reinterred with appropriate dignity, pursuant to Section 5.c.

D. If human remains are not Native American

1. The PI shall contact the Medical Examiner and notify them of the historic era context of the burial.

2. The Medical Examiner will determine the appropriate course of action with the PI and City staff (California Public Resources Code, Section 5097.98).

3. If the remains are of historic origin, they shall be appropriately removed and conveyed to the San Diego Museum of Man for analysis. The decision for internment of the human remains shall be made in consultation with MMC, Environmental

Analysis Section, the applicant/landowner, any known descendant group, and the San Diego Museum of Man.

V. Night and/or Weekend Work

September 2017-10

A. If night and/or weekend work is included in the contract

1. When night and/or weekend work is included in the contract package, the extent and timing shall be presented and discussed at the Preconstruction Meeting.

2. The following procedures shall be followed.

a. No Discoveries

In the event that no discoveries were encountered during night and/or weekend work, the PI shall record the information on the Consultant Site Visit Record and submit to MMC by email by 8 a.m. of the next business day.

b. Discoveries

All discoveries shall be processed and documented using the existing procedures detailed in Sections III – During Construction, and IV – Discovery of Human Remains. Discovery of human remains shall always be treated as a significant discovery.

c. Potentially Significant Discoveries

If the PI determines that a potentially significant discovery has been made, the procedures detailed under Section III – During Construction and IV –Discovery of Human Remains shall be followed.

d. The PI shall immediately contact the RE and MMC, or by 8 a.m. of the next business day to report and discuss the findings as indicated in Section III-B, unless other specific arrangements have been made.

B. If night and/or weekend work becomes necessary during the course of construction

1. The CM shall notify the RE, as appropriate, a minimum of 24 hours before the work is to begin.

2. The RE, or CM, as appropriate, shall notify MMC immediately.

C. All other procedures described above shall apply, as appropriate.

VI. Post Construction

A. Submittal of Draft Monitoring Report

1. The PI shall submit two copies of the Draft Monitoring Report (even if negative), prepared in accordance with the HRG (Appendix C/D) that describes the results, analysis, and conclusions of all phases of the Archaeological Monitoring Program (with appropriate graphics) to MMC via the RE for review and approval within 90 days following the completion of monitoring. **It should be noted that if the PI is unable** to submit the Draft Monitoring Report within the allotted 90-day time frame as a result of delays with analysis, special study results or other complex issues, a schedule shall be submitted to MMC establishing agreed due dates and the provision for submittal of monthly status reports until this measure can be met.

a. For significant archaeological resources encountered during monitoring, the ADRP or Pipeline Trenching Discovery Process shall be included in the Draft Monitoring Report.

b. Recording Sites with State of California Department of Parks and Recreation

The PI shall be responsible for recording (on the appropriate State of California Department of Parks and Recreation forms DPR 523 A/B) any significant or potentially significant resources encountered during the Archaeological Monitoring Program in accordance with the City's HRG, and submittal of such forms to the South Coastal Information Center with the Final Monitoring Report.

2. MMC shall return the Draft Monitoring Report to the PI via the RE for revision or for preparation of the Final Report.

3. The PI shall submit revised Draft Monitoring Report to MMC via the RE for approval.

4. MMC shall provide written verification to the PI of the approved report.

5. MMC shall notify the RE or CM, as appropriate, of receipt of all Draft Monitoring Report submittals and approvals.

B. Handling of Artifacts

1. The PI shall be responsible for ensuring that all cultural remains collected are cleaned and catalogued

and chronology as they relate to the history of the area; that faunal material is identified as to species; and that specialty studies are completed, as appropriate.

C. Curation of Artifacts: Accession Agreement and Acceptance Verification

1. The PI shall be responsible for ensuring that all artifacts associated with the survey, testing and/or data recovery for this project are permanently curated with an appropriate institution. This shall be completed in consultation with MMC and the Native American representative, as applicable.

2. When applicable to the situation, the PI shall include written verification from the Native American consultant/monitor indicating that Native American resources were treated in accordance with state law and/or applicable agreements. If the resources were reinterred, verification shall be provided to show what protective measures were taken to ensure no further disturbance occurs in accordance with Section IV – Discovery of Human Remains, Subsection C.

3. The PI shall submit the Accession Agreement and catalogue record(s) to the RE or CM, as appropriate for donor signature with a copy submitted to MMC.

4. The RE or CM, as appropriate shall obtain signature on the Accession Agreement and shall return to PI with copy submitted to MMC.

5. The PI shall include the Acceptance Verification from the curation institution in the Final Monitoring Report submitted to the RE or CM and MMC.

D. Final Monitoring Report(s)

1. The PI shall submit one copy of the approved Final Monitoring Report to the RE or CM as appropriate, and one copy to MMC (even if negative), within 90 days after notification from MMC of the approved report.

2. The RE shall in no case issue the Notice of Completion until receiving a copy of the approved Final Monitoring Report from MMC which includes the Acceptance Verification from the curation institution.

10.2.6 PALEONTOLOGICAL RESOURCES

Miramar Reservoir Alternative

Potential impacts paleontological resources would be reduced by implementation of the following mitigation measure:

**MM-PALEO-1** If construction of a project would occur within a formation with a moderate to high resource potential, monitoring during construction would be required, and a paleontological resources mitigation program consisting of the following components shall be implemented:

I. Prior to Permit Issuance or Bid Opening/Bid Award

A. Entitlements Plan Check

1. Prior to permit issuance or Bid Opening/Bid Award, whichever is applicable, the Assistant Deputy Director (ADD) Environmental designee shall verify that the requirements for Paleontological Monitoring have been noted on the appropriate construction documents.

B. Letters of Qualification have been submitted to ADD

1. Prior to Bid Award, the applicant shall submit a letter of verification to Mitigation Monitoring Coordinator (MMC) identifying the Principal Investigator (PI) for the Project and the names of all persons involved in the paleontological

monitoring program, as defined in the City of San Diego Paleontology Guidelines.

2. MMC will provide a letter to the applicant confirming the qualifications of the PI and all persons involved in the paleontological monitoring of the Project.

3. Prior to the start of work, the applicant shall obtain approval from MMC for any personnel changes associated with the monitoring program.

II. Prior to Start of Construction

A. Verification of Records Search

1. The PI shall provide verification to MMC that a site-specific records search has been completed. Verification includes, but is not limited to, a copy of a confirmation letter from San Diego Natural History

Museum, other institution or, if the search was in-house, a letter of verification from the PI stating that the search was completed.

2. The letter shall introduce any pertinent information concerning expectations and probabilities of discovery during trenching and/or grading activities.

B. PI Shall Attend Precon Meetings

1. Prior to beginning any work that requires monitoring, the applicant shall arrange a Precon Meeting that shall include the PI, Construction Manager (CM), Grading Contractor, Resident Engineer (RE), Building Inspector (BI), if appropriate, and MMC. The qualified paleontologist shall attend any grading/excavation related Precon Meetings to make comments and/or suggestions concerning the Paleontological Monitoring program with the Construction Manager and/or Grading Contractor.

a. If the PI is unable to attend the Precon Meeting, the applicant shall schedule a focused Precon Meeting with MMC, the PI, RE, CM or BI, if appropriate, prior to the start of any work that requires monitoring.

2. Acknowledgement of Responsibility for Curation (CIP or Other Public Projects)

The applicant shall submit a letter to MMC acknowledging their responsibility for the cost of curation associated with all phases of the paleontological monitoring program.

3. Identify Areas to be Monitored

a. Prior to the start of any work that requires monitoring, the PI shall submit a Paleontological Monitoring Exhibit (PME) based on the appropriate construction documents (reduced to 11x17) to MMC for approval identifying the areas to be monitored including the delineation of grading/excavation limits. Monitoring shall begin at depths below 10 feet from existing grade or as determined by the PI in consultation with MMC. The determination shall be based on site-specific records search data which supports monitoring at depths less than 10 feet.

b. The PME shall be based on the results of a site-specific records search as well as information regarding existing known soil conditions (native or formation).

c. MMC shall notify the PI that the PME has been approved.

4. When Monitoring Will Occur

a. Prior to the start of any work, the PI shall also submit a construction schedule to MMC through the RE indicating when and where monitoring will occur.

b. The PI may submit a detailed letter to MMC prior to the start of work or during construction requesting a modification to the monitoring program. This request shall be based on relevant information such as review of final construction documents which indicate conditions such as depth of excavation and/or site graded to bedrock, presence or absence of fossil resources, etc., which may reduce or increase the potential for resources to be present.

5. Approval of PME and Construction Schedule

After approval of the PME by MMC, the PI shall submit to MMC written authorization of the PME and Construction Schedule from the CM.

III. <u>During Construction</u>

A. Monitor Shall be Present During Grading/Excavation/Trenching

1. The monitor shall be present full-time during grading/excavation/trenching activities including, but not limited to mainline, laterals, jacking and receiving pits, services and all other appurtenances associated with underground utilities as identified on the PME that could result in impacts to formations with high and/or moderate resource sensitivity. The Construction Manager is responsible for notifying the RE, PI, and MMC of changes to any construction activities such as in the case of a potential safety concern within the area being monitored. In certain circumstances Occupational Safety and Health Administration safety requirements may necessitate modification of the PME.

2. The PI may submit a detailed letter to MMC during construction requesting a modification to the monitoring program when a field condition such as trenching activities that do not encounter formational soils as previously assumed, and/or when unique/unusual fossils are encountered, which may reduce or increase the potential for resources to be present.

3. The monitor shall document field activity via the Consultant Site Visit Record (CSVR). The CSVR shall be emailed by the CM to the RE the first day of monitoring, the last day of monitoring, monthly (Notification

of Monitoring Completion), and in the case of ANY discoveries. The RE shall forward copies to MMC.

B. Discovery Notification Process

1. In the event of a discovery, the Paleontological Monitor shall direct the contractor to temporarily divert trenching activities in the area of discovery and immediately notify the RE or CM, as appropriate.

2. The Monitor shall immediately notify the PI (unless Monitor is the PI) of the discovery.

3. The PI shall immediately notify MMC by phone of the discovery, and shall also submit written documentation to MMC within 24 hours by email with photos of the resource in context, if possible.

C. Determination of Significance

1. The PI shall evaluate the significance of the resource.

a. The PI shall immediately notify MMC by phone to discuss significance determination and shall also submit a letter to MMC indicating whether additional mitigation is required. The determination of significance for fossil discoveries shall be at the discretion of the PI.

b. If the resource is significant, the PI shall submit a Paleontological Recovery Program (PRP) and obtain written approval of the program from MMC, MC and/or RE. PRP and any mitigation must be approved by MMC, RE, and/or CM before ground-disturbing activities in the area of discovery will be allowed to resume.

(1) Note: For pipeline trenching projects only, the PI shall implement the Discovery Process for Pipeline Trenching projects identified below under "D."

c. If resource is not significant (e.g., small pieces of broken common shell fragments or other scattered common fossils) the PI shall notify the RE, or CM as appropriate, that a non- significant discovery has been made. The Paleontologist shall continue to monitor the area without notification to MMC unless a significant resource is encountered.

d. The PI shall submit a letter to MMC indicating that fossil resources will be collected, curated, and documented in the Final Monitoring Report. The letter shall also indicate that no further work is required.

(1) Note: For Pipeline Trenching Projects Only. If the fossil discovery is limited in size, both in length and depth; the information value is limited and there are no unique fossil features associated with the discovery area, then the discovery should be considered not significant.

(2) Note, for Pipeline Trenching Projects Only: If significance cannot be determined, the Final Monitoring Report and Site Record shall identify the discovery as Potentially Significant.

D. Discovery Process for Significant Resources Pipeline Trenching Projects

The following procedure constitutes adequate mitigation of a significant discovery encountered during pipeline trenching activities including but not limited to excavation for jacking pits, receiving pits, laterals, and manholes to reduce impacts to below a level of significance.

1. Procedures for documentation, curation, and reporting

a. One hundred percent (100%) of the fossil resources within the trench alignment and width shall be documented in-situ photographically, drawn in plan view (trench and profiles of side walls), recovered from the trench and photographed after cleaning, then analyzed and curated consistent with Society of Invertebrate Paleontology Standards. The remainder of the deposit within the limits of excavation (trench walls) shall be left intact and so documented.

b. The PI shall prepare a Draft Monitoring Report and submit to MMC via the RE as indicated in Section VI-A.

c. The PI shall be responsible for recording (on the appropriate forms for the San Diego Natural History Museum) the resource(s) encountered during the Paleontological Monitoring Program in accordance with the City's Paleontological Guidelines (PG). The forms shall be submitted to the San Diego Natural History Museum and included in the Final Monitoring Report.

d. The Final Monitoring Report shall include a recommendation for monitoring of any future work in the vicinity of the resource.

IV. Night and/or Weekend Work

September 2017-10

A. If night and/or weekend work is included in the contract

1. When night and/or weekend work is included in the contract package, the extent and timing shall be presented and discussed at the precon meeting.

2. The following procedures shall be followed.

a. No Discoveries

In the event that no discoveries were encountered during night and/or weekend work, the PI shall record the information on the CSVR and submit to MMC via the RE by email by 8AM on the next business day.

b. Discoveries

All discoveries shall be processed and documented using the existing procedures detailed in Sections III - During Construction.

c. Potentially Significant Discoveries

If the PI determines that a potentially significant discovery has been made, the procedures detailed under Section III - During Construction shall be followed.

d. The PI shall immediately contact the RE and MMC, or by 8:00 a.m. on the next business day to report and discuss the findings as indicated in Section III-B, unless other specific arrangements have been made.

B. If night and/or weekend work becomes necessary during the course of construction

1. The Construction Manager shall notify the RE, as appropriate, a minimum of 24 hours before the work is to begin.

2. The RE, or CM, as appropriate, shall notify MMC immediately.

C. All other procedures described above shall apply, as appropriate.

V. Post Construction

A. Preparation and Submittal of Draft Monitoring Report

1. The PI shall submit two copies of the Draft Monitoring Report (even if negative), prepared in accordance with the PG, which describes the results, analysis, and conclusions of all phases of the Paleontological Monitoring Program (with appropriate graphics) to MMC via the RE for review and approval within 90 days following the completion of monitoring.

a. For significant paleontological resources encountered during monitoring, the Paleontological Recovery Program or Pipeline Trenching Discovery Process shall be included in the Draft Monitoring Report.

b. Recording Sites with the San Diego Natural History Museum

The PI shall be responsible for recording (on the appropriate forms) any significant or potentially significant fossil resources encountered during the Paleontological Monitoring Program in accordance with the City's PG, and submittal of such forms to the San Diego Natural History Museum with the Final Monitoring Report.

2. MMC shall return the Draft Monitoring Report to the PI via the RE for revision or for preparation of the Final Report.

3. The PI shall submit revised Draft Monitoring Report to MMC via the RE for approval.

4. MMC shall provide written verification to the PI of the approved report.

5. MMC shall notify the RE or CM, as appropriate, of receipt of all Draft Monitoring Report submittals and approvals.

B. Handling of Fossil Remains

1. The PI shall be responsible for ensuring that all fossil remains collected are cleaned and catalogued.

C. Curation of Fossil Remains: Deed of Gift and Acceptance Verification

1. The PI shall be responsible for ensuring that all fossil remains associated with the monitoring for this project are permanently curated with an appropriate institution.

2. The PI shall submit the Deed of Gift and catalogue record(s) to the RE or CM, as appropriate for donor signature with a copy submitted to MMC.

3. The RE or CM, as appropriate shall obtain signature on the Deed of Gift and shall return to PI with copy submitted to MMC.

4. The PI shall include the Acceptance Verification from the curation institution in the Final Monitoring Report submitted to the RE or CM and MMC.

D. Final Monitoring Report(s)

1. The PI shall submit two copies of the Final Monitoring Report to MMC (even if negative), within 90 days after notification from MMC of the approved report.

2. The RE shall, in no case, issue the Notice of Completion until receiving a copy of the approved Final Monitoring Report from MMC which includes the Acceptance Verification from the curation institution.

## 10.3 MITIGATION SUMMARY

The applicability of mitigation measures to each Project component is outlined below in Table 10-1.

Table 10-1
Summary of Mitigation Measures

| Mitigation Measure | Components Common To Project Alternatives | | | | | | | | Miramar Reservoir Alternative | | | | San Vicente Reservoir Alternative | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Morena Pump Station* | *Morena Pipelines* | *NCWRP Expansion* | *NCPWF Influent Pump Station* | *North City Pump Station* | *North City Renewable Energy Facility* | *Landfill Gas Pipeline* | *MBC Improvements* | *NCPWF-MR* | *North City Pipeline* | *Dechlorination Facility* | *Miramar Water Treatment Plant Improvements* | *NCPWF-SVR* | *San Vicente Pipeline* | *Mission Trails Booster Station* |
| MM-NOI-4 | X | | | X | X | X | | | | | | | | | X |
| *Paleontological Resources* | | | | | | | | | | | | | | | |
| MM-PALEO-1 | X | | X | X | X | X | | X | X | | X | X | X | X | X |
| *Public Utilities* | | | | | | | | | | | | | | | |
| MM-PU-1 | | X | | | | | X | | | X | | | | X | |
| *Transportation and Traffic* | | | | | | | | | | | | | | | |
| MM-TRAF-1 | | X | | | | | | | | X | | | | X | |

Table 10-4
Mitigation Measures – North City Water Reclamation Plant Expansion

| Mitigation Measure | Timing of Mitigation | | | Responsible Person | Location/Notes |
|---|---|---|---|---|---|
| | *Pre Const.* | *During Const.* | *Post Const.* | | |
| MM-AQ-1 (construction BMPs) | | X | | Construction Manager | Entire site |
| MM-AQ-2 (construction $NO_x$) | | X | | Construction Manager | Entire site |
| MM-AQ-3 (odor reduction) | | | X | City of San Diego | Entire site |
| MM-BIO-3 (nesting birds) | X | X | | Project Applicant/City of San Diego | Areas of coastal sage-scrub and non-native grassland within the site |
| MM-BIO-4 (Coastal California Gnatcatcher) | X | X | | City of San Diego | Coastal sage scrub within the facility within MCAS Miramar |
| MM-BIO-10a (qualified biologist) | X | | | Owner/Permittee | Coastal sage scrub within the site |
| MM-BIO-10b (preconstruction meeting) | X | | | City of San Diego | Coastal sage scrub within the site |
| MM-BIO-10c (documentation) | X | X | X | Owner/Permittee | Coastal sage scrub within the site y |
| MM-BIO-10d (Biological Construction Mitigation/Monitoring Exhibit) | X | | | City of San Diego | Coastal sage scrub within the site |
| MM-BIO-10e (Construction fencing) | X | | | City of San Diego | Coastal sage scrub within the site |
| MM-BIO-10f (on-site education) | X | | | City of San Diego | Coastal sage scrub within the site |
| MM-BIO-10g (biological monitoring) | | X | | City of San Diego | Coastal sage scrub within the site |
| MM-BIO-10j (BMPs/Erosion/Runoff) | X | X | X | City of San Diego | Mule-fat scrub located immediately east of the site |
| MM-BIO-10k (toxics/project staging areas/equipment storage) | | X | X | Construction Manager/owner | Coastal sage scrub within the site |
| MM-HAZ-2 (hazardous material reporting form) | | | X | City of San Diego | Entire site |
| MM-HAZ-3 (spill prevention and emergency response plan) | | | X | City of San Diego | Entire site |
| MM-HIS-3 (archaeological monitoring) | X | X | X | Principal Investigator (Archaeologist) | Entire site |
| MM-PALEO-1 (paleontological monitoring) | X | X | X | Principal Investigator (Paleontologist) | Entire site |

Table 10-5
Mitigation Measures – North City Pure Water Facility Influent Pump Station

| Mitigation Measure | Timing of Mitigation | | | Responsible Person | Location/Notes |
|---|---|---|---|---|---|
| | *Pre Const.* | *During Const.* | *Post Const.* | | |
| MM-AQ-1 (construction BMPs) | | X | | Construction Manager | Entire site |
| MM-AQ-2 (construction $NO_x$) | | X | | Construction Manager | Entire site |
| MM-BIO-3 (nesting birds) | X | X | | Project Applicant/City of San Diego | Areas of coastal sage-scrub and non-native grassland within the site |
| MM-BIO-4 (Coastal California Gnatcatcher) | X | X | | City of San Diego | Coastal sage scrub within the facility within MCAS Miramar and within the MHPA south of Miramar Road. |
| MM-BIO-10a (Qualified biologist) | X | | | Owner/permittee | Entire site |

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Table 10-5
Mitigation Measures – North City Pure Water Facility Influent Pump Station

| Mitigation Measure | Timing of Mitigation | | | Responsible Person | Location/Notes |
|---|---|---|---|---|---|
| | *Pre Const.* | *During Const.* | *Post Const.* | | |
| MM-BIO-10b (preconstruction meeting) | X | | | City of San Diego | Entire site |
| MM-BIO-10c (documentation) | X | X | X | Owner/Permittee | Entire site |
| MM-BIO-10d (biological construction mitigation/monitoring exhibit) | X | | | City of San Diego | Entire site |
| MM-BIO-10e (construction fencing) | X | | | City of San Diego | Entire site |
| MM-BIO-10f (on-site education) | X | | | City of San Diego | Entire site |
| MM-BIO-10g (biological monitoring) | | X | | City of San Diego | Entire site |
| MM-BIO-10j (BMPs/erosion/runoff) | X | X | X | City of San Diego | Entire site |
| MM-BIO-10k (toxics/project staging areas/equipment storage) | | X | X | Construction Manager/owner | Entire site |
| MM-HAZ-2 (hazardous material reporting form) | | | X | City of San Diego | Entire site |
| MM-HIS-3 (archaeological monitoring) | X | X | X | Principal Investigator (Archaeologist) | Entire site |
| MM-NOI-4 (noise and vibration study) | X | | | Construction Contractor | Entire site |
| MM-PALEO-1 (paleontological monitoring) | X | X | X | Principal Investigator (Paleontologist) | Entire site |

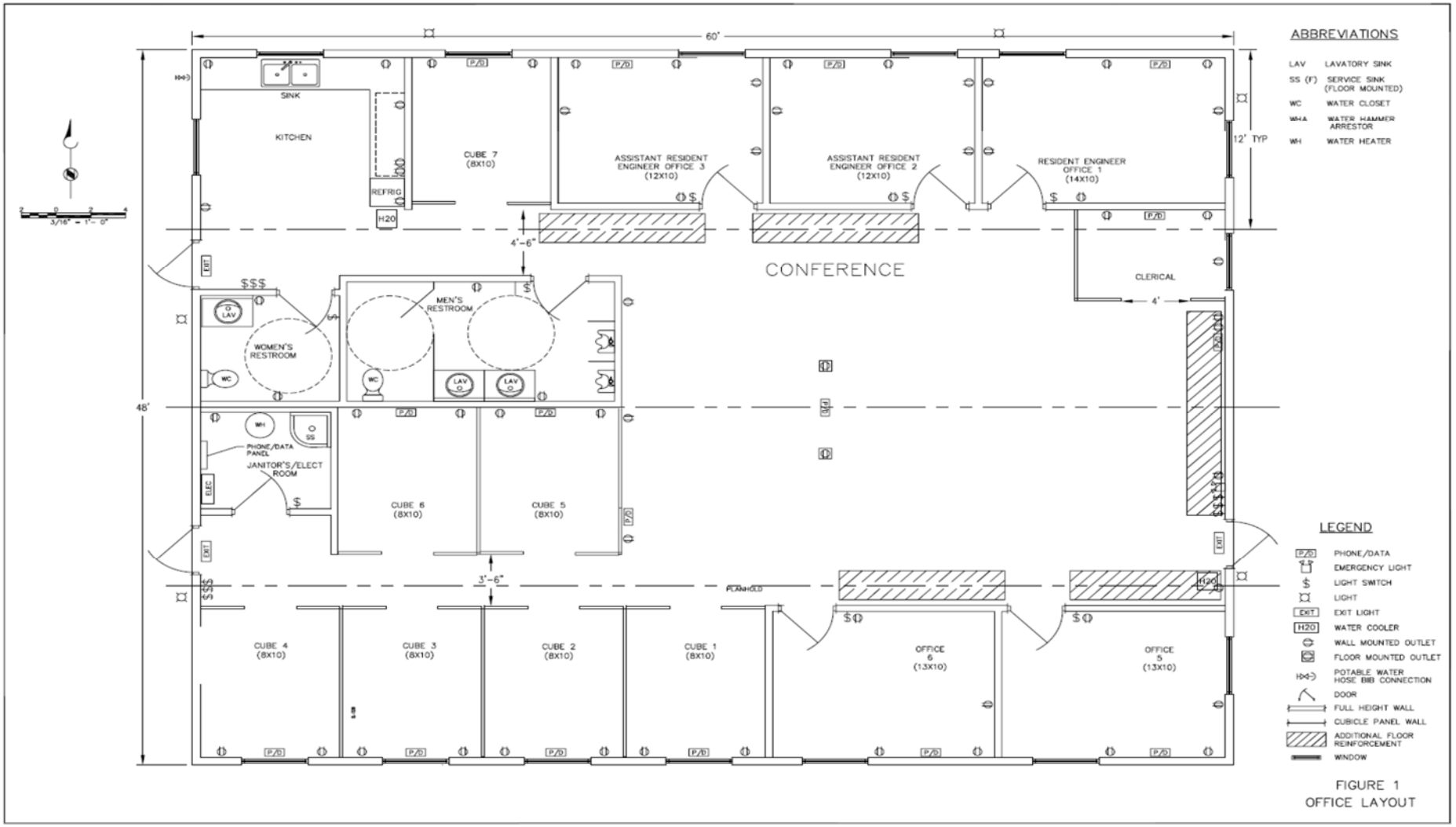


FIGURE 1
OFFICE LAYOUT

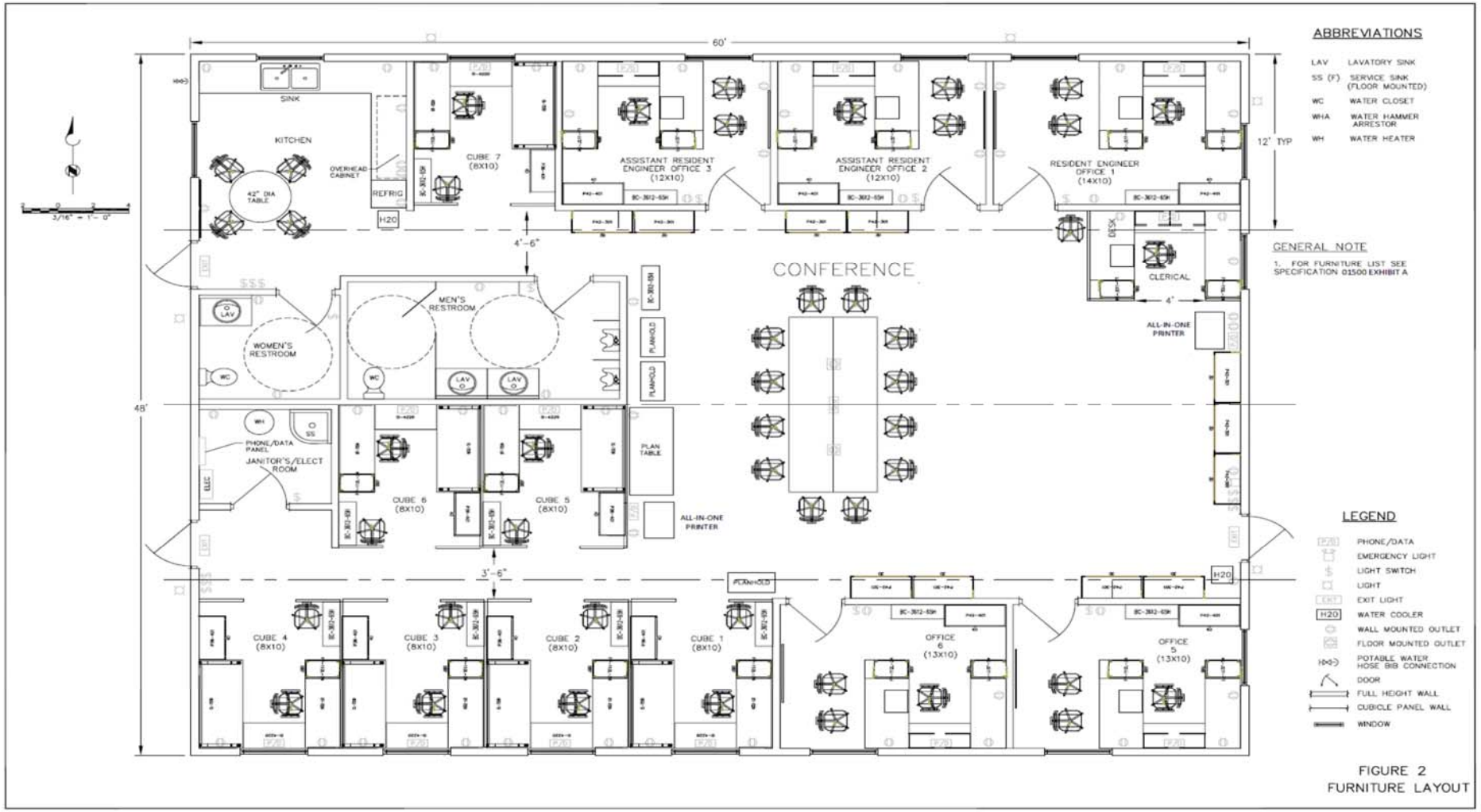


FIGURE 2
FURNITURE LAYOUT

| TABLE 1<br>FURNITURE AND PANELING | |
|---|---|
| Item | Quantity |
| Furnish and install AIM M-Wall 65" and 41" High Fabric Nonpowered Cubicle Panel System for each cubicle as shown on the Contract Drawings. Furnish all necessary hardware, trim and accessory items required to complete each cubicle installation. | 7 Cubicles |
| McDowell DL-7224-112, single pedestal desk 72" W x 24" D with box/box/file pedestal, locking. | 13 Each |
| McDowell DL 7230-112, single pedestal desk 72" W x 30" D with box/box/file pedestal, locking. | 6 Each |
| McDowell BT-4220 bridge unit 42" W x 20" D with flat brackets. | 12 Each |
| McDowell BT-4820 bridge unit 48" W x 20" D with flat brackets. | 1 Each |
| McDowell CL-7230, plan table 72' W x 30" D with C-legs, no pedestal. | 7 Each |
| McDowell MFP-112-14, mobile pedestal units box/box/file, locking. | 6 Each |
| Carter BC6536-12, bookcase unit 65" H x 36" W x 12" D with adjustable shelves. | 13 Each |
| McDowell P36-401DHF, P-series lateral file cabinet, 36" W with 4 drawers, locking, keyed to desk, paint: Black. | 7 Each |
| McDowell P42-401DHF, P-series file cabinet 42" W with 4 drawers, locking letter or legal filing, paint: Black. | 23 Each |
| McDowell over-desk cabinet 42" W x 16" H x 12" D with under-cabinet work light. | 5 Each |
| McDowell over-desk cabinet 24" W x 16" H x 12" D with under-cabinet work light. | 2 Each |
| McDowell under desk pencil drawer 20" W x 20" D or approved equal. | 6 Each |
| Carter OFO-4230-15, overfile organizer 42" W x 30" H x 15" D with 2 upright supports equally spaced, with 4 adjustable shelves in each section, paint: Black. | 6 Each |
| Sisneros CT7230-BT, conference table 72" W x 30" D with T-leg support, banded edge, laminate. Top, color to be selected by District. | 4 Each |
| Plan Hold mobile plan rack 32" W x 16" D x 42" H. | 5 Each |
| ECD 1409JS-D, 1400 series ergonomic task chair, high back, fully adjustable, fabric: Grade D, color: District selected, or approved equal. | 13 Each |
| ECD 102-D, 100 series guest side chair, fully adjustable, Grade D, color: District selected, or approved equal. | 22 Each |
| La-Z-Boy L9105-042-B, Sequel series conference room chair, standard tilt, black frame, Grade B, Color: District selected, or approved equal. | 12 Each |
| 42" diameter round table with X-base, laminated plastic top, commercial grade. | 1 Each |
| Graybeal MB4836 marker board 4' W x 3' H with black frame, porcelain steel. | 5 Each |
| Quartet QRT 3641 TE total erase mobile easel, 4' H x 6' W graphite finish. | 1 Each |
| Kitchen cork bulletin board 4' W x 3' D with black frame. | 1 Each |
| Precision SAF 3953 72" W x 37 1/2" W drafting table with SAF 3962GR stand. | 1 Each |
| Safeco SAF 1850GR 30" H x 28" W x 20" D wood mobile machine stand. | 1 Each |

TABLE 1
FURNITURE AND PANELING

| Item | Quantity |
|---|---|
| Rubbermaid RUB3540-00 gray 23-gallon slim waste receptacle. | 3 Each |
| Rubbermaid RUB29561 black 7-gallon office waste receptacle. | 14 Each |

Contractor shall provide office furniture and paneling for the common areas, office and cubicle workstations. Furniture and paneling shall be as shown on Figure 2 and specified in the table below. Contractor shall submit catalog cuts to District for approval.

- Paneling systems shall be manufactured by AIS, or approved equal.
- Metal furniture shall be manufactured by McDowell-Craig, or approved equal.
- Chairs shall be manufactured by ECD, or approved equal.
- Panels shall be steel framed, covered with Guilford of Maine Terratex panel fabric, or approved equal, made from 100% recycled materials. Work surfaces shall be steel framed with the laminated surface. All other parts/components shall be steel framed with powder-coated paint. The color of the fabric and paint will be selected by the District to match existing.
- All steelcase remanufactured products shall be warranted to be free of defects in design, material, and workmanship, given normal use, for a period of 10 years from the date of original purchase. The manufacturer shall provide support and responsiveness to the District as required.

Partition heights shall be a minimum height of 60” and a maximum height of 66”.

# SECTION 01 56 39
# TREE PROTECTION

## PART 1 GENERAL

### 1. SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Sections:

1. Section 01 50 00, Temporary Facilities and Controls, for temporary site fencing.
2. Section 31 10 00, Site Clearing, for removing existing trees and shrubs.

### 2. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01, General Requirements Specification Sections, apply to this Section.

### 3. DEFINITIONS

A. Tree Caliper: Diameter of a trunk measured by the average of the smallest and largest diameters at 6 inches above the ground for trees up to, and including, 4-inch size; and 12 inches above the ground for trees larger than 4-inch size.

B. Tree and Shrub Protection Critical Root Zone (CRZ): Area surrounding existing trees, tree groupings, or shrub groupings to be protected during construction, as indicated on Drawings.

C. DBH (Diameter Breast Height): Every inch of DBH of each existing tree to be protected represents one required radial foot of tree protection.

D. Arborist must be a Board Certified Master Arborist, Registered Consulting Arborist, and must be Certified by the International Society of Arboriculture (ISA).

E. Appraised Value: Removal of any tree without prior approval will be subject to replacement equal to the Appraised Value of the tree that is lost. Value will be determined by Consulting Arborist.

### 4. SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification:

1. For each type of the following:
   a. Organic Mulch: 1 pint volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
   b. Protection-Zone Fencing: Assembled Samples of full-size components.
   c. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

C. Pruning and Maintenance Schedule: Verify locations of trees and shrubs to remain that are affected by construction, and submit written schedule detailing scope and extent of protective fencing, pruning, root pruning, and scope of on-going maintenance during all phases of construction.

D. Qualification Data: Submit Certificates for qualified Consulting Arborist and tree service firm.

E. Maintenance Recommendations: Submit list of instructions for care and protection of trees and shrubs affected by construction during and after completing the Work. Instructions shall be prepared by Consulting Arborist with clear definition of standards, and shall include instructions for prompt and proper treatment and repair of any trees or shrubs that are damaged.

F. Tree and Shrub Protection Certification: Submit letter from Consulting Arborist, certifying that trees and shrubs indicated to remain have been protected during initial and on-going phases of construction.

G. Existing Conditions: Submit Tree and Shrub Evaluation and Protection Report from Certified Consulting Arborist including detailed Site Map and Photo Documentation of each existing tree, shrub or plant grouping indicated to be protected, which establishes a record of preconstruction conditions, for use in documenting consequential damage caused by construction activities. Report shall include plans and notations indicating specific wounds and damage conditions.

5. QUALITY ASSURANCE

A. Contractor shall take extreme care to protect the root systems of the existing trees. No grading shall occur within the CRZ. Bulk material, equipment, scaffold footings, or vehicles shall not be stockpiled or parked within the critical root zone (CRZ) of any tree or shrub, or within 10 feet of the trunk (whichever is greater). This is done to minimize surface and subsurface root and soil compaction. Any damage to existing trees or shrubs during construction shall be the Contractor's responsibility.

B. Preparatory work shall be performed under direction of Consulting Arborist. Pruning work shall be performed in accordance with ANSI A300 standards and by a qualified, licensed, and insured arborist or tree service company.

C. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

D. Preconstruction Conference:

1. Conduct 'Plant Protection' conference at Project site prior to any site demolition or construction.
2. 'Plant Protection' conference to include General Contractor, Earthwork Contractor, Site Utility Contractor, Landscape Contractor, Consulting Arborist, Tree Service Firm, Landscape Architect and City Project Manager.
3. Purpose of the conference is to review methods and procedures related to tree and plant protection, including the following:
   a. Construction Schedule: Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
   b. Enforcing requirements for protection zones.
   c. Arborist's responsibilities.
   d. Field quality control.

6. PROJECT CONDITIONS

A. The following practices are prohibited within the plant protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking or operation of vehicles or equipment.
3. Erection of sheds or structures.
4. Impoundment or runoff of water or chemicals.
5. Grading, excavation, or digging unless otherwise indicated.
6. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 PRODUCTS

1. MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured

topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch in diameter; and free of weeds, roots, and toxic and other nonsoil materials.

1. Obtain topsoil only from well-drained sites where topsoil is 4 inches deep or more; do not obtain from bogs or marshes.

B. Topsoil: Imported or manufactured topsoil complying with ASTM D5268.

C. Organic Mulch:

1. Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
   a. Type: Bark chips, natural color (not dyed).
   b. Particle Size Range: 3 inches maximum, 1/2 inch minimum.

D. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements. Previously used materials may be used when approved by City Project Manager.

1. Chain-Link Fencing for Trees and Tree/Shrub Groupings: Fence to be 6-foot high galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch diameter wire chain-link fabric; with steel pipe posts, minimum 2-3/8-inch OD line posts, and 2-7/8-inch OD corner and pull posts; with 1-5/8-inch OD top rails and 0.177-inch diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
2. Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; minimum width 36 inches.

E. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading letters.

## PART 3 EXECUTION

### 1. EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Submit written report, endorsed by Consulting Arborist, listing all conditions that may be or become detrimental to tree and plant protection.

2. COORDINATION

A. Coordinate relocation of any irrigation lines to serve protected plant materials as necessary.

B. Coordinate relocation of other utility lines or structures that are in conflict with protection zones. Notify the Owner's Representative of any conflicts encountered.

3. PREPARATION

A. Prior to site demolition or construction operations, install Plant Protection Fencing in all areas and obtain approval from City Project Manager for fence alignment and any anticipated root pruning.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Tie a 1-inch blue-vinyl tape around each tree trunk at 54 inches above the ground.

C. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting.

4. TREE- AND PLANT-PROTECTION ZONES

A. Protection-Zone Fencing: Prior to any construction activities on this site, install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations spaced approximately every 35 feet on protection-zone fencing, but no fewer than four signs with each facing a different direction.

C. Contractor shall not engage in any construction activity within the Tree and Plant Protection Area without the approval of the Owner's Representative including: operating, moving or storing equipment; storing supplies or materials; locating temporary facilities including trailers or portable toilets and shall not permit employees to traverse the area to access adjacent areas of the project or use the area for lunch or any other work breaks. Permitted activity, if any, within the Tree and Plant Protection Area maybe indicated on the drawings along with any required remedial activity as listed below.

D. Contractor shall be fully responsible to ensure that adequate water is provided to all plants to be preserved during the entire construction period. Adequate water is defined to be maintaining soil moisture above the permanent wilt point to a depth of 8 inches or greater. Contractor shall adjust irrigation system or apply additional water, using hoses or water tanks as required. If hand watering, ensure that the watering basin is of sufficient diameter to capture all roots. Do not allow water to pond against the tree trunk.

E. Contractor shall be fully responsible to ensure that plants remain free of disease and insect infestations during the entire construction period. Provide all disease and insect control required to keep the plants in a healthy state using the principles of Integrated Plant Management (IPM). All pesticides shall be applied by a certified pesticide applicator.

F. Contractor shall maintain plant protection zones free of weeds and trash.

G. Contractor shall maintain protection-zone fencing and signage in good condition through all phases of construction. Remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

5. EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 31 23 16, Excavation.

B. Trenching Near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill.

Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

6. ROOT and branch PRUNING

A. Prune roots that are affected by temporary and permanent construction. Prune roots under the direction of Consulting Arborist and with pre-approval by City Project Manager.

7. REGRADING

A. Maintain existing grade within tree protection zone at all times during and after construction.

8. FIELD QUALITY CONTROL

A. Inspections: Engage a Consulting Arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

9. REPAIR AND REPLACEMENT

A. In the event that construction activity is unavoidable within the Tree and Plant Protection Area, Contractor shall submit a detailed written plan of action (prepared by Consulting Arborist) for pre-approval by City Project Manager. Plan shall include a description of proposed activity; the time period for the activity, and a list of remedial actions that will reduce the impact on the Tree and Plant Protection Area from the activity.

B. Contractor is responsible for replacement of trees and shrubs that have been damaged by construction operations.

C. Trees shall be replaced with a tree of similar species and of equal size, or 6-inch caliper (whichever is less). Shrubs and groundcovers shall be replaced with plants of similar species and equal size, or the largest size plants reasonably available. Plant quantities shall match quantities of all plants removed or damaged.

D. Remedial work for damaged plants shall be completed by the Contractor at no cost to the owner, and may extend for a period beyond the Maintenance Period. Remedial work shall include but is not limited to plant replacement, irrigation repair, soil compaction remediation, pruning , staking or cabling, insect and disease control, fertilizing, watering, and mulching.

E. Remedial work shall be done at the direction of a Consulting Arborist and shall be reviewed and approved by the City Project Manager upon completion of all remedial efforts.

10. DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, cuttings, roots, trash, and debris, and legally dispose of them off Project site.

END OF SECTION

# SECTION 01 57 13
# TEMPORARY EROSION AND SEDIMENT CONTROL

## PART 1 GENERAL

### 1. SUMMARY

A. This section covers Work to implement structural and nonstructural Best Management Practices (BMP) to control soil erosion by wind or water and keep eroded sediments and other construction-generated pollutants from moving off project sites. Requirements described in this Specification and shown on Drawings are part of the project Storm Water Pollution Prevention Plan (SWPPP) SWPPP and are the minimum for all project construction sites and conditions. This Specification covers all project activities, including material sources, disposal sites, and offsite mitigation areas unless specific project activities are excluded elsewhere in this Specification or in other Contract Documents controlling the Work.

B. National Pollutant Discharge Elimination System: Comply with federal, state, and local laws, rules and regulations, and the National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer System (MS4) Permit Draining the Watersheds of the San Diego Region, Order No. R9-2013-0001, NPDES No. CAS0109266 and the California Construction General Permit or Permits applicable to the Project. A copy of the Project's General Construction Permit, if applicable to the Project, is available from Owner. NPDES General Construction permits are required on projects that involve disturbance of 1 acre or more with potential to discharge stormwater to surface waters.

C. Other Regulations: A local government erosion and sediment control permit may apply and some local agency requirements may be more stringent than this Specification. Adequate erosion and sediment control is essential for complying with the federal Endangered Species Act where construction runoff enters waters inhabited by protected species.

### 2. REFERENCES

A. Activities shall conform to the California Construction General Permit, Storm Water Resource Control Board Order No. 2009-009-DWQ as amended by Order 2010-0014-DWQ and Order 2012-0006-DWQ, the 2016 City of San Diego Storm Water Standards Manual, the Storm Water Pollution Prevention Plan, the 2015 "Whitebook" the City of San Diego Standard Specifications for Public Works Construction, the 2015 "Greenbook" Standard Specifications for Public Works

Construction and Drawings. In the event of a conflict, the more stringent requirement shall apply.

B. The following is a list of standards that may be referenced in this section:

1. California Stormwater Quality Association (CASQA) Stormwater Best Management Practice Handbook for Construction.
2. Storm Water Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.
3. National Oceanic and Atmospheric Administration (NOAA) National Weather Service:
   a. Precipitation-Frequency of the United States by State/Territory, 2012.
   b. Precipitation Frequency Data Server, 2012.

3. SYSTEM DESCRIPTION

A. Erosion and Sediment Control: Provide, maintain, and operate temporary facilities to control erosion and sediment releases during construction period.

B. Qualified SWPPP Practitioner (QSP):

1. Identify the QSP and the QSD at the preconstruction discussions and in the SWPPP. The QSP shall either be a Qualified SWPPP Developer (QSD), a certified erosion, sediment and storm water inspector registered through Enviro Cert International, Inc, or a certified inspector of sediment and erosion control registered through Certified Inspector of Sediment and Erosion Control, Inc. Additionally the QSP shall have attended a State Water Board-sponsored or approved QSP training course. See Paragraph Temporary Erosion and Sediment Control Plan, for the necessary registrations and certifications to be a QSD.
2. The QSP shall implement the SWPPP, including, but not limited to:
   a. Installing and maintaining all temporary erosion and sediment control Best Management Practices (BMPs) included in the SWPPP to assure continued performance of their intended function. Damaged or inadequate SWPPP BMPs shall be corrected immediately.
   b. QSP shall coordinate with QSD to amend SWPPP to reflect current field conditions.
   c. Terminating SWPPP Plan with a Notice of Termination through the SMARTS website. Notice of termination shall be certified by the legally responsible person (LRP).
3. When a SWPPP is included in the Contract Plans, QSP shall also inspect all areas disturbed by construction activities, all onsite erosion and sediment control BMPs, all stormwater discharge

points, and all temporarily stabilized inactive sites per the schedule in the SWPPP or as directed by QSD. Complete erosion and sediment control inspection forms provided in the SWPPP for each inspection. An annual report of all the storm water monitoring activities shall be submitted to the California State Water Resources Control Board, via the Storm Water Multiple Application and Report Tracking System (SMARTS). Water Quality Monitoring, Sampling and Analysis are delineated in Section 7 of the SWPPP.

C. Personnel Training:

1. Prior to commencement of construction, applicable personnel must have an understanding of the California Construction General Permit's requirements and their specific responsibilities under the permit. At a minimum, personnel must be trained to understand the following as it relates to the scope of their job duties:
   a. The location of all stormwater controls and how to maintain them.
   b. Procedures for complying with the pollution prevention requirements.
   c. Procedures for conducting inspections, recording findings, and taking corrective action.

D. Temporary Erosion and Sediment Control Plan (Stormwater Pollution Prevention Plan):

1. A SWPPP Plan is furnished as part of the Permit Registration Documents (PRDs), which helps fulfill part of the requirements of the Construction General Permit. This initial SWPPP, when adopted by Contractor, may be used as the basis of the construction SWPPP. Additional or revised erosion and sediment control features, not shown on the initial SWPPP, may be required depending on Contractor's methods of operation and schedule.
2. For each phase of the scheduled work, indicate on the SWPPP all the BMPs proposed and installed for erosion and sediment control to minimize clearing, stabilize exposed soil, divert or temporarily store flows, limit runoff from exposed areas, and filter transported sediment. Include all temporary slopes, constructed for staging or other reasons, which may not have been identified in the original Contract plans. Refer to the City of San Diego 2016 Storm Water Standards Manual as well as the California Construction General Permit, Storm Water Resource Control Board Order No. 2009-009-DWQ as amended by Order 2010-0014-DWQ and Order 2012-0006-DWQ.
3. Some SWPPP required elements typically required by NPDES permits:
   a. Narrative Site Description.

b. See Section 2 of SWPPP Site Map.
c. The required BMPs and Procedures for Erosion Prevention, Runoff Control, and Sediment Control.

4. Contractor's construction SWPPP and implementation schedules must be prepared by a Qualified SWPPP Developer (QSD). A QSD shall have one of the following registrations or certifications, and appropriate experience, as required for:
   a. A California registered professional engineer.
   b. A California registered professional geologist or engineering geologist.
   c. A California registered landscape architect.
   d. A professional hydrologist registered through the American Institute of Hydrology.
   e. A certified professional in erosion and sediment control (CPESC) registered through Enviro Cert International, Inc.
   f. A certified professional in storm water quality (CPSWQ) registered through Enviro Cert International, Inc.
   g. A certified professional in erosion and sediment control registered through the National Institute for Certification in Engineering Technologies (NICET).
   h. The QSD shall furnish a signed copy of the SWPPP Plan with individual's name, title, state certifications, and employing firm if different than Contractor's firm.
5. Prior to construction activities, the legally responsible person (LRP) must obtain coverage under the Construction General Permit.
   a. The LRP must electronically file Permit Registration Documents (PRDs) on the SMARTS website. The PRDs shall consist of the following:
      1) Notice of Intent (NOI).
      2) Risk Assessment.
      3) Site Maps.
      4) Storm Water Pollution Prevention Plan.
      5) Annual Fee.
      6) Signed Certification Statement: Once the California State Water Board receives the PRDs, they will issue a Waste Discharge Identification Number (WDID). Do not begin any Site activities that have potential to cause erosion or sediment movement until permit coverage has been obtained and a WDID number has been issued by the State Water Board.
6. Keep a copy of the approved SWPPP with updated changes onsite during all construction activities. See the SWPPP for retention of records requirements.

E. If utilized on the Project Site, environmental and construction fences shall be depicted in the SWPPP. Space posts and attach fence fabric to

posts as shown on Drawings. Do not fasten fence to trees. Throughout the life of the Project, preserve and protect delineated area, acting immediately to repair or restore any fencing damaged or removed.

F. Erosion and Sediment Control devices and implementation are depicted in the SWPPP. Preventing erosion, and controlling runoff, sedimentation, and nonstormwater pollution, requires Contractor to perform temporary Work items including, but not limited to:

1. Providing ditches, berms, culverts, and other measures to control surface water.
2. Building dams, settling basins, energy dissipaters, and other measures, to control downstream flows.
3. Controlling underground water found during construction.
4. Covering or otherwise protecting slopes until permanent erosion control measures are working.

G. To the degree possible, coordinate this temporary Work with permanent drainage and erosion control work the Contract requires.

H. QSD and QSP may require additional temporary control measures if it appears pollution or erosion may result from weather, nature of materials, or progress on the Work.

I. When natural elements rut or erode the slope, restore and repair damage with eroded material where possible, and remove and dispose of any remaining material found in ditches and culverts. When QSD or QSP orders replacement with additional or other materials, unit Contract prices will cover quantities needed.

J. Water Management: Manage site water in accordance with the conditions of the General Construction Permit and the SWPPP waste discharge permit from a local permitting authority.

K. Dispersion/Biofiltration: Convey water only to dispersion or infiltration areas designated in the SWPPP or to sites approved by QSD. Convey storm water to designated biofiltration areas.

L. Detention/Retention Pond Construction: Whether permanent or temporary, construct before beginning other grading and excavation Work in the area that drains into that pond. Install temporary conveyances concurrently with grading in accordance with the SWPPP and the grading plans so that newly graded areas drain to the pond as they are exposed.

M. Pollution Control: Waste Management and Materials Pollution Control BMPs are source control BMPs that prevent pollution by limiting or reducing potential pollutants at their source before they come in contact

with storm water. These BMPs also involve day-to-day operations of the construction site and include material delivery and storage as well as various liquid and solid waste management. The Project-specific waste management BMPs are depicted in the SWPPP. Certain authorized nonstormwater discharges may be necessary for the completion of a construction project. Nonstormwater Management BMPs are source control BMPs that prevent pollution by limiting or reducing potential pollutants at their source or eliminating offsite discharge. Project-specific nonstormwater management BMPs are depicted in the SWPPP.

N. If California State Water Resources Control Board or City of San Diego orders the Work suspended or permit violated, continue to control erosion, pollution, and runoff during the shutdown.

O. Nothing in this section shall relieve Contractor from complying with other Contract requirements.

4. SUBMITTALS

A. Informational Submittals:

1. When a SWPPP is included on Drawings, either adopt or modify the SWPPP. Provide a schedule for SWPPP implementation and incorporate it into Contractor's progress schedule. Obtain Design Engineer's approval of the SWPPP Plan and schedule before any Work begins.
2. Amendments to the SWPPP shall meet all requirements of the Construction General Permit, shall be amended by a QSD and listed in the amendment log in the SWPPP. Some revisions can be field determined by the QSP, see Section 1.4 of the SWPPP.
3. The SWPPP shall cover all areas that may be affected inside and outside the limits of the Project (including all Owner-provided sources, disposal sites, and haul roads, and all nearby land, streams, and other bodies of water).
4. Allow at least 5 working days for the QSD to review any original or revised SWPPP. Failure to approve all or part of any such Plan shall not make Owner liable to Contractor for any Work delays.

PART 2 PRODUCTS

1. FACT SHEETS

A. See Appendix H of SWPPP for CASQA Stormwater BMP Handbook Portal Construction Fact Sheets.

PART 3 EXECUTION

1. PREPARATION

A. The SWPPP shall include proposed stockpile areas and installation of temporary erosion control devices, ditches, or other facilities in Work phasing plans.

B. Areas designated for Contractor's use during Project may be temporarily developed as specified to provide working, staging, and administrative areas. Include control of sediment from these areas in the SWPPP.

C. Implementation of erosion and sediment control BMPs are delineated in the SWPPP.

2. MAINTENANCE

A. The erosion and sediment control measures described in the SWPPP are minimum requirements for anticipated Site conditions. During the construction period, upgrade these measures as needed to comply with all applicable local, state, and federal erosion and sediment control regulations.

B. BMP Inspection and maintenance is depicted in the SWPPP.

3. REMOVAL

A. When QSP determines that an erosion control BMP is no longer required, remove BMP and all associated hardware from the Project limits. When materials are biodegradable, QSP may approve leaving temporary BMP in place.

B. Permanently stabilize all bare and disturbed soil after removal of erosion and sediment control BMPs. Dress sediment deposits remaining after BMPs have been removed to conform to existing grade. Prepare and seed graded area. If installation and use of erosion control BMPs have compacted or otherwise rendered soil inhospitable to plant growth, such as construction entrances, take measures to rehabilitate soil to facilitate plant growth. This may include, but is not limited to, ripping the soil, incorporating soil amendments, or seeding with specified seed.

END OF SECTION

# SECTION 01 61 00
# COMMON PRODUCT REQUIREMENTS

## PART 1 GENERAL

### 1. DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

### 2. DESIGN REQUIREMENTS

A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of the 2016 California Building Code (CBC) by California Building Standards Commission.

1. Wind: Basic wind speed, V: 115 mph (3-second gust), with exposure Category C, and Risk Category III.
2. Seismic: Risk Category III, importance factor, I, of 1.25, Site Class Definition D, mapped maximum considered earthquake, 5 percent damped, spectral response at short periods, Ss 1.06G, mapped maximum considered earthquake, 5 percent damped, spectral response at a period of 1 second, S1 0.41G, unless specified otherwise.

### 3. ENVIRONMENTAL REQUIREMENTS

A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 370 feet above sea level.

B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 36 degrees F to 104 degrees F.

4. PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.

C. Extra Materials, Special Tools, Test Equipment, and Expendables:

1. Furnish as required by individual Specifications.
2. Schedule:
   a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
   b. Transfer to Owner shall occur immediately subsequent to Contractor's acceptance of equipment from Supplier.
3. Packaging and Shipment:
   a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
   b. Prominently displayed on each package, the following:
      1) Manufacturer's part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
      2) Applicable equipment description.
      3) Quantity of parts in package.
      4) Equipment manufacturer.
4. Deliver materials to Site.
5. Notify Construction Manager upon arrival for transfer of materials.
6. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to Owner.

D. Request a minimum 7-day advance notice of shipment from manufacturer. Upon receipt of manufacturer's advance notice of shipment, promptly notify Construction Manager of anticipated date of equipment arrival.

E. Factory Test Results: Reviewed and accepted by Design Engineer before product shipment as required in individual Specification sections.

5. DELIVERY AND INSPECTION

A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.

D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

6. HANDLING, STORAGE, AND PROTECTION

A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01 50 00, Temporary Facilities and Controls. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.

B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.

D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.

E. Store fabricated products aboveground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.

G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.

H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

## PART 2 PRODUCTS

### 1. GENERAL

A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.

B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.

C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.

D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.

F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.

H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized

steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

I. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

J. Equipment Finish:

1. Provide manufacturer's standard finish and color, except where specific color is indicated.
2. If manufacturer has no standard color, provide equipment with finish as approved by Construction Manager.

K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.

L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

M. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

## 2. FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Modify standard products as necessary to meet performance specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

## 3. SOURCE QUALITY CONTROL

A. Where Specifications call for factory testing to be witnessed by Design Engineer, Owner, or Construction Manager, notify Construction Manager not less than 30 days prior to scheduled test date, unless otherwise specified.

B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).

C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

# PART 3 EXECUTION

## 1. INSPECTION

A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays

to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

2. MANUFACTURER'S CERTIFICATE OF COMPLIANCE

A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by entity supplying the product, material, or service, and submitted prior to shipment of product or material or execution of the services.

B. Construction Manager may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.

C. Such form shall certify proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.

D. May reflect recent or previous test results on material or product, if acceptable to Construction Manager.

3. INSTALLATION

A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. No shimming between machined surfaces is allowed.

C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Install the Equipment per Section 01 88 15, Anchorage and Bracing.

E. Repaint painted surfaces that are damaged prior to equipment acceptance.

F. Do not cut or notch any structural member or building surface without specific approval of Design Engineer.

G. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.

H. For material and equipment specifically indicated or specified to be reused in the Work:

1. Use special care in removal, handling, storage, and reinstallation

to assure proper function in the completed Work.

2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

4. FIELD FINISHING

A. In accordance with Section 09 90 00, Painting and Coating, and individual Specification sections.

5. ADJUSTMENT AND CLEANING

A. Perform required adjustments, tests, operation checks, and other startup activities.

6. LUBRICANTS

A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

7. Anchor Bolts

A. Provide anchor bolts as specified in the specification sections and in accordance with Section 05 50 00, Metal Fabrications.

8. SUPPLEMENT

A. The supplement listed below, following “End of Section,” is part of this Specification.

1. Manufacturer’s Certificate of Compliance.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER: _____

PROJECT NAME: _____

PROJECT NO: _____

PRODUCT, MATERIAL, OR SERVICE SUBMITTED: _____

Comments: _____

_____

_____

_____

_____

_____

I hereby certify that the above-referenced product, material, or service called for by the Contract for the named Project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the Contract requirements, and are in the quantity shown.

Date of Execution: _____, 20___

Manufacturer: _____

Manufacturer's Authorized Representative (print): _____

_____

(Authorized Signature)

# SECTION 01 68 00
# RELOCATION AND INSTALLATION
# OF OWNER-FURNISHED EQUIPMENT

EQUIPMENT FURNISHED BY OWNER (EXISTING EQUIPMENT)

5kV: Generator Switchgear.
64-T-001, 64-T-002: Lube Oil Fill and Drain Tanks.
64-T-003: Coolant Water Tank.
64-P-01: Lube Oil Pump.
64-P-02: Used Oil Pump.
64-P-03: Coolant Pump.
64-LCP-01: Pump Control Panel.
64-GWS-01: Gas-Water Separator.
64-LFG-V31, 64-LFG-V37: 6-Inch Stainless Steel Butterfly Valves (Gas-Water Separator Isolation Valves).
64-GC-01: Gas Chromatograph, Helium Gas cylinders, and Calibration Gas Cylinders.
Control Room with associated AC unit, mini power center, control equipment rack, computer monitor and other interior contents.
Storage Container.
Electrical/Control Panels on Coolant Pump Skid.
Hazardous Storage Cabinet.
Landfill Engine Generator Set and Appurtenances.
Landfill Gas Piping Assembly, including Pressure Regulating Valve and Fuel Flow Meter.
Utility Sink, Emergency Eyewash and Shower with Accessories.

## PART 1 GENERAL

### 1. WORK OF THIS SECTION

A. This Work includes relocating the existing engine generator set and switchgear, control room, the related support and ancillary equipment to an adjacent area on the site, as shown on Drawings. All work necessary to relocate and install this Owner-furnished equipment, make complete and ready for operation, and coordinate and conduct functional and performance testing shall be included.

B. General Requirements: See Division 01, General Requirements, which contains information and requirements that apply to the Work specified herein and are mandatory for this Project.

C. Any other new products or services provided for this Work shall conform to the Technical Specifications included as part of this Contract.

### 2. DEFINITIONS

A. Contractor: The party under contract with Owner to furnish the products

or special services specified herein.

B. Owner-Furnished Products: Equipment and products that are being relocated by the Contractor from the existing location to the new location as shown on Drawings.

3. CODES

A. The Work of this Section shall comply with the current editions of the following codes as adopted or amended by the City of San Diego, California:

1. Uniform Mechanical Code.
2. Uniform Plumbing Code.
3. Uniform Fire Code.
4. National Electrical Code.
5. 2016 California Building Code by California Building Standards Commission.

4. CONTRACTOR's RESPONSIBILITY FOR COMPLETE SYSTEM

A. Contractor shall have complete responsibility for necessary handling, installing, adjusting, maintaining, lubricating, testing, and operational startup of Owner-furnished products. Provide and coordinate the construction of interconnecting structures, equipment, piping, electrical and instrumentation work, and appurtenances to achieve installation and operation of the Owner-furnished products as shown and specified and as required to provide a complete and functional system.

B. Contractor shall coordinate relocation of metering and other utility components at the existing facility with electric utility SDG&E, and carry out related work in accordance with SDG&E requirements.

C. Contractor shall coordinate DCS/Controls relocation and reprogramming with the Owner's COMNET group at City of San Diego. All programming shall be performed by the Owner's COMNET group.

5. INFORMATION FURNISHED BY OWNER

A. An electronic copy of the Operation and Maintenance Manuals and Shop Drawings for the Owner-furnished equipment will be available for examination during the bidding period.

B. A meeting will be organized during bidding period with the Owner for inspection of the Owner-furnished equipment located at the San Diego North City Water Reclamation Plant. Owner will not open any cabinets and panels during this inspection.

C. After award of the Contract, one copy of the Operation and Maintenance

Manual for each type of Owner-furnished equipment will be supplied to the Contractor within 10 working days of this request.

6. SUBMITTALS

A. Action Submittals:

1. Prior to construction and the disconnection and relocation of existing equipment, field verify as-found conditions and prepare as-found documentation.
   a. Clearly identify any equipment, concrete pads, surface features, wiring, piping, appurtenances, and/or connections that are different from or in addition to what is shown on the Contract Documents.
   b. Submit as-found documentation for Owner's and Construction Manager's review before disconnection and relocation of existing equipment prior to construction.
2. Furnish, as a part of the Work under this section, detailed Shop Drawings to indicate the Contractor's proposed layout, including location for all Owner-furnished equipment, and identification of materials provided by Contractor.
   a. Include pipe, fittings, valves, specialties, hangers, supports, equipment, and required specialties.
   b. Accurately show openings in floors, walls, and other parts of the structures.
   c. Provide electrical and instrumentation diagrams to indicate connecting and interconnecting electrical and control components.
   d. Conduit layout drawing for all concealed raceways, per Section 26 05 33, Raceways and Boxes.
3. Submit complete list of materials to be provided and associated information as required by the project technical specification.
4. Submit plans to repair or replace products that become damaged or lost after transferred to Contractor for storage and protection.
5. Product relocation, installation, and testing schedule.
6. Submit written Relocation Plan describing method for relocation of equipment to location shown on Drawings.
7. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Pre-relocation inspection and functional testing reports.
2. Relocation Plan.
3. Post-relocation functional test logs and performance test reports.
4. Performance deficiency report, where required.
5. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

6. Component and attachment testing seismic certificate of compliance.

7. SEQUENCING AND SCHEDULING

A. Contractor shall verify availability of Owner-furnished equipment by contacting the Owner before making final arrangements for, or committing resources to, the relocation, handling, protection, or installation of such products. Construction sequencing and scheduling shall conform with the requirements of Section 01 31 13, Project Coordination.

B. Coordinate a site meeting with SDG&E and Owner to verify and clearly define scheduling and sequence of relocation of metering and other utility components.

C. There is no requirement for temporary generator power while the existing Owner-furnished equipment is relocated. The plant will operate on one or both of the utility grid power connections during the relocation period.

D. Include sequencing constraints specified herein as part of Progress Schedule.

E. Provide a minimum of 30 days' advance written notice to Owner of the proposed date for starting the work described herein.

F. Provide a minimum of 30 days' notice to Owner that Owner-furnished product is ready for performance testing.

PART 2 PRODUCTS

1. GENERAL

A. Provide products required to complete the work under this section, except where specifically specified as "Owner-furnished". Such products include, but are not limited to, concrete piers, inserts, anchor bolts, connecting piping and valves, hangers and supports, wiring, conduit, exterior lighting and light poles, junction boxes, wireways, piping accessories, instrumentation, specialties, finish painting, and expendable materials, as necessary to provide a complete and properly functioning system.

2. owner-furnished equipment

A. Landfill Gas Generator Set: The Owner-furnished equipment includes one 1,600 kW landfill gas engine generator set, currently located in Facility 64B. Relocation and installation of the landfill gas engine generator set with appurtenances are described in the Contract

Documents.

B. 5kV Generator Switchgear: The Owner-furnished equipment includes 3-section switchgear including utility metering, currently located in Facility 64B. Relocation and installation of generator switchgear with appurtenances are described in the Contract Documents.

C. Lube Oil Fill and Oil Drain Tanks (64-T-001, 64-T-002): The Owner-furnished equipment includes one lube oil steel tank and one used/drain oil steel tank, nominally 240-gallon capacity each, currently located on the equipment pad in Facility 64B. The approximate dimensions are 36 inches in diameter and 82 inches tall. Relocation and installation of lube oil fill and oil drain tanks with appurtenances are described in Contract Documents.

D. Coolant Water Tank (64-T-003): The Owner-furnished equipment includes one coolant water tank, nominally 300-gallon capacity, currently located on the equipment pad in Facility 64B. Coolant water tank is cylindrical polyethylene tank with approximate dimensions of 36 inches in diameter and 82 inches tall. Relocation and installation of the coolant water tanks with appurtenances are described in Contract Documents.

E. Lube Oil Supply Pump (64-P-01): The Owner-furnished equipment includes the lube oil supply pump manufactured by Worthington Corporation, Model 4GAX, currently located on the equipment pad in Facility 64B. Approximate dimensions are 21 inches deep, 10 inches wide, and 12 inches tall. Relocation and installation of the lube oil pumps with appurtenances are described in Contract Documents.

F. Lube Oil Drain Pump (64-P-02): The Owner-furnished equipment includes the lube oil drain pump manufactured by Worthington Corporation, Model 4GAX, currently located on the equipment pad in Facility 64B. Approximate dimensions are 21 inches deep, 10 inches wide, and 12 inches tall. Relocation and installation of the lube oil pumps with appurtenances are described in Contract Documents.

G. Coolant Pump (64-P-03): The Owner-furnished equipment includes one coolant pump manufactured by Viking Pump, Model G432D, currently located on the equipment pad in Facility 64B. Approximate dimensions are 25 inches deep, 11 inches wide, and 12 inches tall. Relocation and installation of the coolant pumps with appurtenances are described in the Contact Documents.

H. Gas-Water Separator (64-GWS-01): The Owner-furnished equipment includes one carbon steel gas-water separator with 1-1/2-inch NPT drain. The equipment is manufactured by Eaton Filtration, Model Type TS, and is currently located on the equipment pad in

Facility 64B. The approximate dimensions are 24-inch diameter, including 6-inch flange connection points, and 66 inches tall. The relocation and installation of the gas-water separator with appurtenances are described in the Contract Documents.

I. 6-Inch Stainless Steel Butterfly Isolation Valves (64-LFG-031, 64-LFG-037): The Owner-furnished equipment includes two 6-inch size stainless steel butterfly valves with lever actuators attached to the inlet and outlet connections to the Gas-Water Separator currently located on the equipment pad in Facility 64B. The stainless steel butterfly isolation valves are manufactured by DeZurik, Model BOS resilient-seated butterfly valve, and are comprised of a ductile iron body, and Type 316 stainless steel disc and shaft. The relocation and installation of the butterfly valves is described in the Contract Documents.

J. Gas Chromatograph (64-GC-01), Helium Gas Cylinders, and Calibration Gas Cylinders: The Owner-furnished equipment includes one Helium gas cylinder, one Calibration gas cylinder, and one gas chromatograph manufactured by Rosemount Analytical, Model 700XA, mounted in panel and currently located on the equipment pad in Facility 64B. The relocation and installation of the helium gas cylinder, calibration gas cylinder, and gas chromatograph with appurtenances is described in the Contract Documents.

K. Landfill Gas Piping Assembly: The Owner-furnished equipment includes a pressure regulating valve, inline filter, and fuel flow meter. The assembly is attached to the Landfill Gas Generator Set and the Gas Water Separator. The relocation and installation of the Landfill Gas Piping Assembly is described in the Contract Documents.

L. Control Room: The Owner-furnished equipment includes the control room structure and associated AC unit, mini power center, computer monitor, electrical pull box, indoor panels and controls, networking equipment and wiring. All items located in the storage room shall be relocated in kind. The relocation and installation of the Control Room is described in the Contract Documents.

M. Storage Container: The Owner-furnished equipment includes the container structure and all items stored in its interior. All stored items shall be relocated in kind. The relocation and installation of the Storage Container is described in the Contract Documents.

N. Hazardous Storage Cabinet: The Owner-furnished equipment includes the storage cabinet and all items stored within. All stored items shall be relocated in kind. The relocation and installation of the Hazardous Storage Cabinet is described in the Contract Documents.

O. Emergency Eyewash and Shower with Accessories: The

Owner-furnished equipment includes the emergency eye wash and shower assembly. The relocation and installation of the eyewash and shower with accessories is described in the Contract Documents.

3. MISCELLANEOUS PRODUCTS

A. General: Furnish incidental products, such as gaskets, supports, bolts, and lubricants, as shown and as required for proper operation of equipment installed under this section. Products shall conform to applicable sections of these Specifications for the intended service.

B. Piping and Valves: Unless otherwise noted, provide all piping and valves as required for proper operation of equipment installed under this section. The provided products shall conform to applicable specification sections for the intended service. Refer to Piping Schedule on Drawings.

C. Pipe Supports: Unless otherwise noted, provide all necessary pipe supports as required for proper operation of equipment installed under this section. Pipe support requirements are specified in Section 40 05 15, Piping Support Systems.

D. Conduits and Wiring: Furnish conduit, wiring, wireways, junction boxes, handholes, and manholes as shown and as needed for complete interconnections of Owner-furnished electrical equipment in order to restore functionality. Provide labels on all wiring. Refer to Division 26, Electrical specifications for requirements.

E. Equipment Foundation Pads: Provide foundation pads for Owner-furnished equipment, as required by the equipment manufacturer and as specified in Section 03 30 10, Structural Reinforced Concrete, and as shown on Drawings. Approximate pad sizes are shown on Drawings. Contractor shall verify exact dimensions and configuration of all pads, including penetrations, with the manufacturer's Shop Drawings.

F. Anchor Bolts: Furnish anchor bolts, fasteners, washers, etc., and templates needed for installation of Owner-furnished equipment and prefabricated Control Room Building shown on Drawings, and as specified in Section 01 88 15, Anchorage and Bracing.

1. Furnish all necessary anchor bolts not furnished with the equipment.
2. Size and locate anchor bolts in accordance with manufacturer's shop drawings, installation instructions and Section 01 88 15, Anchorage and Bracing.
3. Anchor bolts, fasteners, washers, etc., shall be Type 316 stainless steel unless otherwise specified differently by the manufacturer.

PART 3 EXECUTION

relocation and installation
september 2018 of owner-furnished equipment
01 68 00 - 7

1. general

A. Installation work shall conform with manufacturer's recommended procedures, instructions, and Shop Drawings, as accepted by the Design Engineer.

B. Demolition required for equipment relocation shall be as shown on Drawings and in accordance with Section 02 41 00, Demolition.

C. Transport to its place of installation, inspect, store, handle, and protect Owner-furnished products.

D. Maintain complete inventory on all Owner-furnished products after their transfer to Contractor.

E. Install piping, valves, and miscellaneous fittings in accordance with manufacturer's instructions and with Section 40 27 02, Process Valves and Operators, and Section 40 27 00, Process Piping – General.

F. Install and connect electrical equipment in accordance with Division 26, Electrical, and with equipment manufacturer's instructions. Install and connect control panels and local instruments in accordance with Section 40 90 00, Instrumentation and Control, and with manufacturer's instructions.

2. pre-relocation testing: INSPECTION AND FUNCTIONAL TESTING PRIOR TO RELOCATION

A. Prior to transfer of Owner-furnished products to the Contractor, Owner's Representative, and the manufacturer shall jointly inspect the condition of each product and shall document in writing and photographs, the condition of the material transferred to the Contractor's care, noting any defects in the equipment. Submit information as part of the Pre-Relocation reports.

1. Contractor shall record in writing the products transferred to the Contractor's care.
2. Contractor and Owner shall jointly ensure that all equipment being relocated is functional prior to relocation. Nonfunctioning equipment shall be documented, and will be repaired or replaced, at the discretion of the Owner. Such inspection will not be construed as final or as receipt of any product that, as a result of subsequent inspections and tests, are determined to be nonconforming.
3. Contractor shall record in writing the current operating parameters of Owner-furnished products.
4. Existing items that are damaged shall be listed and submitted for Owner's review. Damaged items are to be replaced or repaired, as

approved by the Owner.

B. Contractor shall record in writing the current operating parameters of the Landfill Gas Generator Set and related equipment, including but not limited to the following:

1. Power output on landfill gas. Power shall be measured at generator output terminals, in kilowatts (kW), amperes (A), and kilovolt-amperes (kVA).
2. Provide operating power factor at generator output terminals.
3. Harmonics: Measure Total Demand Distortion (TDD) at generator output terminals.
4. Circuit breaker and protective device settings at all 5kV and 480V electrical gear.
5. Ambient temperature.
6. Relative humidity.
7. Barometric pressure.
8. Fuel flow rate.
9. Coolant temperature.
10. Oil pressure and temperature.
11. Pump Parameters:
    a. Pressure.
    b. Flow rates.
12. Instrumentation:
    a. Set points.
    b. Range settings.
    c. Alarm set points.

3. PROTECTION OF RELOCATED EQUIPMENT

A. Following transfer of Owner-furnished products, and until final acceptance of the completed Work, Contractor shall protect and maintain products to prevent damage in accordance with manufacturer's instructions.

B. Equipment susceptible to damage by the elements shall be placed in an acceptable temporary storage building prior to installation. Replace products that become corroded, damaged, or deteriorated with new products prior to installation and acceptance of the Work.

C. Contractor and Construction Manager shall meet to determine the condition of equipment to be relocated prior to relocation.

D. Damage to or loss of products after the date of their transfer to Contractor shall be repaired to original condition, or replaced with new identical products, as reviewed and accepted by Construction Manager.

4. Relocation of existing equipment

A. Contractor to provide Owner and SDG&E with 45 days' notice when the existing equipment is to be relocated to the new facility.

B. Contractor shall arrange and attend a preinstallation meeting with the manufacturer(s) to review general procedures, erection and installation instructions, and installation sequence.

1. Provide 30 days' advance notice of the proposed date for starting installation.
2. Additional meetings prior to installation may be required, as determined by the Construction Manager., to transmit manufacturer's installation instructions to the Contractor.
3. Construction Manager and Owner's representative may attend the meetings.

C. Contractor shall develop a written Relocation Plan for items, including:

1. Detailed description of method and equipment to be used for each operation.
2. Procedures for removal and relocation of equipment.
3. Relocation schedule, including all pre and post-testing and anticipated shutdowns.
4. Coordination with other trades for disconnection of services.

D. Contractor shall work with Owner when equipment is to be taken offline and relocated.

E. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trade involved. Clean all items to be relocated prior to reinstallation, to a reasonable fashion, to the satisfaction of the Owner.

5. INSTALLATION

A. Excavation, concrete, mechanical, and electrical work shall conform to applicable standards, final stamped and reviewed Shop Drawings, Specifications, and Drawings included in these Contract Documents.

B. Provide all interconnecting structures, equipment, piping, electrical and instrumentation work, finish painting, and appurtenances to achieve a complete and functional system.

C. Provide foundation pads for Owner-furnished products as shown. Field verify exact dimensions and configuration of all pads, including penetrations, anchor bolt locations, drainage locations, conduit/piping stub ups with actual equipment to be relocated.

D. Anchor Bolts:

1. Where required, provide anchor bolts, fasteners, washers, and templates needed for installation of Owner-furnished equipment.
2. Size and locate anchor bolts in accordance with Section 01 88 15, Anchorage and Bracing.

E. Equipment shall be properly aligned, plumb and level, with no stresses on connecting piping or conduit.

F. Verify direction of motor rotation before starting equipment drives.

G. Verify operability and safety of electrical system needed to operate equipment. Check electrical system for continuity, phasing, grounding, and proper functions.

6. PAINTING

A. Painting shall be in accordance with Section 09 90 00, Painting and Coating.

1. Protect equipment to minimize damage to the finish painted surfaces.
2. Repair damage to painted surfaces to the satisfaction of the Construction Manager.

7. MAINTENANCE

A. Contractor to submit maintenance procedures for Owner approval.

B. Immediately after installation, lubricate components in accordance with manufacturer's instructions.

C. Follow manufacturer's instructions for maintenance during storage, after installation but prior to testing and startup, and after startup but prior to Owner's acceptance.

D. Notify Construction Manager immediately in event that manufacturer's spare parts and maintenance materials are not available.

E. Furnish incidental maintenance, labor, and supplies including lubricants, cleaning fluids, nuts and bolts, and similar products not furnished by manufacturer, as needed for maintaining the Owner-furnished products.

8. FIELD TESTING

A. Preparation: Prepare Owner-furnished equipment for startup including cleanup, lubrication, motor phasing, motor test running, and equipment tolerance adjusting. Furnish incidental materials required for this preparation.

1. Check and adjust settings of components prior to startup.
2. Verify that equipment has been serviced with proper lubricants and that applicable safety equipment has been installed.
3. Verify that proper mechanical and electrical connections have been made for all relocated equipment.
4. Correct misalignment, vibration, excessive noise, or other evidence of improper setting obtained from short startup tests of drives. Do not use flexible couplings to compensate for misalignment.
5. Clean strainers on control valves and verify pressure settings.
6. Correct defects in installation as required by manufacturer's instructions and recommendations.
7. Manufacturer's certification of proper installation for each equipment system must be received by Construction Manager prior to starting functional testing.
8. Test and commission all electrical components as required in Section 26 08 00, Commissioning of Electrical Systems.

B. Functional Tests:

1. Following startup preparation, conduct a functional (or run) test on each Owner-furnished equipment unit in the presence of the Construction Manager, Owner, and manufacturer's representative.
2. Give full access to Work by, and cooperate with, manufacturer(s) during testing to enable gathering of data and information necessary to evaluate performance and develop recommendations for acceptable operation and maintenance instructions.
3. Make adjustments to installed equipment as recommended by manufacturer prior to proceeding to performance testing.
4. Demonstrate system functions, including control, interlock, safety and alarm, monitoring, and remote interface in presence of Construction Manager.
5. Prepare written test documentation, logs, and reports for submission, as part of the Post-relocation report.

C. Performance Tests:

1. Equipment shall be performance tested. Such testing shall be coordinated by the Contractor for the Owner-furnished equipment.
2. Demonstrate equipment operates to meet or exceed performance prior to relocation, as documented in the Pre-relocation reports.
   a. Where performance requirements are not initially met, review system installation and make necessary adjustments to correct performance issues.
   b. Where performance requirements cannot be met with testing and troubleshooting, develop a Performance deficiency report. Review report with Owner and Construction Manager

to develop a plan to address performance issues.

3. Schedule tests in cooperation with the Owner, Construction Manager, and manufacturer's representative.
4. Prepare written test documentation, logs, and reports for submission, as part of the Post-relocation report.

9. MANUFACTURER'S SERVICES

A. The Contractor shall obtain the services of the manufacturers of the Owner-furnished equipment as described herein. The following is a list of the Owner-furnished equipment manufacturers:

1. Landfill Engine Generator Set and 5kV Generator Switchgear and Generator Electrical Components: Hawthorne Power Systems (Caterpillar), 16945 Camino San Bernardo, San Diego, CA 92127. Telephone: (858) 974-6800.
2. Gas Chromatograph: Emerson Process Management, Rosemount Analytical. 5650 Brittmoore Road, Houston, TX 77041. Telephone: (713) 827-6380.
3. Fuel Flowmeter: Spirax Sarco Inc. 2150 Miller Drive, Longmont, CO 80501. Telephone: (303) 682-7060.

B. A manufacturer's representative for the Owner-furnished equipment shall be present at the Job Site designated by the Owner for minimum person-days listed below, travel time excluded:

1. Landfill Engine Generator Set and 5 kV Generator Switchgear and Generator Electrical Components:
   a. 2 person-days for installation assistance and inspection.
   b. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   c. 1/2 person-day for prestartup classroom or site training.
   d. 1/2 person-day for facility startup.
2. Gas Chromatograph:
   a. 1 person-day for installation assistance and inspection.
   b. 1/2 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   c. 1/2 person-day for prestartup classroom or site training.
   d. 1/2 person-day for facility startup.
3. Fuel Flowmeter:
   a. 1/2 person-day for installation assistance and inspection.
   b. 1/2 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   c. 1/2 person-day for prestartup classroom or site training.
   d. 1/2 person-day for facility startup.

C. Manufacturer's Services and Certificate of Proper Installation: Provide Manufacturer's Services and Manufacturer's Certificate of Proper Installation in conformance with the requirements of Section 01 43 33, Manufacturers' Field Services. Manufacturer's representative shall provide supervision of equipment installations, field inspection of equipment before startup and the completion of the Certificate of Proper Installation exclusive of specified services for "Instruction of Owner's Personnel".

END OF SECTION

# SECTION 01 69 00
# OZONE/BIOLOGICAL ACTIVATED CARBON (BAC) RELOCATION AND INSTALLATION OF OWNER-FURNISHED EQUIPMENT

## PART 1 GENERAL

### 1. WORK OF THIS SECTION

A. This Work includes relocating the existing Pure Water Demonstration Plant Ozone and BAC Filter Processes, and ancillary equipment to an adjacent area on the site, as shown on Drawings. All work necessary to relocate and install this Owner-furnished equipment, make complete and ready for operation, and coordinate and conduct functional and performance testing shall be included.

B. General Requirements: See Division 01, General Requirements, which contains information and requirements that apply to the Work specified herein and are mandatory for this Project.

C. Any other new products or services provided for this Work shall conform to the Technical Specifications included as part of this Contract.

### 2. EQUIPMENT FURNISHED BY OWNER

A. Pure Water Demonstration Plant Ozone Injection Process and all associated structural, mechanical, electrical, and instrumentation systems as noted in Volume 5 of the Contract Documents.

B. Pure Water Demonstration Plant Ozone BAC Filter Process and all associated structural, mechanical, electrical, and instrumentation systems as noted in Volume 5 of the Contract Documents. Note the BAC Filter media must be removed and stored prior to relocation of the tanks. The media cannot be removed by vacuum.

### 3. DEFINITIONS

A. Contractor: The party under contract with Owner to furnish the products or special services specified herein.

B. Owner-Furnished Products: Equipment and products that are being provided by the Owner outside of this Contract or equipment that is to be relocated by the Contractor from the existing location to the new location as shown on Drawings.

### 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, California:

1. Uniform Mechanical Code.
2. Uniform Plumbing Code.
3. Uniform Fire Code.
4. National Electrical Code.
5. 2016 California Building Code by California Building Standards Commission.

5. CONTRACTOR's RESPONSIBILITY FOR COMPLETE SYSTEM

A. Contractor shall have complete responsibility for necessary handling, installing, adjusting, maintaining, lubricating, testing, and operational startup of Owner-furnished products. Provide and coordinate the construction of interconnecting structures, equipment, piping, electrical and instrumentation work, and appurtenances to achieve installation and operation of the Owner-furnished products as shown and specified and as required to provide a complete and functional system.

B. Contractor shall coordinate DCS/Controls relocation and reprogramming with the COMNET group at City of San Diego. The programming will be performed by the City.

6. INFORMATION FURNISHED BY OWNER

A. An electronic copy of the Operation and Maintenance Manuals and Shop Drawings for the Owner-furnished equipment will be available for examination during the bidding period.

B. A pre-proposal meeting will be organized during bidding period with the Owner for inspection of the Owner-furnished equipment located at the San Diego North City Water Reclamation Plant. Owner will not open any cabinets and panels during this inspection.

C. After award of the Contract, one copy of the Operation and Maintenance Manual for each type of Owner-furnished equipment will be supplied to the Contractor within 10 working days of this request.

7. SUBMITTALS

A. Action Submittals:

1. Prior to construction and the disconnection and relocation of existing equipment, field verify as-found conditions and prepare as-found documentation.
   a. Clearly identify any equipment, concrete pads, surface

features, wiring, piping, appurtenances, and/or connections that are different from or in addition to what is shown on the contract documents.

b. Provide as-found documentation for Owner's and Construction Manager's review before disconnection and relocation of existing equipment prior to construction.

2. Furnish, as a part of the Work under this section, detailed Shop Drawings to indicate the layout, location, and identification of materials provided by Contractor.
   a. Include pipe, fittings, valves, specialties, hangers, supports, equipment, and required specialties.
   b. Accurately show openings in floors, walls, and other parts of the structures.
   c. Provide electrical and instrumentation diagrams to indicate connecting and interconnecting electrical and control components.
3. Submit complete list of materials to be furnished, and include data necessary to allow Construction Manager to determine their fitness for the work.
4. Submit plans to repair or replace products that become damaged or lost after transferred to Contractor for storage and protection.
5. Product relocation, installation, and testing schedule.
6. Inventory of equipment to be relocated where shown as 'Field Verify'.
7. Submit plans describing method for disconnecting existing equipment from current installation and relocation to location shown on Drawings.
8. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Submit functional test logs and performance test reports as required for specific equipment tested.
2. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
3. Component and attachment testing seismic certificate of compliance.

8. SEQUENCING AND SCHEDULING

A. Contractor shall verify availability of Owner-furnished equipment by contacting the Owner before making final arrangements for, or committing resources to, the relocation, handling, protection, or installation of such products. Construction sequencing and scheduling shall conform with the requirements of Section 01 31 13, Project Coordination.

B. Include sequencing constraints specified herein as part of Progress Schedule.

C. Where a preinstallation meeting is required by this section, provide a minimum of 30 days' advance written notice to Owner of the proposed date for starting installation.

D. Provide a minimum of 30 days' notice to Owner that Owner-furnished product is ready for performance testing listed herein to be furnished by Owner. Contractor shall bear the cost of all damages assessed to Owner resulting from delays caused by Contractor.

## PART 2 PRODUCTS

### 1. GENERAL

A. Provide products required to complete the work under this section, except where specifically specified as "Owner-furnished". Such products include, but are not limited to, concrete equipment pads, inserts, anchor bolts, connecting piping and valves, hangers and supports, wiring, conduit, junction boxes, wireways, piping accessories, specialties, finish painting, and expendable materials, as necessary to provide a complete and properly functioning system.

### 2. owner-furnished equipment

A. Ozone Injection Process: The Owner-furnished equipment includes the Ozone Container System, Chiller, Air Compressor, Air Tank, Ozone Destruct Unit, Ozone Quenching System, Ozone Product Tank, and all other equipment, mechanical, electrical, instrumentation, and control systems as noted in Volume 5 of the Contract Documents. Not all items to be relocated are specifically listed here by name. The relocation and installation of the Ozone Injection Process is described in the Contract Documents.

B. BAC Filter Process: The Owner-furnished equipment includes the BAC Filters 1 and 2, BAC Blower, BAC Filtrate Tank, Transfer Pump and all other equipment, mechanical, electrical, instrumentation, and control systems as noted in Volume 5 of the Contract Documents. Not all items to be relocated are specifically listed here by name. The relocation and installation of the BAC Filter Process is described in the Contract Documents.

### 3. MISCELLANEOUS PRODUCTS

A. General: Furnish incidental products, such as gaskets, supports, bolts, and lubricants, as shown and as required for proper operation of

equipment installed under this section. Products shall conform to applicable sections of these Specifications for the intended service.

B. Piping and Valves: Unless otherwise noted, provide all piping and valves as required for proper operation of equipment installed under this section. The provided products shall conform to applicable specification sections for the intended service. Refer to Piping Schedule on Drawings.

C. Pipe Supports: Unless otherwise noted, provide all necessary pipe supports as required for proper operation of equipment installed under this section. Pipe support requirements are specified in Section 40 05 15, Piping Support Systems.

D. Conduits and Wiring: Furnish conduit, wiring, wireways, junction boxes, handholes, and manholes as shown and as needed for complete interconnections of Owner-furnished electrical equipment in order to restore functionality.

E. Equipment Foundation Pads: Provide foundation pads for Owner-furnished equipment, as required by the equipment manufacturer and as specified in Section 03 30 10, Structural Reinforced Concrete, and as shown on Drawings. Approximate pad sizes are shown on Drawings. Contractor shall verify exact dimensions and configuration of all pads, including penetrations, with the manufacturer's Shop Drawings.

F. Anchor Bolts: Furnish anchor bolts, fasteners, washers, etc., and templates needed for installation of Owner-furnished equipment shown on Drawings, and as specified in Section 01 88 15, Anchorage and Bracing.

1. Furnish all necessary anchor bolts not furnished with the equipment.
2. Size and locate anchor bolts in accordance with manufacturer's shop drawings, installation instructions and Section 01 88 15, Anchorage and Bracing.
3. Anchor bolts, fasteners, washers, etc., shall be Type 316 stainless steel unless otherwise specified differently by the manufacturer.

## PART 3 EXECUTION

### 1. general

A. Installation work shall conform with manufacturer's recommended procedures, instructions, and Shop Drawings, as accepted by the Design Engineer.

B. Demolition required for equipment relocation shall be as shown on

Drawings and in accordance with Section 02 41 00, Demolition.

C. Transport to its place of installation, inspect, store, handle, and protect Owner-furnished products.

D. Maintain complete inventory on all Owner-furnished products after their transfer to Contractor.

E. Install piping, valves, and miscellaneous fittings in accordance with manufacturer's instructions and with Section 40 27 02, Process Valves and Operators and Section 40 27 00, Process Piping – General.

F. Install and connect electrical equipment in accordance with Division 26, Electrical, and with equipment manufacturer's instructions. Install and connect control panels and local instruments in accordance with Section 40 90 00, Instrumentation and Control and with manufacturer's instructions.

2. INSPECTION PRIOR TO RELOCATION

A. Prior to transfer of Owner-furnished products to the Contractor, Owner's Representative, and the manufacturer shall jointly inspect the condition of each product and shall document in writing and photographs, the condition of the material transferred to the Contractor's care, noting any defects in the equipment.

1. Contractor shall record in writing the products transferred to the Contractor's care.
2. Contractor shall ensure that all equipment being relocated is functional prior to relocation. Nonfunctioning equipment shall be repaired or replaced, to the approval of the Owner.
3. Contractor shall record in writing the performance parameters of Owner-furnished products, provided in log books by the Owner.
4. Damage to or loss of equipment and materials shall be immediately reported to the Construction Manager.

3. PREINSTALLATION MEETING

A. Contractor shall arrange and attend a preinstallation meeting with the manufacturer(s) to review general procedures, erection and installation instructions, and installation sequence.

1. Provide 30 days' advance notice of the proposed date for starting installation.
2. Additional meetings prior to installation may be required, as determined by the Construction Manager, to transmit manufacturer's installation instructions to the Contractor.

3. Construction Manager and Owner's representative may attend the meetings.

4. Relocation of existing equipment

A. Contractor shall develop relocation plan for items, including:

1. Detailed description of method and equipment to be used for each operation.
2. Procedures for removal and relocation of equipment.
3. Coordination with other trades for disconnection of services.

B. Contractor shall work with Owner when equipment is to be taken offline and relocated.

C. Contractor shall take photographs of all existing equipment prior to relocation.

D. Conduct with Owner or Construction Manager a joint inspection for the purpose of identifying product, general verification of quantities, and observation of apparent condition. Such inspection will not be construed as final or as receipt of any product that, as a result of subsequent inspections and tests, are determined to be nonconforming.

E. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trade involved. Clean all items to be relocated prior to reinstallation, to a reasonable fashion, to the satisfaction of the Owner.

F. Items that are damaged shall be listed and submitted for Owner's review. Damaged items are to be replaced or repaired, as approved by the Owner.

5. PROTECTION OF RELOCATED EQUIPMENT

A. Following transfer of Owner-furnished products, and until final acceptance of the completed Work, Contractor shall protect and maintain products to prevent damage in accordance with manufacturer's instructions.

B. Equipment susceptible to damage by the elements shall be placed in an acceptable temporary storage building prior to installation. Replace products that become corroded, damaged, or deteriorated with new products prior to installation and acceptance of the Work.

C. Damage to or loss of products after the date of their transfer to Contractor shall be repaired to original condition, or replaced with new identical products, as reviewed and accepted by Construction Manager.

6. INSTALLATION

A. Excavation, concrete, mechanical, and electrical work shall conform to applicable standards, final stamped and reviewed Shop Drawings, Specifications, and Drawings included in these Contract Documents.

B. Provide all interconnecting structures, equipment, piping, electrical and instrumentation work, finish painting, and appurtenances to achieve a complete and functional system.

C. Provide foundation pads for Owner-furnished products as shown. Verify exact dimensions and configuration of all pads, including penetrations, with Owner-furnished product Shop Drawings.

D. Anchor Bolts:

1. Where required, provide anchor bolts, fasteners, washers, and templates needed for installation of Owner-furnished equipment.
2. Size and locate anchor bolts in accordance with Owner-furnished product Shop Drawings and installation instructions.

E. Equipment shall be properly aligned, plumb and level, with no stresses on connecting piping or conduit.

F. Verify direction of motor rotation before starting equipment drives.

G. Verify operability and safety of electrical system needed to operate equipment. Check electrical system for continuity, phasing, grounding, and proper functions.

7. PAINTING

A. Painting shall be in accordance with Section 09 90 00, Painting and Coating.

1. Protect equipment to minimize damage to the finish painted surfaces.
2. Repair damage to painted surfaces to the satisfaction of the Construction Manager.

8. MAINTENANCE

A. Contractor to submit maintenance procedures for Owner approval.

B. Immediately after installation, lubricate components in accordance with manufacturer’s instructions.

C. Follow manufacturer’s instructions for maintenance during storage, after

installation but prior to testing and startup, and after startup but prior to Owner's acceptance.

D. Notify Construction Manager immediately in event that manufacturer's spare parts and maintenance materials are not available.

E. Furnish incidental maintenance, labor, and supplies including lubricants, cleaning fluids, nuts and bolts, and similar products not furnished by manufacturer, as needed for maintaining the Owner-furnished products.

9. FIELD TESTING

A. Preparation: Prepare Owner-furnished equipment for startup including cleanup, lubrication, motor phasing, motor test running, and equipment tolerance adjusting. Furnish incidental materials required for this preparation.

1. Check and adjust settings of components prior to startup.
2. Verify that equipment has been serviced with proper lubricants and that applicable safety equipment has been installed.
3. Verify that proper mechanical and electrical connections have been made.
4. Correct misalignment, vibration, excessive noise, or other evidence of improper setting. Do not use flexible couplings to compensate for misalignment.
5. Clean strainers on control valves and verify pressure settings.
6. Correct defects in installation as required by manufacturer's instructions and recommendations.
7. Manufacturer's certification of proper installation for each equipment system must be received by Construction Manager prior to starting functional testing.

B. Functional Tests:

1. Following startup preparation, conduct a functional (or run) test on each Owner-furnished equipment unit in the presence of the Construction Manager, Owner, and manufacturer's representative.
2. Give full access to Work by, and cooperate with, manufacturer(s) during testing to enable gathering of data and information necessary to evaluate performance and develop recommendations for acceptable operation and maintenance instructions.
3. Make adjustments to installed equipment as recommended by manufacturer prior to proceeding to performance testing.
4. Demonstrate system functions, including control, interlock, safety and alarm, monitoring, and remote interface in presence of Construction Manager.

5. Prepare all test logs and reports for submission.

C. Performance Tests:

1. Prior to plant startup, equipment shall be performance tested as specified in the applicable equipment specifications. Such testing shall be coordinated by the Contractor and will be performed by the manufacturer for the Owner-furnished equipment.
2. Demonstrate equipment operates to match performance prior to relocation, as recorded during the inspection prior to relocation.
3. Schedule tests in cooperation with the Owner, Construction Manager, and manufacturer's representative.

10. MANUFACTURER'S SERVICES

A. The Contractor shall obtain the services of the manufacturers of the Owner-furnished equipment as described herein. The following is a list of the Owner-furnished equipment manufacturers:

1. Ozone Injection and BAC Filter Processes: Xyem, Inc, 14125 South Bridge Circle, Charlotte, NC 28273. Telephone: (704) 409-9766.

B. A manufacturer's representative for the Owner-furnished equipment shall be present at the jobsite designated by the Owner for minimum person-days listed below, travel time excluded:

1. Ozone Injection and BAC Filter Processes:
   a. 2 person-days for installation assistance and inspection.
   b. 4 person-days for functional testing and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   c. 1 person day for prestartup classroom or site training.
   d. 4 person days for facility startup.

C. Manufacturer's Services and Certificate of Proper Installation: Provide Manufacturer's Services and Manufacturer's Certificate of Proper Installation in conformance with the requirements of Section 01 43 33, Manufacturers' Field Services. Manufacturer's representative shall provide supervision of equipment installations, field inspection of equipment before startup, and the completion of the Certificate of Proper Installation exclusive of specified services for "Instruction of Owner's Personnel".

END OF SECTION

# SECTION 01 77 00
# CLOSEOUT PROCEDURES

## PART 1 GENERAL

### 1. SUBMITTALS

A. Informational Submittals:

1. Submit prior to application for final payment.
   a. Record Documents: As described in Section 01 33 00, Submittal Requirements.
   b. Approved Shop Drawings and Samples: As described in Section 01 33 00, Submittal Requirements. Special bonds, Special Guarantees, and Service Agreements.
   c. Consent of Surety to Final Payment: As required in General Conditions.
   d. Releases or Waivers of Liens and Claims: As required in General Conditions.
   e. Releases from Agreements.
   f. All documentation as required by all Funding Agencies.
   g. Final Application for Payment: Submit in accordance with procedures and requirements stated in the General Conditions.
   h. Extra Materials: As required by individual specification sections.

### 2. RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents and to ensure compliance with the requirements of the Contract Documents and Funding Agencies.
2. Accuracy of Records:
   a. Coordinate changes within record documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
   b. Purpose of Project record documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
3. Make entries within 24 hours after receipt of information that a change in the Work has occurred.
4. Prior to submitting each request for progress payment, request Construction Manager's review and approval of current status of

record documents. Failure to properly maintain, update, and submit record documents may result in a deferral by Construction Manager to recommend whole or any part of Contractor's Application for Payment, either partial or final.

3. RELEASES FROM AGREEMENTS

A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.

B. In the event Contractor is unable to secure written releases:

1. Inform Owner of the reasons.
2. Owner or its representatives will examine the Site, and Owner will direct Contractor to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
3. Should Contractor refuse to perform this Work, Owner reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require Contractor to furnish a satisfactory bond in a sum to cover legal Claims for damages.
4. When Owner is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement or special easement, right is reserved to waive requirement for written release if: (i) Contractor's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that Contractor has failed to fulfill terms of side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting grantor.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

1. MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. Promptly following commencement of Contract Times, secure from Construction Manager at no cost to Contractor, one complete set of Contract Documents. Drawings will be full size.
2. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.
3. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by Construction Manager.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required. Entries shall be adequately clear to accurately locate and indicate changes on Drawings. Entries shall be dark enough to allow scanned copies.
    a. Color Coding:
        1) Green when showing information deleted from Drawings.
        2) Red when showing information added to Drawings.
        3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by “cloud” drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
    a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
    b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Horizontal and vertical locations of utilities placed at locations different than the coordinates shown on Drawings shall be surveyed, with revised coordinates to two decimal places, marked on Record Documents. Reference to at least two measurements to permanent surface improvements.
    c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
    d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
    e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and Construction Manager’s written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number. Changes shall also be physically annotated on Drawings, in addition to noting the associated change.
5. Dimensions on Schematic Layouts: Show on Record Drawings, by

dimension, the centerline of each run of items such as are described in previous subparagraph above.

a. Clearly identify the item by accurate note such as “cast iron drain,” “galv. water,” and the like.
b. Show, by symbol or note, vertical location of item (“under slab,” “in ceiling plenum,” “exposed,” and the like).
c. Make identification so descriptive that it may be related reliably to Specifications.

2. FINAL CLEANING

A. At completion of the Work or of a part thereof and immediately prior to Contractor’s request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor’s notice of completion, clean entire Site or parts thereof, as applicable.

1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Owner and Construction Manager.
2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
4. Clean all windows.
5. Clean and wax wood, vinyl, or painted floors.
6. Broom clean exterior paved driveways and parking areas.
7. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
8. Rake clean all other surfaces.
9. Remove snow and ice from access to buildings.
10. Replace air-handling filters and clean ducts, blowers, and coils of ventilation units operated during construction.
11. Leave water courses, gutters, and ditches open and clean.

B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

END OF SECTION

## PART 1 GENERAL

### 1. SECTION INCLUDES

A. Detailed information for the preparation, submission, and Design Engineer's review of Operations and Maintenance (O&M) Data, as required by individual specification sections.

### 2. DEFINITIONS

A. Preliminary Data: Initial and subsequent submissions for Design Engineer's review.

B. Final Data: Design Engineer-accepted data, submitted as specified herein.

C. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

### 3. SEQUENCING AND SCHEDULING

A. Equipment and System Data:

1. Preliminary Data:
   a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Design Engineer.
   b. Submit prior to shipment date.
2. Final Data: Submit Instructional Manual Formatted data not less than 30 days prior to equipment or system field functional testing. Submit final Compilation Formatted and Electronic Media Formatted data prior to Substantial Completion of Project.

B. Materials and Finishes Data:

1. Preliminary Data: Submit at least 15 days prior to request for final inspection.
2. Final Data: Submit within 10 days after final inspection.

### 4. DATA FORMAT

A. Prepare preliminary data in the form of an instructional manual. Prepare final data in data compilation format and on electronic media.

B. Instructional Manual Format:

1. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
2. Size: 8-1/2 inches by 11 inches, minimum.
3. Cover:
   a. Identify manual with typed or printed title “OPERATION AND MAINTENANCE DATA” and list:
      1) Project title.
      2) Designate applicable system, equipment, material, or finish.
      3) Identity of separate structure as applicable.
      4) Identify volume number if more than one volume.
      5) Identity of general subject matter covered in manual. Identity of equipment number and Specification section.
4. Spine:
   a. Project title.
   b. Identify volume number if more than one volume.
5. Title Page:
   a. Contractor name, address, and telephone number.
   b. Subcontractor, Supplier, installer, or maintenance contractor’s name, address, and telephone number, as appropriate.
      1) Identify area of responsibility of each.
      2) Provide name and telephone number of local source of supply for parts and replacement.
6. Table of Contents:
   a. Neatly typewritten and arranged in systematic order with consecutive page numbers.
   b. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
7. Paper: 20-pound minimum, white for typed pages.
8. Text: Manufacturer’s printed data, or neatly typewritten.
9. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
10. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.

C. Data Compilation Format:

1. Compile all Design Engineer-accepted preliminary O&M data into a hard-copy, hard-bound set.
2. Each set shall consist of the following:
   a. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
   b. Cover: Identify each volume with typed or printed title

"OPERATION AND MAINTENANCE DATA, VOLUME NO. ___ OF ___", and list:

1) Project title.
2) Contractor's name, address, and telephone number.
3) If entire volume covers equipment or system provided by one Supplier include the following:
    a) Identity of general subject matter covered in manual.
    b) Identity of equipment number and Specification section.

c. Provide each volume with title page and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.

d. Table of contents neatly typewritten, arranged in a systematic order:
    1) Include list of each product, indexed to content of each volume.
    2) Designate system or equipment for which it is intended.
    3) Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.

e. Section Dividers:
    1) Heavy, 80-pound cover weight, tabbed with numbered plastic index tabs.
    2) Fly-Leaf:
        a) For each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment.
        b) List with Each Product:
            (1) Name, address, and telephone number of Subcontractor, Supplier, installer, and maintenance contractor, as appropriate.
            (2) Identify area of responsibility of each.
            (3) Provide local source of supply for parts and replacement.
        c) Identity of separate structure as applicable.

f. Assemble and bind material, as much as possible, in same order as specified in the Contract Documents.

D. Electronic Media Format:

1. Portable Document Format (PDF):
    a. After all preliminary data has been found to be acceptable to Design Engineer, submit Operation and Maintenance data in PDF format on CD.
    b. Files to be exact duplicates of Design Engineer-accepted preliminary data. Arrange by specification number and name.

c. Files to be fully functional, bookmarked, and viewable in most recent version of Adobe Acrobat.

5. SUBMITTALS

A. Informational:

1. Data Outline: Submit electronic copies of a detailed outline of proposed organization and contents of Final Data prior to preparation of Preliminary Data.
2. Preliminary Data:
   a. Submit electronic copies for Design Engineer's review.
   b. If data meets conditions of the Contract: Design Engineer will accept manual.
   c. If data does not meet conditions of the Contract: Resubmit manual revised in accordance with Design Engineer's comments.
3. Final Data: Submit two printed copies and an electronic copy in format specified herein.

6. DATA FOR EQUIPMENT AND SYSTEMS

A. Content for Each Unit (or Common Units) and System:

1. Product Data:
   a. Include only those sheets that are pertinent to specific product.
   b. Clearly annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information.
   c. Function, normal operating characteristics, and limiting conditions.
   d. Performance curves, engineering data, nameplate data, and tests.
   e. Complete nomenclature and commercial number of replaceable parts.
   f. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
   g. Spare parts ordering instructions.
   h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).
2. As-installed, color-coded piping diagrams.
3. Charts of valve tag numbers, with the location and function of each valve.

4. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
    a. Format:
        1) Provide reinforced, punched, binder tab; bind in with text.
        2) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
        3) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
        4) Identify Specification section and product on Drawings and envelopes.
    b. Relations of component parts of equipment and systems.
    c. Control and flow diagrams.
    d. Coordinate drawings with Project record documents to assure correct illustration of completed installation.
5. Instructions and Procedures: Within text, as required to supplement product data.
    a. Format:
        1) Organize in consistent format under separate heading for each different procedure.
        2) Provide logical sequence of instructions for each procedure.
        3) Provide information sheet for Owner's personnel, including:
            a) Proper procedures in event of failure.
            b) Instances that might affect validity of guarantee or Bond.
    b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
    c. Operating Procedures:
        1) Startup, break-in, routine, and normal operating instructions.
        2) Test procedures and results of factory tests where required.
        3) Regulation, control, stopping, and emergency instructions.
        4) Description of operation sequence by control manufacturer.
        5) Shutdown instructions for both short and extended duration.
        6) Summer and winter operating instructions, as applicable.
        7) Safety precautions.
        8) Special operating instructions.
    d. Maintenance and Overhaul Procedures:
        1) Routine maintenance.
        2) Guide to troubleshooting.

3) Disassembly, removal, repair, reinstallation, and re-assembly.

6. Guarantee, Bond, and Service Agreement: In accordance with Section 01 77 00, Closeout Procedures.

B. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:
   a. Function, normal operating characteristics, and limiting conditions.
   b. Performance curves, engineering data, nameplate data, and tests.
   c. Complete nomenclature and commercial number of replaceable parts.
   d. Interconnection wiring diagrams, including control and lighting systems.
2. Circuit directories of panelboards.
3. Electrical service.
4. Control requirements and interfaces.
5. Communication requirements and interfaces.
6. List of electrical relay settings, and control and alarm contact settings.
7. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
8. As-installed control diagrams by control manufacturer.
9. Operating Procedures:
   a. Routine and normal operating instructions.
   b. Startup and shutdown sequences, normal and emergency.
   c. Safety precautions.
   d. Special operating instructions.
10. Maintenance Procedures:
    a. Routine maintenance.
    b. Guide to troubleshooting.
    c. Adjustment and checking.
    d. List of relay settings, control and alarm contact settings.
11. Manufacturer’s printed operating and maintenance instructions.
12. List of original manufacturer’s spare parts, manufacturer’s current prices, and recommended quantities to be maintained in storage.

C. Maintenance Summary:

1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
2. Format:
   a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.

b. Each Maintenance Summary may take as many pages as required.
c. Use only 8-1/2-inch by 11-inch size paper.
d. Complete using typewriter or electronic printing.

3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
   a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
   b. "Unit" is the unit of measure for ordering the part.
   c. "Quantity" is the number of units recommended.
   d. "Unit Cost" is the current purchase price.

7. DATA FOR MATERIALS AND FINISHES

A. Content for Architectural Products, Applied Materials, and Finishes:

1. Manufacturer's data, giving full information on products:
   a. Catalog number, size, and composition.
   b. Color and texture designations.
   c. Information required for reordering special-manufactured products.
2. Instructions for Care and Maintenance:
   a. Manufacturer's recommendation for types of cleaning agents and methods.
   b. Cautions against cleaning agents and methods that are detrimental to product.
   c. Recommended schedule for cleaning and maintenance.

B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer's data, giving full information on products:
   a. Applicable standards.
   b. Chemical composition.
   c. Details of installation.
2. Instructions for inspection, maintenance, and repair.

8. SUPPLEMENT

A. The supplement listed below, following "End of Section," is part of this Specification.

1. Maintenance Summary Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT:_____ CONTRACT NO.:_____

1. EQUIPMENT ITEM____
2. MANUFACTURER ____
3. EQUIPMENT/TAG NUMBER(S) _____
4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS)_____
5. NAMEPLATE DATA (hp, voltage, speed, etc.) ____
6. MANUFACTURER'S LOCAL REPRESENTATIVE _
   a. Name_ Telephone No. _____
   b. Address ____
7. MAINTENANCE REQUIREMENTS

| Maintenance Operation Comments | Frequency | Lubricant (If Applicable) |
|---|---|---|
| List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable (Reference to manufacturer's catalog or sales literature is not acceptable). | List required frequency of each maintenance operation. | Refer by symbol to lubricant required. |
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8. LUBRICANT LIST

| Reference Symbol | Shell | Exxon Mobile | Chevron Texaco | BP Amoco | Or Equal |
|---|---|---|---|---|---|
| List symbols used in No. 7 above. | List equivalent lubricants, as distributed by each manufacturer for the specific use recommended. | | | | |
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9. RECOMMENDED SPARE PARTS FOR OWNER'S INVENTORY.

| Part No. | Description | Unit | Quantity | Unit Cost |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| Note: Identify parts provided by this Contract with two asterisks. | | | | |

# SECTION 01 88 15
# ANCHORAGE AND BRACING

## PART 1 GENERAL

### 1. SUMMARY

A. This section covers requirements for anchorage and bracing of equipment, distribution systems, and other nonstructural components required in accordance with the 2016 California Building Code (CBC), for seismic, wind, gravity, soil, and operational loads.

### 2. REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Institute of Steel Construction (AISC) 360, Specification for Structural Steel Buildings.
2. American Society of Civil Engineers (ASCE): ASCE 7, Minimum Design Loads for Buildings and Other Structures.
3. California Building Commission: 2016 CBC.
4. International Code Council (ICC): International Building Code (IBC).

### 3. DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.

B. Designated Seismic System: Architectural, electrical, and mechanical system or their components for which component importance factor is greater than 1.0.

### 4. DESIGN AND PERFORMANCE REQUIREMENTS

A. General:

1. Contractor shall be responsible for designing code required gravity, wind and seismic supports, attachments, braces, and anchors to the structure including concrete pads and foundations for elements of the architectural, mechanical, and electrical systems included in the Work, the Owner-furnished equipment listed in the Section 01 68 00, Relocation and Installation of

Owner-Furnished Equipment, and the Owner-furnished prefabricated Control Room Building, in accordance with this section unless a design is specifically provided within the Contract Documents.

2. Anchorage and bracing systems shall be designed by a qualified professional civil or structural engineer registered in the State of California.
3. Design anchorage and bracing of architectural, mechanical, and electrical components and systems in accordance with this section, unless a design is specifically provided within Contract Documents or where exempted hereinafter.
4. Design attachments, braces, and anchors for equipment, components, and distribution systems to structure for gravity, seismic, wind, and operational loading.
5. Design seismic anchorage and bracing for modified existing architectural, mechanical, or electrical systems where code requirements would dictate design for similar new components.
6. Anchor and brace piping and ductwork, whether exempt or not exempt for this section, so that lateral or vertical displacement does not result in damage or failure to essential architectural, mechanical, or electrical equipment.
7. Provide supplementary framing where required to transfer anchorage and bracing loads to structure.
8. Adjust equipment pad sizes or provide additional anchorage confinement reinforcing to provide required anchorage capacities.
9. Design anchorage and bracing for:
    a. Equipment and components that weigh more than 400 pounds and have center of mass located 4 feet or less above adjacent finished floor.
    b. Equipment weighing more than 20 pounds that has center of mass located more than 4 feet above adjacent finished floor.
    c. Mechanical and electrical components that are not provided with flexible connections between components and associated ductwork, piping, or conduit.
    d. Distribution systems that weigh more than 5 pounds per foot that have center of mass located more than 4 feet above adjacent finished floor.
10. Design seismic anchorage and bracing for Designated Seismic Systems regardless of weight or mounting height.
    a. Component Important Factor:
        1) Ip equals 1.0, unless noted otherwise.
        2) Ip shall be taken as 1.5 if any of the following conditions apply:
            a) Component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems and egress stairways.
            b) Component contains hazardous materials.

c) Component is in or attached to Risk Category IV structure and is needed for continued operation of facility or its failure could impair continued operation of facility.

11. For components exempted from design requirements of this section, provide bolted, welded, or otherwise positively fastened attachments to supporting structure.

B. Design Loads:

1. Gravity: Design anchorage and bracing for self weight and superimposed loads on components and equipment.
2. Wind: Design anchorage and bracing for wind criteria provided on General Structural Notes on Drawings for exterior and wind-exposed mechanical and electrical equipment.
3. Operational:
   a. For loading supplied by equipment manufacturer for CBC required load cases.
   b. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), water hammer, and other load-inducing conditions.
   c. Locate braces to minimize vibration to or movement of structure.
   d. For vibrating loads, use anchors meeting requirements of Section 05 50 00, Metal Fabrications, for anchors with designated capacities for vibratory loading per manufacturer's ICC-ES report.
4. Seismic:
   a. In accordance with 2016 CBC, Section 1613, and Chapter 13 of ASCE 7.
   b. Design anchorage and bracing for design criteria listed on General Structural Notes on Drawings.

C. Seismic Design Requirements:

1. Nonstructural Components: Design as nonbuilding structures for components with weights greater than or equal to 25 percent of effective seismic weight of overall structure.
2. Analyze local region of body of nonstructural component for load transfer of anchorage attachment if component Ip equals 1.5.
3. The following are exempt from requirements for provision of seismic anchorages and bracing, in addition to those items specifically exempted in ASCE 7, Part 13.6 for electrical and mechanical equipment:
   a. Temporary or movable equipment.
4. Fire protection sprinkler systems designed and constructed in accordance with NFPA 13 shall be considered to meet requirements of Chapter 13 of ASCE 7.
5. Provide support drawings and calculations for electrical distribution

components if any of the following conditions apply:

a. Conduit diameter is greater than 2.5-inch trade size.
b. Total weight of bus duct, cable tray, or conduit supported by trapeze assemblies exceeds 10 pounds per foot.

6. Existing components, systems, and equipment in their final condition that are modified by Project requirements and are not exempted by above paragraph require the same anchorage and bracing drawing and calculation submittals as new equipment. Field verify existing conditions.
7. Other seismic design and detailing information identified in ASCE 7, Chapter 13, is required to be provided for new and modified or noted architectural, mechanical, and electrical components, systems, or equipment.

5. SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. List of mechanical and electrical equipment, including Owner-furnished Equipment and Control Building, requiring Contractor-designed anchorage and bracing, unless specifically exempted.
   b. Attachment assemblies' drawings including seismic attachments; include connection hardware, braces, and anchors or anchor bolts for nonexempt components, equipment, and systems.
   c. List of existing mechanical, and electrical equipment or components to be modified in Project requiring Contractor-designed anchorage and bracing in final retrofitted condition.
   d. Drawings for seismic attachment assemblies include connection hardware, braces, and anchors (or anchor bolts) for modified, nonexempt existing components, equipment, and systems where a combination of new and existing systems or components' final condition would require anchorage or bracing under this Specification for new equipment.
   e. Submittal will be rejected if proposed anchorage method would create excessive stress to supporting member. Revise anchorages and strengthen structural support to eliminate overstressed condition.

B. Informational Submittals:

1. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include CBC and Project-specific criteria as noted on General Structural Notes on Drawings, in addition to manufacturer's specific criteria used for design; sealed by a civil or structural engineer registered in the State of California.

2. Manufacturer's hardware installation requirements.

C. Deferred Submittals:

1. Submitted seismic anchorage drawings and calculations for Designated Seismic Systems are identified as CBC deferred submittals and will be submitted to and must be accepted by AHJ prior to installation of component, equipment, or distribution system.
2. Submit deferred Action Submittals such as Shop Drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment, or distribution system to be anchored to structure.

6. SOURCE QUALITY CONTROL

A. Provide all other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

B. Provide Source Quality Control for welding and hot-dip galvanizing of anchors in accordance with Section 05 50 00, Metal Fabrications.

## PART 2 PRODUCTS

1. GENERAL

A. Design and construct attachments and supports transferring seismic and non-seismic loads to structure of materials and products suitable for application and in accordance with design criteria shown on Drawings and nationally recognized standards.

B. Provide anchor bolts for anchorage of equipment to concrete in accordance with Section 05 50 00, Metal Fabrications and Section 01 68 00, Relocation and Installation of Owner-Furnished Equipment. Provide anchor bolts of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Design Engineer.

C. Provide post-installed concrete anchors for anchorage of equipment to concrete in accordance with Section 05 05 19, Post-Installed Anchors. Provide post-installed anchors of the type, size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Design Engineer.

D. Do not use powder-actuated fasteners or sleeve anchors for seismic attachments and anchorage where resistance to tension loads is required. Do not use expansion anchors, other than undercut anchors,

for nonvibration isolated mechanical equipment rated over 10 hp.

## PART 3 EXECUTION

### 1. GENERAL

A. Make attachments, bracing, and anchorage in such a manner that component lateral force is transferred to lateral force resisting system of structure through a complete load path.

B. Design, provide, and install overall seismic anchorage system to provide restraint in all directions, including vertical, for each component or system so anchored.

C. Provide snubbers in each horizontal direction and vertical restraints for components mounted on vibration isolation systems where required to resist overturning.

D. Provide piping anchorage that maintains design flexibility and expansion capabilities at flexible connections and expansion joints.

1. Piping and ductwork suspended more than 12 inches below supporting structure shall be braced for seismic effects to avoid significant bending of hangers and their attachments unless high or limited deformability piping is used per ASCE 7, Section 13.6.8 or HVAC ducts have a cross-sectional area of less than 6 square feet or weigh 17 pounds per foot or less.

E. Anchor tall and narrow equipment such as motor control centers and telemetry equipment at base and within 12 inches from top of equipment, unless approved otherwise by Design Engineer.

F. Do not attach mechanical or electrical components to more than one element of a structure at a single restraint location where such elements may respond differently during a seismic event.

### 2. INSTALLATION

A. Do not install components or their anchorages or restraints prior to review and acceptance by Design Engineer and AHJ.

B. Notify Construction Manager upon completion of installation of seismic restraints in accordance with Section 01 45 33, Special Inspection, Observation, and Testing.

### 3. FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. In accordance with Section 05 50 00, Metal Fabrications and Section 05 05 19, Post-Installed Anchors.

B. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

C. Provide any other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

# SECTION 01 91 14
# TESTING, INTEGRATION, AND STARTUP

## PART 1 GENERAL

### 1. STARTUP

A. The goal of startup is to verify proper performance and operation of the Facility.

B. Testing, integration, and startup are complex portions of the Work required for satisfactory completion and require thorough planning and proper execution.

### 2. DEFINITIONS

A. Acceptance Testing: A contractually required, specific, and measurable test, often with liquidated damages attached, to demonstrate a system or facility performs to its intended function (e.g. flow amounts, duration, and quality criteria are met). All major defects are resolved at this point.

B. Distributed Control System Provider (DCSP): Entity who is responsible for the development and programming of the Facility DCS.

C. Auxiliary Systems: Subsystems and systems selected by the Owner as critical to the operation and function of the Work. Auxiliary systems are more specifically identified in the Contract Documents.

D. Commissioning:

1. The disciplined and systematic process of assuring that all components, subsystems, and systems of a constructed unit are designed, installed, tested, and operated in conformance with the design intent, and functional intent and operational requirements of the Owner.
2. This includes:
    a. Proof testing of design intent using static check sheets, dynamic check sheets, and defined procedures to ensure compliance with design drawings, data sheets, and specifications.
    b. Achieving a smooth and safe transition from an inert state to a completely tested, clean, leak tight, operable and safe unit ready for start-up and performance testing.

E. Components: Individual items of equipment or portions of the Work that when combined with other components make up subsystems or systems. Components may be minor items such as pressure gauges, or they may be significant items such as pump motors.

F. Contract Documents: Construction Contract, Specifications, and Drawings.

G. Facility: The combined equipment and systems collocated to perform a specified function e.g. North City Water Reclamation Plant.

H. Factory Acceptance Testing (FAT): All testing required to be conducted at the fabricator's/manufacturer's/vendor's offsite locations, witnessed or unwitnessed. Includes all such testing, regardless of the specific descriptive title used for said testing in the Contract Documents.

I. Final Completion: Refer to the Contract requirements and Supplementary Provisions.

J. Functional Testing: A test of a given component, subsystem or system to confirm its operation meets specifications and Contract requirements. Often a prerequisite to Acceptance Testing.

K. Major Equipment Systems: Systems, subsystems, or major equipment components selected by the Owner as critical to the operation and function of the Work. Major equipment systems are more specifically identified in the Contract Documents.

L. Manufacturer's Installation Inspection: Preliminary inspection conducted by Manufacturer or Manufacturer's accepted representative to confirm proper installation of components, systems, and subsystems.

M. Mechanical/Electrical Functional Testing: Testing performed to confirm general performance of mechanical and electrical systems. Hydrostatic leak testing of pipes is an example. Electrical testing specified in Division 26, Electrical, shall be considered Mechanical/Electrical Functional Testing.

N. Performance Test: A defined test of a system, systems or facility over a specified period of time to demonstrate the system or facility is fully operational and meets all specifications, performance objectives and Contract requirements. Performance testing will be done with clean water and wastewater, as defined with these Contract Documents.

O. Operational Readiness Test Part 1, See Section 40 90 00, Instrumentation and Control.

P. Operational Readiness Test Part 2, See Section 40 90 00, Instrumentation and Control.

Q. Process Instrumentation and Control (PIC): Computer-based system whose purpose is to control and supervise the overall Facility operation. See Section 40 90 00, Instrumentation and Control.

R. Startup: The act of starting or operating a component, subsystem or system and testing its functionality and performance against defined metrics.

S. Subsystems: A group of related equipment that performs a defined function and is an element of a larger system.

T. Substantial Completion: Refer to Contract requirements and Supplementary Provisions.

U. Systems: A group of related components, equipment, or subsystems that perform a defined function or set of functions within a facility.

V. Training: Classroom and equipment area instruction by Manufacturer or Manufacturer accepted representative intended to educate the Owner on the proper operation and maintenance of components, systems, and subsystems.

W. Unit Process: Portion of the facility that performs a specific process function, such as influent pumping, screening and grit removal, chemical feed, blowers, membrane system, and plant water.

3. SUBMITTALS

A. Action Submittals:

1. Startup Management Plan: Submitted within 60 days after Notice to Proceed.
2. Overall Facility Startup Plan.
3. Acceptance Test Plans.
4. Startup Schedule:
    a. Schedule shall be a snapshot of the overall Project Schedule.
    b. Schedule may not be a separate schedule from overall Project Schedule.
    c. Schedule shall be submitted in hard copy and electronic version.
5. Startup Results Submittal:
    a. Include the following:
        1) Completed test plans (endorsed by Construction Manager and Contractor).
        2) Record of all Training:
            a) Training requests.
            b) Agendas.
            c) Sign in sheets.
            d) Handouts.
            e) Electronic copy of all training presentations.
        3) Record of all Manufacturer Services/Inspections.
        4) Record of all testing not covered above.

4. organization of startup phases

A. The following table summarizes the various phases of startup:

| Description | Duration | Preceding Constraints | Comments |
|---|---|---|---|
| Submittals | As required to meet testing schedule | | |
| Mechanical/Electrical Functional Testing and Equipment Testing | As required to meet testing schedule for individual unit process | Complete all FATs<br>Complete equipment and piping installation<br>Approved submittals required prior to testing (including O&Ms) | Includes hydrostatic testing |
| PIC Operational Readiness Test Part 1 | As required to meet testing schedule | Manufacturer's installation assistance and inspection<br>Approved submittals required prior to testing (including O&Ms) | |
| PIC Operational Readiness Test Part 2 | As required to meet testing schedule | Completion of PICS Operational Readiness Test Part 1<br>Completion of staging site demonstration test and loading of application software<br>Approved submittals required prior to testing (including O&Ms) | |
| Functional Testing on Unit Processes and Auxiliary Systems | As required to meet testing schedule | Completion of PIC Operational Readiness Test Part 2<br>Approved submittals required prior to testing (including O&Ms) | |
| Training | As specified | Completion of all functional and performance testing | |

| Description | Duration | Preceding Constraints | Comments |
|---|---|---|---|
| Facility Commissioning | As required | Completion of Functional Testing of Unit Processes and Auxiliary Systems | |
| Facility Acceptance Test | 30 days | Completion of commissioning of the unit processes and facilities<br>Manufacturer's CPI<br>Training<br>Approved submittals required prior to testing (including O&Ms) | |

5. contractor startup personnel

A. Contractor shall provide personnel, both supervisory and from the applicable trades, who are experienced in startup, testing, and commissioning for the execution of the Work described in these Contract Documents.

6. THE STARTUP MANAGEMENT PLAN

A. The Startup Manager shall conduct a startup coordination workshop and prepare and submit a Startup Management Plan that describes how Contractor will accomplish the minimum scope of services and manage the daily startup activities. The coordination workshop shall, at a minimum, include the Contractor's Startup Manager, Project Integrator, and Project Superintendent. The requirements for Startup requirements for the Work will be reviewed at the workshop. The Startup Management Plan shall be prepared immediately following the workshop and shall include a detailed description, including procedures and examples of how the Startup Team will manage the interface between Contractor's trades, Contractor's management, Contractor's subcontractors, Contractor's PLC programmers, Construction Manager's field team, Owner, and the DCSP programming team. The workshop shall be conducted within 4 weeks of Notice to Proceed. The draft Startup Management Plan shall be completed and submitted within 4 weeks of the startup coordination workshop. The plan will be reviewed and processed for acceptance in accordance with Section 01 33 00, Submittal Procedures.

7. THE STARTUP AND TEST PLANS

A. The Contractor will develop specific plans for the testing of all elements of the Facility. These plans shall outline the detailed sequence of activities necessary to confirm the proper operation of every component, system, and subsystem.

B. Test plans will be prepared for each phase of startup where testing is required including, but not limited to the following:

1. Manufacturer's installation inspection.
2. Mechanical/electrical functional testing.
3. Operational Readiness Test Part 1.
4. Operational Readiness Test Part 2.
5. Functional testing on unit processes and auxiliary systems.
6. Equipment performance testing.
7. Facility commissioning.
8. Facility acceptance test.

C. Test plans will be developed as described below:

1. The Overall Startup Plan shall include six main sections arranged as follows:
    a. Overall Startup Plan Summary.
    b. Operational Readiness Testing.
    c. Functional and Performance Testing.
    d. Commissioning and Acceptance Testing.
    e. Startup Schedule.
2. The contents and requirements pertaining to each section are described below. It is expected that each section could require multiple volumes, depending on the size and complexity of the Work.
3. Overall Startup Plan Summary:
    a. The Overall Startup Plan Summary is the master startup plan document. It includes a brief summary of all testing and startup activities and provides the basic organization of the startup and testing program. It shall be submitted in advance of any other test plans except for Factory Acceptance Test Plans as described herein.
    b. The Overall Startup Plan Summary shall include the following:
        1) Introduction with a narrative description of the overall testing and startup program planned for implementation by the Contractor. Tables and flowcharts in addition to those described below should be included to clearly illustrate the Contractor's intent for the testing and startup program.
        2) List of major Acceptance Test Plan categories. At a minimum, a separate acceptance test plan shall be prepared for the following four categories:
            a) All PIC and DCS testing specified in Division 40, Process Integration, of the Specifications and

including all related testing referring to Division 40 from other specification sections and divisions.

b) All electrical testing specified in Division 26, Electrical, of the Specifications and including all related testing referring to Division 26, Electrical, from other specification sections and divisions.

c) All hydrostatic testing of piping and appurtenances, pipelines, aqueducts, valves, water holding structures, pressure vessels, tanks, and any other component, subsystem, or system specified to be hydrostatic or pressure tested.

d) Unless otherwise indicated in the Contract Documents, all other testing.

c. In addition to the breakdown listed above, the Contractor may propose to further divide, or group, the testing into categories assigned by process area or physical site delineation. However, said division or grouping must be agreed to, in writing, by the Construction Manager prior to the initial submittal of the Overall Startup Plan Summary. The Construction Manager will be the sole judge as to the acceptability of the additional division or grouping of testing proposed by the Contractor.

1) Complete listing of component, subsystem, and system tests within each Test Plan category. Special focus should be placed on a complete listing of tests for all major equipment items and all auxiliary systems identified in the Contract Document. In any case, all components, sub-systems, and systems and their associated testing shall be included in the listing.

2) Flowchart the full testing program from initial shakedown through Acceptance Testing, and ending at Substantial Completion. The flowchart shall demonstrate the precedence, or order, by which the testing will take place. The order of testing shall be such that it is consistent with the requirements of the Contract Documents.

3) Provide a preliminary schedule illustrating the timeline associated with the flowchart described above. This schedule does not need to be CPM based as it will be replaced with schedules developed according to requirements stated below for the Startup Schedule.

D. Contractor shall execute these test plans with the witnessing of the Construction Manager and/or Design Engineer and/or Owner.

E. For startup and testing purposes, the following designations are made:

1. Main Unit Processes:
   a. 27 – Electro-Dialysis Reversal Facility.

b. 29 – Ozone and BAC Filter Facility.

2. Auxiliary Systems:
   a. Main Piping: Appurtenant instruments, devices, valves, and piping.
   b. Building Systems (all structures, as applicable):
      1) Utility water – potable.
      2) Nonpotable water utility piping.
      3) Lighting.
      4) Miscellaneous instruments and devices (i.e., flood switches).
   c. Electrical service.
   d. Corrosion Control: Coating materials.
   e. Water Quality Instrumentation.

F. Contractor shall submit the completed test reports as part of the Startup Results Submittal.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

1. GENERAL STARTUP AND TESTING REQUIREMENTS

A. Contractor is responsible for the complete testing, check out, startup, and commissioning of all elements of the Facility. Verify these activities through daily inspection reports, test records/reports, onsite vendor certifications, specified testing, and by other appropriate means. Startup and Testing Plans and Test Reports shall include specific language to demonstrate that the requirements stated herein are planned, executed, and accomplished. The requirements below are complementary to those indicated elsewhere in the Contract Documents.

B. Design Engineer and Construction Manager shall be solely responsible for determining the party responsible for conducting any and all corrective actions and for determining the party responsible for any and all delays.

C. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.

D. Owner will:

1. Provide water, power, chemicals, and other items as required for startup, unless otherwise indicated.
2. Operate process units and facility with support of Contractor.
3. Provide labor and materials as required for laboratory analyses.

2. Manufacturer’s Installation Inspection

A. When Contractor has completed installation of components, systems, or subsystems, they shall schedule a manufacturer inspection. This manufacturer or approved manufacturer's representative shall certify that the component, system, or subsystem is properly installed and that testing of the component, system, or subsystem may commence.

B. Preparation:

1. Complete installation before testing.
2. Furnish qualified manufacturers' representatives, when required by individual Specification sections.
3. Obtain and submit from equipment manufacturer's representative Manufacturer's Certificate of Proper Installation Form, in accordance with Section 01 43 33, Manufacturers' Field Services, when required by individual Specification sections.
4. Cleaning and Checking:
    a. Prior to beginning functional testing:
        1) Calibrate testing equipment in accordance with manufacturer's instructions.
        2) Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
        3) Lubricate equipment in accordance with manufacturer's instructions.
        4) Turn rotating equipment by hand when possible to confirm that equipment is not bound.
        5) Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
        6) Check power supply to electric-powered equipment for correct voltage.
        7) Adjust clearances and torque.
        8) Test piping for leaks.
5. Ready-to-test determination will be by Design Engineer and Construction Manager based at least on the following:
    a. Acceptable Operation and Maintenance Data.
    b. Notification by Contractor of equipment readiness for testing.
    c. Receipt of Manufacturer's Certificate of Proper Installation, if so specified.
    d. Adequate completion of work adjacent to, or interfacing with, equipment to be tested, including Membrane Equipment System.
    e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
    f. Satisfactory fulfillment of other specified manufacturer's responsibilities.
    g. Equipment and electrical tagging complete.
    h. Delivery of all spare parts and special tools.

3. <u>Mechanical/Electrical Functional Testing</u>

A. After each mechanical system is completely installed, the Contractor shall confirm proper installation according to these Contract Documents. Mechanical system testing shall include, but not be limited to the following system types:

1. Piping (buried and exposed).
2. Freestanding tanks.

B. After the complete installation of electrical systems (or portions thereof), the Contractor shall conduct all testing, including the independent electrical testing, as specified in Division 26, Electrical.

4. Operational Readiness Test Part 1

A. The Operational Readiness Test Part 1 shall be performed by the Process Instrumentation and Control (PIC) Integrator to test and document the PIC, excluding DCSP provided applications software, is ready for operation. This test is fully described in Division 40, Process Interconnections.

B. This work shall consist of manual verification of controls, verification of instrument calibration, and the completion of all loop checks.

5. Operational Readiness Test Part 2

A. The Operational Readiness Test Part 2 shall be a coordinated effort between the Contractor, PIC System Integrator, and DCSP to confirm the PIC, including the applications software is ready for operation. This testing is described in Division 40, Process Interconnections.

6. functional testing on unit processes

A. Functional Testing shall include successful completion of all specified testing and related work required by the Contract Documents. Successful Functional Testing will demonstrate that all portions of the unit processes or auxiliary systems are functional, operational, installed as specified, and perform their intended function.

B. Demonstration of the ability of all portions of the facilities to successfully operate, as specified, over their full range of capacity or capability is required as part of Functional Testing. Functional Testing shall include all balancing, adjustments, specified tests (both factory and field), tuning, and startup activities not included in Performance Testing.

C. Functional testing shall be performed using the process flow stream intended to be used for the given unit process.

D. Functional Testing shall include testing of all specified shutdown conditions, failure conditions, pumping station power fail and restart, bypass conditions, and failure resets. Functional Testing shall include all equipment testing for

operating parameters. Functional Testing shall not be considered complete until all testing produces successful results and all documentation of tests and all manufacturer's certifications required by the Contract Documents are submitted and accepted by the Construction Manager. Functional Testing shall be successfully completed prior to conducting and Performance Testing or Facility Commissioning.

E. Equipment Testing shall be conducted as part of Functional Testing.

1. Furnish the services of an experienced and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedules (excluding manually-operated valves smaller than 24 inches in size, injectors, tanks, batch-type disc meters, rotameters, and other minor items of equipment specifically exempted by the Design Engineer or Construction Manager in writing), who shall visit the Site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, arrange to have the supplier or manufacturer's representative revisit the Site as often as necessary until any and all trouble is corrected and the equipment installation and operation are satisfactory to the Construction Manager.
2. Contractor shall require that each manufacturer's representative furnish to the Construction Manager a written report addressed to the City certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, and has been operated satisfactorily over its full range of capability and under full-load conditions.
3. Contractor shall require that the electrical and/or instrumentation subcontractor and the adjustable speed drive supplier furnish a written and signed report to the Construction Manager certifying that the motor control logic for the equipment items that reside in motor control centers, control panels, control boards, microprocessors, computers, and the like furnished by the electrical and/or instrumentation Subcontractor have been properly tested and calibrated. The report shall certify that the control logic for equipment startup, shutdown, sequencing, resets, interlocks, and emergency shutdown has been tested and is properly operating. The Contractor shall also sign said certification.

7. <u>Equipment performance testing</u>

A. Testing specified within specific equipment specifications to verify performance requirements of a piece of equipment.

B. This testing shall be performed by the equipment supplier with support from the Contractor.

C. The method for testing to validate the performance requirements shall be provided in submitted and approved test plan submittals.

8. facility COMMISSIONING

A. Facility Commissioning Testing:

1. The disciplined and systematic process of assuring that all components, subsystems, and systems of a constructed unit are designed, installed, tested and operated in conformance with the design intent, and functional intent and operational requirements of the Owner.
2. Notify Construction Manager, Design Engineer, and Owner in writing at least 10 days prior to scheduled date of test.
3. Commissioning shall not commence until equipment has been accepted by Construction Manager and Design Engineer as having satisfied performance test requirements specified.
4. Type of fluid, gas, or solid for testing shall be as specified.
5. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking samples and performance measurements.
6. Prepare Test Reports summarizing test method and results.
7. When, in Construction Manager's and Design Engineer's opinion, the integrated facility operates as specified and is accepted as to conforming to Contract requirements. Such acceptance will be evidenced by Construction Manager's and Design Engineer's signature on Facility Commissioning Report.

9. training

A. All components, systems, or subsystems require separate training by the manufacturer.

B. Training for each component, system, or subsystem shall be a minimum of 4 hours if no specific requirements are described in the individual specification sections.

C. All training shall be requested at least 14 days in advance of proposed training date.

1. Proposed training shall be requested by the Contractor in an acceptable format including the following information as a minimum:
   a. Description of training.
   b. Name and contact information of trainer.
   c. Location of training.
   d. Proposed date.
   e. Alternative dates (if applicable).
   f. Proposed start time.

g. Proposed duration.
h. Proposed detailed agenda including topics, times, breaks, etc.

D. All training shall be scheduled through the Construction Manager.

E. If suitable training facilities are not available at the Facility, Contractor shall arrange and pay for training offsite.

10. Facility acceptance Test

A. The Facility Acceptance Test shall be a 30-day operational run of the completed systems demonstrating that all portions of the facility operate continuously as intended.

B. All aspects of the Work and all Project facilities must be functional and operate in automatic mode 24 hours per day, 7 days per week during the acceptance test at varying flow rates established by the Construction Manager.

C. Unless indicated otherwise, if any item fails or malfunctions during the test, the item shall be repaired and the test restarted at time zero with no credit given for the operating time before the aforementioned failure or malfunction. Malfunctions meeting all of the following conditions, in the opinion of the Owner/Construction Manager, will not be considered grounds for restarting the test at time zero:

1. Malfunctions that do not cause any interruption of the continuous operation of any other components, subsystems, systems, and equipment during the acceptance test.
2. Malfunctions that are corrected without causing or requiring any components, subsystems, systems, and equipment to cease operations during the acceptance.
3. Malfunctions that are corrected properly and permanently, in the opinion of the Owner and Construction Manager, within 4 hours of the time the malfunction is detected (the 4-hour period includes the time required to locate the cause of the malfunction and shall begin upon Contractor's notification from the Construction Manager that a malfunction exists and shall end when the item is corrected and the system is successfully placed back into operation).

D. Time lost during the test for equipment repairs, wiring corrections, control point settings, or other reasons that are not determined by the Construction Manager to be grounds to restart the test shall be justifiable cause for extending the test duration by an amount of time equal to the time required to repair the problems.

E. Operation of the system for the acceptance test shall be conducted on a schedule or plan of operations developed by the Contractor. The Contractor

shall provide personnel to operate the Work and support said testing activities to be performed jointly with the Construction Manager in accordance with a test plan prepared by the Contractor.

F. During the test, furnish the services of authorized representatives of the manufacturers, in addition to those services required in support of other testing, as necessary, to correct faulty equipment operation, calibration, adjustment, or related flaws.

G. Contractor's acceptance test personnel shall include qualified representatives for the electrical and instrumentation crews as indicated for Acceptance Testing.

H. The Contractor's warrantee period.

11. WITNESSING AND SUPERINTENDENCE

A. The Design Engineer, Owner, Construction Manager, and others as necessary shall be allowed to witness all testing conducted during any phase of startup.

B. The Contractor shall maintain overall superintendence of the Work during all phases of startup.

C. The Contractor shall promptly and permanently repair damage to any portion of the Work during startup and testing.

1. All repair work shall be performed by the manufacturer or with manufacturer's approved published methods.

D. The Contractor shall perform all scheduled maintenance in strict compliance with manufacturers' published procedures and with products acceptable to manufacturers.

E. Authorized representatives of equipment suppliers or manufacturers shall certify that all corrective actions for all defects, malfunctions, faulty equipment operation, calibration, adjustment, or related flaws are complete and acceptable.

F. The Contractor shall keep on 24-hour local standby and provide all crews, materials, and equipment required to repair, replace adjust, balance, modify and provide other services as may be required to immediately correct all failures or malfunctions of any kind.

END OF SECTION

PURE WATER PROGRAM
FOR
THE CITY OF SAN DIEGO, CALIFORNIA

# BIDDING REQUIREMENTS
# AND
# CONTRACT DOCUMENTS

for the construction of the

## NCWRP EXPANSION AND NCPWF
## INFLUENT PUMP STATION AND PIPELINE

## PACKAGE 4

## EARLY SITE WORK AND OZONE/BAC RELOCATION

VOLUME 2
SPECIFICATIONS
DIVISIONS 02 THROUGH 30

****

*Issued for Construction*

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CH2M HILL
San Diego, CA
September 2018

Project No. 684476

**SECTION 00 01 07**
**SEALS PAGE**

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SPECIFICATIONS


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**END OF SECTION**

# SECTION 02 41 00
# DEMOLITION

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): Guideline K, Containers for Recovered Non-flammable Fluorocarbon Refrigerants.
2. American National Standards Institute (ANSI): A10.6, Safety Requirements for Demolition Operations.
3. Environmental Protection Agency (EPA), U.S. Code of Federal Regulations (CFR), Title 40:
   a. Part 61—National Emission Standards for Hazardous Air Pollutants.
   b. Part 82—Protection of Stratospheric Ozone.
   c. Part 273—Standards for Universal Waste Management.
4. Occupational Safety and Health Administration (OSHA), U.S. Code of Federal Regulations (CFR) Title 29 Part 1926—Occupational Safety and Health Regulations for Construction.

### 1.02 DEFINITIONS

A. ACM: Asbestos-containing material.

B. Demolition: Dismantling, razing, destroying, or wrecking of any fixed building or structure or any part thereof. Demolition also includes removal of pipes, manholes tanks, conduit, and other underground facilities, whether as a separate activity or in conjunction with construction of new facilities.

C. Modify: Provide all necessary material and labor to modify an existing item to the condition indicated or specified.

D. Relocate: Remove, protect, clean and reinstall equipment, including electrical, instrumentation, and all ancillary components required to make the equipment fully functional, to the new location identified on Drawings.

E. Renovation: Altering a facility or one or more facility components in any way.

F. Salvage/Salvageable: Remove and deliver, to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property to remain that of Owner. Unless otherwise specified, title to items identified for demolition shall revert to Contractor.

G. Universal Waste Lamp: In accordance with 40 CFR 273, the bulb or tube portion of an electric lighting device, examples of which include, but are not limited to, fluorescent, high-intensity discharge, neon, mercury vapor, high-pressure sodium, and metal halide lamps.

H. Universal Waste Thermostat: A temperature control device that contains metallic mercury in an ampule attached to a bimetal sensing element, and mercury-containing ampules that have been removed from these temperature control devices in compliance with the requirements of 40 CFR 273.

1.03 SUBMITTALS

A. Informational Submittals:

1. Submit proposed Demolition/Renovation Plan, in accordance with requirements specified herein, for approval before such Work is started.
2. Submit copies of any notifications, authorizations, and permits required to perform the Work.
3. Copies of reports and other documentation required for abandoning wells.

1.04 REGULATORY AND SAFETY REQUIREMENTS

A. When applicable, demolition Work shall be accomplished in strict accordance with 29 CFR 1926-Subpart T.

B. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the General Conditions, Contractor's safety requirements shall conform to ANSI A10.6.

C. Furnish timely notification of this demolition project to applicable federal, state, regional, and local authorities in accordance with 40 CFR 61-Subpart M.

1.05 DEMOLITION/RENOVATION PLAN

A. Demolition/Renovation Plan shall provide for safe conduct of the Work and shall include:

1. Detailed description of methods and equipment to be used for each operation.

2. The Contractor's planned sequence of operations, including coordination with other work in progress.
3. Disconnection schedule of utility services.

1.06 SEQUENCING AND SCHEDULING

A. The Work of this Specification shall not commence until Contractor's Demolition/Renovation Plan has been approved by the Design Engineer.

B. Include the Work of this Specification in the progress schedule, as specified in Section 01 32 00, Construction Progress Documentation.

C. Certain demolition services are constrained by ongoing plant operations and the sequence of Work. Stage demolition in accordance with sequencing constraints indicated in Section 01 31 13, Project Coordination.

1.07 USE OF EXPLOSIVES

A. Prohibited.

1.08 ENVIRONMENTAL PROTECTION

A. Preconstruction nesting survey required prior to vegetation removal between February 1 and September 15.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

3.01 EXISTING FACILITIES TO BE DEMOLISHED OR RENOVATED

A. Facilities:

1. Buildings and adjacent designated areas scheduled for complete demolition are as shown.
2. Portions of buildings and other areas scheduled for selective demolition, partial demolition, and renovation Work are as shown.

B. Structures:

1. Existing abovegrade structures indicated shall be removed to grade.
2. Sidewalks, curbs, gutters, and street light bases shall be removed as indicated.

C. Utilities and Related Equipment:

1. Notify Owner or appropriate utilities to turn off affected services at least 48 hours before starting demolition activities.
2. Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by Design Engineer.
3. When utility lines are encountered that are not indicated on Drawings, notify Construction Manager prior to further work in that area.
4. Reroute any existing utilities that must remain in service per Drawings.
5. Remove meters and related equipment and deliver to a location as determined by the Construction Manager.
6. Excavate and remove utility lines serving buildings to be demolished to a minimum distance of 5 feet beyond the outside perimeter of the demolition and as required for excavation.
7. Provide a permanent leak-proof closure for water and gas lines.
8. Plug abandoned sewer lines with concrete slurry to prevent groundwater infiltration.

D. Paving and Slabs:

1. Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated on Drawings.
2. Provide neat sawcuts at limits of pavement removal as indicated.

E. Concrete:

1. Core drill corners of new opening to avoid overcutting adjacent reinforcing in existing concrete to remain. Saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished Work, and the remaining concrete is sound.
2. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Repair exposed rebar ends and embeds as shown on Drawings.
3. Where new concrete adjoins existing concrete, thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 3/16 inch. Rebar and small embeds at existing concrete may be required to be left to engage new concrete. Saturate surface with water for 24 hours prior to placing new concrete. The new Work shall tie into the existing construction as shown on Drawings.

F. Patching:

1. Where removals leave holes and damaged surfaces exposed in the finished Work, patch and repair to match adjacent finished surfaces as to texture and finish.
2. Where new Work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new Work.
3. Patching shall be as specified and indicated, and shall include: Fill holes and depressions left as a result of removals in existing concrete walls with an approved patching material, applied in accordance with the manufacturer's printed instructions.

G. Air-Conditioning Equipment: Remove air-conditioning equipment without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990.

H. Electrical:

1. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 3/4 inch below final finished surface.
2. When removing designated equipment, conduit and wiring may require rework to maintain service to other equipment.
3. Rework existing circuits, or provide temporary circuits as necessary during renovation to maintain service to existing lighting and equipment not scheduled to be renovated. Existing equipment and circuiting shown are based upon limited field surveys. Verify existing conditions, make all necessary adjustments, and record the Work on Record Drawings. This shall include, but is not limited to, swapping and other adjustments to branch circuits and relocation of branch circuit breakers within panelboards as required to accomplish the finished work.
4. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated.
5. Raceways and cabling not scheduled for reuse.
6. Inaccessibly Concealed: Cut off and abandon in place.
7. Exposed or Concealed Above Accessible Ceilings: Remove.
8. Raceways and Cabling Scheduled for Future Use: Cap/seal and tag.
9. Relocating Equipment: Extend existing wiring or run new wiring from the source.
10. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover plate installed.
11. Where the concealed raceway is uncovered remove raceway (or extended to new location if appropriate).
12. Provide new typewritten panelboard circuit directory cards.

I. Universal Waste Lamps and Thermostats: Manage, contain, package, and label in strict accordance with 40 CFR 273.

3.02 PROTECTION

A. Dust and Debris Control:

1. Prevent the spread of dust and debris to occupied portions of the Site and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.
2. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to vehicular traffic.

B. Traffic Control Signs: Where pedestrian and driver safety are endangered in the area of removal Work, use traffic barricades with flashing lights.

C. Existing Work:

1. Survey the Site and examine Drawings and Specifications to determine the extent of the Work before beginning any demolition or renovation.
2. Take necessary precautions to avoid damage to existing items scheduled to remain in place, to be reused, or to remain the property of Owner; any Contractor-damaged items shall be repaired or replaced as directed by Construction Manager.
3. Ensure that structural elements are not overloaded as a result of or during performance of the Work. Responsibility for additional structural elements or increasing the strength of existing structural elements as may be required as a result of any Work performed under this Contract shall be that of the Contractor. Repairs, reinforcement, or structural replacement must have Design Engineer approval.
4. Do not overload pavements to remain.

D. Trees: Protect trees within the Site that might be damaged during demolition and are indicated to be left in place, by a 6-foot-high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the Work shall be replaced in kind, as approved by the Design Engineer.

E. Facilities:

1. Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

2. Floors, roofs, walls, columns, pilasters, and other structural elements that are designed and constructed to stand without lateral support or shoring, and are determined by Contractor to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Construction Manager.
3. Protect all facility elements not scheduled for demolition.
4. Provide interior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities.

F. Protection of Personnel:

1. During demolition, continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.
2. Provide temporary barricades and other forms of protection to protect Owner's personnel and the general public from injury due to demolition Work.
3. Provide protective measures as required to provide free and safe passage of Owner's personnel and the general public to occupied portions of the site.

3.03 BURNING

A. The use of burning at the Site for the disposal of refuse and debris will not be permitted.

3.04 RELOCATIONS

A. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Clean all items to be relocated prior to reinstallation, to the satisfaction of Construction Manager. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by Construction Manager.

3.05 BACKFILL

A. Do not use demolition debris as backfill material.

B. Fill excavations, open basements, and other hazardous openings to existing ground level or foundation level of new construction in accordance with Section 31 23 23, Fill and Backfill.

## 3.06 TITLE TO MATERIALS

A. All salvaged equipment and materials will remain the property of Owner.

B. With the exception of the salvaged equipment per plan, all items designated to be removed shall become the property of Contractor.

C. Title to equipment and materials resulting from demolition is vested in the Contractor upon approval by Construction Manager of Contractor's Demolition/Renovation Plan, and the resulting authorization by Construction Manager to begin demolition.

## 3.07 DISPOSITION OF MATERIAL

A. Do not remove equipment and materials without approval of Contractor's Demolition/Renovation Plan by Design Engineer.

B. Salvage equipment and material to the maximum extent possible.

C. Remove materials and equipment that are indicated and specified to be removed by Contractor and deliver to a storage site as directed on the Site.

D. Remove salvaged items in a manner to prevent damage, and pack or crate to protect the items from damage while in storage or during shipment. Properly identify containers as to contents.

E. Repair or replace, at the discretion of Construction Manager, items damaged during removal or storage.

F. Remove salvaged items designated as the property of Owner in a manner to prevent damage, and pack or crate to protect the items from damage while in storage or during shipment. Properly identify containers as to contents.

G. Repair or replace, at the discretion of Construction Manager, items damaged during removal or storage.

H. Deliver salvaged items that are designated as the property of Owner to a storage site as directed on the Site.

I. Owner will not be responsible for the condition or loss of, or damage to, property scheduled to become Contractor's property after Construction Manager's authorization to begin demolition. Materials and equipment shall not be viewed by prospective purchasers or sold on the Site.

J. Owner will not be responsible for the condition or loss of, or damage to, such property after Construction Manager's authorization to begin demolition.

K. Store salvaged items as approved by Construction Manager and remove them from Owner's property before completion of the Contract. Materials and equipment shall not be either viewed by prospective purchasers or sold on the Site.

3.08 REUSE OF MATERIALS AND EQUIPMENT

A. Remove and store materials and equipment listed in Article Title To Materials to be reused or relocated to prevent damage, and reinstall as the Work progresses.

B. Properly store and maintain equipment and materials in same condition as when removed.

C. Store equipment and material designated to be reused in a location designated by Owner.

D. Equipment and material designated to be reused shall be cleaned, serviced, and checked for proper operability before being put back into service.

E. Construction Manager will determine condition of equipment and materials prior to removal.

3.09 SPECIALIZED SALVAGE

A. Historical Items: Remove in a manner to prevent damage.

B. Ozone Depleting Substances (ODS):

1. Class I and Class II ODS are defined in Section 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling.
2. Dispose of all Class I and Class II ODS refrigerants in accordance with the Clean Air Act Amendment of 1990.
3. Products, equipment, and appliances containing ODS in a sealed, self-contained system (e.g., residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

C. Fire Suppression Containers: Fire suppression system cylinders and canisters with electrical charges or initiators shall be deactivated prior to shipment. Also, safety caps shall be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

## 3.10 UNSALVAGEABLE MATERIAL

A. Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of offsite.

B. Combustible material shall be disposed of offsite.

C. Universal Waste Lamps and Thermostats: Dispose of in strict accordance with 40 CFR 273.

## 3.11 CLEANUP

A. Debris and rubbish shall be removed from excavations. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

**END OF SECTION**

# SECTION 03 01 33
# REPAIR OF HORIZONTAL CONCRETE SURFACES

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): T277, Standard Method of Test for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration.
2. ASTM International (ASTM):
   a. A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   b. A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   c. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   d. A706/A706M, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   e. C42/C42M, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   f. C78/C78M, Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
   g. C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
   h. C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
   i. C348, Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
   j. C469, Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression.
   k. C496/C496M, Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
   l. C666/C666M, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
   m. C779/C779M, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
   n. C882/C882M, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

o. C928/C928M, Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs.
p. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
q. C1202, Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration.
r. C1583/C1583M, Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method).
s. D638, Standard Test Method for Tensile Properties of Plastics.
t. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
u. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
v. D4259, Standard Practice for Abrading Concrete.
w. E699, Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components.

1.02 DEFINITIONS

A. Abrasive Blasting: Surface preparation method that uses compressed air intermixed with an abrasive medium to clean surface of substrate concrete, exposed steel, and steel reinforcement. Compressed air and abrasive medium is projected at high speed through a nozzle directly at the surface. Method is used to remove corrosion by-products, laitance, or other materials that may inhibit bond of repair concrete.

B. Defective Area Surface defect such as honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4-inch diameter, cracks in liquid containment structures and belowgrade habitable spaces 0.005-inch wide and wider, cracks in other structures 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances which include but are not limited to fins, form pop-outs, and other projections, and at exposed concrete which includes texture irregularities, stains, and other color variations that cannot be removed by cleaning.

C. High-Pressure Water Blasting (sometimes referred to as hydro-demolition): Uses water that may contain an abrasive medium, projected under high pressure and high velocity. Used for demolition, cutting, partial or full depth

removal, cleaning, scarifying, or roughening of concrete surfaces, or removing existing coatings, for preparation of substrate concrete surfaces.

1.03 SUBMITTALS

A. Action Submittals:

1. Product data sheets for each material supplied.
2. Drawings indicating results of sounding for hollow areas including location, size, estimated quantity, of hollow-sounding areas for each repair location.

B. Informational Submittals:

1. Repair Mortar System: Manufacturer's preparation and installation instructions.
2. Written description of equipment proposed for concrete removal and surface preparation.
3. Certificates:
   a. Manufacturer's Certificate of Compliance in accordance with Section 01 61 00, Common Product Requirements, that proposed repair mortar systems meet requirements of ASTM C928/C928M**.**
   b. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that repair mortar systems are prepackaged, shrinkage compensated, specially designed for use on horizontal surfaces that are exposed to weather mortar Manufacturer's Certificate of Proper Installation.
   c. Confirmation epoxy resin bonding agents conform to ASTM C882/C882M.
4. Statements of Qualification: Repair mortar system applicator.
5. Field and laboratory test results.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Repair Mortar System Applicator: Trained and experienced applicator endorsed by repair mortar system manufacturer.

B. Prerepair Conference:

1. Required Meeting Attendees:
   a. Contractor.
   b. Repair Subcontractor.
   c. Engineer.
2. Schedule and conduct prior to incorporation of respective products into Project. Notify Engineer of location and time.
3. Agenda shall include, but not limited to:
   a. Review of field conditions. Conduct field observations of the Work to be performed.
   b. Based on above observations, confirm material selection and make Project specific repair method recommendations.
   c. Review proposed surface preparation, material application, consolidation, finishing, curing, and protection of repair material from weather conditions.
   d. Other specified requirements requiring coordination.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package repair mortar system products in moisture-resistant bags, pails, or moisture-resistant bulk bags.

B. Deliver, store, and handle repair materials in accordance with manufacturer's printed instructions.

## PART 2 PRODUCTS

2.01 REPAIR MORTAR SYSTEM NO. 1—MAGNESIUM PHOSPHATE REPAIR MORTAR

A. One or two - component, magnesium-ammonium-phosphate concrete mortar.

B. Compressive Strength, ASTM C109/C109M modified:

1. 1 Hour: 2,000 psi minimum.
2. 3 Hours: 5,000 psi minimum.
3. 1 Day: 6,000 psi minimum.
4. 28 Days: 7,500 psi minimum.

C. Flexural Strength, ASTM C78/C78M Modified (3-inch by 4-inch by 16-inch prism) at 1 Day: 550 psi minimum.

D. Modulus of Elasticity, ASTM C469 at 7 Days: 4.18 by $10^6$ psi minimum.

E. Freeze-thaw Resistance and Resistance to Deicing Chemicals, ASTM C666/C666M, Procedure A, at 300 Cycles: 80 percent RDM minimum.

F. Sulfate Resistance, ASTM C1012/C1012M, Length Change after 52 Weeks: 0.09 percent maximum.

G. Application Temperature Range: 20 degrees F to 85 degrees F for normal weather applications Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building System, Shakopee, MN; MasterEmaco T 545.
2. Euclid Chemical Co., Cleveland, OH; Eucospeed MP.

2.02 REPAIR MORTAR SYSTEM NO. 2—HIGH EARLY STRENGTH REPAIR MORTAR

A. One or two-component, fast-setting, high early strength repair mortar.

B. Compressive Strength, ASTM C109/C109M:

1. 2 Hours: 1,500 psi minimum.
2. 1 Day: 4,500 psi minimum.
3. 7 Days: 8,000 psi minimum.
4. 28 Days: 9,000 psi minimum.

C. Flexural Strength, ASTM C348:

1. 1 Day: 850 psi minimum.
2. 7 Days: 1,000 psi minimum.
3. 28 Days: 1,100 psi minimum.

D. Modulus of Elasticity, ASTM C469:

1. 1 Day: 3.8 by $10^6$ psi minimum.
2. 28 Days: 4.5 by $10^6$ psi minimum.

E. Slant Shear Bond Strength, ASTM C882/C882M (Modified):

1. 1 Day: 2,500 psi minimum.
2. 7 Days: 2,900 psi minimum.
3. 28 Days: 3,100 psi minimum.

F. Splitting Tensile Strength, ASTM C496/C496M:

1. 1 Day: 850 psi minimum.
2. 7 Days: 1,200 psi minimum.
3. 28 Days: 1,300 psi minimum.

G. Freeze-thaw Resistance, ASTM C666/C666M, Procedure A, at 300 Cycles: 98 percent RDM.

H. Chloride Ion Permeability Based on Charge Passed, ASTM C1202 or AASHTO T277, 28 Days: 960 coulombs maximum.

I. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco T 415.
2. Euclid Chemical Co., Cleveland, OH; VersaSpeed.

2.03 REPAIR MORTAR SYSTEM NO. 3—SHRINKAGE COMPENSATED REPAIR MORTAR

A. One or two-component cement-based, flowable, shrinkage compensated repair mortar system.

B. Compressive Strength, ASTM C109/C109M:

1. 1 Day: 2,500 psi minimum.
2. 7 Days: 6,000 psi minimum.
3. 28 Days: 8,000 psi minimum.

C. Flexural Strength, ASTM C348 at 28 Days: 770 psi minimum.

D. Modulus of Elasticity, ASTM C469 at 28 Days: 5.9 by $10^6$ psi minimum.

E. Slant Shear Bond Strength, ASTM C882/C882M Modified:

1. 7 Days: 2,150 psi minimum.
2. 28 Days: 3,000 psi minimum.

F. Freeze-thaw Resistance, ASTM C666/C666M, Procedure A, at 300 Cycles: 97.0 percent RDM.

G. Chloride Ion Permeability Based on Charge Passed, ASTM C1202 at 28 Days: 650 coulombs maximum.

H. Sulfate Resistance, ASTM C1012/C1012M after 6 Months: 0.01 percent length change maximum.

I. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco S 466 CI.
2. Euclid Chemical Co., Cleveland, OH; Eucocrete Supreme.

2.04 REPAIR MORTAR SYSTEM NO. 4—METALLIC AGGREGATE REPAIR MORTAR

A. One or two-component cement-based, flowable, metallic-aggregate repair mortar system:

B. Compressive Strength, ASTM C109/C109M:

1. 1 Day: 5,000 psi minimum.
2. 7 Days: 8,800 psi minimum.
3. 28 Days: 12,000 psi minimum.

C. Abrasion Resistance, ASTM C779/C779M, Procedure A: Eight times more wear resistance than plain concrete, 0.017 inch maximum.

D. Density: 215 pound per cubic foot.

E. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; Master T 300.
2. Euclid Chemical Co. (The), Cleveland, OH; Super Euco-Top.

2.05 REPAIR MORTAR SYSTEM NO. 5—POLYMER MODIFIED REPAIR MORTAR

A. One or two-component, fast-setting, polymer modified cementitious based repair mortar system.

B. Compressive Strength, ASTM C109/C109M:

1. 1 Day: 2,500 psi minimum.
2. 7 Days: 5,000 psi minimum.
3. 28 Days: 7,000 psi minimum.

C. Flexural Strength, ASTM C348 at 28 Days: 1,500 psi minimum.

D. Slant Shear Bond Strength, ASTM C882/C882M Modified at 28 Days: 2,000 psi minimum.

E. Splitting Tensile Strength, ASTM C496/C496M at 28 Days: 600 psi minimum.

F. Abrasion Resistance Depth of Wear, ASTM C779/C779M, Procedure A, at 60 Minutes: 0.033 inch maximum.

G. Drying Shrinkage, ASTM C157/C157M Modified, at 28 Days: 0.09 percent maximum.

H. Rapid Chloride Ion Permeability Based on Charge Passed, ASTM C1202, 28 Days: Under 850 coulombs maximum.

I. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco T 310 CI.
2. Euclid Chemical Co., Cleveland, OH; Duraltop Flowable Mortar.
3. Sika Corp., Lyndhurst, NJ; Sika Top 111, 122 PLUS.

2.06 WATER

A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances, meeting federal drinking water standards, as specified in Section 03 30 00, Cast-in-Place Concrete.

2.07 REINFORCEMENT

A. Deformed Steel Reinforcement:

1. ASTM A615/A615M, Grade 60, where welding is not required.
2. ASTM A706/A706M, Grade 60, for steel reinforcement to be welded.

B. Mesh Reinforcement: Welded wire fabric flat sheets with spacing of wires and wire size in accordance with ASTM A185/A185M, wire 75 ksi minimum tensile strength per ASTM A82/A82M, and repair mortar system manufacturer’s recommendations.

## 2.08 CEMENTITIOUS BONDING AGENT AND REINFORCEMENT COATING

A. Cementitious adhesive, specifically formulated for bonding plastic portland cement concrete or mortar to hardened portland cement concrete.

1. Mixed Bonding Agent Properties:
   a. Pot Life: 75 minutes to 105 minutes.
   b. Contact Time: 24 hours.
   c. Color: Concrete gray.
2. Cured Cementitious Adhesive Properties:
   a. Splitting Tensile Strength, ASTM C496/C496M at 28 Days: 600 psi minimum.
   b. Flexural Strength, ASTM C348: 1,000 psi minimum.
   c. Slant Shear Bond Strength, ASTM C882/C882M:
      1) 2-Hour Open Time: 2,500 psi minimum.
      2) 24-Hour Open Time: 2,000 psi minimum.
3. Bonding agent shall not produce a vapor barrier.
4. Compatible with, and from same manufacturer as the, repair mortar system used.

B. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco P 124.
2. Sika Corp., Lyndhurst, NJ; Sika Armatec 110 EpoCem.
3. Euclid Chemical Co., Cleveland, OH; Dural Prep AC.

## 2.09 EPOXY BONDING AGENT

A. Two-component, moisture insensitive, 100 percent solids epoxy resin.

B. Tensile Strength, ASTM D638, at 14 Days: 4,400 psi minimum.

C. Elongation at Break, ASTM D638: 1.49 percent minimum.

D. Compressive Strength, ASTM D695, at 28 Days for Application Temperature of 73 Degrees F to 77 Degrees F: 8,000 psi minimum.

E. Bond Strength, ASTM C882/C882M, at 14 Days: 1,800 psi minimum.

F. Pot Life, at 73 Degrees F to 77 Degrees F: 75 minutes minimum.

G. Manufacturers and Products: BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco ADH 326 when ambient temperature is 73 degrees F or higher.

2.10 EVAPORATION RETARDANT

A. As specified in Section 03 39 00, Concrete Curing.

2.11 CURING COMPOUND

A. As specified in Section 03 39 00, Concrete Curing.

**PART 3 EXECUTION**

3.01 GENERAL

A. Existing Concrete Work: Repair concrete as identified in Contract Documents.

3.02 APPLICATION

A. General:

1. Repair Mortar System No. 1: Patches, joints, and overlays 1/2 inch to 3 inches thick. Return to service in 1 hour.
2. Repair Mortar System No. 2: Patches, joints, or overlays 1/2 inch to 3 inches thick. Return to service in 3 hours to 7 days.
3. Repair Mortar System No. 3: Patches, joints, or overlays 1 inch thick or greater. Return to service in 7 days or more.
4. Repair Mortar System No. 4: Heavy-duty joints or overlays 2 inches thick or greater. Return to service in 7 days or more.
5. Repair Mortar System No. 5:
   a. Patches and Overlays: 1/4 inch to 3 inches thick.
   b. Return to service for foot traffic in 4 hours; wheel traffic in 7 days.
   c. Working Time: 30 minutes at 70 degrees F.
   d. Application Temperature Range: 45 degrees F to 90 degrees F.

3.03 PREPARATION

A. Identify unsound and deteriorated concrete by sounding techniques, or as directed by Engineer. Review proposed extent of repair with Engineer.

B. Remove unsound, deteriorated, or otherwise defective areas of concrete from Work areas.

1. Use 8,000 psi minimum high-pressure water or abrasive blasting machine, as appropriate to suit Site conditions.

2. Remove concrete to abrade substrate concrete surface to a minimum amplitude roughness of 3/16 inch measured between high and low points with a 3-foot-long straightedge, in accordance with ASTM D4259.
3. For existing structures, extent of concrete removal as shown on Drawings.
4. Where final surface is required to be flush with existing adjacent surface, remove existing concrete depth as required for application of minimum thickness of repair mortar.

C. Do not use power-driven jackhammers, chipping hammers, scabblers, or scarifiers unless water blasting is not permitted or practical because of Site conditions, or may cause other damage to equipment or facilities. In such cases where chipping hammers are required, limit size of chipping hammer to 16 pounds or lighter, or use small electric chipping hammer, to reduce formation of micro-fractures in substrate concrete surface.

D. Following removal of unsound or deteriorated concrete, check substrate concrete surface by sounding techniques to identify unsound concrete remaining or resulting from use of chipping hammer.

E. Remove unsound concrete to satisfaction of Engineer.

F. Square edges of patch areas by sawing or chipping to avoid tapered shoulders or featheredges. Avoid cutting embedded steel reinforcement. Roughen polished saw-cut edge by high-pressure water blasting or abrasive blasting.

G. Remove concrete adjacent to steel reinforcement to a minimum of 1-inch clearance around steel reinforcement for application and bonding of new repair mortar to entire circumference of exposed steel reinforcement if one or more of the following surface conditions exist:

1. 50 percent or more of circumference around steel reinforcement is exposed during concrete removal.
2. 25 percent or more of circumference around steel reinforcement is exposed during concrete removal and corrosion is present to extent that more than 25 percent loss of section has occurred.
3. Otherwise evident that bond between existing concrete and steel reinforcement has been destroyed or has deteriorated as determined by Engineer.

H. Clean exposed steel reinforcement of loose rust and concrete splatter per recommendations of repair material manufacturer and in accordance with ASTM D4258.

I. Keep areas from which concrete has been removed free of dirt, dust, and water blasting waste slurry. Remove laitance and other bond inhibiting contaminates from prepared areas.

J. Preparation of Substrate Concrete Surface in Areas to Receive Repair Mortar System Nos. 1, 2, 3, and 5 Dampen repair areas at least 6 inches beyond area to receive repair mortar for at least 24 hours to provide saturated surface dry (SSD) condition without standing water at time of application of mortar, as required by and in accordance with repair mortar manufacturer's printed instructions.

K. Preparation of Substrate Concrete Surface in Areas to Receive Repair Mortar System No. 4 Repair Mortar: Dry, in accordance with material manufacturer's printed instructions.

L. Spalled Joints:

1. Saw cut edge 1 inch deep and 6 inches back from old joint.
2. Remove unsound concrete and concrete between saw cut and joint.
3. Place wood or fiber spacer to thickness of joint at joint line.

M. Overlays:

1. Square cut edges to a minimum of 1/4 inch deep.
2. Do not feather edge area.
3. Perform special preparation recommended by mortar manufacturer.

N. Collect and dispose of spent water and concrete debris from removal operations offsite in manner and location acceptable to Owner.

## 3.04 REINFORCEMENT INSTALLATION

A. Provide steel reinforcement when existing steel reinforcement is not exposed and when mortar application is more than 4 inches deep, unless otherwise shown on Drawings.

B. Replace deteriorated steel reinforcement with new steel reinforcement equivalent in cross-sectional area to original steel reinforcement**.** Weld new bars to existing where indicated. Refer to details on Drawings.

C. Fasten steel reinforcement to chairs with tie wire to prevent from moving during placement of repair mortar.

D. Lap reinforcement mesh a minimum of one mesh spacing and securely fasten mesh to mesh anchors, or to steel reinforcement fastened to mesh anchors,

with tie wire at intervals no more than 12 inches to prevent movement during application of repair mortar.

E. Coat exposed new and existing steel reinforcement with cementitious reinforcement coating at the same time as substrate concrete is coated, as specified below, per repair mortar and cementitious reinforcement coating manufacturers' printed instructions.

3.05 PROTECTION

A. If cementitious coating or bonding agent is used, protect adjacent surfaces from over application. Promptly remove bonding agent applied beyond repair area.

B. Protect adjacent surfaces, and equipment from spillage of repair mortar and dust, as applicable for repair mortar system used.

3.06 PLACEMENT

A. Repair Mortar System Nos. 1, 2, 3, and 5:

1. Remove standing and free water from prepared area.
2. Apply bond scrub coat of mortar to prepared surface in accordance with manufacturer's instructions. Do not apply more scrub coat of mortar than can be covered with repair mortar before scrub coat begins drying.
3. Immediately place mixed repair mortar into prepared area from one side to the other side.
4. Work material firmly into bottom and sides of patch to ensure a good continuous bond.
5. Level repair mortar and screed to elevation of existing concrete.
6. Finish to same texture as existing concrete around patch.
7. Repair Mortar System No. 5 screed or use self-leveling mixture to obtain a uniform and plane surface.

B. Repair Mortar System No. 4:

1. Remove free water from prepared area.
2. Apply bonding agent to prepared surface in accordance with manufacturer's instructions. Do not apply more bonding agent than can be covered with mortar before bonding agent cures, past tacky to the touch.
3. Immediately place mixed repair mortar into prepared area from one side to the other side.
4. Work material firmly into bottom and sides of patch to ensure a good continuous bond.

5. Level repair mortar and screed to elevation of existing concrete.
6. Finish to same texture as existing concrete around patch.

C. Joint Repair:

1. Remove joint spacer when repair mortar is hard enough that a pointed trowel will penetrate surface less than 1/2 inch.
2. When repair mortar is cured and ready for use, fill joint in accordance with repair mortar system manufacturer's instructions.

3.07 FINISHING

A. Spray full strength evaporation retardant on fresh concrete to prevent rapid drying during hot and windy weather.

3.08 CURING

A. Repair Mortar System No. 1:

1. No curing is required.
2. Protect from rain immediately after placing.
3. Liquid-membrane curing compounds or plastic sheeting may be used in accordance with repair mortar manufacturer's instructions to protect the surface from precipitation.
4. Never wet cure.

B. Repair Mortar System Nos. 2, 3, 4, or 5: Apply curing compound in accordance with Section 03 39 00, Concrete Curing.

3.09 FIELD QUALITY CONTROL

A. Sounding for Hollow Areas:

1. Chain drag or light hammer tap repaired areas listening for hollow sound to determine areas that have not properly bonded to substrate concrete.
2. Mark hollow areas for removal and replacement.

B. Compression Strength Test:

1. Test in accordance with ASTM C109/C109M, except modified by making samples using repair mortar.
2. Obtain production samples of mixed materials from mixer during construction for compliance with Specifications.

3. Provide minimum of three samples for each 200 square feet of mortar repair, and a minimum of three samples in total, whichever is greater for testing.
4. Record location where repair mortar is being applied at time production samples are obtained.

C. Direct Tension Bond Test:

1. In Situ Bond Testing: Perform tension bond test in accordance with ASTM C1583/C1583M.
2. Record locations on in situ bond tests on each type of applied repair mortar.

D. Testing laboratory retained by Owner will provide the following:

1. Compression Strength Test:
   a. Testing will follow a "modified" ASTM C109/C109M.
   b. A minimum of three production samples of mixed material will be obtained from each 200 square feet of mortar repair, and a minimum of three samples in total, whichever is greater, for testing at 7 days, and 28 days.
   c. Record location where repair mortar is being applied at time production samples are obtained.
2. Direct Tension Bond Test:
   a. Two core samples will be obtained and tested for each 2,000 square feet of repair work.
   b. Cores will be 2-1/2-inch or 3-inch diameter to a total depth equal to at least 2.5 times repair mortar thickness.
   c. Bond Strength of Repair Mortar to Substrate Concrete: 300 psi minimum in direct tension without failure or movement.
   d. Record locations of bond tests on each type of applied repair mortar tested.

E. Retest mortar repairs that do not meet test requirements.

F. Repair and fill holes using same repair mortar where core samples have been removed.

## 3.10 MORTAR REPAIR FAILED TEST

A. Remove and replace unacceptable Work.

B. Hollow Sounding Areas: Saw cut hollow sounding areas to a new square edge, remove unsound mortar repair. Prepare substrate surface and reapply repair mortar as specified herein above.

C. Failed Compression Strength Test: Remove affected areas of repair mortar represented by failed compression strength test results. Prepare substrate surface and reapply repair mortar as specified herein above.

D. Failed Bond Tests: Remove affected areas of repair mortar represented by failed bond test results. Prepare substrate surface and reapply repair mortar as specified herein above.

E. Retest areas where repair mortar was removed and replaced, in accordance with test requirements specified herein above.

3.11 CLEANING

A. Remove excess repair mortar materials as the Work proceeds. Remove waste materials, unsound material from concrete surfaces, material chipped from structure, and water used in preparation of repair areas, finishing, and curing, and dispose offsite at approved disposal site.

**END OF SECTION**

# SECTION 03 30 10
# STRUCTURAL REINFORCED CONCRETE

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards (latest edition) which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 301, Specifications for Structural Concrete.
   b. 318, Building Code Requirements for Structural Concrete and Commentary.
   c. 347, Guide to Formwork for Concrete.
   d. SP-66, Detailing Manual.
2. ASTM International (ASTM):
   a. A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   b. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   c. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   d. C33, Standard Specification for Concrete Aggregates.
   e. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   f. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   g. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
   h. C150, Standard Specification for Portland Cement.
   i. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
   j. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
   k. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   l. C311, Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete.
   m. C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
   n. C595, Standard Specification for Blended Hydraulic Cements.
   o. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

p. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
q. C1602/C1602M, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

3. Concrete Reinforcing Steel Institute (CRSI):
   a. Manual of Standard Practice.
   b. Recommended Practice for Placing Reinforcing Bars.
4. National Institute of Standards and Technology (NIST): Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.
5. National Ready Mixed Concrete Association (NRMCA).

1.02 DESIGN REQUIREMENTS

A. Design formwork in accordance with ACI 347 and ACI 301 to provide specified concrete finishes.

B. When high range water reducer (superplasticizer) is used in concrete mix, forms shall be designed for full hydrostatic pressure per ACI 347.

C. Limit panel deflection to 1/240th of each component span to achieve tolerances specified.

1.03 SUBMITTALS

A. Action Submittals:

1. Reinforcing steel prepared in accordance with CRSI Manual of Standard Practice and ACI SP-66 Detailing Manual:
   a. Bending lists.
   b. Placing drawings.
2. Product Data: Admixtures, premolded joint filler, curing compound, and patching materials.
3. Design Data: Complete data on the concrete mix design, including tremie concrete mix design (if required), aggregate gradations, and admixtures, in accordance with ASTM C94.

B. Informational Submittals:

1. Manufacturer’s application instructions for curing compound.
2. Ready-mix delivery tickets for each truck in accordance with ASTM C94/C94M.
3. Welding Qualification: Prior to welding, submit welder qualifications and nondestructive testing procedures in accordance with Section 05 05 23, Welding.

4. Manufacturer's Certificate of Compliance:
   a. Portland cement.
   b. Admixtures.
   c. Fly ash.
   d. Aggregates.
   e. Patching materials.

1.04 QUALITY ASSURANCE

A. Concrete: Unless otherwise specified, meet the requirements of ACI 301 and ACI 318.

B. Batch Plant: Currently certified by the National Ready Mixed Concrete Association.

C. Welder Qualifications: Certified in accordance with AWS D1.4/D1.4M.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Unload, store, and handle bars in accordance with CRSI publication "Placing Reinforcing Bars."

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not use curing compound where solvents in the curing compounds are prohibited by state or federal air quality laws.

**PART 2 PRODUCTS**

2.01 GENERAL

A. Products shall be in accordance with requirements of ACI 301 unless otherwise noted.

2.02 FORMWORK

A. Form Materials:

1. For exposed areas, use hard plastic finished plywood overlaid waterproof particle board, or steel in "new and undamaged" condition, of sufficient strength and surface smoothness to produce specified finish.
2. For unexposed areas, use new shiplap or plywood.

B. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

C. Form Ties:

1. Material: Steel.
2. Spreader Inserts:
   a. Conical or spherical type.
   b. Design to maintain positive contact with forming material.
   c. Furnish units that will leave no metal closer than 1.5 inches to concrete surface when forms, inserts, and tie ends are removed.
3. Wire ties not permitted.

2.03 CONCRETE

A. Ready-mixed: In accordance with ASTM C94/C94M, Option C.

B. Materials: Unless otherwise specified, in accordance with ACI 301.

1. Cementitious Materials:
   a. Portland Cement: ASTM C150, Type V.
2. Pozzolonic Mineral Admixture: ASTM C618, Class F. When fly ash is used, the minimum amount shall be 15 percent by weight of total cementitious materials, unless otherwise specified.
3. Aggregates: Furnish from one source.
   a. Natural Aggregates:
      1) Free from deleterious coatings and substances in accordance with ASTM C33, except as modified herein.
      2) Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
   b. Coarse Aggregate:
      1) Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
      2) Materials Passing 200 Sieve: 0.5 percent maximum.
      3) Limit deleterious substances in accordance with ASTM C33, Table 3 for exposed concrete.
   c. Fine Aggregates:
      1) Clean, sharp, natural sand.
      2) Materials Passing 200 Sieve: 4 percent maximum.
      3) Limit deleterious substances in accordance with ASTM C33, Table 1 with material finer than 200 sieve limited to 3 percent, coal and lignite limited to 0.5 percent.
   d. Mixing Water and Ice: In accordance with ASTM C1602/ C1602M, except maximum content of chloride ions shall be 500 ppm.

e. Admixtures: Furnish from one manufacturer.
   1) Characteristics: Compatible with each other and free of chlorides or other corrosive chemicals.
   2) Air-Entraining: ASTM C260.
   3) Water-Reducing: ASTM C494/C494M, Type A or Type D.
   4) Superplasticizers: ASTM C494/C494M, Type F or Type G.
   5) Fly Ash: ASTM C618, Class F.

C. Mix Design:

1. Select and proportion ingredients using trial batches; sample, cure and test concrete mix through approved independent testing laboratory in accordance with ACI 301.
2. Minimum Allowable 28-day Compressive Field Strength: 4,000 psi; when cured and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
3. Minimum Allowable 56-day Compressive Field Strength: 4,500 psi, when cured and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
4. Water-Cementitious Materials Ratio: 0.45, maximum.
5. Cementitious Content: Shall be in accordance with requirements of Table 4.1.2.9 of ACI 301.
6. Coarse Aggregate Size: 1 inch and smaller, unless noted otherwise.
7. Slump Range: 3 inches to 5 inches for concrete without superplasticizers; 4-1/2 inches to 8 inches for concrete with superplasticizers.
8. Air Content: Test in accordance with ASTM C231.
9. Water Reducers: Use in all concrete.
10. High Range Water Reducers (Superplasticizers): Use at Contractor's option.
11. Fly Ash: Use at Contractor's option. Maximum 25 percent, minimum 15 percent of total weight of fly ash plus cement.
12. Truck Mixers: For every truck, test slump of samples taken per ASTM C94/C94M. Where specified slump is more than 4 inches, and if slump tests differ by more than 2 inches, discontinue use of truck mixer unless causing condition is corrected and satisfactory performance is verified by additional slump tests.
13. Mixing: Minimum 70 and maximum 270 revolutions of mixing drum. Nonagitating equipment is not allowed.

## 2.04 REINFORCING STEEL

A. Deformed Steel Reinforcing Bars: ASTM A615/A615M, Grade 60 and ASTM A706/A706M, Grade 60, for reinforcing to be welded.

B. Welding of reinforcing bars per Section 05 05 23, Welding.

C. Fabrication: Follow CRSI Manual of Standard Practice.

2.05 ANCILLARY MATERIALS

A. Premolded Joint Filler:

1. Bituminous Type: ASTM D994 or ASTM D1751.

B. Tie Wire:

1. Black, soft-annealed 16-gauge wire.
2. Nylon-, epoxy-, or plastic-coated wire.

C. Bar Supports and Spacers:

1. Use precast concrete bar supports and side form spacers or wire bar supports over existing construction, unless noted otherwise.
2. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports.

D. Nonshrink Grout: Refer to Section 03 62 00, Grouting.

E. Tie Hole Patching:

1. Roughen surface in accordance with manufacturer's recommendation.
2. Product shall show no segregation.
3. Minimum strength at 1 day 4,000 psi.
4. Manufacturers and Products:
   a. Dayton Superior Corp., Kansas City, KS; Poly Fast LPL.
   b. Euclid Chemical Co., Cleveland, OH; Verticoat.
   c. Sika Corp., Lyndhurst, NJ; Sika Top 123 Plus.
   d. Or approved equal.

F. Curing Compound:

1. Water-based, high solids content nonyellowing curing compound meeting requirements of ASTM C309 except as noted below, or ASTM C1315.
   a. Moisture Loss: 0.40 kg per square meter per 72 hours maximum.
   b. Capable of meeting moisture retention at manufacturer's specified application rate.

2. Manufacturers and Products:
   a. BASF, Shakopee, MN; Masterkure.
   b. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
   c. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
   d. Vexcon Chemical, Inc., Philadelphia, PA; Starseal 1315.
   e. Dayton Superior; Safe Cure and Seal 30 Percent.
   f. Or approved equal.

2.06 PATCHING MATERIAL

A. Polymer-modified, cementitious based, chloride resistant, flowable, gray in color, working time of 20 minutes minimum. Provide bonding agent as recommended by manufacturer.

B. Manufacturers and Products:

1. BASF Building Systems, Shakopee, MN; MBT P&R Emaco S66 CI.
2. Sika Corp., Lyndhurst, NJ; SikaTop - Series of Products.
3. Or approved equal.

2.07 SOURCE QUALITY CONTROL

A. Cement: Test for total chloride content.

B. Fly Ash: Test in accordance with ASTM C311.

C. Batch Plant Inspection: Construction Manager shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and Subcontractors, providing products included in these Specifications.

1. Weighing Scales: Tested and certified within tolerances set forth in the NIST Handbook No. 44.
2. Batch Plant Equipment: Either semiautomatic or fully automatic in accordance with ASTM C94/C94M.

**PART 3 EXECUTION**

3.01 GENERAL

A. Execution shall be in accordance with requirements of ACI 301 unless otherwise noted.

3.02 FORMWORK

A. Form Construction:

1. Construct forms and provide smooth-form finish in accordance with ACI 301 and ACI 347.
2. Form 3/4-inch bevels at concrete edges, unless otherwise shown. Do not bevel tops of wall.
3. Make joints tight to prevent escape of mortar and to avoid formation of fins.
4. Brace as required to prevent distortion during concrete placement.
5. On exposed surfaces locate form ties in uniform pattern or as shown.
6. Construct so ties remain embedded in the member with no metal within 1 inch of concrete surface when forms, inserts, and tie ends are removed.

B. Form Removal:

1. Nonsupporting forms (walls and similar parts of Work) may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:
   a. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
   b. Curing and protection operations are maintained.
2. Remove forms with care to prevent scarring and damaging the surface.
3. Prior to form removal, provide thermal protection for concrete being placed.

3.03 PLACING REINFORCING STEEL

A. Unless otherwise specified, place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars.

B. Splices and Laps:

1. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.
2. Lap Splice Reinforcing: Per structural notes on Drawings.
3. Tie splices with 16-gauge annealed wire as specified in CRSI Standard.

3.04 PLACING CONCRETE

A. Prior to placing concrete, remove water from surface, and debris and foreign material from forms. Check reinforcing steel for proper placement and correct discrepancies.

B. Before depositing new concrete on old concrete, clean surface using sandblast or bushhammer or other mechanical means to obtain a 1/4-inch rough profile.

C. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 2 feet deep. Place within 1-1/2 hours after adding cement to mix.

D. Do not subject concrete to any procedure that will result in segregation. Three feet maximum vertical drop to final placement, when not guided with chutes or other devices to prevent segregation due to impact with reinforcing.

3.05 CONSOLIDATION

A. Vibrate concrete as follows:

1. Consolidate concrete with internal vibrators with a minimum frequency of 8,000 cycles per minute and amplitude required to consolidate being placed.
2. Apply approved vibrator at points spaced not farther apart than vibrator's effective radius.
3. Apply close enough to forms to vibrate surface effectively but not damage form surfaces.
4. Vibrate until concrete becomes uniformly plastic.
5. Vibrator must penetrate fresh placed concrete and into previous layer of fresh concrete below.

3.06 CONSTRUCTION JOINTS

A. Locate as shown or as approved.

B. Maximum Spacing Between Construction Joints: 40 feet.

3.07 PREMOLDED JOINT FILLER INSTALLATION

A. Sufficient in width to completely fill joint space where shown.

B. Drive nails approximately 1 foot 6 inches on center through filler, prior to installing, to provide anchorage embedment into concrete during concrete placement.

C. Secure premolded joint filler in forms before concrete is placed.

3.08 FINISHING

A. Exterior Slabs and Sidewalks:

1. Bull float with wood float, wood trowel, and lightly trowel with steel trowel.
2. Finish with broom to obtain nonskid surface.
3. Finish exposed edges with steel edging tool.
4. Mark sidewalks transversely at 5-foot intervals with jointing tool.

3.09 FINISHING AND PATCHING FORMED SURFACES

A. Fill form tie holes with an approved patching material.

B. Knock off projections exceeding 1/2 inch in height.

C. Leave surface with texture imparted by the forms.

D. Cut out honeycombed and defective areas.

E. Cut edges perpendicular to surface at least 1 inch deep. Do not feather edges. Soak area with water for 24 hours.

F. Patch with polymer-modified repair material. Follow manufacturer's application instructions.

G. Finish surfaces to match adjacent concrete.

H. Keep patches damp for minimum spray with curing compound to minimize shrinking.

3.10 PROTECTION AND CURING

A. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.

B. Keep concrete slabs continuously wet for a 7-day period. Intermittent wetting is not acceptable.

C. Use curing compound only where approved by Design Engineer.

D. Cure formed surfaces with curing compound applied in accordance with manufacturer's directions as soon as forms are removed and finishing is completed.

E. Remove and replace concrete damaged by freezing.

3.11 NONSHRINK GROUT

A. Refer to Section 03 62 00, Grouting.

3.12 FIELD QUALITY CONTROL

A. General:

1. Provide adequate facilities for safe storage and proper curing of concrete test cylinders onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
2. Provide concrete for testing of slump, air content, and for making cylinders from the point of discharge into forms. When concrete is pumped, Samples used shall be taken from discharge end of pump hose.
3. Evaluation will be in accordance with ACI 301 and Specifications.
4. Specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
5. Frequency of testing may be changed at discretion of Construction Manager.
6. Pumped Concrete: Take concrete samples for slump (ASTM C143/C143M) and test cylinders (ASTM C31/C31M and ASTM C39/C39M).
7. Reject concrete represented by cylinders failing to meet strength and air content specified.

B. High Range Water Reducer (Superplasticizer) Admixture Segregation Test: Test each truck prior to use on job.

1. Segregation Test Objective: Concrete with 4-inch to 8-inch slump must stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump test.
2. Test Procedure: Make slump test and check for excessive slump and observe to see if mortar or moisture flows from slumped concrete.
3. Reject concrete if mortar or moisture separates and flows out of mix.

**END OF SECTION**

# SECTION 03 62 00
# GROUTING

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C230, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
   b. C307, Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.
   c. C531, Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   d. C579, Standard Test Methods for Compressive Grout Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   e. C882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
   f. C939, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
   g. C940, Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.
   h. C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
   i. C1181, Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
   j. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

### 1.02 SUBMITTALS

A. Action Submittals:

1. Product data of grouts.
2. Proposed method for keeping existing concrete surfaces wet prior to placing nonshrink grout.
3. Forming method for fluid grout placements.
4. Curing method for grout.

B. Informational Submittals:

1. Manufacturer's Written Instructions:
   a. Adding fiber reinforcing to batching.
   b. Mixing of grout.
2. Manufacturer's proposed training schedule for grout work.
3. Manufacturer's Certificate of Compliance in accordance with Section 01 61 00, Common Product Requirements.
   a. Grout free from chlorides and other corrosion-causing chemicals.
   b. Nonshrink grout properties of Category II and Category III, verifying expansion at 3 days or 14 days will not exceed the 28-day expansion and nonshrink properties are not based on gas or gypsum expansion.
4. Manufacturer's Certificate of Proper Installation.
5. Statements of Qualification: Grout manufacturer's representative.
6. Test Reports:
   a. Test report for 24-hour evaluation of nonshrink grout.
   b. Test results and service report from demonstration and training session.
   c. Field test reports and laboratory test results for field-drawn Samples.
7. List of Contractor's equipment installation staff trained by grout manufacturer's representative in:
   a. Nonshrink grout installation and curing.
   b. Epoxy grout installation and curing.

1.03 QUALIFICATIONS

A. Grout Manufacturer's Representative: Authorized and trained representative of grout manufacturer. Minimum of two projects of similar size that has resulted in successful installation of grouts similar to those for this Project.

B. For grout suppliers not listed herein, provide completed 24-hour Evaluation of Nonshrink Grout Test Form, attached at the end of this section. Provide independent testing laboratory test results for testing conducted within last 18 months.

## PART 2 PRODUCTS

### 2.01 NONSHRINK GROUT AND EPOXY GROUT SCHEDULE

A. Furnish nonshrink grout (Category I, II, and III) and epoxy grout for applications as indicated in the following schedule:

| Application | Temperature Range | Max. Placing Time | |
|---|---|---|---|
| | 40 deg F to 100 deg F | 20 Min. | Greater Than 20 Min. |
| Blockouts for gate guides | I or II | | II |
| Precast joints | I or II | | II |
| Column baseplates single-story | I or II | | II |
| Machine bases 25 hp or less | II | II | II |
| Bases for precast wall sections | II | II | II |
| Baseplates for columns over one story | II | II | II |
| Precast base joints higher than one story | II | II | II |
| Form Tie-Through bolt openings | II | II | II |
| Machine bases 26 hp and up | III or Epoxy Grout | III or Epoxy Grout | III or Epoxy Grout |
| Baseplates and/or soleplates with vibration, thermal movement, etc. | III or Epoxy Grout | III or Epoxy Grout | III or Epoxy Grout |

### 2.02 NONSHRINK GROUT

A. Category I:

1. Nonmetallic and nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.

3. Test in accordance with ASTM C1107/C1107M:
   a. Grout shall have flowable consistency.
   b. Flowable for 15 minutes.
4. Grout shall not bleed at maximum allowed water.
5. Minimum strength of flowable grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
6. Manufacturers and Products:
   a. BASF Building System, Inc., Shakopee, MN; MasterFlow 100.
   b. Euclid Chemical Co., Cleveland, OH; NS Grout.
   c. Dayton Superior Corp., Miamisburg, OH; 1107 Advantage Grout.
   d. US MIX Co., Denver, CO; US SPEC GP Grout.
   e. Five Star Products Inc., Fairfield, CT; Five Star Grout.
   f. Or approved equal.

B. Category II:

1. Nonmetallic, nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
   a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
   b. Temperatures of 40 degrees F, 80 degrees F, and 90 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 3,500 psi at 1 day, 4,500 psi at 3 days, and 7,500 psi at 28 days.
7. Maintain fluid consistency when mixed in 1-yard to 9-yard loads in ready-mix truck.
8. Manufacturers and Products:
   a. BASF Building Systems, Inc., Shakopee, MN; MasterFlow 928.
   b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
   c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
   d. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.
   e. US MIX Co., Denver, CO; US SPEC MP Grout.
   f. Or approved equal.

C. Category III:

1. Metallic and nongas-liberating.
2. Prepackaged aggregate grout requiring only the addition of water.

3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
   a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
   b. Temperatures of 40 degrees F and 100 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 4,000 psi at 1 day, 5,000 psi at 3 days, and 9,000 psi at 28 days.
7. Maintain fluid consistency when mixed in 1-yard to 9-yard loads in ready-mix truck.
8. Manufacturers and Products:
   a. BASF Building Systems, Inc., Shakopee, MN; MasterFlow 885.
   b. Euclid Chemical Co, Cleveland, OH; Hi-Flow Metallic Grout.
   c. Or approved equal.

2.03 EPOXY GROUT

A. High-strength, nonshrink, high-temperature epoxy grouting material developed for the support of heavy equipment with vibratory loads.

B. Three-component mixture of a two-component epoxy resin system (100 percent solids) with a graded, precision aggregate blend.

C. Premeasured, prepackaged system.

D. Flowable.

E. Minimum compressive strength in accordance with ASTM C579 Method B, 9,500 psi at 75 degrees F at 7 days, 11,000 psi at post cure.

F. Maximum creep resistance in accordance with ASTM C1181 at 600 psi, 140 degrees F; 6.0 by $10^{-3}$ in/in.

G. Minimum bond strength in accordance with ASTM C882, 2,000 psi.

H. Minimum tensile strength in accordance with ASTM C307, 2,000 psi.

I. Maximum coefficient of thermal expansion in accordance with ASTM C531 at 73 degrees F to 210 degrees F, 23.0 by $10^{-6}$ in/in/degrees F.

J. Working Time: Minimum 2 hours at 50 degrees F; 1.5 hours at 70 degrees F; 50 minutes at 90 degrees F.

K. Good chemical resistance.

L. Good effective bearing area.

M. Noncorrosive.

N. Moisture insensitive.

O. Modify resin and aggregate content where recommended by epoxy grout manufacturer to provide desired epoxy grout flow properties.

P. Manufacturers and Products:

1. BASF Building System, Inc., Shakopee MN; MasterFlow 648.
2. Euclid Chemical Co., Cleveland, OH; $E^3$-G.
3. Dayton Superior Corp., Miamisburg, OH; Pro-Poxy 2000 Normal Set.
4. Five Star Products Inc., Fairfield, CT; DP Epoxy Grout.
5. Or approved equal.

## PART 3 EXECUTION

### 3.01 GROUT

A. General: Mix, place, and cure grout in accordance with grout manufacturer's representative's training instructions.

B. Epoxy Grout: Concrete slab shall be fully cured for 28 days to ensure excess water has evaporated. Test concrete surface for moisture in accordance with ASTM D4263 before epoxy grout is placed.

C. Form Tie-Through Bolt Holes: Provide nonshrink grout, Category II, fill space with dry pack dense grout hammered in with steel tool and hammer. Through-bolt holes; coordinate dry pack dense grout application with vinyl plug in Section 03 30 10, Structural Reinforced Concrete, and bonding agent in Section 03 30 10, Structural Reinforced Concrete.

D. Form Snap-Tie Hole: Fill tie hole in accordance with requirements of Section 03 30 10, Structural Reinforced Concrete.

### 3.02 GROUTING MACHINERY FOUNDATIONS

A. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.

B. Clean metal surfaces of all paint, oil, grease, loose rust, and other foreign material that will be in contact with grout.

C. Sandblast to bright metal all metal surfaces in contact with epoxy grout in accordance with manufacturer's written instructions.

D. Set machinery in position and wedge to elevation with steel wedges or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.

E. Form with watertight forms at least 2 inches higher than bottom of plate.

F. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's representative's training instructions.

G. If grout cannot be placed from one edge and flowed to the opposite edge, air vents shall be provided through the plate to prevent air entrapment.

H. Radius all corners of grout pad.

I. Install expansion joints for epoxy grout placement in accordance with manufacturer's written instructions.

3.03 TANK FOUNDATIONS

A. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.

B. Clean metal surfaces of all paint, oil, grease, loose rust, and other foreign material that will be in contact with grout.

C. Set tank in position and wedge to elevation with steel wedges or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.

D. Form with watertight forms at least 2 inches higher than bottom of plate.

E. Fill space between bottom of tank base and original concrete in accordance with manufacturer's representative's training instructions.

3.04 FIELD QUALITY CONTROL

A. General:

1. Performed by Construction Manager.
2. Perform the following quality control inspections. The grout manufacturer's representative shall accompany the Construction Manager on the first installation of each size and type of equipment.

B. Evaluation and Acceptance of Nonshrink Grout:

1. Inspect the surface preparation of concrete substrates onto which nonshrink grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.
2. Inspect preparation and application of nonshrink grout form work for conformance to the manufacturer's recommendations.
3. Conduct a final review of completed nonshrink grout installation for conformance to these Specifications.
4. Provide a flow cone and cube molds with restraining plates onsite. Continue tests during Project as demonstrated by grout manufacturer's representative.
5. Perform flow cone and bleed tests, and make three 2-inch by 2-inch cubes for each 25 cubic feet of each type of nonshrink grout used. Use restraining caps for cube molds in accordance with ASTM C1107/ C1107M.
6. For large grout applications, make three additional cubes and one more flow cone test. Include bleed test for each additional 25 cubic feet of nonshrink grout placed.
7. Consistency: As specified in Article Nonshrink Grout. Flow cone test in accordance with ASTM C939. Grout with consistencies outside range requirements shall be rejected.
8. Segregation: As specified in Article Nonshrink Grout. Grout when aggregate separates shall be rejected.
9. Nonshrink grout cubes shall test equal to or greater than minimum strength specified.
10. Strength Test Failures: Nonshrink grout work failing strength tests shall be removed and replaced.
11. Perform bleeding test in accordance with ASTM C940 to demonstrate grout will not bleed.
12. Store cubes at 70 degrees F.
13. Independent testing laboratory shall prepare, store, cure, and test cubes in accordance with ASTM C1107/C1107M.
14. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

C. Evaluation and Acceptance of Epoxy Grout:

1. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.

2. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.
3. Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.
4. Inspect the epoxy-primed metallic substrate for coverage and adhesion.
5. Inspect preparation and application of epoxy grout form work for conformance to the manufacturer's recommendation.
6. Verify consistency obtained is sufficient for the proper field placement at the installed temperatures.
7. Inspect and record that the "pot life" of epoxy grout materials is not exceeded during the installation.
8. Inspect epoxy grout for cure.
9. Inspect and record that localized repairs made to grout voids are in conformance with the specification requirements.
10. Conduct a final review of completed epoxy grout installation for conformance to these Specifications.
11. Compression tests and fabrication of specimens for epoxy grout shall be made in accordance to ASTM C579, Method B, at intervals during construction as selected by the Project representative. A set of three specimens shall be made for testing at 7 days, and each earlier time period as appropriate.
12. Independent testing laboratory shall prepare, store, cure, and test cubes in accordance with ASTM C579.
13. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

## 3.05 MANUFACTURER'S SERVICES

A. General:

1. Coordinate demonstrations, training sessions, and applicable Site visits with grout manufacturer's representative. Allow 2-week notice to grout manufacturer's representative for scheduling purposes.
2. Provide and conduct onsite demonstration and training sessions for bleed tests, mixing, flow cone measurement, cube testing, application, and curing for each category and type of grout.
3. Necessary equipment and materials shall be available for demonstration.
4. Conduct training prior to equipment mount installation work on equipment pads.
5. Training for each type of grout shall be not less than 4 hours' duration.

B. Nonshrink Grout Training:

1. Training is required for all Type II and Type III grout installations.
2. Provide nonshrink grout installation training by the qualified grout manufacturer's representative for Contractor's workers that will be installing nonshrink grout for baseplates and equipment mounts. Schedule training to allow Construction Manager's attendance.
3. Mix nonshrink grouts to required consistency, test, place, and cure on actual Project, such as, baseplates and form tie-through bolt holes to provide actual on-the-job training.
4. Use minimum of two bags for each grout Category II and Category III. Mix grout to fluid consistency and conduct flow cone and two bleed tests, make a minimum of six cubes for testing of two cubes at 1 day, 3 days, and 28 days. Use remaining grout for final Work.
5. Include recommended grout curing methods in the training.
6. Mix and demonstrate patching through-bolt holes and blockouts for gate guides, and similar items.
7. Transport test cubes to independent test laboratory and obtain test reports.
8. Training by manufacturer's representative does not relieve Contractor of overall responsibility for this portion of the work.
9. Submit a list of attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

C. Epoxy Grout Training:

1. Provide epoxy grout installation training by the qualified epoxy grout manufacturer's representative for Contractor's workers that will be installing epoxy grout for equipment mounts. Schedule training to allow Construction Manager's attendance.
2. Include training in:
   a. Performance testing such as compressive strength testing of the epoxy grout.
   b. All aspects of using the products, from mixing to application.
3. Transport test cubes to independent test laboratory and obtain test reports.
4. Training by manufacturer's representative does not relieve Contractor of overall responsibility for this portion of the work.
5. Submit a list of attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

3.06 SUPPLEMENT

A. The supplement listed below, following "End of Section," is part of this Specification.

1. 24-Hour Evaluation of Nonshrink Grout Test Form and Grout Testing Procedures.

**END OF SECTION**

**SUPPLEMENT 1**

_____
**(Test Lab Name)**

_____
**(Address)**

_____
**(Phone No.)**

## 24-HOUR EVALUATION OF NONSHRINK GROUT TEST FORM

OBJECTIVE: Define standard set of test procedures for an independent testing laboratory to perform and complete within a 24-hour period.

SCOPE: Utilize test procedures providing 24-hour results to duplicate field grouting demands. Intent of evaluation is to establish grout manufacturer's qualifications.

PRIOR TO TEST: Obtain three bags of each type of grout.

1. From intended grout supplier for Project.
2. Three bags of grout shall be of same lot number.

ANSWER THE FOLLOWING QUESTIONS FOR GROUT BEING TESTED FROM LITERATURE, DATA, AND PRINTING ON BAG:

| | | |
|---|---|---|
| A. | Product data and warranty information contained in company literature and data? | Yes_____ No_____ |
| B. | Literature and bag information meet specified requirements? | Yes_____ No_____ |
| C. | Manufacturer guarantees grout? | Yes_____ No_____ |
| D. | Guarantee extends beyond grout replacement value and allows participation with Contractor in replacing and repairing defective areas? | Yes_____ No_____ |
| E. | Water demands and limits printed on bag? | Yes_____ No_____ |
| F. | Mixing information printed on the bag? | Yes_____ No_____ |
| G. | Temperature restrictions printed on bag? | Yes_____ No_____ |

*Rejection of a grout will occur if one or more answers are noted NO.

## GROUT TESTING PROCEDURES

A. Bagged Material:

1. List lot numbers. _____
2. List expiration date. _____
3. Weigh bags and record weight. _____

Owner's Representative will disqualify grout if bag weights have misstated measure plus or minus 2 pounds by more than one out of three bags (accuracy of weights is required to regulate amount of water used in mixing since this will affect properties).

B. Mixing and Consistency Determination:

1. Mix full bag of grout in 10-gallon pail.
2. Use electric drill with a paddle device to mix grout (jiffy or jiffler type paddle).
3. Use maximum water allowed per water requirements listed in bag instructions.
4. Mix grout to maximum time listed on bag instructions.
5. In accordance with ASTM C939 (flow cone) determine time of mixed grout through the flow cone. _____ seconds
6. Add water to attain 20- to 30-second flow in accordance with ASTM C939.
7. Record time of grout through cone at new water demand. _____ seconds
8. Record total water needed to attain 20- to 30-second flow. _____ pounds
9. Record percent of water. _____ percent

C. When fluid grout is specified and additional water is required beyond grout manufacturer's listed maximum water, ASTM C1107/C1107M will be run at new water per grout ratio to determine whether grout passes using actual water requirements to be fluid. Use new water per grout ratio on remaining tests.

D. Bleed Test:

1. Fill two gallon cans half full of freshly mixed grout at ambient temperatures for each category and at required consistency for each.
2. Place one can of grout in tub of ice water and leave one can at ambient temperature.
3. Cover top of both cans with glass or plastic plate preventing evaporation.
4. Maintain 38 degrees F to 42 degrees F temperature with grout placed in ice and maintain ambient temperature for second container for 1 hour.
5. Visually check for bleeding of water at 15-minute intervals for 2 hours.

6. Perform final observation at 24 hours.

7. If grout bleeds a small amount at temperatures specified, grout will be rejected.

E. Extended Flow Time and Segregation Test (for Category II and Category III):

1. Divide the remaining grout into two 3-gallon cans. Place the cans into the 40-degree F and 90-degree F containers and leave for 20, 40, and 60 minutes. Every 20 minutes remove and check for segregation or settlement of aggregate. Use a gloved hand to reach to the bottom of the can, if more than 1/4 inch of aggregate has settled to the bottom or aggregate has segregated into clumps, reject the grout.

2. Right after the settlement test mix the grout with the drill mixer for 10 seconds. Take a ASTM C939 flow cone test of grout and record flow time. Maintain this process for 1 hour at ambient temperatures of 40 degrees F and 90 degrees F.

   a. 20 min _____, sec. @ 40 degrees F.

   b. 40 min _____, sec. @ 40 degrees F.

   c. 60 min _____, sec. @ 40 degrees F.

   d. 20 min _____, sec. @ 90 degrees F.

   e. 40 min _____, sec. @ 90 degrees F.

   f. 60 min _____, sec. @ 90 degrees F.

All Category II and Category III grout that will not go through the flow cone with continuous flow after 60 minutes will be disqualified.

_____ _____

Qualified Disqualified

F. 24-hour Strength Test:

1. Using grout left in mixing cans in accordance with ASTM C1107/C1107M for mixing and consistency determination test and for extended time flow test, make minimum of nine cube samples.

2. Store cubes at 70 degrees F for 24 hours.

3. Record average compressive strength of nine cubes at 24 hours.

Grout will be disqualified if 24-hour compressive strengths are less than 2,500 psi for grouts claiming fluid placement capabilities.

Grouts that have not been disqualified after these tests are qualified for use on the Project for the application indicated in Nonshrink Grout Schedule.

_____ _____

Signature of Independent Testing Laboratory Date Test Conducted

# SECTION 05 05 19
# POST-INSTALLED ANCHORS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 318, Building Code Requirements for Structural Concrete.
   b. 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
   c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
2. American Iron and Steel Institute (AISI): Stainless Steel Type 316.
3. American National Standards Institute (ANSI).
4. ASTM International (ASTM):
   a. A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A143, Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   c. A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   d. A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   e. A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
   f. A380, Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   g. A385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
   h. A563, Specification for Carbon and Alloy Steel Nuts.
   i. A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   j. A967, Specification for Chemical Passivation Treatments for Stainless Steel Parts.
   k. E488, Standard Test Methods for Strength of Anchors in Concrete Elements.
   l. F436, Specification for Hardened Steel Washers.
   m. F468, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.

n. F568M, Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.
o. F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
p. F594, Specification for Stainless Steel Nuts.
q. F1554, Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

5. International Association of Plumbing and Mechanical Officials Uniform ES (IAPMO-UES): Evaluation Reports for Concrete and Masonry Anchors.
6. International Code Council Evaluation Service (ICC-ES):
   a. Evaluation Reports for Concrete and Masonry Anchors.
   b. AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
   c. AC70, Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements.
   d. AC106, Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.
   e. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
   f. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements. Evaluation Reports for Concrete and Masonry Anchors.
7. Specialty Steel Industry of North America (SSINA):
   a. Specifications for Stainless Steel.
   b. Design Guidelines for the Selection and Use of Stainless Steel.
   c. Stainless Steel Fabrication.
   d. Stainless Steel Fasteners.

## 1.02 DEFINITIONS

A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.

B. Exterior Area: Location not protected from weather by a building or other enclosed structure to include buried roof structures.

C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or wash down, and where wall or roof slab is not common to a water-holding or earth-retaining structure.

D. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or wash down, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

E. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling, or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

B. Informational Submittals:

1. Concrete Anchors:
   a. Manufacturer's product description and installation instructions.
   b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.
2. Passivation method for stainless steel members.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program or equivalent.
2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package stainless steel items in a manner to provide protection from carbon impregnation.

B. Protect hot-dip galvanized finishes from damage as a result of metal banding and rough handling.

## PART 2 PRODUCTS

2.01 GENERAL

A. Unless otherwise indicated, meet the following requirements:

| Item | ASTM Reference |
|---|---|
| Stainless Steel: | |
| Threaded Rods | F593, AISI Type 316, Condition CW |
| Nuts* | F594, AISI Type 316, Condition CW |
| Carbon Steel: | |
| Threaded Rods | F1554, Grade 36 or F568M Class 5.8 |
| Flat and Beveled Washers (Hardened) | F436 |
| Nuts* | A194/A194M, Grade 2H |
| Galvanized Steel: | |
| All | A153/A153M |
| *Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod. | |

B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, and zinc-plated steel material types as indicated in Fastener Schedule at end of this section.

2.02 POST-INSTALLED CONCRETE ANCHORS

A. General:

1. AISI Type 316 stainless, hot-dip galvanized or zinc-plated steel, as shown in Fastener Schedule at end of this section.
2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind and earthquake.
3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.

B. Torque-Controlled Expansion Anchors (Wedge Anchors):

1. Manufacturers and Products:
   a. Hilti, Inc., Tulsa, OK; Kwik-Bolt –TZ (KB-TZ) Anchors (ESR-1917).
   b. DeWalt/Powers Fasteners, Brewster, NY; Power-Stud +SD1, +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818).
   c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-1771 and ESR-3037).
   d. Or approved equal.

C. Undercut Anchors:

1. Manufacturers and Products:
   a. USP Structural Connectors, Burnsville, MN; DUC Undercut Anchor (ESR-1970).
   b. Hilti, Inc., Tulsa, OK; HDA Undercut Anchor (ESR-1546).
   c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; TORQ-CUT Self-Undercutting Anchor (ESR-2705).
   d. DeWalt/Powers Fasteners, Brewster, NY; Atomic+ Undercut Anchor (ESR-3067).
   e. Or approved equal.

D. Self-Tapping Concrete Screw Anchors:

1. Manufacturers and Products:
   a. DeWalt/Powers Fasteners, Brewster, NY; Wedge-Bolt+ (ESR-2526).
   b. DeWalt/Powers Fasteners, Brewster, NY; Vertigo+ Rod Hanger Screw Anchor (ESR-2989).
   c. DeWalt/Powers Fasteners, Brewster, NY; Snake+ Flush Mount Screw Anchor (ESR-2272).
   d. Hilti, Inc., Tulsa, OK; HUS-EZ Screw Anchor (ESR-3027).
   e. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Titen HD Screw Anchor (ESR-2713).
   f. Or approved equal.

E. Adhesive Anchors:

1. Threaded Rod:
   a. Diameter as shown on Drawings.
   b. Length as required to provide minimum depth of embedment indicated and thread projection required.
   c. Clean and free of grease, oil, or other deleterious material.

2. Adhesive:
   a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
   b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
3. Packaging and Storage:
   a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
   b. Store adhesive on pallets or shelving in a covered storage area.
   c. Package Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
   d. Dispose of When:
      1) Shelf life has expired.
      2) Stored other than in accordance with manufacturer's instructions.
4. Manufacturers and Products:
   a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT RE 500 V3 (ESR-3814), or HIT-HY 200 (ESR-3187).
   b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-XP Epoxy Adhesive Anchors (ESR-2508), or AT-XP Adhesive Anchors (IAPMO UES-263).
   c. DeWalt/Powers Fasteners, Brewster NY; Pure 110+ Epoxy adhesive anchor system (ESR-3298).
   d. Or approved equal.

F. Adhesive Threaded Inserts:

1. Type 316 stainless steel, internally threaded inserts.
2. Manufacturer and Product:
   a. Hilti, Inc., Tulsa, OK; HIS-RN Insert with HIT-RE 500-V3 or HIT-HY 200 adhesive.
   b. Or approved equal.

## PART 3 EXECUTION

### 3.01 CONCRETE ANCHORS

A. Begin installation only after concrete to receive anchors has attained design strength.

B. Locate existing reinforcing with Ground Penetrating Radar or other method approved by Construction Manager prior to drilling. Coordinate with

Construction Manager to adjust anchor locations where installation would result in hitting reinforcing.

C. Install in accordance with written manufacturer's instructions.

D. Provide minimum embedment, edge distance, and spacing as indicated on Drawings.

E. Use only drill type and bit type and diameter recommended by anchor manufacturer.

F. Clean hole of debris and dust per manufacturer's requirements.

G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer's installation instructions to clear obstruction, notify Design Engineer for direction on how to proceed.

H. Adhesive Anchors:

1. Unless otherwise approved by Design Engineer and adhesive manufacturer:
   a. Do not install adhesive anchors when temperature of concrete is below 40 degrees F or above 100 degrees F.
   b. Do not install prior to concrete attaining an age of 21 days.
   c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
   d. Do not disturb anchor during recommended curing time.
   e. Do not exceed maximum torque as specified in manufacturer's instructions.

I. Prestressed Concrete: Do not use drilled-in anchors in prestressed or post-tensioned concrete members without Design Engineer's prior approval unless specifically shown on Drawings.

## 3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.03 MANUFACTURER'S SERVICES

A. Adhesive and Mechanical Anchors: Conduct Site training of installation personnel for proper installation, handling, and storage of adhesive anchor system. Notify Construction Manager of time and place for sessions.

3.04 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

| **Service Use and Location** | **Product** | **Remarks** |
|---|---|---|
| 1. Post-Installed Anchors for Metal Components to Cast-in-Place Concrete (such as, Ladders, Handrail Posts, Electrical Panels, Platforms, and Equipment) | | |
| Submerged, Exterior, Interior Wet, and Corrosive Areas | Stainless steel adhesive anchors | Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application |
| 2. All Others | | |
| All service uses and locations | Stainless steel fasteners | |

B. Antiseizing Lubricant: Use on all stainless steel threads.

C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

**END OF SECTION**

# SECTION 05 05 23
# WELDING

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
   a. BPVC SEC V, Nondestructive Examination.
   b. BPVC SEC IX, Welding and Brazing Qualifications.
2. American Society of Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
3. ASTM International (ASTM): A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
4. American Welding Society (AWS):
   a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   b. A3.0, Standard Welding Terms and Definitions.
   c. D1.1/D1.1M, Structural Welding Code - Steel.
   d. D1.2/D1.2M, Structural Welding Code - Aluminum.
   e. D1.3/1.3M, Structural Welding Code - Sheet Steel.
   f. D1.4/D1.4M, Structural Welding Code - Reinforcing Steel.
   g. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
   h. D1.8/D1.8M, Structural Welding Code - Seismic Supplement.
   i. QC1, Standard for AWS Certification of Welding Inspectors.

### 1.02 DEFINITIONS

A. CJP: Complete Joint Penetration.

B. CWI: Certified Welding Inspector.

1. Contractor's Welding Inspector: Contractor's CWI acts for, and on behalf of, the Contractor for all inspection and quality matters within the scope of the Contract Documents. Contractor is required to provide a welding inspector to oversee welding operations and be responsible for visual inspection and necessary correction of all deficiencies in materials and workmanship required to meet referenced welding codes. This type of Quality Control Inspection is not classified as Special Inspection.

2. Verification Inspector: CWI who acts on behalf of the Owner and is part of the Construction Manager's team. This type of independent inspection and testing is the prerogative of the Owner, who may perform this function, or waive independent verification inspection if it is not required by the building official and building code.

C. MT: Magnetic Particle Testing.

D. NDE: Nondestructive Examination.

E. NDT: Nondestructive Testing.

F. PJP: Partial Joint Penetration.

G. PQR: Procedure Qualification Record.

H. PT: Liquid Penetrant Testing.

I. Special Inspection: Nondestructive examination exclusive of VT. Special inspection includes NDE such as MT, PT, UT, RT, and Verification Inspection. Special Inspection personnel report to and are retained by the Owner. See additional requirements in Section 01 45 33, Special Inspection, Observation, and Testing.

J. RT: Radiographic Testing.

K. UT: Ultrasonic Testing.

L. VT: Visual Inspection/Testing.

M. WPQ: Welder/Welding Operator Performance Qualification Record.

N. WPS: Welding Procedure Specification.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Shop and field WPSs and PQRs.
   b. NDT procedure specifications prepared in accordance with ASME BPVC SEC V.

c. Welding Data (Shop and Field): Submit welding data together with Shop Drawings as a complete package.
   1) Show on Shop Drawings, or on a weld map, complete information regarding base metal specification designation, location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tails of combined welding and NDE symbols as indicated in AWS A2.4.
   2) Clearly distinguish between shop and field welds.
   3) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
   4) Welding and NDE Symbols: In accordance with AWS A2.4.
   5) Welding Terms and Definitions: In accordance with AWS A3.0.

B. Informational Submittals:

1. WPQs.
2. CWI credentials.
3. Testing agency personnel credentials.
4. CWI visual inspection (VT) reports.
5. Welding Documentation: Submit on forms in referenced welding codes.

1.04 QUALIFICATIONS

A. WPSs: In accordance with AWS D1.1/D1.1M (Annex M Forms) for shop or field welding; or ASME BPVC SEC IX (Forms QW-482 and QW-483) for shop welding only.

B. WPQs: In accordance with AWS D1.1/D1.1M (Annex M Forms); or ASME BPVC SEC IX (Form QW-484).

C. CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require prior approval by Construction Manager.

D. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

1.05 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, Submittals required in this section shall be submitted and approved prior to commencement of welding operations.

## PART 2 PRODUCTS

### 2.01 SOURCE QUALITY CONTROL

A. Fabricator's CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:

1. Verifying conformance of specified job material and proper storage.
2. Monitoring conformance with approved WPS.
3. Monitoring conformance of WPQ.
4. Inspecting weld joint fit-up and performing in-process inspection.
5. Providing 100 percent visual inspection of welds.
6. Coordinating with nondestructive testing personnel and reviewing NDE test results.
7. Maintaining records and preparing reports documenting that results of CWI VT and subsequent NDE testing comply with the Work and referenced welding codes.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

### 3.02 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Quality Control Inspection:

1. All Welds: 100 percent VT by Contractor's CWI.
2. Acceptance Criteria:
   a. Structural Pipe and Tubing: AWS D1.1/D1.1M, Paragraph 9.25.
   b. All Other Structural Steel: AWS D1.1/D1.1M, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
   c. Stud Connections: AWS D1.1/D1.1M, Paragraph 7.8.1.

B. Nondestructive Testing Requirements:

1. NDT frequency shall be as specified below, as required by referenced welding codes, or as specified in the attached table. In case there is a conflict, the higher frequency level of NDT shall apply.
   a. Nontubular Connections:
      1) CJP Butt Joint Groove Welds: 10 percent random RT. Use UT for CJP butt joint groove welds that cannot be readily radiographed.
      2) All Other CJP Groove Welds: 10 percent random UT.
      3) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
   b. Tubular Connections:
      1) CJP butt joint groove welds made from one side without backing: 100 percent RT or UT in accordance with AWS D1.1/D1.1M, Paragraph 9.26.2 requirements.
      2) CJP Butt Joint Groove Welds made without backing or back-gouging: 10 percent random RT. Use UT for CJP butt joint groove welds that cannot be readily radiographed.
      3) All Other CJP Groove Welds: 10 percent random UT.
      4) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
2. NDT Procedures and Acceptance Criteria:
   a. Nontubular Connections:
      1) RT: Perform in accordance with AWS D1.1/D1.1M, Clause 6, Part E. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 6.12.1.
      2) UT: Perform in accordance with AWS D1.1/D1.1M, Clause 6, Part F. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 6.13.1.
      3) PT and MT:
         a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.14.4, and Paragraph 6.14.5.
         b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
   b. Tubular Connections:
      1) RT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 9, Paragraph 9.28 and Paragraph 9.29.
      2) UT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 9, Paragraph 9.27.

3) PT and MT:
   a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.14.4 and Paragraph 6.14.5.
   b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 9.25.

3.03 FIELD QUALITY CONTROL

A. Contractor's CWI shall be present whenever field welding is performed. CWI shall perform inspection, at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:

1. Verify conformance of specified job material and proper storage.
2. Monitor conformance with approved WPS.
3. Monitor conformance of WPQ.
4. Inspect weld joint fit-up and perform in-process inspection.
5. Provide 100 percent visual inspection of all welds in accordance with Paragraph Quality Control Inspection.
6. Supervise nondestructive testing personnel and evaluating test results.
7. Maintain records and prepare report confirming results of inspection and testing comply with the Work.

3.04 WELD DEFECT REPAIR

A. Repair and retest rejectable weld defects until sound weld metal has been deposited in accordance with appropriate welding codes.

3.05 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification:

1. Welding and Nondestructive Testing Table.

**END OF SECTION**

| WELDING AND NONDESTRUCTIVE TESTING | | | | | | |
|---|---|---|---|---|---|---|
| **Specification Section** | **Governing Welding Codes or Standards** | **Submit WPS** | **Submit WPQ** | **Onsite CWI Req'd** | **Submit Written NDT Procedure Specifications** | **NDT Requirements** |
| 03 30 10 Structural Reinforced Concrete --- Steel Reinforcement Welding | AWS D1.4/D1.4M, Structural Welding Code - Reinforcing Steel | Yes | Yes | Yes | Yes | 100% VT and 100% MT of all rebar splices; also see Section 03 30 10 |
| 05 50 00 Metal Fabrications | AWS D1.1/D1.1M, Structural Welding Code–Steel or AWS D1.2/D1.2M, Structural Welding Code - Aluminum or AWS D1.6/D1.6M, Structural Welding Code - Stainless Steel | Yes | Yes | Yes | No | 100% VT; also see Section 05 50 00 |
| 05 52 16 Aluminum Railings | AWS D1.2/D1.2M, Structural Welding Code - Aluminum | No | No | No | No | 100% VT; also see Section 05 52 16, Aluminum Railings |

# SECTION 05 50 00
# METAL FABRICATIONS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. The Aluminum Association, Inc. (AA): The Aluminum Design Manual.
2. American Galvanizers Association (AGA):
   a. Inspection of Hot-Dip Galvanized Steel Products.
   b. Quality Assurance Manual.
3. American Iron and Steel Institute (AISI): Stainless Steel Types.
4. American Ladder Institute (ALI): A14.3, Ladders - Fixed - Safety Requirements.
5. American National Standards Institute (ANSI).
6. American Society of Safety Engineers (ASSE): A10.11, Safety Requirements for Personnel and Debris Nets.
7. American Welding Society (AWS):
   a. D1.1/D1.1M, Structural Welding Code - Steel.
   b. D1.2/D1.2M, Structural Welding Code - Aluminum.
   c. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
8. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48/A48M, Specification for Gray Iron Castings.
   c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   d. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   e. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   f. A143/A143M, Standard for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

j. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
k. A276, Standard Specification for Stainless Steel Bars and Shapes.
l. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
m. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
n. A325, Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
o. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
p. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
q. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
r. A489, Standard Specification for Carbon Steel Lifting Eyes.
s. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
t. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
u. A563, Standard Specification for Carbon and Alloy Steel Nuts.
v. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
w. A780/A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
x. A786/A786M, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
y. A793, Standard Specification for Rolled Floor Plate, Stainless Steel.
z. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
aa. A992/A992M, Standard Specification for Structural Steel Shapes.
bb. A1085, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
dd. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
ee. B429/B429M, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

ff. B632/B632M, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
gg. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
hh. D1056, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
ii. F436, Standard Specification for Hardened Steel Washers.
jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ll. F594, Standard Specification for Stainless Steel Nuts.
mm. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
nn. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

9. Occupational Safety and Health Administration (OSHA):
   a. 29 CFR 1910.27, Fixed Ladders.
   b. 29 CFR 1926.105, Safety Nets.
   c. 29 CFR 1926.502, Fall Protection Systems Criteria and Practices.
10. Specialty Steel Industry of North America (SSINA):
   a. Specifications for Stainless Steel.
   b. Design Guidelines for the Selection and Use of Stainless Steel.
   c. Stainless Steel Fabrication.
   d. Stainless Steel Fasteners.

1.02 DEFINITIONS

A. Anchor Bolt: Cast-in-place anchor; concrete or masonry.

B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals. Corrosive area includes areas exposed to corrosive atmosphere such as hydrogen sulfide from wastewater.

C. Exterior Area: Location not protected from weather by building or other enclosed structure.

D. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.

E. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

F. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Metal fabrications, including welding and fastener information.
2. Samples: Color samples of abrasive stair nosings.

B. Informational Submittals:

1. Pre-engineered Ladders: Letter of certification that ladder meets OSHA 29 CFR 1910.27 requirements.
2. Passivation method for stainless steel members.
3. Galvanized coating applicator qualifications.
4. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer, with description of material processed and ASTM standard used for coating.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Insofar as practical, factory assemble specified items. Package assemblies, which have to be shipped unassembled to protect materials from damage and tag to facilitate identification and field assembly.

B. Package stainless steel items to provide protection from carbon impregnation.

C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.

D. Store fabricated items in dry area, not in direct contact with ground.

## PART 2 PRODUCTS

2.01 GENERAL

A. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit the combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon (such as plates over 1.5 inches thick for ASTM A36/A36M steel), limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.

B. All aluminum components shall be anodized.

C. Unless otherwise indicated, meet the following requirements:

| Item | ASTM Reference |
|---|---|
| Steel Wide Flange Shapes | A992/992M |
| Other Steel Shapes and Plates | A36/A36M or A572/A572M, Grade 50 or A992/A992M for other steel shapes |
| Steel Pipe | A500, Grade B |
| Hollow Structural Sections (HSS) | A500/A500M, Grade C |
| Aluminum: | |
| Aluminum Plates | B209, Alloy 6061-T6 |
| Aluminum Structural Shapes | B308/B308M, Alloy 6061-T6 |
| Stainless Steel: | |
| Bars and Angles | A276, AISI Type 316 (316L for welded connections) |
| Shapes | A276, AISI Type 304 (304L for welded connections) |
| Steel Plate, Sheet, and Strip | A240/A240M, AISI Type 316 (316L for welded connections) |
| Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs | F593, AISI Type 316, Group 2, Condition SH |
| Nuts | F594, AISI Type 316, Condition CW |
| Steel Bolts and Nuts: | |
| Carbon Steel | A307 bolts, with A563 nuts |

| Item | ASTM Reference |
|---|---|
| High-Strength | A325, Type 1 bolts, with A563 nuts |
| Anchor Bolts and Rods | F1554, Grade 55, with weldability Supplement S1 |
| Eyebolts | A489 |
| Threaded Rods | A36/A36M |
| Flat Washers (Unhardened) | F844 |
| Flat and Beveled Washers (Hardened) | F436 |
| Thrust Ties for Steel Pipe: | |
| Threaded Rods | A193/A193M, Grade B7 |
| Nuts | A194/A194M, Grade 2H |
| Plate | A283/A283M, Grade D |
| Welded Anchor Studs | A108, Grades C-1010 through C-1020 |
| Aluminum Bolts and Nuts | F468, Alloy 2024-T4 |
| Cast Iron | A48/A48M, Class 35 |

D. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

A. Cast-In-Place Anchor Bolts:

1. Headed type, unless otherwise shown on Drawings.
2. Material type and protective coating as shown in Fastener Schedule at end of this section.

B. Anchor Bolt Sleeves:

1. Plastic:
   a. Single unit construction with corrugated sleeve.
   b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
   c. Material: High-density polyethylene.
2. Fabricated Steel: ASTM A36/A36M.

2.03 EMBEDDED STEEL SUPPORT FRAMES FOR GRATING

A. Steel angle support frames to be embedded in concrete shall be stainless steel, ASTM A276, AISI Type 316, unless indicated otherwise.

B. Welded anchors for stainless steel support frames shall also be stainless steel.

2.04 SIDEWALK DOORS

A. Load Capacity: 300 psf with maximum deflection of 1/150th of span. Provide H-20 wheel loading capacity where indicated on Drawings.

B. Component Fabrication:

1. Access Door Leaf(s): 1/4-inch aluminum diamond pattern plate. Provide stainless steel safety chain and attachments for end of double-leaf door assembly when open.
2. Channel Frame: 1/4-inch-thick extruded aluminum trough frame with continuous anchor flange around perimeter. Weld 1-1/2-inch diameter drain coupling, and drain pipe, to frame trough at front right corner, unless indicated otherwise on Drawings.
3. Safety Grate: Aluminum grating with 300 psf live load capacity, 5-inch by 5-inch grate openings, permanent hinging system that locks grate in 90-degree position, and opening arm with vinyl grip handle and locking device.

C. Door Hardware:

1. Hinges: Heavy-duty brass or stainless steel with stainless steel pins through-bolted to cover plate with tamper-proof stainless steel bolts flush with top of cover and to outside leg of channel frame with stainless steel bolts and locknuts.
2. Lifting Mechanism: Stainless steel compression lift springs enclosed in telescoping vertical housing or stainless steel torsion lift springs.
3. Hold-Open Arm:
   a. Locks automatically in open position.
   b. Disengages with slight pull on vinyl grip with one hand.
   c. Door can be easily closed with one hand by pulling forward and down on vinyl grip.
4. Snap Lock:
   a. Stainless steel snap lock mounted on bottom of door leaf with removable topside key wrench and inside fixed lever handle.
   b. Threaded plug for flush outside surface with key wrench removed.

D. Aluminum: Mill finished with protective coating applied to surfaces to be in contact with concrete, as specified in Section 09 90 00, Painting and Coating.

E. Manufacturers and Products:

1. Bilco Co., New Haven, CT; J Series.
2. Nystrom Products Co., Minneapolis, MN; FG Series.
3. U.S.F. Fabrication, Hialeah, FL; T Series.
4. ITT Flygt Corporation, Trumbull, CT; FDRN Series.
5. Thompson Fabricating Co., Birmingham, AL; TE Series.
6. Halliday Products, Orlando, FL; WS Series.
7. Or approved equal.

## 2.05 HATCH SAFETY NET

A. General:

1. Conforms to ASSE A10.11 and OSHA CFR Part 1926.105.
2. Size to fit hatch opening where indicated.

B. Components and Accessories:

1. Rails and Slide Rings: Aluminum 6061-T6 extruded rails and aluminum-alloy 713.0 slide rings.
2. Corner Hooks and Eyebolts: AISI Type 316 stainless steel.
3. Netting: Polyester, 5-inch by 5-inch net openings; 5,000 pounds minimum breaking strength.
4. Bolts, Nuts, and Concrete Anchors: AISI Type 316 stainless steel.

C. Manufacturer and Product:

1. Safe Approach Inc., Auburn, ME; Hatch Net 121.
2. Or approved equal.

## 2.06 LADDERS

A. Fabricate ladders with rails, rungs, landings, and cages to meet applicable requirements of OSHA, CFR Part 1910.27, and ALI A14.3.

1. Design ladder for concentrated load of 200 pounds imposed by user concentrated at points that will cause maximum stress in structural member being considered.
2. Include weight of ladder and attached appurtenances together with live load in design of rails and fastenings.
3. Self-closing gates at landings.

B. Flat Bar Ladder:

1. Punch rails, pass rungs through rails, and weld on outside.
2. Weld brackets to ladder for fastening ladder to wall.
3. Hot-dip galvanize steel after fabrication in accordance with ASTM A123/A123M and ASTM A385/A385M.
4. ASTM A276, AISI Type 316L stainless steel.

C. Aluminum Pre-engineered Pipe Ladder:

1. Rungs:
   a. Aluminum extrusions of Alloy 6063-T6.
   b. Nonslip grip surface, 1-inch wide flat top, and semicircular bottom with mill finish.
   c. Diamondback, finish to match rails, as manufactured by:
      1) Alcoa Building Products, Inc., Sidney, OH.
      2) Or approved equal.
2. Side Rails: ASTM B429/B429M, Alloy 6063-T6, 1-1/2 inches, Schedule 40 pipe with anodized finish, AA M32-C22-A41.
3. Ladder Attachments and Cage Assembly Fasteners: Stainless steel.
4. Welded, pop riveted, or glued construction is not acceptable.
5. Fabricate to longest length as practical but not to exceed 24 feet.
6. Furnish support attachments to side rails at 6 feet maximum spacing.
7. Manufacturer:
   a. Thompson Fabricating Co. Inc., Tarrant, AL.
   b. Or approved equal.

D. Ladder Safety Post:

1. Telescoping tubular, spring balanced and automatically locking in raised position, with release lever for unlocking.
2. Post: Hot-dip galvanized steel in accordance with ASTM A123/A123M.
3. Hardware: Stainless steel, AISI Type 316.
4. Furnish dissimilar metal protective coatings at connections.
5. Manufacturer and Product:
   a. Bilco Co., New Haven, CT; “Ladder Up” to fit ladder rungs.
   b. Or approved equal.

## 2.07 ACCESSORIES

A. Antiseizing Lubricant for Stainless Steel Threaded Connections:

1. Resists washout.

2. Manufacturers and Products:
   a. Bostik, Middleton, MA; Neverseez.
   b. Saf-T-Eze Div., STL Corp., Lombard, IL; Anti-Seize.
   c. Or approved equal.

B. Neoprene Gasket:

1. ASTM D1056, 2C1, soft, closed-cell neoprene gasket material, suitable for exposure to sewage and sewage gases, unless otherwise shown on Drawings.
2. Thickness: Minimum 1/4 inch.
3. Furnish without skin coat.
4. Manufacturer and Product:
   a. Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK1111LD.
   b. Or approved equal.

## 2.08 FABRICATION

A. General:

1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical; where exposed, flush countersink.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
6. Fit and assemble in largest practical sections for delivery to Site.

B. Materials:

1. Use steel shapes, unless otherwise noted.
2. Steel to be Hot-dip Galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 percent and 0.25 percent.
3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures–Allowable Stress Design.

C. Welding:

1. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
3. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.

4. Aluminum: Meet requirements of AWS D1.2/D1.2M.
5. Stainless Steel: Meet requirements of AWS D1.6/D1.6M.
6. Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1/D1.1M, Section 7, and manufacturer's instructions.
7. Complete welding before applying finish.

D. Painting:

1. Shop prime with rust-inhibitive primer as specified in Section 09 90 00, Painting and Coating, unless otherwise indicated.
2. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
3. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

E. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385/A385M.
3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
7. Galvanized steel sheets in accordance with ASTM A653/A653M.
8. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.

F. Electrolytic Protection: Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.

G. Watertight Seal: Where required or shown, furnish neoprene gasket of a type that is satisfactory for use in contact with sewage. Cover full bearing surfaces.

H. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.

I. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.09 SOURCE QUALITY CONTROL

A. Visually inspect all fabrication welds and correct deficiencies.

1. Steel: AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
2. Aluminum: AWS D1.2/D1.2M.
3. Stainless Steel: AWS D1.6/D1.6M.

B. Hot-Dip Galvanizing:

1. An independent testing agency will be retained by Owner to inspect and test hot-dip galvanized fabricated items in accordance with ASTM A123/A123M and ASTM A153/A153M.
2. Visually inspect and test for thickness and adhesion of zinc coating for minimum of three test samples from each lot in accordance with ASTM A123/A123M and ASTM A153/A153M.
3. Reject and retest nonconforming articles in accordance with ASTM A123/A123M and ASTM A153/A153M.

## PART 3 EXECUTION

3.01 INSTALLATION OF METAL FABRICATIONS

A. General:

1. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.
2. Install rigid, substantial, and neat in appearance.
3. Install manufactured products in accordance with manufacturer’s recommendations.
4. Obtain Construction Manager’s approval prior to field cutting steel members or making adjustments not scheduled.

B. Aluminum:

1. Do not remove mill markings from concealed surfaces.
2. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.
3. Fabrication, mechanical connections, and welded construction shall be in accordance with the AA Aluminum Design Manual.

C. Pipe Sleeves:

1. Provide where pipes pass through concrete or masonry.
2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.
3. Provide center flange for water stoppage on sleeves in exterior or water-bearing walls.
4. Provide rubber caulking sealant or a modular mechanical unit to form watertight seal in annular space between pipes and sleeves.

## 3.02 CAST-IN-PLACE ANCHOR BOLTS

A. Locate and hold anchor bolts in place with templates at time concrete is placed.

B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.

C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

## 3.03 ACCESS COVERS

A. Install access covers, including sidewalk doors, floor hatches, and hinged manhole covers in accordance with manufacturer’s instructions.

B. Accurately position prior to placing concrete, such that covers are flush with floor surface.

C. Protect from damage resulting from concrete placement. Thoroughly clean exposed surfaces of concrete spillage to obtain a clean, uniform appearance.

D. Route drain pipe to exterior face of concrete or as shown on Drawings.

E. Position cover so that hinge is on side opposite ladder.

## 3.04 ELECTROLYTIC PROTECTION

A. Aluminum and Galvanized Steel:

1. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.
3. Allow coating to dry before installation of the material.
4. Protect coated surfaces during installation.
5. Should coating become marred, prepare and touch up in accordance with paint manufacturer's written instructions.

B. Stainless Steel:

1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.
3. Remove contamination using cleaning and passivation methods in accordance with requirements of ASTM A380 and ASTM A967.
4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.
5. After treatment, visually inspect surfaces for compliance.

## 3.05 PAINTING

A. Painted Galvanized Surfaces: Prepare as specified in Section 09 90 00, Painting and Coating.

B. Repair of Damaged Hot-Dip Galvanized Coating:

1. Conform to ASTM A780/A780M.
2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

C. Field Painting of Shop Primed Surfaces: Prepare surfaces and field finish in accordance with Section 09 90 00, Painting and Coating.

## 3.06 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance:

1. In accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings.
2. Contractor responsibilities and related information on special inspection, observation, and testing are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control:

1. Inspection and testing required in Section 01 45 16.13, Contractor Quality Control.
2. Manufacturer's Certificate of Compliance per Section 01 61 00, Common Product Requirements, for test results, or calculations, or drawings that ensure material and equipment design and design criteria meet requirements of Section 01 61 00, Common Product Requirements, and Section 01 88 15, Anchorage and Bracing.

## 3.07 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

| Service Use and Location | Product | Remarks |
|---|---|---|
| 1. Anchor Bolts Cast Into Concrete for Structural Steel, Metal Fabrications and Castings | | |
| Exterior and Interior Wet Areas | Stainless steel headed anchor bolts | |
| Submerged and Corrosive Areas | Stainless steel headed anchor bolts with fusion bonded coating | See Section 09 90 00, Painting and Coating |
| 2. Anchor Bolts Cast Into Concrete for Equipment Bases | | |
| Interior Dry Areas | Stainless steel headed anchor bolts, unless otherwise specified with equipment | |

| Service Use and Location | Product | Remarks |
|---|---|---|
| Exterior, Interior Wet, and Corrosive Areas | Stainless steel headed anchor bolts with fusion bonded coating, unless otherwise specified with equipment | See Section 09 90 00, Painting and Coating |
| 3. Connections for Structural Steel Framing | | |
| Exterior and Interior Wet and Dry Areas | High-strength steel bolted connections | Use hot-dipped galvanized high-strength bolted connections for galvanized steel framing members |
| 4. Connections of Aluminum Components | | |
| Submerged, Exterior and Interior Wet and Dry Areas | Stainless steel bolted connections, unless otherwise specified with equipment | |
| 5. All Others | | |
| Exterior and Interior Wet and Dry Areas | Stainless steel fasteners | |

B. Antiseizing Lubricant: Use on stainless steel threads.

**END OF SECTION**

# SECTION 05 52 16
# ALUMINUM RAILINGS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Aluminum Association: Aluminum Design Manual.
2. Aluminum Association, Incorporated (AA): DAF45, Designation System for Aluminum Finishes.
3. American Concrete Institute (ACI): 318, Building Code Requirements for Structural Concrete.
4. American Iron and Steel Institute (AISI).
5. ASTM International (ASTM):
   a. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   b. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   c. E894, Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
   d. E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
   e. E985, Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
6. California Buildings Commission: California Building Code (IBC).
7. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.

### 1.02 DEFINITIONS

A. ICC Evaluation Services Report: ICC report on evaluation of manufactured concrete anchor systems.

B. Railings: This term includes guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.

C. Special Inspection: As defined by the ICC IBC.

D. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.

1.03 DESIGN REQUIREMENTS

A. Structural Performance of Railing Systems: Design, test, fabricate, and install railings to withstand the following structural loads without exceeding allowable design working stress or allowable deflection. Apply each load to produce maximum stress and deflection in railing system components.

1. Railing System:
   a. Capable of withstanding the following load cases applied:
      1) Concentrated load of 200 pounds applied at any point and in any direction in accordance with CBC and OSHA.
      2) Uniform load of 50 pounds per linear foot applied in any direction in accordance with CBC.
      3) Concentrated load need not be assumed to act concurrently with uniform loads in accordance with CBC.
2. In-Fill Area of Railing Systems:
   a. Capable of withstanding a horizontally applied normal load of 50 pounds applied to 1 square foot at any point in system including panels, intermediate rails, balusters, and openings and space between railings.
   b. Horizontal concentrated load need not be assumed to act concurrently with loads on top rails of railings.
3. Calculated lateral deflection at top of posts shall not exceed 1 inch.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.
   b. Manufacturer’s literature and catalog data of railing and components.
   c. Design Data: Calculations or test data using specified design performance loads and including the following:
      1) Railing calculations including the connection design shall be performed based on Aluminum Design Manual.
      2) Bending stress in, and deflection of, posts in accordance with ASTM E985 as modified herein.
      3) Design of post base connection.

4) Documentation that concrete anchors have been designed in accordance with one of the following:
   a) ACI 318, Appendix D.
   b) ICC Evaluation Services Report for selected anchor.

2. Samples:
   a. Rail sections, 6 inches long showing each type of proposed connection, proposed finish, and workmanship.
   b. Each fitting including wall brackets, castings, toeboard, and rail expansion joints.

B. Informational Submittals:

1. Manufacturer's assembly and installation instructions.
2. Special Inspection: Manufacturer's instructions for Special Inspection of post-installed anchors.
3. Test Reports:
   a. Test data may supplement load calculations providing data covers complete railing system, including anchorage:
      1) Test data for railing and components showing load and deflection as a result of load, in enough detail to prove railing is strong enough and satisfies national, state, local standards, regulations, code requirements, and OSHA 29 CFR 1910, using design loads specified. Include test data for the following:
         a) Railing and post connections.
         b) Railing wall connections.
         c) Railing expansion joint connections.
         d) Railing system gate assembly, including latch, gate stop, and hinges. Both gate latch and stop to support required loads applied independent of each other.
         e) Railing picket panel clamps and connections.
      2) Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with ICC IBC.
      3) Deflection Criteria:
         a) In accordance with ASTM E985 and design loads specified, except as follows:
            (1) Maximum calculated lateral deflection at top of posts shall not exceed 1 inch.
      4) Aluminum Rail Piping: Test data showing yield strength of pipe as delivered equals or exceeds specified values.
   b. Manufacturer's written recommendations describing procedures for maintaining railings including cleaning materials, application methods, and precautions to be taken in use of cleaning materials.

1.05 QUALITY ASSURANCE

A. Qualifications: Calculations required for design data shall be stamped by a registered civil or structural engineer licensed in state where Project will be constructed.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package and wrap railings to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to the extent possible until railing is completely installed.

B. Delivery:

1. Shop assemble into practical modules of lengths not exceeding 24 feet for shipment.
2. Deliver toeboards loose for field assembly.
3. Deliver clear anodized railing pipe and posts with protective plastic wrap.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Thermal Movements: Allow for thermal movement resulting from the following maximum range in ambient temperature in design, fabrication, and installation of railings to prevent buckling, opening up of joints, over stressing of components, connections and other detrimental effects. Base design calculation on actual surface temperature of material as a result of both solar heat gain and night time sky heat loss. Temperature change is difference between high or low temperature and installation temperature.

1. Temperature Change Range: 70 degrees F, ambient; 100 degrees F, material surfaces.

**PART 2 PRODUCTS**

2.01 ALUMINUM RAILINGS

A. General:

1. Furnish pre-engineered and prefabricated railing systems as shown on Drawings.
2. Railing systems using pop rivets or glued railing construction are not permitted.
3. Sand cast accessories and components are not permitted.
4. Fasteners shall be AISI Type 304 or Type 316 stainless steel, unless otherwise noted.

B. Rails, Posts, and Formed Elbows:

1. Extruded Alloy 6105-T5, 6061-T6, or equivalent.
2. Tensile Strength: 38,000 psi, minimum.
3. Yield Strength: 35,000 psi, minimum.
4. Wall Thickness: 0.145 inch, minimum.
5. Posts and railings shall be nominal 1-1/2-inch diameter (1.90-inch outside diameter).

C. Accessories:

1. Fittings and Accessories:
   a. Extruded, machined bar stock, permanent mold castings, or die castings of sufficient strength to meet load requirements.
   b. Gauge metal components are not acceptable for load-resisting components.
   c. Fittings shall match color of pipe in railings.
2. Miscellaneous Extruded Aluminum Parts: Alloys 6063-T6, 6061-T6, or 6105 T5 aluminum, or equivalent, and of adequate strength for all loads.
3. Castings for Railings:
   a. Cast Al-mag with sufficient strength to meet load and test requirements.
   b. Anodizable grade finish with excellent resistance to corrosion when subjected to exposure of sodium chloride solution intermittent spray and immersion.
4. Post Anchorages:
   a. Refer to standard details for types of post anchorages and minimum requirements.
   b. Bolts at anchorages shall be minimum 1/2-inch diameter.
5. Wall Brackets: Adjustable wall fitting, with provision for minimum three 3/8-inch diameter AISI Type 304 or Type 316 stainless steel bolts or concrete anchors.
6. Rail Terminals (including Wall Returns): Aluminum wall fitting with provision for three 3/8-inch Type 304 fasteners.
7. Railing System Gate:
   a. Extruded aluminum rail components.
   b. Hardware Manufacturers and Products:
      1) Julius Blum & Co., Inc., Carlstadt, NJ; No. 782/3 gate hinges with springs, and No. 784 gate latch and stop.
      2) CraneVeyor Corp., South El Monte, CA; No. C4370b gate hinges with spring, No. C4369 gate latch, and No. C4368 gate stop.
      3) Moultrie Manufacturing Co., Moultrie, GA; Part No. W60006.
      4) Or approved equal.

8. Railing Picket Panels and Clamps:
   a. 1/2-inch Schedule 40 aluminum pipe (picket).
   b. Extruded aluminum 1-1/2-inch by 7/8-inch by 1/8-inch channel.
   c. Furnish neoprene plug for each end of picket.
   d. Fasteners: Stainless steel.
9. Toeboards:
   a. Molded or extruded Alloy 6063-T6 or 6061-T6 aluminum.
   b. Provide slotted holes for expansion and contraction where required.
10. Fasteners: Stainless steel.

D. Metal Supports Embedded in Concrete: In accordance with Section 05 50 00, Metal Fabrications.

E. Finishes:

1. Pipe and Post: In accordance with AA DAF45, Designation AA-M32-C22-A41.
2. Cast Fittings and Toeboards: In accordance with AA DAF45, Designation AA-M10-C22-A41.

## 2.02 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

A. Locknuts, Washers, and Screws:

1. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): AISI Type 304 or Type 316 stainless steel.
2. Flat Washers: Molded nylon.

B. Bolts and Nuts for Bolting Railing to Metal Beams: ASTM A193/A193M and ASTM A194/A194M, Type 304 or Type 316 stainless steel.

C. Concrete Anchors:

1. Stainless steel, AISI Type 304 or Type 316.
2. Post-installed anchors in accordance with Section 05 50 00, Metal Fabrications, unless otherwise specified herein.
3. Bolt Diameter: 1/2-inch, minimum.

2.03 FABRICATION

A. Shop Assembly:

1. Post Spacing: Maximum 6-foot horizontal spacing.
2. Railing Posts Bolted to Metal or Concrete:
   a. In lieu of field cutting, provide approved fitting with sufficient post overlap, containing provisions for vertical adjustment.
   b. Field fit-up is required.
3. Free of burrs, nicks, and sharp edges when fabrication is complete.
4. Welding is not permitted.

B. Shop/Factory Finishing:

1. Use same alloy for uniform appearance throughout fabrication for railings.
2. Railing and Post Fittings: Match fittings with color of pipe in railing.

C. Shop Assembly:

1. Shop assemble rails, posts, and formed elbows with a close tolerance for tight fit.
2. Fit dowels tightly inside posts.

D. Repair of Defective Work: Remove stains and replace defective Work.

**PART 3 EXECUTION**

3.01 GENERAL

A. Field fabrication of aluminum railing systems is not permitted.

B. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on actual structure.

C. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.

D. Modification to supporting structure is not permitted where railing is to be attached.

E. Mount railings only on completed walls. Do not support railings temporarily by means not satisfying structural performance requirements.

F. Protection from Entrapped Water:

1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
2. For posts mounted in concrete, bends, and elbows occurring at low points, drill weep holes of 1/4-inch diameter at lowest possible elevations, one hole per post or rail. Drill hole in plane of rail.

3.02 RAILING INSTALLATION

A. Assembly and Installation: Perform in accordance with manufacturer's written recommendations for installation.

B. Expansion Joints:

1. Maximum intervals of 54 feet on center and at structural joints.
2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
3. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.
4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.

C. Posts and Rails:

1. Surface Mounted Posts:
   a. Bolt post baseplate connectors firmly in place.
   b. Shims, wedges, grout, and similar devices for railing post alignment not permitted.
2. Grouted Posts:
   a. Clean dust and foreign matter from sleeves or blockouts.
   b. Moisten interior of hole and surrounding surface with clean water. Fill hole with nonshrink grout or epoxy grout prior to installing post.
   c. Brace railing until grout sets.
   d. Posts installed outside and exposed to freezing temperatures, drill weep hole through post approximately 1/2 inch above level of grout inside post and in plane of rail to prevent entrapment and freezing of water inside post.
3. Set posts plumb and aligned to within 1/8 inch in 12 feet.
4. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
5. Install posts and rails in same plane.
6. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.

7. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
8. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.

D. Wall Brackets: Support wall rails on brackets spaced maximum 5 feet on centers as measured on the horizontal projection.

E. Toeboard:

1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or at stairways unless shown otherwise.
2. Accurately measure in field for correct length; after railing post installation cut and secure to posts.
3. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.
4. Install plumb and aligned to within 1/8 inch in 12 feet.

F. Railing System Gate: Install in accordance with manufacturer's installation instructions.

## 3.03 FIELD FINISHING

A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces as specified in Section 09 90 00, Painting and Coating.

## 3.04 FIELD QUALITY CONTROL

A. Post-installed anchors supporting railing systems require special inspection.

B. Owner-Furnished Quality Assurance, in accordance with ICC IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

C. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

## 3.05 CLEANING

A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.

B. Do not use acid solution, steel wool, or other harsh abrasive.

C. If stain remains after washing, restore in accordance with railing manufacturer's recommendations or replace stained railings.

**END OF SECTION**

# SECTION 07 92 00
# JOINT SEALANTS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C661, Standard Test Method for Indentation Hardness of Elastomeric Type Sealants by Means of a Durometer.
   b. C834, Standard Specification for Latex Sealants.
   c. C920, Standard Specification for Elastomeric Joint Sealants.
   d. C1193, Standard Guide for Use of Joint Sealants.

### 1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Surface preparation instructions. Indicate where each product is proposed to be used.
2. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

B. Informational Submittals:

1. Installation instructions.
2. Documentation showing applicator qualifications.
3. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
4. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency, or a qualified testing agency.
5. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in Article Preconstruction Testing.
6. Field-Adhesion-Test Reports: For each sealant application tested.
7. Special guarantee.

1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Provide project experience and references installing sealants in projects of similar scope.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.04 PRECONSTRUCTION TESTING

A. Preconstruction Field-Adhesion Testing:

1. Before installing sealants, field test their adhesion to Project joint substrates as follows:
   a. Locate test joints where indicated on Project or, if not indicated, as directed by Design Engineer.
   b. Conduct field tests for each kind of sealant and joint substrate.
   c. Notify Construction Manager 7 days in advance of dates and times when test joints will be erected.
   d. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
      1) Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
         a) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   e. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
   f. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Ambient Temperature: Between 40 degrees F and 80 degrees F (4 degrees C and 27 degrees C) when sealant is applied. Consult manufacturer when sealant cannot be applied within these temperature ranges.

B. Do not proceed with installation of joint sealants under the following conditions:

1. When joint substrates are wet.
2. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
3. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.06 SPECIAL GUARANTEE

A. Product: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction or, at the option of the Owner, removal and replacement of Work specified in this section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.

B. Conditions: No adhesive or cohesive failure of sealant.

C. Sealed Joints: Watertight and weathertight with normal usage.

**PART 2 PRODUCTS**

2.01 SEALANT MATERIALS

A. Characteristics:

1. Uniform, homogeneous.
2. Free from lumps, skins, and coarse particles when mixed.
3. Nonstaining, nonbleeding.
4. Hardness of 15 minimum and 50 maximum, measured by ASTM C661 method.
5. Immersible may be substituted for nonimmersible.

6. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Color: As selected by Construction Manager.

C. Type 1—Silicone, Nonsag, Nonimmersible:

1. Silicone base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
2. Capable of withstanding movement up to 50 percent of joint width.
3. Manufacturers and Products:
   a. Dow Corning Corp.; No. 790.
   b. General Electric; Silpruf.
   c. BASF; Sonneborn, Omniseal-50.
   d. Or approved equal.

D. Type 2—Multipart Polyurethane, Self-leveling, Immersible:

1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade P, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products:
   a. BASF; Sonneborn, SL-2.
   b. Pecora Corp.; Urexspan NR-200.
   c. Tremco; THC-900/901.
   d. Sika Chemical Corp.; Sikaflex 2c SL.
   e. Or approved equal.

E. Type 3—Multipart Polyurethane, Nonsag, Immersible:

1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade NS, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products:
   a. Pecora; DynaTrol II.
   b. Tremco; Dymeric 240.
   c. BASF; Sonneborn NP-2.
   d. Sika Chemical Corp.; Sikaflex 2c NS.
   e. Or approved equal.

F. Type 4—Multipart Polyurethane, Nonsag, Nonimmersible:

1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade NS, Class 25.
2. Manufacturers and Products:
   a. BASF; Sonneborn NP-2.
   b. Pecora Corp.; Dynatrol II.
   c. Tremco; Dymeric 240.
   d. Sika Chemical Corp.; Sikaflex 2c NS.
   e. Or approved equal.

G. Type 5—One-Part Polyurethane, Immersible:

1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products for Nonsag:
   a. Sika Chemical Corp.; Sikaflex-1a.
   b. Tremco; Vulkem 116.
   c. Or approved equal.
4. Manufacturers and Products for Self-leveling:
   a. BASF; Sonneborn, SL-1.
   b. Tremco; Vulkem 45.
   c. Sika Chemical Corp.; Sikaflex 1c SL.
   d. Or approved equal.

H. Type 6—One-Part Polyurethane, Nonimmersible:

1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
2. Manufacturers and Products:
   a. Pecora Corp.; Dynatrol 1 XL.
   b. Tremco; Dymonic.
   c. BASF; Sonneborn, NP-I.
   d. Or approved equal.

I. Type 7—Multipart Polysulfide, Immersible:

1. Polysulfide base, two-component, chemical curing; ASTM C920, Type M, Grade P or NS, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products:
   a. W. R. Meadows; Deck-O-Seal Gun Grade, two-part.
   b. BASF; Sonolastic, two-part Polysulfide.
   c. Or approved equal.

J. Type 8—One-Part Polysulfide, Nonsag, Nonimmersible:

1. Polysulfide base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 12 1/2.
2. Capable of withstanding movement up to 20 percent of joint width.
3. Manufacturer and Product:
   a. W. R. Meadows; Deck-O-Seal, one-part.
   b. Or approved equal.

K. Type 11—Fire Penetration Seal:

1. Manufacturers and Products:
   a. 3M Corp.; Fire Barrier Caulk CP25 and Putty 303.
   b. General Electric; Pensil Sealant or Foam.
   c. Unifrax Corporation; Fyre Putty.
   d. Hilti USA; CP 604.
   e. Or approved equal.

L. Type 12—One-Part Polycarbonate, Immersible:

1. Polycarbonate base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturer and Product:
   a. Pro-Seal Products, Inc.; Pro-Seal 34.
   b. Or approved equal.

M. Type 13—Tape Sealant:

1. Compressible polyurethane foam impregnated with polybutylene or polymer-modified asphalt.
2. Color: Black.
3. Size: 3/4-inch-wide by length required by expanded thickness recommended by manufacturer for particular application.
4. Manufacturers and Products:
   a. Emseal Joint Systems, Ltd.; AST—High Acrylic.
   b. Dayton Superior; Polytite Standard.
   c. PARR Technologies; PARR Sealant EP-7212-T.
   d. Or approved equal.

2.02 BACKUP MATERIAL

A. Nongassing, extruded, closed-cell round polyurethane foam or polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.

B. Size: As shown or as recommended by sealant material manufacturer. Provide for joints greater than 3/16-inch wide.

C. Manufacturers and Products:

1. Sonneborn; Sonolastic Closed-cell Backing Rod.
2. Tremco; Closed-cell Backing Rod.
3. Pecora Corporation; Green Rod.
4. Or approved equal.

2.03 ANCILLARY MATERIALS

A. Bond Breaker: Pressure sensitive tape as recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Primer: Nonstaining type recommended by sealant manufacturer to suit application.

**PART 3 EXECUTION**

3.01 GENERAL

A. Use of more than one material for the same joint is not allowed unless approved by sealant manufacturer.

B. Install joint sealants in accordance with ASTM C1193.

C. Horizontal and Sloping Joints up to 1 Percent Maximum Slope: Use self-leveling (Grade P) joint sealant.

D. Steeper Sloped Joints, Vertical Joints, and Overhead Joints: Use nonsag (Grade NS) joint sealant.

E. Use joint sealant as required for the applicable application and as follows:

| Joint Size | Sealant Type |
|---|---|
| Less than 1" | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 12 |
| Less than 2" | 1, 2, 3, 4, or 7 |
| Over 2" | Follow manufacturer's recommendation |

3.02 PREPARATION

A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.

B. Surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.

1. Mask adjacent surfaces where necessary to maintain neat edge.
2. Starting of work will be construed as acceptance of subsurfaces.
3. Apply primer to dry surfaces as recommended by sealant manufacturer.

C. Verify joint shaping materials and release tapes are compatible with sealant.

D. Examine joint dimensions and size materials to achieve required width/depth ratios.

E. Follow manufacturer's instructions for mixing multi-component products.

3.03 INSTALLATION

A. Use joint filler to achieve required joint depths, to allow sealants to perform intended function.

1. Install backup material as recommended by sealant manufacturer.
2. Where possible, provide full length sections without splices; minimize number of splices.
3. Tape sealant may be used as joint filler if approved by sealant manufacturer.

B. Use bond breaker where recommended by sealant manufacturer.

C. Seal joints around window, door and louver frames, expansion joints, control joints, and elsewhere as indicated.

D. Joint Sealant Materials: Follow manufacturer's recommendation and instructions, filling joint completely from back to top, without voids.

E. Joints: Tool slightly concave after sealant is installed.

1. When tooling white or light color sealant, use a water wet tool.
2. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.

F. Tape Sealant: Compress to 50 percent of expanded thickness and install in accordance with manufacturer's instructions.

## 3.04 CLEANING AND PROTECTION

A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.

B. Replace damaged surfaces resulting from joint sealing or cleaning activities.

C. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

## 3.05 JOINT SEALANT SCHEDULE

A. This schedule lists the sealant types acceptable for each joint location. Use as few different sealant types as possible to meet the requirements of Project.

| Joint Locations | Sealant Type(s) |
|---|---|
| **Expansion/Contraction and Control Joints At:** | |
| Concrete Walls (except water-holding and belowgrade portions of structures) | 1, 3, 4, 5, 6, 7, 12 |
| Concrete Floor Slabs (except for water-holding Structures) | 2, 5 |
| Slabs Subject to Vehicle and Pedestrian Traffic | 2, 5 |
| **Material Joints At:** | |
| Metal Door, Window, and Louver Frames (Exterior) | 1, 5, 6, 8, 12 |
| Wall Penetrations (Exterior) | 1, 5, 6, 8, 12 |

| Joint Locations | Sealant Type(s) |
|---|---|
| Wall Penetrations (Interior) | 1, 5, 6, 8 |
| Floor Penetrations | 5, 6, 7 |
| Roof Penetrations | 5 |
| Sheet Metal Flashings | 5, 13 |
| Sheet Metal Roofing and Siding | 5, 13 |
| **Other Joints:** | |
| Threshold Sealant Bed | 5 |
| Openings Around Pipes, Conduits, and Ducts Through Fire-Rated Construction | 11 |
| Concrete Form Snap-Tie Holes | 1, 4, 5 |

**END OF SECTION**

# SECTION 09 90 00
# PAINTING AND COATING

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Mechanical Engineers (ASME): A13.1 – Scheme for the Identification of Piping Systems.
2. American Water Works Association (AWWA):
   a. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot-Applied.
   b. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   c. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   d. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
3. Environmental Protection Agency (EPA).
4. NACE International (NACE): SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
5. NSF International (NSF): 61, Drinking Water System Components - Health Effects.
6. Occupational Safety and Health Act (OSHA).
7. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.
8. The Society for Protective Coatings (SSPC):
   a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
   b. PA 10, Guide to Safety and Health Requirements for Industrial Painting Projects.
   c. SP 1, Solvent Cleaning.
   d. SP 2, Hand Tool Cleaning.
   e. SP 3, Power Tool Cleaning.
   f. SP 5, White Metal Blast Cleaning.
   g. SP 6, Commercial Blast Cleaning.
   h. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
   i. SP 10, Near-White Blast Cleaning.
   j. SP 11, Power Tool Cleaning to Bare Metal.
   k. SP 13, Surface Preparation of Concrete.

l. SP 16, Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
m. Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCl: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness, mils.
5. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
6. Mil: Thousandth of an inch.
7. PPDS: Paint Product Data Sheet.
8. PSDS: Paint System Data Sheet.
9. PVC: Polyvinyl Chloride.
10. SFPG: Square Feet per Gallon.
11. SFPGPC: Square Feet per Gallon per Coat.
12. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Data Sheets:
      1) For each product, furnish a Paint Product Data Sheet (PPDS), the manufacturer's technical data sheets, and paint colors available (where applicable). The PPDS form is appended to the end of this section.
      2) For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.
      3) Technical and performance information that demonstrates compliance with specification.
      4) Furnish copies of paint system submittals to the coating applicator.
      5) Indiscriminate submittal of only manufacturer's literature is not acceptable.
   b. Detailed chemical and gradation analysis for each proposed abrasive material.

2. Samples:
    a. Proposed Abrasive Materials: Minimum 5-pound sample for each type.
    b. Reference Panel:
        1) Surface Preparation:
            a) Prior to start of surface preparation, furnish a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared to specified requirements.
            b) Provide panel representative of the steel used; prevent deterioration of surface quality.
            c) Panel to be reference source for inspection upon approval by Construction Manager.
        2) Paint:
            a) Unless otherwise specified, before painting work is started, prepare minimum 8-inch by 10-inch sample with type of paint and application specified on similar substrate to which paint is to be applied.
            b) Furnish additional samples as required until colors, finishes, and textures are approved.
            c) Approved samples to be the quality standard for final finishes.

B. Informational Submittals:

1. Applicator's Qualification: List of references substantiating experience.
2. Coating manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services.
3. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
4. Manufacturer's written verification that submitted material is suitable for the intended use.
5. Coating for Faying Surfaces: Manufacturer's test results that show the proposed coating meets the slip resistance requirements of the AISC Specification for Structural Joints using ASTM A325 or ASTM A490 bolts.
6. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer's written confirmation that materials are compatible.
7. Manufacturer's written instructions and special details for applying each type of paint.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Provide project experience and references in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
2. Perform surface preparation and painting in accordance with recommendations of the following:
   a. Paint manufacturer's instructions.
   b. SSPC PA 10.
   c. Federal, state, and local agencies having jurisdiction.

C. Mockup:

1. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.
2. After Construction Manager approval, sample spaces or items shall serve as a standard for similar work throughout the Project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.
2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
2. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.

B. Provide project experience and references in manufacture of specified product.

2.02 ABRASIVE MATERIALS

A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.03 PAINT MATERIALS

A. General:

1. Manufacturer's highest quality products suitable for intended service.
2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

B. Products:

| Product | Definition |
|---|---|
| Acrylic Latex | Single-component, finish as required |
| Acrylic Latex (Flat) | Flat latex |
| Acrylic Sealer | Clear acrylic |

| Product | Definition |
|---|---|
| Alkyd (Semigloss) | Semigloss alkyd |
| Alkyd Enamel | Optimum quality, gloss or semigloss finish as required, medium long oil |
| Alkyd Wood Primer | Flat alkyd |
| Bituminous Paint | Single-component, coal-tar pitch based |
| Block Filler | Primer-sealer designed for rough masonry surfaces, 100% acrylic emulsion |
| Coal-Tar Epoxy | Amine, polyamide, or phenolic epoxy type 70% volume solids minimum, suitable for immersion service |
| DTM Acrylic Primer | Surface tolerant, direct-to-metal water borne acrylic primer |
| DTM Acrylic Finish | Surface tolerant, direct-to-metal water borne acrylic finish coat |
| Elastomeric Polyurethane | 100% solids, plural component, spray applied, high build, elastomeric polyurethane coating, suitable for the intended service |
| Epoxy Filler/Surfacer | 100% solids epoxy trowel grade filler and surfacer, nonshrinking, suitable for application to concrete and masonry. Approved for potable water contact and conforming to NSF 61, where required |
| Epoxy Nonskid (Aggregated) | Polyamidoamine or amine converted epoxies aggregated; aggregate may be packaged separately |
| Epoxy Primer—Ferrous Metal | Anticorrosive, converted epoxy primer containing rust-inhibitive pigments |
| Epoxy Primer—Other | Epoxy primer, high-build, as recommended by coating manufacturer for specific galvanized metal, copper, or nonferrous metal alloy to be coated |
| Fusion Bonded Coating | 100% solids, thermosetting, fusion bonded, dry powder epoxy, suitable for the intended service |
| TFE Lube or Grease Lube | Tetrafluoroethylene, liquid coating, or open gear grease as supplied by McMaster-Carr Supply Corporation, Elmhurst, IL |
| High Build Epoxy | Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat |

| Product | Definition |
|---|---|
| Inorganic Zinc Primer | Solvent or water based, having 85% metallic zinc content in the dry film; follow manufacturer's recommendation for topcoating |
| Latex Primer Sealer | Waterborne vinyl acrylic primer/sealer for interior gypsum board and plaster. Capable of providing uniform seal and suitable for use with specified finish coats |
| NSF Epoxy | Polyamidoamine epoxy, approved for potable water contact and conforming to NSF 61 |
| Epoxy, High Solids | Polyamidoamine epoxy, 80% volume solids, minimum, suitable for immersion service |
| Polyurethane Enamel | Two-component, aliphatic or acrylic based polyurethane; high gloss finish |
| Organic Zinc Rich Primer | Epoxy or moisture cured urethane with 85-percent zinc content in the dry film, meeting the requirements of RCSC Specification for Structural Joints using High Strength Bolts, Class A or Class B, as required |
| Rust-Inhibitive Primer | Single-package steel primers with anticorrosive pigment loading |
| Sanding Sealer | Co-polymer oil, clear, dull luster |
| Silicone/Silicone Acrylic | Elevated temperature silicone or silicone/acrylic based |
| Stain, Concrete | Acrylic, water repellant, penetrating stain |
| Stain, Wood | Satin luster, linseed oil, solid or transparent as required |
| Varnish | Nonpigmented vehicle based on a variety of resins (alkyd, phenolic, urethane) in gloss, semigloss, or flat finishes, as required |
| Water Base Epoxy | Two-component, polyamide epoxy emulsion, finish as required |

2.04 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.

3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.05 SHOP FINISHES

A. Shop Blast Cleaning: Reference Paragraph Shop Coating Requirements.

B. Surface Preparation: Provide Construction Manager minimum 7 days' advance notice to start of shop surface preparation work and coating application work.

C. Shop Coating Requirements:

1. When required by equipment specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
2. Where manufacturer's standard coating is not suitable for intended service condition, Design Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

D. Pipe:

1. Polyvinyl Chloride (PVC) and FRP Surfaces: located inside of buildings and enclosed structures will not require painting, except as noted or scheduled.

## PART 3 EXECUTION

3.01 GENERAL

A. Provide Construction Manager minimum 7 days' advance notice to start of field surface preparation work and coating application work.

B. Perform the Work only in presence of Construction Manager, unless Construction Manager grants prior approval to perform the Work in Construction Manager's absence.

C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Construction Manager.

3.02 EXAMINATION

A. Factory Finished Items:

1. Schedule inspection with Construction Manager before repairing damaged factory-finished items delivered to Site.
2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.

B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect surfaces adjacent to or downwind of Work area from overspray.

## 3.04 SURFACE PREPARATION

A. Metal Surface Preparation:

1. Where indicated, meet requirements of SSPC Specifications summarized below:
   a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
   b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
   c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.
   d. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.
   e. SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
   f. SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.
   g. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
   h. SP 11, Power Tool Cleaning to Bare Metal: Removal of visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power-assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.

i. SP 16, Brush Blasting of Nonferrous Metals: A brush-off blast cleaned nonferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. Bare metal substrates shall have a minimum profile of 19 micrometers (0.75-mil).

2. The words "solvent cleaning", "hand tool cleaning", "wire brushing", and "blast cleaning", or similar words of equal intent in these Specifications or in paint manufacturer's specification refer to the applicable SSPC Specification.
3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.
4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.
5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
7. Welds and Adjacent Areas:
   a. Prepare such that there is:
      1) No undercutting or reverse ridges on weld bead.
      2) No weld spatter on or adjacent to weld or any area to be painted.
      3) No sharp peaks or ridges along weld bead.
   b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
8. Preblast Cleaning Requirements:
   a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
   b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
   c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
9. Blast Cleaning Requirements:
   a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.

b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.
c. Use only dry blast cleaning methods.
d. Do not reuse abrasive, except for designed recyclable systems.
e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.

10. Post-Blast Cleaning and Other Cleaning Requirements:
a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

B. Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation:

1. Remove soil, cement splatter, and other surface dirt with appropriate hand or power tools.
2. Brush blast in accordance with SSPC SP-16.
3. Obtain and follow coating manufacturer's recommendations for additional preparation that may be required.

C. Plastic and FRP Surface Preparation:

1. Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system.
2. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.

## 3.05 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.

5. Construction Manager will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
6. Repair or replace surface damaged by blast cleaning.

B. Acid Etching:

1. After precleaning, spread the following solution by brush or plastic sprinkling can: One part commercial muriatic acid reduced by two parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HCl.
2. Application:
   a. Rate: Approximately 2 gallons per 100 square feet.
   b. Work acid solution into surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained.
   c. Acid will react vigorously for a few minutes, during which time brushing shall be continued.
   d. After bubbling subsides (10 minutes), hose down remaining slurry with high pressure clean water.
   e. Rinse immediately to avoid formation on the surface of salts that are difficult to remove.
   f. Thoroughly rinse to remove any residual acid surface condition that may impair adhesion.
3. Ensure surface is completely dry before application of coating.
4. Apply acid etching to obtain a “grit sandpaper” surface profile. If not, repeat treatment.

C. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.
2. Meet requirements of SSPC SP 1.

## 3.06 APPLICATION

A. General:

1. The intention of these Specifications is for new surfaces to be painted, whether specifically mentioned or not, except as specified otherwise. Do not paint exterior concrete surfaces, unless specifically indicated.
2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.

3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.
4. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
5. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
6. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
7. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
8. Water-Resistant Gypsum Board: Use only solvent type paints and coatings.
9. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
10. Keep paint materials sealed when not in use.
11. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Film Thickness and Coverage:

1. Number of Coats:
   a. Minimum required without regard to coating thickness.
   b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
   a. Do not exceed coating manufacturer's recommendations. If the coating is not in compliance with the specified requirements, the submittal or coating will be deemed not suitable for the application and will be rejected.
   b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
   a. Perform with properly calibrated instruments.
   b. Recoat and repair as necessary for compliance with Specification.
   c. Coats are subject to inspection by Construction Manager and coating manufacturer's representative.
4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.

5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Design Engineer before starting work in question.

B. System No. 2 Submerged Metal—Domestic Sewage:

| Surface Prep. | Paint Material | Min. Coats, Cover |
|---|---|---|
| SP 5, White Metal Blast Cleaning | Prime in accordance with manufacturer's recommendations | 1 coat, 2 MDFT |
| | High Build Epoxy | 2 coats, 16 MDFT |

1. Use on the following items or areas:
   a. Metal surfaces, new and existing below a plane 3 feet above maximum liquid surface that are a part of immersed equipment, concrete embedded surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel, and the following specific surfaces:
      1) Overflow Sump Pump.

C. System No. 4 Exposed Metal:

| Surface Prep. | Paint Material | Min. Coats, Cover |
|---|---|---|
| SP 10, Near White Metal Blast Cleaning | Epoxy Primer—Ferrous Metal | 1 coat, 2.5 MDFT |
| | High Build Epoxy | 1 coat, 4 MDFT |
| | Polyurethane Enamel | 1 coat, 3 MDFT |

1. Use on the following items or areas:
   a. Exposed metal surfaces, new located inside or outside of structures or exposed to weather, including vents, exterior metal

ductwork, flashing, sheet metalwork, and miscellaneous architectural metal trim.
1) Instrumentation and control systems exposed enclosures for process.
2) BAC Backwash Supply Pump.

b. Apply surface preparation and primer to surfaces prior to installation. Finish coats need only be applied to surfaces exposed after completion of construction.

D. System No. 10 Galvanized Metal, Copper, and Nonferrous Metal Alloy Conditioning:

| Surface Prep. | Paint Material | Min. Coats, Cover |
|---|---|---|
| In accordance with Paragraph Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation | Epoxy Primer—Other | As recommended by coating manufacturer<br><br>Remaining coats as required for exposure |

1. Use on the following items or areas:
   a. Galvanized surfaces requiring painting.

3.08 COLORS

A. Provide as shown in Piping Schedule as shown on Drawings.

B. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.

C. Equipment Colors:

1. Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.
2. Paint equipment and piping one color as selected.
3. Paint nonsubmerged portions of equipment the same color as the piping it serves, except as itemized below:
   a. Dangerous Parts of Equipment and Machinery: OSHA Orange.
   b. Fire Protection Equipment and Apparatus: OSHA Red.
   c. Radiation Hazards: OSHA Purple.
   d. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.

D. Pipe Identification:

1. Color code nonsubmerged metal piping, except electrical conduit. Paint fittings and valves the same color as pipe, except equipment isolation valves.
2. Pipe Color Coding: In accordance with Piping Schedule as shown on Drawings.
   a. Identify piping with both pipe color and band color when scheduled in the drawings.
3. Band colors
   a. Apply band colors as a six-inch wide band at 30-inch intervals along the pipe axis when pipe requires painting.
4. On exposed stainless steel piping, apply color 24 inches in length along pipe axis at connections to equipment, valves, or branch fittings, at wall boundaries, and at intervals along piping not greater than 9 feet on center.
5. Pipe Supports: Painted light gray, as approved by Owner.
6. Lettering and flow direction arrows:
   a. Stencil lettering on painted bands or use snap-on markers on pipe to identify pipe. When stenciling, stencil 3/4-inch high letters on 3/4 through 4-inch pipe or coverings, or 5-inch high letters on 5-inch and larger pipe or coverings.
7. Provide lettering and flow direction arrows near equipment served, adjacent to valves, both sides of walls and floors where pipe passes through, at each branch or tee, and at intervals of not more than 15 feet in straight runs of pipe.

## 3.09 FIELD QUALITY CONTROL

A. Testing Equipment:

1. Provide calibrated electronic type dry film thickness gauge to test coating thickness specified in mils.
2. Provide low-voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high-build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by:
   a. Tinker and Rasor, San Gabriel, CA, Model M-1.
   b. Or approved equal.
3. Provide high-voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit as recommended by coating manufacturer.

B. Testing:

1. Thickness and Continuity Testing:
   a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.
   b. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE SP0188.
   c. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE SP0188.
   d. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Construction Manager.

C. Inspection: Leave staging and lighting in place until Construction Manager has inspected surface or coating. Replace staging removed prior to approval by Construction Manager. Provide additional staging and lighting as requested by Construction Manager.

D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
2. Remove rust and contaminants from metal surface. Provide surface cleanliness and profile in accordance with surface preparation requirements for specified paint system.
3. Feather edges and repair in accordance with recommendations of paint manufacturer.

4. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

## 3.10 MANUFACTURER'S SERVICES

A. In accordance with Section 01 43 33, Manufacturers' Field Services, coating manufacturer's representative shall be present at Site as follows:

1. On first day of application of any coating system.
2. A minimum of two additional Site inspection visits, each for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation.
3. As required to resolve field problems attributable to or associated with manufacturer's product.
4. To verify full cure of coating prior to coated surfaces being placed into immersion service.

## 3.11 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.

C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

## 3.12 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Paint System Data Sheet (PSDS).
2. Paint Product Data Sheet (PPDS).

**END OF SECTION**

## PAINT SYSTEM DATA SHEET (PSDS)

Complete this PSDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PSDS.

| | | |
|---|---|---|
| Paint System Number (from Spec.): | | |
| Paint System Title (from Spec.): | | |
| Coating Supplier: | | |
| Representative: | | |
| Surface Preparation: | | |
| **Paint Material (Generic)** | **Product Name/Number (Proprietary)** | **Min. Coats, Coverage** |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

## PAINT PRODUCT DATA SHEET (PPDS)

Complete and attach manufacturer's Technical Data Sheet to this PPDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

| Temperature/RH | 50/50 | 70/30 | 90/25 |
|---|---|---|---|
| Induction Time | | | |
| Pot Life | | | |
| Shelf Life | | | |
| Drying Time | | | |
| Curing Time | | | |
| Min. Recoat Time | | | |
| Max. Recoat Time | | | |

Provide manufacturer's recommendations for the following:

Mixing Ratio: _____

Maximum Permissible Thinning:_____

Ambient Temperature Limitations: min.: _____ max.:_____

Surface Temperature Limitations: min.: _____ max.:_____

Surface Profile Requirements: min.: _____ max.:_____

Attach additional sheets detailing manufacturer's recommended storage requirements and holiday testing procedures.

# SECTION 09 97 13
# STEEL TANK COATINGS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. NACE International: SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
2. NSF International (NSF): 61, Drinking Water System Components - Health Effects.
3. Society for Protective Coatings (SSPC):
   a. Surface Preparation Standards:
      1) SP 1, Solvent Cleaning.
      2) SP 2, Hand Tool Cleaning.
      3) SP 3, Power Tool Cleaning.
      4) SP 5, White Metal Blast Cleaning.
      5) SP 7, Brush-Off Blast Cleaning.
      6) SP 10, Near White Blast Cleaning.
      7) SP 11, Power Tool Cleaning to Bare Metal.
      8) SP 16, Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
   b. Paint Application Guides:
      1) PA 1, Shop, Field, and Maintenance Painting of Steel.
      2) PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
      3) PA Guide 10, Guide to Safety and Health Requirements for Industrial Painting Projects.

### 1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils, or square feet per gallon.
2. MDFT: Minimum Dry Film Thickness, mils.
3. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
4. Mil: Thousandth of an inch.
5. PPDS: Paint Product Data Sheet.
6. PSDS: Paint System Data Sheet.
7. SP: Surface preparation.
8. VOC: Volatile Organic Compounds.

1.03 SUBMITTALS

A. Action Submittals:

1. Data Sheets:
   a. For each paint system used, furnish a Paint System Data Sheet (PSDS), Paint Product Data Sheet (PPDS), and paint colors available (where applicable) for each product used in paint system. The PSDS and PPDS forms are appended to the end of this section.
   b. Submit required information on a system-by-system basis.
   c. Provide copies of paint system submittals to coating applicator.
   d. Indiscriminate submittal of manufacturer's literature only is not acceptable.
2. Detailed chemical and gradation analysis for each proposed abrasive material.
3. Samples: For each paint system used, furnish colors available (where applicable) for each product used in paint system.

B. Informational Submittals:

1. Coating manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services.
2. Current NSF certification for potable water contact.
3. Anticipated tank coating sequence.
4. Dehumidification plan, including equipment and air change rates. Submit plan based on type of equipment used, length of time required to hold blast, tank volume, and time of year that coating work is undertaken.
5. Applicator's Qualification: List of references substantiating experience.
6. Shop and field applicator's quality control program, including, but not limited to:
   a. Environmental test methods and frequency.
   b. Steel surface temperature and profile measurement procedure and frequency.
   c. Record keeping form.
   d. Submit Quality Control Plan in accordance with Section 01 45 16.13, Contractor Quality Control.
7. Manufacturer's written instructions for applying each type of coating.
8. Field Testing: Inspection and test reports.
9. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Provide project experience and references in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local agencies having jurisdiction for Site and types of work activities included in Project, including, but not limited to:
   a. Limitations on emission of volatile organic compounds, dust, and other contaminants.
   b. Requirements for disturbance, handling, and disposal of paint waste and associated debris, including lead, coal tar, abrasive, and other regulated substances.

C. Industry Best Practices:

1. Perform surface preparation and painting in accordance with recommendations of the following:
   a. Paint manufacturer's instructions.
   b. SSPC–PA Guide 10.
2. Do not apply paint in temperatures outside of manufacturer's recommended maximum or minimum allowable, in dust, in smoke-laden atmosphere, in damp or humid weather.
3. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent or whenever surface temperature is less than 5 degrees F above dewpoint of ambient air.

D. Mockup:

1. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.
2. After approval, sample spaces or items shall serve as a standard for similar work throughout the Project.

E. Preinstallation Meeting:

1. Prior to beginning painting Work, schedule a meeting and be prepared to discuss the following subjects, as a minimum:
   a. Required schedule.
   b. Sequence of critical path work items.
   c. Use of Site, access, office and storage areas, security, and temporary facilities.

d. Major product delivery and priorities.
e. Safety plan.

2. Attendees shall include:
   a. Owner's representatives.
   b. Contractor's office representative.
   c. Contractor's resident superintendent.
   d. Contractor's quality control representative.
   e. Subcontractors' representatives whom Contractor may desire or Construction Manager may request to attend.
   f. Construction Manager's representative.
   g. Paint manufacturer's technical representative.
   h. Others as appropriate.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Protect precoated items from damage. Batten coated items to prevent abrasion.
2. Use nonmetallic or padded slings and straps in handling.

B. Deliver materials to Site in unopened containers labeled with designated name, date of manufacture, color, and manufacturer.

C. Store paints in a protected area that is heated or cooled as required to maintain temperatures within range recommended by paint manufacturer.

1.06 SPECIAL GUARANTEE

A. Furnish extended guarantee or warranty. Special guarantee shall provide for correction, or at the option of Owner, removal and replacement of Work specified in this Specification section found defective during a period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

1. 60-Month Warranty Period Inspection: Owner will conduct inspection of interior and exterior coated surfaces prior to the end of warranty period. Owner will notify Contractor in advance of inspection and Contractor may attend at its option. Owner will prepare list of coating defects and failures identified during inspection and transmit to Contractor. List shall serve as notice of repairs required under warranty.

2. Repairs:
   a. If repairs are required, requirements of Contract shall apply including, but not limited to, requirements to remove standing water in tanks, perform repair work, and tank cleaning prior to disinfection.
   b. Repair defective coatings using coating materials, equipment, and methods similar to those used in original work. Materials shall be of fresh manufacture and within manufacturer's stated shelf life at time of application.
   c. Provide extended warranty of 1 year for repairs.
   d. Complete repairs within 30 calendar days of Warranty Period Inspection.

## PART 2 PRODUCTS

### 2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption:

1. Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements.
2. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
3. Use or reuse of components and materials without a traceable certification is prohibited.

### 2.02 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of one of the following:

1. Akzo Nobel, Houston, TX (includes Devoe and International).
2. Carboline Coatings Company, St. Louis, MO.
3. Sherwin-Williams, Cleveland, OH.
4. Tnemec Coatings, Kansas City, MO.
5. PPG Coatings, Pittsburgh, PA (includes Ameron).
6. Or approved equal.

2.03 MATERIALS

A. Quality: Manufacturer's highest quality products and suitable for intended use.

B. Materials Including Primer and Finish Coat (or two finish coats): Produced by same paint manufacturer.

C. Thinners, Cleaners, Driers, and Other Additives: As recommended by paint manufacturer of the particular coating.

D. NSF Epoxy, Interior Coating: Two-component, 83 percent solids epoxy for water tank lining, approved for potable water contact and conforming to NSF 61. Minimum dry film thickness (DFT) per coat 5 mils.

E. Urethane Mastic Exterior Coating: 65 percent solids, VOC compliant. Minimum dry film thickness (DFT) per coat 4 mils.

2.04 COLORS

A. Formulate with colorants free of lead and lead compounds.

B. Furnish as selected by Owner.

C. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.

2.05 MIXING

A. Multiple-Component Coatings:

1. Prepare using contents of container for each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Keep paint material containers sealed when not in use.

2.06 ABRASIVES

A. Select abrasive type and size to produce a surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

B. Select abrasives that conform to federal and state regulations for metals and toxicity.

2.07 SOURCE QUALITY CONTROL

A. Prime coat structural steel surfaces.

B. Notify Construction Manager at least 7 days prior to start of shop blast cleaning to allow for inspection of the Work during surface preparation and shop application of paints. Work shall be subject to Construction Manager's approval before shipment to Site.

**PART 3 EXECUTION**

3.01 GENERAL

A. Surface Preparation and Coating Application: Meet or exceed requirements of these Specifications and SSPC–PA 1, whichever is more stringent.

B. Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied.

C. Paint interior and exterior exposed metal surfaces whether specifically mentioned or not, except as modified herein.

D. Provide Construction Manager a minimum of 7 days' advanced notice prior to start of surface preparation work or coating application work. Perform such work only in the presence of Construction Manager, unless Construction Manager grants prior approval to perform such work in Construction Manager's absence.

E. Schedule inspection with Construction Manager in advance for cleaned surfaces and coats prior to succeeding coat.

F. Do not apply paint in temperatures outside of manufacturer's recommended maximum or minimum allowable, or in dust, smoke-laden atmosphere, damp or humid weather.

G. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dewpoint of ambient air.

H. Ventilation for Coating Cure: Provide fans to continuously ventilate tank interior, as required, to assist with coating cure.

3.02 PREPARATION

A. Remove, mask, or otherwise protect hardware, machined surfaces, nameplates, and other surfaces not intended to be painted.

B. Protect surfaces adjacent to or downwind of Work area from overspray.

3.03 ENVIRONMENTAL CONTROLS

A. Containment System:

1. Provide full containment of blast emissions during entire blast operation for tank exterior. Meet requirements of SSPC–Guide 6 as modified below.
   a. Design: Reviewed by civil or structural engineer, licensed in the State of California.
   b. Provide Class 1 containment structure. Completely shroud tank with opaque fabric that prevents spread of blast media, spent chips, corrosion byproducts, and dust.
   c. Exhaust air shall be filtered by appropriately sized dust collectors.
   d. Verify effectiveness using Method A, General Surveillance, Level 2, as described in SSPC–Guide 6.

B. Dehumidification Equipment:

1. Provide dehumidification for field painting interior of tank as required to maintain schedule during adverse weather conditions. Dehumidification and heating equipment shall be provided by a supplier with project experience.
2. Use dehumidification and heating equipment to control environment during blast cleaning and coating application. At Contractor's option, dehumidification equipment may also be used during curing process.
3. Provide desiccant dehumidifiers with a single rotary desiccant wheel capable of fully continuous operation. No liquid, granular, or loose lithium chloride drying systems will be allowed.
4. Seal interior space of tank and maintain a slight positive pressure as recommended by supplier of dehumidification equipment.
5. During blasting operation, dehumidification equipment shall continuously maintain a dewpoint of air inside tank at least 5 degrees F

less than temperature of coldest part of tank where the Work is underway. Inside relative humidity shall not exceed 45 percent, unless specifically required by paint manufacturer for coating application and cure.

6. Provide auxiliary heat as necessary to maintain surface temperature in the range specified by the coating manufacturer. Auxiliary heating equipment shall be approved for use by dehumidification equipment supplier and shall meet the following requirements:
   a. Install heaters in process air supply duct between, and blended with, dehumidifier as close to space as possible.
   b. Use electric, indirect fired combustion, or steam coil auxiliary heaters. Direct fired space heaters will not be allowed during blasting, coating, or curing cycles.
   c. Equip heaters with controls that automatically turn heater off if airflow is interrupted or internal temperature of heater exceeds its design temperature or design temperature of supply duct.
7. Measure and record ambient temperature, relative humidity, dewpoint and tank wall temperature a minimum of twice daily (beginning and end of work shifts) to verify proper environmental levels are achieved inside tank. Field-measured test results shall be made available to Construction Manager upon request.

C. Filtration System:

1. Designed to remove dust from air so that it does not interfere with dehumidification equipment's ability to control dewpoint and relative humidity inside tank.
2. Air from tank or dust filtration equipment shall not be recirculated through dehumidifier during coating application or when solvent vapors are present.

## 3.04 PREPARATION OF SURFACES

A. Metal Surfaces:

1. Meet requirements of the following SSPC Specifications:
   a. Solvent Cleaning: SP 1.
   b. Hand Tool Cleaning: SP 2.
   c. Power Tool Cleaning: SP 3.
   d. White Metal Blast Cleaning: SP 5.
   e. Brush-Off Blast Cleaning: SP 7.
   f. Near-White Blast Cleaning: SP 10.
   g. Power Tool Cleaning to Bare Metal: SP 11.
   h. Brush Blasting of Non-Ferrous Metals: SP 16.

2. Wherever the words “solvent cleaning”, “hand tool cleaning”, “wire brushing”, or “blast cleaning”, or similar words of equal intent are used in these Specifications or in paint manufacturer’s specifications, they shall be understood to refer to the applicable SSPC Specifications listed above.
3. Where air quality regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers’ recommendations for wet blast additives and first coat application shall apply.
4. Preblast Cleaning Requirements:
    a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
    b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
    c. Clean small isolated areas as above or solvent clean with suitable solvents and clean cloths.
    d. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
    e. Prepare welds and adjacent areas to eliminate undercutting or reverse ridges on weld bead, weld spatter on or adjacent to weld or other area to be painted, and sharp peaks or ridges along weld bead.
    f. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
5. Blast Cleaning Requirements:
    a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer’s recommendations.
    b. Select type and size of abrasive to produce a surface profile that meets coating manufacturer’s recommendations for particular primer to be used.
    c. Use only dry blast cleaning methods.
    d. Do not reuse abrasive, except for designed recyclable systems.
    e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning and disposition of spent aggregate and debris.
6. Post-blast Cleaning and Other Cleaning Requirements:
    a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.

b. Paint surfaces the same day they are blast cleaned. Reblast surfaces that have started to rust before they are coated.

## 3.05 APPLICATION

A. General:

1. The intention of these Specifications is for new, interior and exterior metal and submerged metal surfaces to be painted, whether specifically mentioned or not, except as modified herein.
2. Coatings Subject to Immersion:
   a. Apply coatings to internal vessel, pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals unless otherwise specified.
   b. Curing:
      1) Obtain full cure for completed system.
      2) Consult coatings manufacturer's written instructions.
      3) Do not immerse coating until completion of curing cycle.
3. Apply coatings in accordance with paint manufacturer's recommendations. Allow sufficient time between coats to ensure thorough drying of previously applied coat.
4. Prior to assembly or installation, paint units to be bolted together and to structures.
5. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that required number of coats have been applied.
6. With brush, work coating into and behind anchor bolts, anchor chairs, and other areas that are difficult to paint by spray.

## 3.06 FIELD QUALITY CONTROL

A. Test Equipment:

1. Provide a dry film thickness gauge to test coating thickness as specified in mils. Use magnetic or electronic type as manufactured by:
   a. Elcometer.
   b. DeFelsko.
   c. Or approved equal.
2. Provide electrical holiday detector, low voltage, wet sponge type to test finish coat less than 20 mils dry film thickness, as manufactured by:
   a. Elcometer.
   b. Tinker and Rasor.
   c. Or approved equal.

3. Provide high-voltage holiday detector to test finish coats 20 mils dry film thickness or greater. Provide equipment approved by the coating manufacturer.

B. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:

1. Perform with properly calibrated instruments.
2. Repair or recoat defective areas as necessary for compliance with Specifications.
3. All coats are subject to inspection by Construction Manager and coating manufacturer's representative.
4. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.

C. Thickness Testing:

1. Measure coating thickness specified in mils with magnetic or electronic type dry film thickness gauge in accordance with SSPC–PA 2.
2. Check each coat for correct thickness. Do not make measurement before a minimum of 8 hours after application of coating.
3. After repaired and recoated areas have dried sufficiently, repeat tests to demonstrate specified dry film thickness has been achieved.

D. Holiday (Pinhole) Testing: Test finish coat on 100 percent of tank interior and all other submerged surfaces for holidays and discontinuities with low-voltage or high-voltage electrical holiday detector, depending on final dry film thickness. Conduct test in accordance with NACE SP0188.

E. Unsatisfactory Application:

1. If improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections are causes for rejection.
3. Repair defects in coating systems in accordance with written recommendations of coating manufacturer.
4. Leave staging up until Construction Manager has inspected surface or coating. Replace staging removed prior to approval by Construction Manager.

F. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.
2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat in accordance with Specifications. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

## 3.07 MANUFACTURER'S SERVICES

A. Coating manufacturer's technical representative shall be present at Site as follows:

1. On the first day of application of coating.
2. As required for application quality assurance, and to determine compliance with manufacturer's instructions and these Specifications.
3. As necessary to resolve field problems attributable to or associated with manufacturer's products.
4. To verify full cure of coating prior to placing coated surfaces into immersion service.

## 3.08 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.

C. Completely remove paint spots, oil, or stains upon adjacent surfaces and floors and leave Site clean.

## 3.09 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Paint System Data Sheet (PSDS).
2. Paint Product Data Sheet (PPDS).

**END OF SECTION**

## PAINT SYSTEM DATA SHEET (PSDS)

Complete and attach manufacturer's Technical Data Sheet to this PSDS for each coating system.

| | | |
|---|---|---|
| Paint System Number (from Spec.): | | |
| Paint System Title (from Spec.): | | |
| Coating Supplier: | | |
| Representative: | | |
| Surface Preparation: | | |
| Paint Material (Generic) | Product Name/Number (Proprietary) | Min. Coats, Coverage |
| | | |
| | | |
| | | |
| | | |

Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

| Temperature/RH | 50/50 | 70/30 | 90/25 |
|---|---|---|---|
| Induction Time | | | |
| Pot Life | | | |
| Shelf Life | | | |
| Drying Time | | | |
| Curing Time | | | |
| Min. Recoat Time | | | |
| Max. Recoat Time | | | |

Provide manufacturer's recommendations for the following:

Mixing Ratio: _____

Maximum Permissable Thinning: _____

Ambient Temperature Limitations: min.: _____ max.: _____

Surface Temperature Limitations: min.: _____ max.: _____

Surface Profile Requirements: min.: _____ max.: _____

## PAINT PRODUCT DATA SHEET (PPDS)

Complete and attach manufacturer's Technical Data Sheet to this PPDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

| Temperature/RH | 50/50 | 70/30 | 90/25 |
|---|---|---|---|
| Induction Time | | | |
| Pot Life | | | |
| Shelf Life | | | |
| Drying Time | | | |
| Curing Time | | | |
| Min. Recoat Time | | | |
| Max. Recoat Time | | | |

Provide manufacturer's recommendations for the following:

Mixing Ratio: _____

Maximum Permissable Thinning: _____

Ambient Temperature Limitations: min.: _____ max.: _____

Surface Temperature Limitations: min.: _____ max.: _____

Surface Profile Requirements: min.: _____ max.: _____

# SECTION 10 14 00
# SIGNAGE

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems.
2. ASTM International (ASTM):
   a. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   b. D709, Standard Specification for Laminated Thermosetting Materials.
3. California Building Code; Chapter 11B Accessibility.
   California Fire Code (CFC): Chapter 50, Hazardous Materials-General Provisions.
4. California Occupational Safety and Health Act (CAL/OSHA).
5. National Fire Protection Association (NFPA):
   a. 704, Standard System for the Identification of the Hazards of Materials for Emergency Response.
   b. HAZ-01, Fire Protection Guide to Hazardous Materials.

### 1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Drawings showing layouts, actual letter sizes and styles, and Project-specific mounting details.
   b. Manufacturer's literature showing letter sizes and styles, sign materials, and standard mounting details.
2. Samples: One full size for each type of nameplate, sign, and label specified.

B. Informational Submittals: Manufacturer's installation instructions.

## PART 2 PRODUCTS

### 2.01 BUILDING SIGN

A. Text Material: Type 316 stainless steel dimensional letters (Type E).

B. Background Material: Aluminum plate.

C. Size: 18 inches by 66 inches and minimum 1/4-inch-thick.

D. Lettering: 1/4 inch, minimum thickness.

E. Finish:

1. Background: Dark bronze anodized finish, all six sides.
2. Letters: No. 4 brushed finish. All letters brushed in same direction.

F. Lettering Style: Helvetica Medium.

G. Lettering Height: 3 inches.

H. Building Sign requires the following copy:

1. Refer to Sign Schedule.

I. For locations and typical sign layout, dimensions and mounting details, refer to Sign Schedule.

J. Provide two signs for each structure.

K. Fasteners: Stainless steel screws with rosettes. Concealed.

L. Manufacturer’s name is allowed on backside.

2.02 DOOR NAMEPLATES

A. Material: Metal Sign (Type B).

B. Thickness: 1/8 inch.

C. Height: 6 inches.

D. Width: Minimum 10 inches wide. Longer as dictated by required copy and text size.

E. Finish: Nondirectional matte.

F. Background: Dark bronze anodized aluminum, all sides.

G. Letters: Raised.

1. Size: 1 inch high.
2. Color: White.

3. Style: Helvetica Regular upper case.
4. Message Text: As shown on Sign Schedule.
5. Braille Text: Domed or rounded as required by ADA regulations, with 3/8-inch minimum clearance on all sides. Must comply with California Contracted Grade 2 Braille.

2.03 SIGN TYPES

A. Metal Sign (Type B):

1. Material: Baked enamel finished 18-gauge (minimum) aluminum signs.
2. Manufacturers:
   a. Seton Identification Products.
   b. Office Sign Co.
   c. Or approved equal.

B. Individual Letter and Number Signs (Type E): Stainless steel for concealed flush mounting.

1. Manufacturers:
   a. Eder Metal Letter Co., Milwaukee, WI.
   b. Spanjer Brothers, Inc., Chicago, IL.
   c. Andco Industries Corp., Greensboro, NC.
   d. Or approved equal.

C. Hazardous Material Sign (Type H):

1. Conform to NFPA 704 and NFPA HAZ-01.
2. Material: Fiberglass 1/8-inch-thick. Reflective sheeting applied to 0.040-inch-thick aluminum. Adhesive vinyl for curved surfaces.
3. Background, Letters, and Numbers: Die-cut vinyl with pressure sensitive adhesive.
4. Manufacturers:
   a. Brady Signmark.
   b. Emed Co., Inc.
   c. Or approved equal.

2.04 IDENTIFICATION LABELS

A. Pipe Labels:

1. Snap-on, reversible type with lettering and directional arrows, sized for outside diameter of pipe and insulation.
2. Provided with ties or straps for pipes of 6 inches and over diameter.
3. Designed to firmly grip pipe so labels remain fixed in vertical pipe runs.

4. Material: Heavy-duty vinyl or polyester, suitable for exterior use, long lasting, and resistance to moisture, grease, and oils.
5. Letters and Arrows: Black on OSHA safety yellow background.
6. Color Field and Letter Height: Meet ASME A13.1.
7. Message: Piping system name as indicated in Piping Schedule as shown on Drawings.
8. Manufacturers and Products:
    a. Brady Signmark; B-915 BradySnap-On and Strap-On Pipe Markers.
    b. Seton Identification Products; Ultra-mark Pipe Markers.
    c. Or approved equal.

B. Equipment Labels:

1. Applies to equipment with assigned tag numbers, where specified.
2. Letters: Black bold face, 3/4 inch minimum high.
3. Background: OSHA safety yellow.
4. Materials: Aluminum or stainless steel with a baked-on finish suitable for use on wet, oily, exposed, abrasive, and corrosive areas.
5. Furnish 1-inch margin with holes at each end of label, for mounting. On fiberglass labels, furnish grommets at each hole.
6. Size:
    a. 2 inches minimum and 3 inches maximum high, by 14 inches minimum and 18 inches maximum long.
    b. Furnish same size base dimensions for all labels.
7. Message: Equipment names and tag numbers as used in sections where equipment is specified.
8. Manufacturers:
    a. Brady Signmark.
    b. Seton Identification Products.
    c. Or approved equal.

## 2.05 ANCILLARY MATERIALS

A. Fasteners: Stainless steel screws or bolts of appropriate sizes.

B. Pipe Posts: 2-1/2-inch galvanized steel pipe meeting ASTM A53/A53M, Type S, Grade B.

C. Chain: Type 304 stainless steel, No. 16 single jack chain or No. 2 double loop coil chain.

## PART 3 EXECUTION

3.01 INSTALLATION—GENERAL

A. In accordance with manufacturer's recommendations.

B. Mount securely, plumb, and level.

3.02 BUILDING SIGN

A. Mount as indicated in Sign Schedule with concealed fasteners.

3.03 DOOR NAMEPLATES

A. Attach to doors or walls adjacent to doors with Phillips head screws. See Sign Schedule for locations and messages.

B. Mount with bottom of nameplate at 5 feet 6 inches above floor.

3.04 SIGNS

A. General:

1. Fasten to walls, doors, or as scheduled.
2. Anchor in place for easy removal and reinstallation with ordinary hand tools.

B. Information and Safety Signs: Install facing traffic. Locate for high visibility with minimum restriction of working area around walkways and equipment.

C. Hazardous Material Sign:

1. Area 7, Facility 64B; Power Generation Facility, Power Generation Control Building and Power Generation Mechanical Equipment area.
   a. Replace existing signs exhibiting wear and tear, fading or are damaged.
   b. Install where required by NFPA No. 704 and CFC, Chapter 50.
   c. Install at entrances to spaces where hazardous materials are stored, dispensed, used, or handled, and on sides of stationary tanks.

3.05 IDENTIFICATION LABELS

A. Pipe Labels:

1. Locate at connections to equipment, valves, or branching fittings at wall boundaries.

2. At intervals along piping not greater than 18 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe.
3. At exposed piping not normally in view, such as above suspended ceilings and in closets and cabinets.
4. Supplementary Labels: Provide to Owner those listed in Piping Schedule as shown on Drawings that do not receive arrows.
5. Apply to pipe after painting in vicinity is complete, or as approved by Construction Manager.
6. Install in accordance with manufacturer's instructions.

B. Equipment Labels:

1. Locate and install on equipment or concrete equipment base as shown on Drawings.
2. Anchor to equipment or base for easy removal and replacement with ordinary hand tools.

3.06 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification.

1. Sign Schedule: Tabulation of characteristics and mounting information for warning, and informational signs on Project. Provide items as scheduled. Meet requirements of California Occupational Safety and Health Act (CAL/OSHA).

**END OF SECTION**

## SIGN SCHEDULE

| Sign | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Size | | | Mounting | | | Lettering | | | | | |
| Facility Number | Sign Type | Detail Reference | Width | Height | Color | Location | Method | Height to Top | Height | Style | Color | Message | Faces | Other Requirements |
| 64B | BUILDING SIGN (Type E) | 1014-015 | 66” | 24” | Dark Bronze Anodized | Wall | Bolts | Match Existing at Effluent Pump Station | 3” | Helvetica Medium | Stainless Steel, #4 Brushed | POWER GENERATION CONTROL BUILDING 64B | 1 | Provide matching dark anodized aluminum plugs to cover bolt holes and heads once installed; Quantity 4. Locate as directed by Owner. |
| 64B | BUILDING SIGN (Type E) | 1014-015 | 66” | 24” | Dark Bronze Anodized | Wall | Bolts | Match Existing at Effluent Pump Station | 3” | Helvetica Medium | Stainless Steel, #4 Brushed | POWER GENERATION BUILDING 64B | 1 | Provide matching dark anodized aluminum plugs to cover bolt holes and heads once installed; Quantity 4. Locate as directed by Owner. |
| 64B | B | 1014-001 | 20” | 14” | White | Wall | Screws | 5’-6” | 1” min | Helvetica | Black | DANGER HIGH VOLTAGE | 1 | Locate adjacent to doors entering Power Generation enclosure. |
| 64B | B | 1014-002 | 20” | 14” | White | Wall | Screws | 5’-6” | 1” min | Helvetica | Black | CAUTION Ear Protection Required | 1 | Locate adjacent to doors entering Power Generation enclosure. |
| 64B | B | 1014-002 | 20” | 14” | White | Wall | Screws | 5’-6” | 1” min | Helvetica | Black | CAUTION Equipment Stars Automatically | 1 | Locate adjacent to doors entering Power Generation enclosure. |
| 64B | B | 1014-008 | 20’ | 14” | White | Wall | Screws | 5’-6” | 1” min | Helvetica | Black | NOTICE Authorized Personnel Only | 1 | Locate at doors entering Power Generation enclosure. |

## SIGN SCHEDULE

| Sign | | | | | | | | | Lettering | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Size | | | Mounting | | | | | | | | |
| Facility Number | Sign Type | Detail Reference | Width | Height | Color | Location | Method | Height to Top | Height | Style | Color | Message | Faces | Other Requirements |
| 64B | H | 1014-006 | 10” | 10” | NFPA 704, NFPA HAZ-01 | As Directed by Design Engineer | As Directed by Design Engineer | Varies | As Specified | As Specified | As Specified | | 1 | Replace all existing Hazardous signs at 64B location. |
| 64B | B | As Specified, See Article 2.02 | 10” | 6” | Dark Bonze Anodized | Door | Screws | 5’-3” | 1” | Helvetica | White | Power Generation Room | 1 | Locate at doors entering Power Generation enclosures. |
| 64B | B | As Specified, See Article 2.02 | 10” | 6” | Dark Bonze Anodized | Door | Screws | 5’-3” | 1” | Helvetica | White | Power Generation Storage | 1 | Locate at door entering Power Generation Storage Container. |
| 64B | B | As Specified, See Article 2.02 | 10” | 6” | Dark Bonze Anodized | Door | Screws | 5’-3” | 1” | Helvetica | White | Power Generation Control Room | 1 | Locate at door entering Power Generation Control Building. |

# SECTION 26 05 02
# BASIC ELECTRICAL REQUIREMENTS

## PART 1 GENERAL

### 1.01 RELATED SECTIONS

A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

### 1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
2. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. Z535.4, Product Safety Signs and Labels.
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
4. UL.

### 1.03 DESIGN REQUIREMENTS

A. Design and submit conduit layout design, as required in Section 26 05 33, Raceway and Boxes.

### 1.04 ELECTRIC SERVICE DIVISION OF RESPONSIBILITY

A. Incoming underground electrical service facilities provided by the serving utility as part of its normal obligation to customers is work provided outside this Contract. Under this Contract provide customer required service provisions and electrical work including, but not limited to, primary trench and backfill, primary duct system, service equipment pad site preparation and pad, metering components and associated conduit, and secondary facilities. Schedule and coordinate work of serving utility as required to provide electric service to the Work.

1.05 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
   a. Nameplates, signs, and labels.

B. Information Submittals:

1. Electrical Systems Diagrams: In electrical switchgear room, provide power distribution system single line diagram(s) in glazed metal frames.

1.06 QUALITY ASSURANCE

A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark or label.

C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

1.07 ENVIRONMENTAL CONDITIONS

A. Refer to the Area Classification and Material Selection Table on Drawings.

**PART 2 PRODUCTS**

2.01 GENERAL

A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.

C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range stated in Section 01 61 00, Common Product Requirements.

2.02 EQUIPMENT FINISH

A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with light gray color finish as approved by Owner.

2.03 NAMEPLATES

A. Material: Laminated plastic.

B. Attachment Screws: Stainless steel.

C. Color: Black, engraved to a white core.

D. Letter Height:

1. Pushbuttons/Selector Switches: 1/8 inch.
2. Other Electrical Equipment: 3/8 inch.

2.04 SIGNS AND LABELS

A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

**PART 3 EXECUTION**

3.01 GENERAL

A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Construction Manager.

B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Construction Manager in writing.

C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Keep openings in boxes and equipment closed during construction.

E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Design Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

## 3.02 ANCHORING AND MOUNTING

A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements for seismic zone criteria given in Section 01 61 00, Common Product Requirements.

## 3.03 COMBINING CIRCUITS INTO COMMON RACEWAY

A. Homerun circuits shown on Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:

1. Analog control circuits from devices in same general area to same destination.
    a. No power or ac discrete control circuits shall be combined in same conduit with analog circuits.
    b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.
    c. Analog circuits shall be continuous from source to destination. Do not add TJB, splice, or combine into a multi-pair cable without authorization of Design Engineer.
    d. Raceways shall be sized per General Circuit and Raceway Schedule and do not exceed 40 percent fill.
    e. Changes shall be documented on Record Drawings.
2. Discrete control circuits from devices in the same general area to the same destination.
    a. No power or analog control circuits shall be combined in same conduit with discrete circuits.
    b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.
    c. Raceways shall be sized per the General Circuit and Raceway Schedule and do not exceed 40 percent fill.
    d. Changes shall be documented on Record Drawings.

3. Power circuits from loads in same general area to same source location (such as panelboard, switchboard, low voltage motor control center).
   a. Lighting Circuits: Combine no more than three circuits to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
   b. Receptacle Circuits, 120-Volt Only: Combine no more than three circuits to a single raceway. Provide a separate neutral conductor for each circuit. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
   c. All Other Power Circuits: Do not combine power circuits without authorization of Design Engineer.

## 3.04 NAMEPLATES, SIGNS, AND LABELS

A. Arc Flash Protection Warning Signs: Field mark all equipment as specified in Section 26 05 70, Electrical System Analysis, to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.

B. Multiple Power Supply Sign: Install permanent plaque or directory at each service disconnect location denoting other services, feeders, and branch circuits supplying the building and the area served by each.

C. Equipment Nameplates:

1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.
3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

## 3.05 LOAD BALANCE

A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.

C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

## 3.06 CLEANING AND TOUCHUP PAINTING

A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.

B. Touchup Paint:

1. Touchup scratches, scrapes, and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Construction Manager.

## 3.07 PROTECTION FOLLOWING INSTALLATION

A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.

B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Construction Manager.

**END OF SECTION**

# SECTION 26 05 04
# BASIC ELECTRICAL MATERIALS AND METHODS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
   b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
2. Canadian Standards Association (CSA).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. C12.1, Code for Electricity Metering.
   c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
   d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
   e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
   f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. UL:
   a. 98, Standard for Enclosed and Dead-Front Switches.
   b. 248, Standard for Low Voltage Fuses.
   c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
   d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   e. 508, Standard for Industrial Control Equipment.
   f. 810, Standard for Capacitors.

g. 943, Standard for Ground-Fault Circuit-Interrupters.
h. 1059, Standard for Terminal Blocks.
i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
   a. Control devices.
   b. Control relays.
   c. Circuit breakers.
   d. Nonfused switches.
   e. Enclosures: Include enclosure data for products having enclosures.
2. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals: Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

**PART 2 PRODUCTS**

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

A. General:

1. Type: Molded case.
2. Trip Ratings: 15 amps to 800 amps.
3. Voltage Ratings: 120, 240, 277, 480, and 600V ac.
4. Suitable for mounting and operating in any position.
5. UL 489.

B. Operating Mechanism:

1. Overcenter, trip-free, toggle type handle.
2. Quick-make, quick-break action.
3. Locking provisions for padlocking breaker in OPEN position.
4. ON/OFF and TRIPPED indicating positions of operating handle.
5. Operating handle to assume a CENTER position when tripped.

C. Trip Mechanism:

1. Individual permanent thermal and magnetic trip elements in each pole.
2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
3. Two- and three-pole, common trip.
4. Automatically opens all poles when overcurrent occurs on one pole.
5. Test button on cover.
6. Calibrated for 40 degrees C ambient, unless shown otherwise.
7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.

D. Short Circuit Interrupting Ratings:

1. Equal to, or greater than, available fault current or interrupting rating shown.
2. Series Connected Ratings: Do not apply series connected short circuit ratings.

E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).

1. Ground fault sensor shall be rated same as circuit breaker.
2. Push-to-test button.

F. Magnetic Only Type Breakers: Where shown; instantaneous trip adjustment which simultaneously sets magnetic trip level of each individual pole continuously through a 3X to 10X trip range.

G. Accessories: Shunt trip, auxiliary switches, handle lock ON devices, mechanical interlocks, key interlocks, unit mounting bases, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.

H. Connections:

1. Supply (line side) at either end.
2. Mechanical wire lugs, except crimp compression lugs where shown.
3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.

5. Use bolted bus connections, except where bolt-on is not compatible with existing breaker provisions.

I. Enclosures for Independent Mounting:

1. See Article Enclosures.
2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

2.02 NONFUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

A. NEMA KS 1.

B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

C. Lugs: Suitable for use with 75 degrees C wire at NEC 75 degrees C ampacity.

D. Auxiliary Contact:

1. Operation: Make before power contacts make and break before power contacts break.
2. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.

E. Enclosures: See Article Enclosures.

F. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.03 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.

B. Selector Switch Operating Lever: Standard.

C. Indicating Light: LED, full voltage, push-to-test.

D. Pushbutton Color:

1. ON or START.
2. OFF or STOP: Red.

E. Pushbutton and selector switch lockable in OFF position where indicated.

F. Legend Plate:

1. Material: Aluminum.
2. Engraving: Enamel filled in high contrasting color.
3. Text Arrangement: 11-characters/spaces on one line, 14-characters/spaces on each of two lines, as required, indicating specific function.
4. Letter Height: 7/64 inch.

G. Manufacturers and Products:

1. Heavy-Duty, Oil-Tight Type:
   a. General Electric Co.; Type CR 104P.
   b. Square D Co.; Type T.
   c. Eaton/Cutler-Hammer; Type 10250T.
   d. Or approved equal.
2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
   a. Square D Co.; Type SK.
   b. General Electric Co.; Type CR 104P.
   c. Eaton/Cutler-Hammer; Type E34.
   d. Crouse-Hinds; Type NCS.
   e. Or approved equal.

2.04 TERMINAL BLOCK, 600 VOLTS

A. UL 486E and UL 1059.

B. Size components to allow insertion of necessary wire sizes.

C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.

D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.

E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.

F. Yoke shall guide all strands of wire into terminal.

G. Current bar shall ensure vibration-proof connection.

H. Terminals:

1. Capable of wire connections without special preparation other than stripping.
2. Capable of jumper installation with no loss of terminal or rail space.
3. Individual, rail mounted.

I. Marking system, allowing use of preprinted or field-marked tags.

J. Manufacturers:

1. Weidmuller, Inc.
2. Ideal.
3. Electrovert USA Corp.
4. Or approved equal.

## 2.05 MAGNETIC CONTROL RELAY

A. Industrial control with field convertible contacts rated 10 amps continuous, 7,200VA make, 720VA break.

B. NEMA ICS 2, Designation: A600 (600 volts).

C. Time Delay Relay Attachment:

1. Pneumatic type, timer adjustable as shown.
2. Field convertible from ON delay to OFF delay and vice versa.

D. Latching Attachment: Mechanical latch, having unlatching coil and coil clearing contacts.

E. Manufacturers and Products:

1. Eaton/Cutler-Hammer; D26 Type M.
2. General Electric Co.; Type CR120A.
3. Square D; Type X.
4. Or approved equal.

## 2.06 SUPPORT AND FRAMING CHANNELS

A. Carbon Steel Framing Channel:

1. Material: Rolled, mild strip steel, 12-gauge minimum, ASTM A1011/ A1011M, Grade 33.
2. Finish: Hot-dip galvanized after fabrication.

B. Paint Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.

C. PVC-Coated Framing Channel: Carbon steel framing channel with 40-mil polyvinyl chloride coating.

D. Stainless Steel Framing Channel: Rolled, Type 316 stainless steel, 12-gauge minimum.

E. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.
3. Aickinstrut.
4. Or approved equal.

2.07 ENCLOSURES

A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.

B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.

C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

D. Enclosure Selections: Except as shown otherwise, provide electrical enclosures according to the Area Classification and Material Selection Table on Drawings.

## PART 3 EXECUTION

3.01 GENERAL

A. Install equipment in accordance with manufacturer's recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, unless otherwise shown.

B. Install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas, unless otherwise shown.

3.03 SUPPORT AND FRAMING CHANNEL

A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.

B. Channel type shall be as indicated in the Area Classification and Material Selection Table on Drawings.

C. Paint cut ends prior to installation with the following:

1. Carbon Steel Channel: Zinc-rich primer.
2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
3. PVC-Coated Channel: PVC patch.

**END OF SECTION**

# SECTION 26 05 05
# CONDUCTORS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
2. ASTM International (ASTM):
   a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   b. B3, Standard Specification for Soft or Annealed Copper Wire.
   c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV Through 500 kV.
   b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
   c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2,500V to 500,000V.
4. Insulated Cable Engineer's Association, Inc. (ICEA):
   a. S-58-679, Standard for Control Cable Conductor Identification.
   b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
5. National Electrical Manufacturers' Association (NEMA):
   a. CC 1, Electric Power Connectors for Substations.
   b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
   c. WC 70, Standard for Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.
   d. WC 71, Standard for Nonshielded Cables Rated 2,001-5,000 Volts for Use in the Distribution of Electric Energy.
   e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.

6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
7. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
8. UL:
   a. 13, Standard for Safety for Power-Limited Circuit Cables.
   b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
   c. 62, Standard for Safety for Flexible Cord and Cables.
   d. 486A-486B, Standard for Safety for Wire Connectors.
   e. 486C, Standard for Safety for Splicing Wire Connectors.
   f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
   g. 854, Standard for Safety for Service-Entrance Cables.
   h. 1072, Standard for Safety for Medium-Voltage Power Cables.
   i. 1569, Standard for Safety for Metal-Clad Cables.
   j. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

## 1.02 SUBMITTALS

A. Action Submittals:

1. Product Data:
   a. Wire and cable.
   b. Wire and cable accessories.

B. Informational Submittals:

1. Journeyman lineman or electrician splicing credentials for conductors above 600 volts.
2. Factory Test Report per AEIC CS 8, including AEIC qualification report for conductors above 600 volts.

## 1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.

2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

B. Terminations and Splices for Conductors above 600 Volts: Work shall be done by journeyman lineman with splicing credentials or electrician certified to use materials approved for cable splices and terminations.

## PART 2 PRODUCTS

### 2.01 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 70.

B. Conductor Type:

1. 120-Volt and 277-Volt Lighting, 10 AWG and Smaller: Solid copper.
2. 120-Volt Receptacle Circuits, 10 AWG and Smaller: Solid copper.
3. All Other Circuits: Stranded copper.

C. Insulation: Type THHN/THWN-2, except for sizes No. 6 and larger, with XHHW-2 insulation.

D. Flexible Cords and Cables:

1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

### 2.02 CONDUCTORS ABOVE 600 VOLTS

A. EPR Insulated Cable:

1. Extrusion: Single-pass, triple-tandem, of conductor screen, insulation, and insulation screen.
2. Type: 5 kV and 15 kV, shielded, UL 1072, Type MV-105.
3. Conductors: Aluminum, concentric lay Class B round stranded in accordance with ASTM B3, ASTM B8, and ASTM B496.
4. Strand Fill: Waterproof strand compound enclosing conductors.
5. Conductor Screen: Extruded, semiconducting ethylene-propylene rubber in accordance with NEMA WC 71 and AEIC CS 8.
6. Insulation: 133 percent insulation level, ethylene-propylene rubber (EPR) containing no polyethylene, in accordance with NEMA WC 71, and AEIC CS 8.
7. Insulation Thickness: 115-mil, 5 kV or 220-mil, 15 kV, nominal.

8. Insulation Screen: Thermosetting, semiconducting ethylene-propylene rubber (EPR), extruded directly over insulation in accordance with NEMA WC 74 and AEIC CS 8.
9. Metallic Shield: Uncoated, 5-mil, copper shielding tape, helically applied with 12-1/2 percent minimum overlap.
10. Jacket: Extruded polyvinyl chloride (PVC) compound applied in accordance with NEMA WC 71 or NEMA WC 74.
11. Operating Temperature: 105 degrees C continuous normal operations, 130 degrees C emergency operating conditions, and 250 degrees C short-circuit conditions.
12. Manufacturers:
    a. Okonite Co.
    b. General Cable.
    c. Southwire Co.
    d. Or approved equal.

## 2.03 600-VOLT RATED CABLE

A. General:

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 1, Multiconductor Control Cable:

1. Conductors:
    a. 14 AWG, seven-strand copper.
    b. Insulation: 15-mil PVC with 4-mil nylon.
    c. UL 1581 listed as Type THHN/THWN rated VW-1.
    d. Conductor group bound with spiral wrap of barrier tape.
    e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.
2. Cable: Passes the ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.

3. Manufacturers:
   a. Okonite Co.
   b. Southwire.
   c. Or approved equal.

C. Type 2, Multiconductor Power Cable:

1. General:
   a. Meet or exceed UL 1581 for cable tray use.
   b. Meet or exceed UL 1277 for direct burial and sunlight-resistance.
   c. Overall Jacket: PVC.
2. Conductors:
   a. Class B stranded, coated copper.
   b. Insulation: Chemically cross-linked ethylene-propylene or cross-linked polyethylene.
   c. UL rated VW-1 or listed Type XHHW-2.
   d. Color Code:
      1) Conductors, size 8 AWG and smaller, colored conductors, ICEA S-58-679, Method 1, Table 1.
      2) Conductors, size 6 AWG and larger, ICEA S-73-532, Method 4.
3. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
4. Manufacturers:
   a. Okonite Co.
   b. Southwire.
   c. Or approved equal.

D. Type 3, 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

1. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
   b. 20 AWG, seven-strand tinned copper drain wire.
   c. Insulation: 15-mil nominal PVC.
   d. Jacket: 4-mil nominal nylon.
   e. Color Code: Pair conductors, black and red.

5. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.
   c. Belden.
   d. Or approved equal.

2.04 SPECIAL CABLES

A. Type 30, Unshielded Twisted Pair (UTP) Telephone and Data Cable, 600V:

1. Category 6 UTP, UL listed, and third party verified to comply with TIA/EIA 568-C Category 6 requirements.
2. Suitable for high speed network applications including gigabit Ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
3. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket.
4. NFPA 70 Plenum (CMP) rated; comply with flammability plenum requirements of NFPA 70 and NFPA 262.
5. Cable shall withstand a bend radius of 2.5-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
6. Manufacturer and Product:
   a. Belden; 7927A.
   b. Or approved equal.

2.05 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.

B. Direct Buried: Bare stranded copper.

2.06 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape:

1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.

3. Arc and Fireproofing:
   a. 30-mil, elastomer.
   b. Manufacturers and Products:
      1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
      2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.
      3) Or approved equal.

B. Identification Devices:

1. Sleeve:
   a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
   b. Manufacturers and Products:
      1) Raychem; Type D-SCE or ZH-SCE.
      2) Brady; Type 3PS.
      3) Or approved equal.
2. Heat Bond Marker:
   a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
   b. Self-laminating protective shield over text.
   c. Machine printed black text.
   d. Manufacturer and Product:
      1) 3M Co.; Type SCS-HB.
      2) Or approved equal.
3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
4. Tie-On Cable Marker Tags:
   a. Chemical-resistant white tag.
   b. Size: 1/2 inch by 2 inches.
   c. Manufacturer and Product:
      1) Raychem; Type CM-SCE.
      2) Or approved equal.
5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
   a. Manufacturers and Products:
      1) Thomas & Betts; Sta-Kon.
      2) Burndy; Insulug.
      3) ILSCO.
      4) Or approved equal.

2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
   a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
   b. Seamless.
   c. Manufacturers and Products:
      1) Thomas & Betts; Sta-Kon.
      2) Burndy; Insulink.
      3) ILSCO; ILSCONS.
      4) Or approved equal.
3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
   a. UL 486C.
   b. Plated steel, square wire springs.
   c. Manufacturers and Products:
      1) Thomas & Betts.
      2) Ideal; Twister.
      3) Or approved equal.
4. Self-Insulated, Set Screw Wire Connector:
   a. Two piece compression type with set screw in brass barrel.
   b. Insulated by insulator cap screwed over brass barrel.
   c. Manufacturers:
      1) 3M Co.
      2) Thomas & Betts.
      3) Marrette.
      4) Or approved equal.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Uninsulated Crimp Connectors and Terminators:
   a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
   b. Manufacturers and Products:
      1) Thomas & Betts; Color-Keyed.
      2) Burndy; Hydent.
      3) ILSCO.
      4) Or approved equal.
4. Uninsulated, Bolted, Two-Way Connectors and Terminators:
   a. Manufacturers and Products:
      1) Thomas & Betts; Locktite.
      2) Burndy; Quiklug.
      3) ILSCO.
      4) Or approved equal.

E. Cable Ties:

1. Nylon, adjustable, self-locking, and reusable.
2. Manufacturer and Product:
   a. Thomas & Betts; TY-RAP.
   b. Or approved equal.

F. Heat Shrinkable Insulation:

1. Thermally stabilized cross-linked polyolefin.
2. Single wall for insulation and strain relief.
3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.
4. Manufacturers and Products:
   a. Thomas & Betts; SHRINK-KON.
   b. Raychem; RNF-100 and ES-2000.
   c. Or approved equal.

## 2.07 ACCESSORIES FOR CONDUCTORS ABOVE 600 VOLTS

A. Heat Shrinkable Splice Kits:

1. Components necessary to provide insulation, metallic shielding and grounding systems, and overall jacket.
2. Capable of making splices with a current rating equal to, or greater than, cable ampacity, conforming to IEEE 404.
3. Class 5 kV or 15 kV, with compression connector, splice insulating and conducting sleeves, stress-relief materials, shielding braid and mesh, and abrasion-resistant heat shrinkable adhesive-lined rejacketing sleeve to provide a waterproof seal.
4. Manufacturers:
   a. Raychem.
   b. 3M Co.
   c. Or approved equal.

B. Termination Kits:

1. Capable of terminating 5 kV or 15 kV, single-conductor, polymeric-insulated shielded cables plus a shield ground clamp.
2. Capable of producing a termination with a current rating equal to, or greater than, cable ampacity meeting Class 1 requirements of IEEE 48.
3. Capable of accommodating cable shielding or construction without need for special adapters or accessories.

4. Manufacturers:
   a. Raychem.
   b. 3M Co.
   c. Or approved equal.

C. Bus Connection Insulation:

1. Heat shrinkable tubing, tape, and sheets of flexible cross-linked polymeric material formulated for high dielectric strength.
2. Tape and sheet products to have coating to prevent adhesion to metal surfaces.
3. Insulating materials to be removable and reusable.
4. Manufacturer:
   a. Raychem.
   b. Or approved equal.

D. Cable Lugs:

1. In accordance with NEMA CC1.
2. Rated 5 kV or 15 kV of same material as conductor metal.
3. Manufacturers and Products, Uninsulated Compression Connectors and Terminators:
   a. Burndy; Hydent.
   b. Thomas & Betts; Color-Keyed.
   c. ILSCO.
   d. Or approved equal.
4. Manufacturers and Products, Uninsulated, Bolted, Two-Way Connectors and Terminators:
   a. Thomas & Betts; Locktite.
   b. ILSCO.
   c. Or approved equal.

## 2.08 PULLING COMPOUND

A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.

B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.

C. Approved for intended use by cable manufacturer.

D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

E. Manufacturers:

1. Ideal Co.
2. Polywater, Inc.
3. Cable Grip Co.
4. Or approved equal.

2.09 WARNING TAPE

A. As specified in Section 26 05 33, Raceway and Boxes.

2.10 SOURCE QUALITY CONTROL

A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.

B. Conductors Above 600 Volts: Test in accordance with NEMA WC 71 and AEIC CS 8 partial discharge level test for EPR insulated cable.

**PART 3 EXECUTION**

3.01 GENERAL

A. Conductor installation shall be in accordance with manufacturer's recommendations.

B. Conductor and cable sizing shown is based on copper conductors for 600V circuits and aluminum conductors for circuits greater than 600V, unless noted otherwise.

C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

D. Terminate conductors and cables, unless otherwise indicated.

E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors and aluminum conductors.

F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

G. Bundling: Where single conductors and cables in manholes, handholes, vaults, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches on center.

H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.

3.02 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
2. 8 AWG and Smaller: Provide colored conductors.
3. Colors:

| System | Conductor | Color |
|---|---|---|
| All Systems | Equipment Grounding | Green |
| 240/120 Volts, Single-Phase, Three-Wire | Grounded Neutral<br>One Hot Leg<br>Other Hot Leg | White<br>Black<br>Red |
| 208Y/120 Volts, Three-Phase, Four-Wire | Grounded Neutral<br>Phase A<br>Phase B<br>Phase C | White<br>Black<br>Red<br>Blue |
| 480Y/277 Volts, Three-Phase, Four-Wire | Grounded Neutral<br>Phase A<br>Phase B<br>Phase C | White<br>Brown<br>Orange<br>Yellow |
| Note: Phase A, B, C implies direction of positive phase rotation. | | |

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

B. Conductors Above 600 Volts:

1. Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.

2. Colors:
   a. Grounded Neutral: White.
   b. Phase A: Brown.
   c. Phase B: Orange.
   d. Phase C: Yellow.

## 3.03 CIRCUIT IDENTIFICATION

A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.

B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations.

C. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.
2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

D. Method:

1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables and Conductors 2 AWG and Larger:
   a. Identify with marker plates or tie-on cable marker tags.
   b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

## 3.04 CONDUCTORS 600 VOLTS AND BELOW

A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.

B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Design Engineer.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.

3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.
5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
7. Place no more than one conductor in any single-barrel pressure connection.
8. Install crimp connectors with tools approved by connector manufacturer.
9. Install terminals and connectors acceptable for type of material used.
10. Compression Lugs:
    a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
    b. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Insulate uninsulated connections.
2. Indoors: Use general purpose, flame retardant tape or single wall heat shrink.
3. Outdoors, Dry Locations: Use flame retardant, cold- and weather-resistant tape or single wall heat shrink.
4. Belowgrade and Wet or Damp Locations: Use dual wall heat shrink.

F. Cap spare conductors with UL listed end caps.

G. Cabinets, Panels, and Motor Control Centers:

1. Remove surplus wire, bridle and secure.
2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.

2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
4. Where connections of cables installed under this section are to be made under Section 40 90 00, Instrumentation and Control, leave pigtails of adequate length for bundled connections.
5. Cable Protection:
    a. Under Infinite Access Floors: May install without bundling.
    b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2 inch in diameter.
    c. Maintain integrity of shielding of instrumentation cables.
    d. Ensure grounds do not occur because of damage to jacket over shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.05 CONDUCTORS ABOVE 600 VOLTS

A. Do not splice unless specifically indicated or approved.

B. Make joints and terminations with splice and termination kits, in accordance with kit manufacturer's instructions.

C. Install splices or terminations as continuous operation in accessible locations under clean, dry conditions.

D. Single Conductor Cable Terminations: Provide heat shrinkable stress control and outer nontracking insulation tubings, high relative permittivity stress relief mastic for insulation shield cutback treatment, and a heat-activated sealant for environmental sealing, plus a ground braid and clamp.

E. Install terminals or connectors acceptable for type of conductor material used.

F. Provide outdoor rain skirts for riser pole and outdoor switchgear terminations.

G. Provide shield termination and grounding for terminations.

H. Provide necessary mounting hardware, covers, and connectors.

I. Connections and Terminations:

1. Install uninsulated crimp connectors and terminators for power circuit conductors 4 AWG and larger.
2. Install uninsulated, bolted, two-way connectors for motor circuit conductors No. 12 and larger.
3. Insulate bus connections with heat shrinking tubing, tape, and sheets.
4. Make bus connections removable and reusable in accordance with manufacturer's instructions.

J. Where aluminum conductors are used, apply oxide-inhibiting compound at joints and terminations. Use compounds compatible with cable insulation and with components used for splicing and terminating.

3.06 CONDUCTOR ARC AND FIREPROOFING

A. Install arc and fireproofing tape on 5 kV and 15 kV cables throughout entire exposed length at splices in manholes, handholes, vaults, cable trays, and other indicated locations.

B. Wrap conductors of same circuit entering from separate conduit together as single cable.

C. Follow tape manufacturer's installation instructions.

D. Secure tape at intervals of 5 feet with bands of tapebinder. Each band to consist of a minimum of two wraps directly over each other.

3.07 BUSWAY

A. Install in strict accordance with manufacturer's recommendations and NFPA 70.

B. Maximum Support Spacing: 10 feet.

**END OF SECTION**

# SECTION 26 05 26
# GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product data for the following:
      1) Exothermic weld connectors.
      2) Mechanical connectors.
      3) Compression connectors.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

## PART 2 PRODUCTS

2.01 GROUND ROD

A. Material: Copper-clad.

B. Diameter: Minimum 5/8 inch.

C. Length: 8 feet.

2.02 GROUND CONDUCTORS

A. As specified in Section 26 05 05, Conductors.

2.03 CONNECTORS

A. Exothermic Weld Type:

1. Outdoor Weld: Suitable for exposure to elements or direct burial.
2. Indoor Weld: Utilize low-smoke, low-emission process.
3. Manufacturers and Products:
   a. Erico Products, Inc.; Cadweld and Cadweld Exolon.
   b. Thermoweld.
   c. Or approved equal.

B. Compression Type:

1. Compress-deforming type; wrought copper extrusion material.
2. Single indentation for conductors 6 AWG and smaller.
3. Double indentation with extended barrel for conductors 4 AWG and larger.
4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.
5. Manufacturers and Products:
   a. Burndy Corp.; Hyground Irreversible Compression.
   b. Thomas and Betts Co.
   c. ILSCO.
   d. Or approved equal.

C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

1. Manufacturers:
   a. Burndy Corp.
   b. Thomas and Betts Co.
   c. Or approved equal.

2.04 GROUNDING WELLS

A. Ground rod box complete with cast iron riser ring and traffic cover marked GROUND ROD.

B. Manufacturers and Products:

1. Christy Co.; No. G5.
2. Lightning and Grounding Systems, Inc.; I-R Series.
3. Or approved equal.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Grounding shall be in compliance with NFPA 70 and IEEE C2.

B. Ground electrical service neutral at service entrance equipment with grounding electrode conductor to grounding electrode system.

C. Ground each separately derived system neutral with common grounding electrode conductor to grounding electrode system.

D. Bond together all grounding electrodes that are present at each building or structure served to form one common grounding electrode system.

E. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

F. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.

G. Shielded Instrumentation Cables:

1. Ground shield to ground bus at power supply for analog signal.
2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
3. Do not ground instrumentation cable shield at more than one point.

### 3.02 WIRE CONNECTIONS

A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.

B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Connect ground conductors to raceway grounding bushings.

D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.

E. Connect enclosure of equipment containing ground bus to that bus.

F. Bolt connections to equipment ground bus.

G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

I. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amps use minimum 5/16-inch diameter bolt.

3.03 MOTOR GROUNDING

A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.

B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Motors Less Than 10 hp: Use furnished ground lug in motor connection box; if none furnished, provide compression, spade-type terminal connected to conduit box mounting screw.

D. Motors 10 hp and Above: Use furnished ground lug in motor connection box; if none furnished, tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.

E. Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 GROUND RODS

A. Install full length with conductor connection at upper end.

B. Install with connection point below finished grade, unless otherwise shown.

C. Space multiple ground rods by one rod length.

D. Install to 8 feet below local frost depth.

3.05 GROUNDING WELLS

A. Install for ground rods located inside buildings, asphalt and paved areas, and where shown on Drawings.

B. Install riser ring and cover flush with surface.

C. Place 6 inches of crushed rock in bottom of each well.

3.06 CONNECTIONS

A. General:

1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
2. Belowgrade Connections: Install exothermic weld or compression type connectors.
3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
4. Notify Owner prior to backfilling ground connections.

B. Exothermic Weld Type:

1. Wire brush or file contact point to bare metal surface.
2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
3. Avoid using badly worn molds.
4. Mold to be completely filled with metal when making welds.
5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Compression Type:

1. Install in accordance with connector manufacturer's recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer's compression tool having proper-sized dies and operate per manufacturer's instructions.

D. Mechanical Type:

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.

2. Install in accordance with connector manufacturer's recommendations.
3. Do not conceal mechanical connections.

3.07 METAL STRUCTURE GROUNDING

A. Bond metal sheathing and exposed metal vertical structural elements to grounding system.

B. Bond electrical equipment supported by metal platforms to the platforms.

C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.08 MANHOLE AND HANDHOLE GROUNDING

A. Install one ground rod inside each manhole and handhole larger than 24-inch by 24-inch inside dimensions.

B. Ground Rod Floor Protrusion: 4 inches to 6 inches above floor.

C. Make connections of grounding conductors fully visible and accessible.

D. Connect all noncurrent-carrying metal parts, and any metallic raceway grounding bushings to ground rod with 6 AWG copper conductor.

3.09 TRANSFORMER GROUNDING

A. Bond neutrals of transformers within buildings to system ground network, and to any additional indicated grounding electrodes.

B. Bond neutrals of substation transformers to substation grounding grid and system grounding network.

C. Bond neutrals of pad-mounted transformers to four locally driven ground rods and buried ground wire encircling transformer and system ground network.

3.10 SURGE PROTECTION EQUIPMENT GROUNDING

A. Connect surge arrestor ground terminals to equipment ground bus.

**END OF SECTION**

# SECTION 26 05 33
# RACEWAY AND BOXES

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges.
2. ASTM International (ASTM):
   a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
   b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   e. D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
3. National Electrical Contractor's Association, Inc. (NECA): Installation standards.
4. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. C80.1, Electrical Rigid Steel Conduit (ERSC).
   c. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   d. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.
   e. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   f. TC 6, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.
5. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
6. UL:
   a. 5, Standard for Safety for Surface Metal Raceways and Fittings.
   b. 6, Standard for Safety for Electrical Rigid Metal Conduit – Steel.
   c. 6A, Standard for Safety for Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless.

d. 514B, Standard for Safety for Conduit, Tubing, and Cable Fittings.
e. 651, Standard for Safety for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
f. 651A, Standard for Safety for Type EB and A Rigid PVC Conduit and HDPE Conduit.
g. 870, Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings.
h. 1660, Standard for Safety for Liquid-Tight Flexible Nonmetallic Conduit.
i. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway.

## 1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer's Literature:
   a. Conduit and conduit fittings.
   b. Wireways.
   c. Junction boxes.
2. Precast Manholes and Handholes:
   a. Dimensional drawings and descriptive literature.
   b. Traffic loading calculations.
   c. Accessory information.
   d. Layout drawings and list of accessories being provided.
3. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
4. Conduit Layout:
   a. Provide drawings for underground and concealed conduits including, but not limited to ductbanks, under floor slabs, concealed in floor slabs, and concealed in walls.
   b. Provide plan and section showing arrangement and location of conduit and duct bank required for:
      1) Low and medium voltage feeder and branch circuits.
      2) Instrumentation and control systems.
      3) Communications systems.
      4) Empty conduit for future use.
   c. Electronic CAD; scale not greater than 1 inch equals 20 feet.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's certification of training for PVC-coated rigid galvanized steel conduit installer.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

B. PVC-Coated, Rigid Galvanized Steel Conduit Installer: Certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

**PART 2 PRODUCTS**

2.01 CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of NEMA C80.1 and UL 6.
2. Material: Hot-dip galvanized with chromated protective layer.

B. PVC Schedule 40 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

C. PVC Schedule 80 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

D. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of NEMA RN 1.
2. Material:
   a. Meet requirements of NEMA C80.1 and UL 6.
   b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
   c. Interior Finish: Urethane coating, 2-mil nominal thickness.
3. Threads: Hot-dipped galvanized and factory coated with urethane.
4. Bendable without damage to interior or exterior coating.

E. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Material: PVC core with fused flexible PVC jacket.
2. UL 1660 listed for:
   a. Dry Conditions: 80 degrees C insulated conductors.
   b. Wet Conditions: 60 degrees C insulated conductors.
3. Manufacturers and Products:
   a. Carlon; Carflex or X-Flex.
   b. T & B; Xtraflex LTC or EFC.
   c. Or approved equal.

F. Innerduct:

1. Resistant to spread of fire, per requirements of UL 2024.
2. Smooth or corrugated HDPE.

2.02 FITTINGS

A. Rigid Galvanized Steel:

1. General:
   a. Meet requirements of UL 514B.
   b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.
2. Bushing:
   a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
   b. Manufacturers and Products:
      1) Appleton; Series BU-I.
      2) O-Z/Gedney; Type HB.
      3) Or approved equal.
3. Grounding Bushing:
   a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.

b. Manufacturers and Products:
   1) Appleton; Series GIB.
   2) O-Z/Gedney; Type HBLG.
   3) Or approved equal.

4. Conduit Hub:
   a. Material: Malleable iron with insulated throat with bonding screw.
   b. UL listed for use in wet locations.
   c. Manufacturers and Products:
      1) Appleton; Series HUB-B.
      2) O-Z/Gedney; Series CH.
      3) Meyers; ST Series.
      4) Or approved equal.
5. Conduit Bodies:
   a. Sized as required by NFPA 70.
   b. Manufacturers and Products (for Normal Conditions):
      1) Appleton; Form 35 threaded unilets.
      2) Crouse-Hinds; Form 7 or Form 8 threaded condulets.
      3) Killark; Series O electrolets.
      4) Thomas & Betts; Form 7 or Form 8.
      5) Or approved equal.
   c. Manufacturers (for Hazardous Locations):
      1) Appleton.
      2) Crouse-Hinds.
      3) Killark.
      4) Or approved equal.
6. Couplings: As supplied by conduit manufacturer.
7. Unions:
   a. Concrete tight, hot-dip galvanized malleable iron.
   b. Manufacturers and Products:
      1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.
      2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.
      3) Or approved equal.
8. Conduit Sealing Fitting:
   a. Manufacturers and Products:
      1) Appleton; Type EYF, EYM, or ESU.
      2) Crouse-Hinds; Type EYS or EZS.
      3) Killark; Type EY or Type EYS.
      4) Or approved equal.
9. Drain Seal:
   a. Manufacturers and Products:
      1) Appleton; Type EYD.
      2) Crouse-Hinds; Type EYD or Type EZD.
      3) Or approved equal.

10. Drain/Breather Fitting:
    a. Manufacturers and Products:
        1) Appleton; Type ECDB.
        2) Crouse-Hinds; ECD.
        3) Or approved equal.
11. Expansion Fitting:
    a. Manufacturers and Products:
        1) Deflection/Expansion Movement:
            a) Appleton; Type DF.
            b) Crouse-Hinds; Type XD.
            c) Or approved equal.
        2) Expansion Movement Only:
            a) Appleton; Type XJ.
            b) Crouse-Hinds; Type XJ.
            c) Thomas & Betts; XJG-TP.
            d) Or approved equal.
12. Cable Sealing Fitting:
    a. To form watertight nonslip cord or cable connection to conduit.
    b. For Conductors with OD of 1/2 inch or Less: Neoprene bushing at connector entry.
    c. Manufacturers and Products:
        1) Appleton; CG-S.
        2) Crouse-Hinds; CGBS.
        3) Or approved equal.

B. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC 3.
2. Type: PVC, slip-on.

C. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of UL 514B.
2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
3. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
4. Finish: 40-mil PVC exterior, 2-mil urethane interior.
5. Overlapping pressure-sealing sleeves.
6. Conduit Hangers, Attachments, and Accessories: PVC-coated.
7. Manufacturers:
    a. Robroy Industries.
    b. Ocal.
    c. Or approved equal.

8. Expansion Fitting:
    a. Manufacturer and Product:
        1) Ocal; OCAL-BLUE XJG.
        2) Or approved equal.

D. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Meet requirements of UL 514B.
2. Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.
3. Body/compression nut (gland) design to ensure high mechanical pullout strength and watertight seal.
4. Manufacturers and Products:
    a. Carlon; Type LT.
    b. O-Z/Gedney; Type 4Q-P.
    c. Thomas & Betts; Series 6300.
    d. Or approved equal.

E. Watertight Entrance Seal Device:

1. New Construction:
    a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
    b. Manufacturer and Product:
        1) O-Z/Gedney; Type FSK or Type WSK, as required.
        2) Or approved equal.
2. Cored-Hole Application:
    a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
    b. Manufacturer and Product:
        1) O-Z/Gedney; Series CSM.
        2) Or approved equal.

## 2.03 OUTLET AND DEVICE BOXES

A. Sheet Steel: One-piece drawn type, zinc-plated or cadmium-plated.

B. Cast Metal:

1. Box: Malleable iron or cast ferrous metal.
2. Cover: Gasketed, weatherproof, malleable iron, or cast ferrous metal, with stainless steel screws.
3. Hubs: Threaded.
4. Lugs: Cast mounting.

5. Manufacturers and Products, Nonhazardous Locations:
   a. Crouse-Hinds; Type FS or Type FD.
   b. Appleton; Type FS or Type FD.
   c. Killark.
   d. Or approved equal.
6. Manufacturers and Products, Hazardous Locations:
   a. Crouse-Hinds; Type GUA or Type EAJ.
   b. Appleton; Type GR.
   c. Or approved equal.

C. Cast Aluminum:

1. Material:
   a. Box: Cast, copper-free aluminum.
   b. Cover: Gasketed, weatherproof, cast copper-free aluminum with stainless steel screws.
2. Hubs: Threaded.
3. Lugs: Cast mounting.
4. Manufacturers and Products, Nonhazardous Locations:
   a. Crouse-Hinds; Type FS-SA or Type FD-SA.
   b. Appleton; Type FS or Type FD.
   c. Killark.
   d. Or approved equal.
5. Manufacturers and Products, Hazardous Locations:
   a. Crouse-Hinds; Type GUA-SA.
   b. Appleton; Type GR.
   c. Or approved equal.

## 2.04 JUNCTION AND PULL BOXES

A. Outlet Box Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.

B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.

C. Sheet Steel Box:

1. NEMA 250, Type 1.
2. Box: Code-gauge, galvanized steel.
3. Cover: Full access, screw type.
4. Machine Screws: Corrosion-resistant.

D. Cast Metal Box:

1. NEMA 250, Type 4.
2. Box: Cast malleable iron, or ferrous metal, electrogalvanized finished, with drilled and tapped conduit entrances and exterior mounting lugs.
3. Cover: Hinged with clamps.
4. Gasket: Neoprene.
5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
6. Manufacturers and Products, Surface Mounted Nonhinged Type:
   a. Crouse-Hinds; Series W.
   b. O-Z/Gedney; Series Y.
   c. Or approved equal.
7. Manufacturer and Product, Surface Mounted, Hinged Type:
   a. O-Z/Gedney; Series YW.
   b. Or approved equal.
8. Manufacturers and Products, Recessed Type:
   a. Crouse-Hinds; Type WJBF.
   b. O-Z/Gedney; Series YR.
   c. Or approved equal.

E. Stainless Steel Box:

1. NEMA 250 Type 4X.
2. Box: 14-gauge, ASTM A240/A240M, Type 316 stainless steel, with white enamel painted interior mounting panel.
3. Cover: Hinged with clamps.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Manufacturers:
   a. Hoffman Engineering Co.
   b. Robroy Industries.
   c. Wiegman.
   d. Or approved equal.

F. Steel Box:

1. NEMA 250 Type 1, 3R, and 12.
2. Box: 10-gauge steel, with white enamel painted interior and gray primed exterior, over phosphated surfaces. Provide gray finish.
3. Cover: Hinged with clamps.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Manufacturers:
   a. Hoffman Engineering Co.
   b. Robroy Industries.
   c. Wiegman.
   d. Or approved equal.

G. Concrete Box, Nontraffic Areas:

1. Box: Reinforced, cast concrete with extension.
2. Cover: Steel diamond plate with locking bolts.
3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
4. Size: 10 inches by 17 inches, minimum.
5. Manufacturers and Products:
   a. Utility Vault Co.; Series 36-1017.
   b. Christy, Concrete Products, Inc.; N9.
   c. Quazite; “PG” Style.
   d. Or approved equal.

H. Concrete Box, Traffic Areas:

1. Box: Reinforced, cast concrete with extension and bottom slab.
2. Cover: Steel checked plate; H/20 loading with screw down.
3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
4. Manufacturers and Products:
   a. Christy, Concrete Products, Inc.; B1017BOX.
   b. Utility Vault Co.; 3030 SB.
   c. Or approved equal.

## 2.05 METAL WIREWAYS

A. Meet requirements of UL 870.

B. Type: Steel-enclosed, lay-in type.

C. Cover: Removable, screw type.

D. Rating: Indoor.

E. Finish: Rust inhibiting phosphatizing primer and gray baked enamel.

F. Hardware: Plated to prevent corrosion; screws installed toward the inside protected by spring nuts or otherwise guarded to prevent wire insulation damage.

G. Knockouts: Without knockouts, unless otherwise indicated.

H. Manufacturers:

1. Circle AW.
2. Hoffman.
3. Square D.
4. Or approved equal.

## 2.06 CAST-IN-PLACE MANHOLES

A. Concrete and reinforcing steel as specified in Section 03 30 10, Structural Reinforced Concrete.

B. Dimensions as shown on Drawings.

C. Provide all accessories and a cover identical to precast manholes as specified in this section.

## 2.07 PRECAST MANHOLES AND HANDHOLES

A. Concrete Strength: Minimum, 3,000 psi compressive, in 28 days.

B. Loading: AASHTO, H-20 in accordance with ASTM C857.

C. Access: Provide cast concrete risers and access hole adapters between top of manhole and finished grade at required elevations.

D. Drainage:

1. Slope floors toward drain points, leaving no pockets or other nondraining areas.
2. Provide drainage outlet or sump at low point of floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and a minimum 4-inch outlet and outlet pipe.

E. Raceway Entrances:

1. Provide on all four sides.
2. Provide knockout panels or precast individual raceway openings.
3. At entrances where raceways are to be installed by others, provide minimum 12-inch-high by 24-inch-wide knockout panels for future raceway installation.

F. Embedded Pulling Iron:

1. Material: 3/4-inch-diameter stock, fastened to overall steel reinforcement before concrete is placed.
2. Location:
   a. Wall: Opposite each raceway entrance and knockout panel for future raceway entrance.
   b. Floor: Centered below manhole or handhole cover.

G. Cable Racks:

1. Arms and Insulators: Adjustable, of sufficient number to accommodate cables for each raceway entering or leaving manhole, including spares.
2. Wall Attachment:
   a. Adjustable inserts in concrete walls. Bolts or embedded studs not permitted.
   b. Insert Spacing: Maximum 3 feet on center for inside perimeter of manhole.
   c. Arrange in order that spare raceway ends are clear for future cable installation.

H. Manhole Frames and Covers:

1. Material: Machined cast iron.
2. Size and Type: As indicated on Drawings.
3. Cover Loading: AASHTO H-20.
4. Cover Designation:
   a. On upper side, in integral letters, minimum 2 inches in height, appropriate titles:
      1) Above 600 Volts: ELECTRIC HV.
      2) 600 Volts and Below: ELECTRIC LV.
      3) COMMUNICATIONS.

I. Handhole Frames and Covers:

1. Size and Type: As indicated on Drawings.
2. Cover Loading: AASHTO H-20.
3. Cover Designation:
   a. On upper side in integral letters, minimum 2 inches in height, appropriate titles:
      1) 600 Volts and Below: ELECTRIC LV.
      2) COMMUNICATIONS.

J. Hardware: Stainless steel.

K. Furnish knockout for ground rod in each handhole and manhole.

L. Manufacturer:

1. Utility Vault Co.
2. Or approved equal.

## 2.08 ACCESSORIES

A. Duct Bank Spacers:

1. Modular Type:
   a. Nonmetallic, interlocking, for multiple conduit sizes.
   b. Suitable for all types of conduit.
   c. Manufacturers:
      1) Underground Device, Inc.
      2) Carlon.
      3) Or approved equal.
2. Template Type:
   a. Nonmetallic, custom made one-piece spacers.
   b. Suitable for all types of conduit.
   c. Material: HDPE or polypropylene, 1/2-inch minimum thickness.
   d. Conduit openings cut 1 inch larger than conduit outside diameter.
   e. Additional openings for stake-down, rebar, and concrete flow through as required.
   f. Manufacturer and Product:
      1) SP Products; Quik Duct.
      2) Or approved equal.

B. Identification Devices:

1. Raceway Tags:
   a. Material: Permanent, nylon.
   b. Raceway Designation: Pressure stamped, embossed, or engraved.
   c. Tags relying on adhesives or taped-on markers not permitted.
2. Warning Tape:
   a. Material: Polyethylene, 4-mil gauge with detectable strip.
   b. Color: Red.
   c. Width: Minimum 6 inches.
   d. Designation: Warning on tape that electric circuit is located below tape.
   e. Identifying Letters: Minimum 1-inch-high permanent black lettering imprinted continuously over entire length.
   f. Manufacturers and Products:
      1) Panduit; Type HTDU.
      2) Reef Industries; Terra Tape.
      3) Or approved equal.

C. Heat Shrinkable Tubing:

1. Material: Heat-shrinkable, cross-linked polyolefin.
2. Semi-flexible with meltable adhesive inner liner.

3. Color: Black.
4. Manufacturers:
   a. Raychem.
   b. 3M.
   c. Or approved equal.

D. Wraparound Duct Band:

1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
2. Width: 50 mm minimum.
3. Manufacturer and Product:
   a. Raychem; Type TWDB.
   b. Or approved equal.

## PART 3 EXECUTION

3.01 GENERAL

A. Conduit and tubing sizes shown are based on use of copper conductors. Reference Section 26 05 05, Conductors, concerning conduit sizing for aluminum conductors.

B. Comply with NECA Installation Standards.

C. Crushed or deformed raceways not permitted.

D. Maintain raceway entirely free of obstructions and moisture.

E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.

F. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.

G. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

H. Group raceways installed in same area.

I. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.

J. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.

K. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.

L. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.

M. Install watertight fittings in outdoor, underground, or wet locations.

N. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.

O. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.

P. Do not install raceways in concrete equipment pads, foundations, or beams without Design Engineer approval.

Q. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.

R. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

S. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of TIA 569B.

3.02 REUSE OF EXISTING CONDUITS

A. Where Drawings indicate existing conduits may be reused, they may be reused only where they meet the following criteria.

1. Conduit is in useable condition with no deformation, corrosion, or damage to exterior surface.
2. Conduit is sized per the NEC.
3. Conduit is of the type specified in Contract Documents.
4. Conduit is supported as specified in Contract Documents.

B. Conduit shall be reamed with wire brush, then with a mandrel approximately 1/4 inch smaller than raceway inside diameter, then cleaned prior to pulling new conductors.

## 3.03 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

A. Minimum Cover: 2 inches, including fittings.

B. Conduit placement shall not require changes in reinforcing steel location or configuration.

C. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.

D. Conduit larger than 1 inch shall not be embedded in concrete slabs, walls, foundations, columns, or beams unless approved by Design Engineer.

E. Slabs and Walls (Requires Design Engineer Approval):

1. Trade size of conduit not to exceed one-fourth of slab or wall thickness.
2. Install within middle two-fourths of slab or wall.
3. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.
4. Separate conduit 2-inch and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
5. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1 inch.
6. Separate conduit by a minimum six times the outside dimension of expansion/deflection fittings at expansion joints.
7. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.

F. Columns and Beams (Requires Design Engineer Approval):

1. Trade size of conduit not to exceed one-fourth of beam thickness.
2. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

## 3.04 CONDUIT APPLICATION

A. Diameter: Minimum 3/4 inch.

B. In addition to the requirements below, refer to the Area Classification Table on Drawings.

C. Direct Earth Burial: PVC Schedule 40.

D. Concrete-Encased Ductbank: PVC Schedule 40 for ac circuits, PVC-Coated Rigid Galvanized Steel for dc, analog, or copper communication or other circuits sensitive to electromagnetic interference.

E. Under Slabs-on-Grade: PVC Schedule 40 for ac circuits, PVC-Coated Rigid Galvanized Steel for dc, analog, or copper communication or other circuits sensitive to electromagnetic interference.

F. Transition from Underground or Concrete Embedded to Exposed: PVC-coated rigid steel conduit.

3.05 FLEXIBLE CONNECTIONS

A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other locations approved by Construction Manager where flexible connection is required to minimize vibration:

1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.
2. Conduit Size Over 4 Inches: Nonflexible.
3. Wet or Corrosive Areas: Flexible, nonmetallic liquid-tight.
4. Dry Areas: Flexible, metallic liquid-tight.
5. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.

B. Suspended Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.

C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

D. Flexible Conduit Length: 18 inches minimum, 60 inches maximum; sufficient to allow movement or adjustment of equipment.

3.06 PENETRATIONS

A. Make at right angles, unless otherwise shown.

B. Notching or penetration of structural members, including footings and beams, not permitted.

C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating as specified in Section 26 05 04, Basic Electrical Materials and Methods.

D. Apply heat shrinkable tubing or single layer of wraparound duct band to metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface.

E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.

F. Entering Structures:

1. General: Seal raceway at first box or outlet with oakum or expandable plastic compound to prevent entrance of gases or liquids from one area to another.
2. Concrete Roof or Membrane Waterproofed Wall or Floor:
   a. Provide a watertight seal.
   b. Without Concrete Encasement: Install watertight entrance seal device on each side.
   c. With Concrete Encasement: Install watertight entrance seal device on accessible side.
   d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
   e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
3. Heating, Ventilating, and Air Conditioning Equipment:
   a. Penetrate equipment in area established by manufacturer.
   b. Terminate conduit with flexible nonmetallic conduit at junction box or condulet attached to exterior surface of equipment prior to penetrating equipment.
   c. Seal penetration with Type 5 sealant, as specified in Section 07 92 00, Joint Sealants.
4. Corrosive-Sensitive Areas:
   a. Seal conduit passing through walls.
   b. Seal conduit entering equipment panel boards and field panels containing electronic equipment.
   c. Seal penetration with Type 5 sealant, as specified in Section 07 92 00, Joint Sealants.
5. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.
6. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
   a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
   b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.
7. Manholes and Handholes:
   a. Metallic Raceways: Provide insulated grounding bushings.
   b. Nonmetallic Raceways: Provide bell ends flush with wall.
   c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.07 SUPPORT

A. Support from structural members only, at intervals not exceeding NFPA 70 requirements. Do not exceed 10 feet in any application. Do not support from piping, pipe supports, or other raceways.

B. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 25 percent extra space for future conduit.

C. Application/Type of Conduit Strap:

1. Rigid Steel Conduit: Zinc coated steel, pregalvanized steel or malleable iron.
2. PVC-Coated Rigid Steel Conduit: PVC-coated metal.
3. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.

D. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

1. Wood: Wood screws.
2. Hollow Masonry Units: Toggle bolts.
3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
4. Steelwork: Machine screws.
5. Location/Type of Hardware: Refer to the Area Classification and Materials Selection Table on Drawings.

E. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

F. Support aluminum conduit on concrete surfaces with stainless steel or nonmetallic spacers, or aluminum or nonmetallic framing channel.

3.08 BENDS

A. Install concealed raceways with a minimum of bends in the shortest practical distance.

B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.

C. Install with symmetrical bends or cast metal fittings.

D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.

E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

G. PVC Conduit:

1. Bends 30 Degrees and Larger: Provide factory-made elbows.
2. 90-Degree Bends: Provide rigid steel elbows, PVC-coated rigid steel where direct buried.
3. Use manufacturer's recommended method for forming smaller bends.

H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

## 3.09 EXPANSION/DEFLECTION FITTINGS

A. Provide on raceways at structural expansion joints and in long tangential runs.

B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.

C. Install in accordance with manufacturer's instructions.

## 3.10 PVC CONDUIT

A. Solvent Welding:

1. Apply manufacturer recommended solvent to joints.
2. Install in order that joint is watertight.

B. Adapters:

1. PVC to Metallic Fittings: PVC terminal type.
2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.

C. Belled-End Conduit: Bevel unbelled end of joint prior to joining.

## 3.11 PVC-COATED RIGID STEEL CONDUIT

A. Install in accordance with manufacturer's instructions.

B. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.

C. Provide PVC boot to cover exposed threading.

## 3.12 WIREWAYS

A. Install in accordance with manufacturer's instructions.

B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.

C. Applications:

1. Metal wireway in indoor dry locations.
2. Nonmetallic wireway in indoor wet, outdoor, and corrosive locations.

## 3.13 TERMINATION AT ENCLOSURES

A. Cast Metal Enclosure: Install manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. Nonmetallic, Cabinets, and Enclosures:

1. Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.
2. Metallic Conduit: Provide ground terminal for connection to maintain continuity of ground system.

C. Sheet Metal Boxes, Cabinets, and Enclosures:

1. General:
   a. Install insulated bushing on ends of conduit where grounding is not required.
   b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
   c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.
   d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
   e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.

2. Rigid Galvanized Conduit:
   a. Provide one lock nut each on inside and outside of enclosure.
   b. Install grounding bushing at source enclosure.
   c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.
3. Electric Metallic Tubing: Provide gland compression, insulated connectors.
4. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
5. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.
6. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.
7. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut, except where threaded hubs required above.

D. Control Center, Switchboard, Switchgear, and Free-Standing Enclosures:

1. Terminate metal conduit entering bottom with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.
2. Terminate PVC conduit entering bottom with bell end fittings.

## 3.14 UNDERGROUND RACEWAYS

A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.

B. Cover: Maintain minimum 2-foot cover above concrete encasement, unless otherwise shown.

C. Make routing changes as necessary to avoid obstructions or conflicts.

D. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.

E. Union type fittings not permitted.

F. Spacers:

1. Provide preformed, nonmetallic spacers designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.

G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.

H. Installation with Other Piping Systems:

1. Crossings: Maintain minimum 12-inch vertical separation.
2. Parallel Runs: Maintain minimum 12-inch separation.
3. Installation over valves or couplings not permitted.

I. Provide expansion fittings that allow minimum of 4 inches of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.

J. Provide expansion/deflection fittings in conduit runs that exit building or structure belowgrade. Conduit from building wall to fitting shall be PVC-coated rigid steel.

K. Concrete Encasement: As specified in Section 03 30 10, Structural Reinforced Concrete.

L. Backfill: As specified in Section 31 23 23.15, Trench Backfill.

## 3.15 UNDER SLAB RACEWAYS

A. Make routing changes as necessary to avoid obstructions or conflicts.

B. Support raceways so as to prevent bending or displacement during backfilling or concrete placement.

C. Install raceways with no part embedded within slab and with no interference with slab on grade construction.

D. Raceway spacing, in a single layer or multiple layers:

1. 3 inches clear between adjacent 2-inch or larger raceway.
2. 2 inches clear between adjacent 1-1/2-inch or smaller raceway.

E. Multiple Layers of Raceways: Install under slab on grade in trench below backfill zone, as specified in Section 31 23 23.15, Trench Backfill.

F. Individual Raceways and Single Layer Multiple Raceways: Install at lowest elevation of backfill zone with spacing as specified herein. Where conduits cross at perpendicular orientation, installation of conduits shall not interfere with placement of under slab fill that meets compaction and void limitations of earthwork specifications.

G. Under slab raceways that emerge from below slab to top of slab as exposed, shall be located to avoid conflicts with structural slab rebar. Coordinate raceway stub ups with location of structural rebar.

H. Fittings:

1. Union type fittings are not permitted.
2. Provide expansion/deflection fittings in raceway runs that exit building or structure below slab. Locate fittings 18 inches, maximum, beyond exterior wall. Raceway type between building exterior wall to fitting shall be PVC-coated rigid steel.
3. Couplings: In multiple raceway runs, stagger so couplings in adjacent runs are not in same traverse line.

## 3.16 OUTLET AND DEVICE BOXES

A. General:

1. Install plumb and level.
2. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.
3. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.
4. Install galvanized mounting hardware in industrial areas.

B. Size:

1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
   a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
2. Ceiling Outlet: Minimum 4-inch octagonal device box, unless otherwise required for installed fixture.
3. Switch and Receptacle: Minimum 2-inch by 4-inch device box.

C. Locations:

1. Drawing locations are approximate.
2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Construction Manager.
3. Light Fixture: Install in symmetrical pattern according to room layout, unless otherwise shown.

D. Mounting Height:

1. General:
   a. Dimensions given to centerline of box.
   b. Where specified heights do not suit building construction or finish, adjust up or down to avoid interference.
   c. Do not straddle CMU block or other construction joints.
2. Light Switch:
   a. 48 inches above floor.
   b. When located next to door, install on lock side of door.
3. Thermostat: 54 inches above floor.
4. Telephone Outlet:
   a. 15 inches above floor.
   b. 6 inches above counter tops.
   c. Wall Mounted: 52 inches above floor.
5. Convenience Receptacle:
   a. General Interior Areas: 15 inches above floor.
   b. General Interior Areas (Counter Tops): Install device plate bottom or side flush with top of backsplash, or 6 inches above counter tops without backsplash.
   c. Outdoor Areas: 24 inches above finished grade.
6. Special-Purpose Receptacle: 24 inches above floor or as shown.
7. Switch, Motor Starting: 48 inches above floor, unless otherwise indicated on Drawings.

E. Flush Mounted:

1. Install with concealed conduit.
2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
3. Holes in surrounding surface shall be no larger than required to receive box.

F. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
   a. Wood: Wood screws.
   b. Concrete or Brick: Bolts and expansion shields.
   c. Hollow Masonry Units: Toggle bolts.
   d. Steelwork: Machine screws.
3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

4. Provide plaster rings where necessary.
5. Boxes embedded in concrete or masonry need not be additionally supported.

G. Install separate junction boxes for flush or recessed lighting fixtures where required by fixture terminal temperature.

H. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

## 3.17 JUNCTION AND PULL BOXES

A. General:

1. Install plumb and level.
2. Installed boxes shall be accessible.
3. Do not install on finished surfaces.
4. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
5. Use conduit bodies as junction and pull boxes where no splices are required and allowed by applicable codes.
6. Install pull boxes where necessary in raceway system to facilitate conductor installation.
7. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
8. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

B. Mounting Hardware: Refer to the Area Classification and Material Selection Table on Drawings.

C. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
   a. Wood: Wood screws.
   b. Concrete or Brick: Bolts and expansion shields.
   c. Hollow Masonry Units: Toggle bolts.
   d. Steelwork: Machine screws.
3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
4. Boxes embedded in concrete or masonry need not be additionally supported.

D. At or Belowgrade:

1. Install boxes for belowgrade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
3. Obtain Owner's written acceptance prior to installation in paved areas, roadways, or walkways.
4. Use boxes and covers suitable to support anticipated weights.

E. Install drain/breather fittings in NEMA 250 Type 4 and Type 4X enclosures.

## 3.18 MANHOLES AND HANDHOLES

A. Excavate, shore, brace, backfill, and final grade in accordance with Section 31 23 16, Excavation, and Section 31 23 23.15, Trench Backfill.

B. Do not install until final raceway grading has been determined.

C. Install such that raceway enters at nearly right angle and as near as possible to end of wall, unless otherwise shown.

D. Grounding: As specified in Section 26 05 26, Grounding and Bonding for Electrical Systems.

E. Identification: Field stamp covers with manhole or handhole number as shown. Stamped numbers to be 1-inch minimum height.

## 3.19 EMPTY RACEWAYS

A. Provide permanent, removable cap over each end.

B. Provide PVC plug with pull tab for underground raceways with end bells.

C. Provide nylon pull cord.

D. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

## 3.20 IDENTIFICATION DEVICES

A. Raceway Tags:

1. Identify origin and destination.
2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every 50 feet, whether in ceiling space or surface mounted.

3. Install tags at each terminus for concealed raceways.
4. Provide nylon strap for attachment.

B. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of run.

3.21 PROTECTION OF INSTALLED WORK

A. Protect products from effects of moisture, corrosion, and physical damage during construction.

B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.

C. Touch up painted conduit threads after assembly to cover nicks or scars.

D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

**END OF SECTION**

# SECTION 26 05 70
# ELECTRICAL SYSTEMS ANALYSIS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
   b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
   c. 399, Recommended Practice for Industrial and Commercial Power System Analysis.
   d. 1584, Guide for Performing Arc Flash Hazard Calculations.
3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
4. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70E, Standard for Electrical Safety in the Workplace.
5. Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910 Subpart S, Electrical.

### 1.02 SUBMITTALS

A. Action Submittals:

1. Short circuit study.
2. Protective Device Coordination Study: Submit within 90 days after approval of short circuit study.
3. Arc Flash Study: Submit initial study with protective Device Coordination Study. Submit final study prior to equipment energization.
4. Arc flash warning labels; submit sample with initial study.
5. Electronic files of final studies including all engineering software input files, output reports, and libraries.

### 1.03 QUALITY ASSURANCE

A. Short circuit and protective device coordination and arc flash studies shall be prepared by a professional electrical engineer registered in the State of California.

1.04 SEQUENCING AND SCHEDULING

A. Initial complete short circuit study shall be submitted and reviewed before Design Engineer will review Shop Drawings for equipment for incoming service equipment.

B. Initial complete protective device coordination and arc flash studies shall be submitted within 90 days after approval of initial short circuit study.

C. Initial complete arc flash study shall be submitted and accepted prior to energization of the electrical equipment.

D. Revised short circuit, protective device coordination, arc flash studies, and arc flash labels shall be submitted 10 days before energizing electrical equipment.

E. Final short circuit, protective device coordination, and arc flash studies shall be completed prior to Project Substantial Completion. Final version of study shall include as-installed equipment, materials, and parameter data or settings entered into equipment based on study.

F. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to Project Substantial Completion.

1.05 GENERAL STUDY REQUIREMENTS

A. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on Drawings.

B. Perform studies using one of the following electrical engineering software packages:

1. SKM Power Tools for Windows.
2. ETAP.
3. Paladin.
4. Easy Power.

C. Perform complete fault calculations for each proposed source combination.

1. Source combination may include present and future power company supply circuits, large motors, or generators.

D. Utilize proposed and existing load data for study as shown on Drawings and as provided by Construction Manager and obtained from available Record Drawings.

E. Existing System and Equipment:

1. Extent of existing system to be included in study is limited to system elements that affect new system and equipment.
2. Include fault contribution of existing motors and equipment in study.
3. Include impedance elements that affect new system and equipment.
4. Include protective devices in series with new equipment.

F. Device coordination time-current curves for medium voltage distribution system; include individual protective device time-current characteristics.

1.06 SHORT CIRCUIT STUDY

A. General:

1. Prepare in accordance with IEEE 399.
2. Use cable impedances based on copper conductors, except where aluminum conductors are specified or shown.
3. Use bus impedances based on copper bus bars, except where aluminum bus bars are specified or shown.
4. Use cable and bus resistances calculated at 25 degrees C.
5. Use medium-voltage cable reactances based on use of typical dimensions of shielded cables with 133 percent insulation levels.
6. Use 600-volt cable reactances based on use of typical dimensions of XHHW conductors.
7. Use transformer impedances 92.5 percent of "nominal" impedance based on tolerances specified in IEEE C57.12.00.

B. Provide:

1. Calculation methods and assumptions.
2. Typical calculation.
3. Tabulations of calculated quantities.
4. Results, conclusions, and recommendations.
5. Selected base per unit quantities.
6. One-line diagrams.
7. Source impedance data, including electric utility system and motor fault contribution characteristics.
8. Impedance diagrams.
9. Zero-sequence impedance diagrams.

C. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault at each:

1. Electric utility's supply termination point.
2. Main switchgear.

D. Verify:

1. Equipment and protective devices are applied within their ratings.
2. Adequacy of switchgear bus bars to withstand short circuit stresses.
3. Cable and busway sizes for ability to withstand short circuit heating, in addition to normal load currents.

E. Tabulations:

1. General Data:
   a. Short circuit reactances of rotating machines.
   b. Cable and conduit material data.
   c. Bus data.
   d. Transformer data.
   e. Circuit resistance and reactance values.
2. Short Circuit Data (for each source combination):
   a. Fault impedances.
   b. X to R ratios.
   c. Asymmetry factors.
   d. Motor contributions.
   e. Short circuit kVA.
   f. Symmetrical and asymmetrical fault currents.
3. Equipment Evaluation:
   a. Equipment bus bracing, equipment short circuit rating, transformer, cable, busway.
   b. Maximum fault current available.

F. Written Summary:

1. Scope of studies performed.
2. Explanation of bus and branch numbering system.
3. Prevailing conditions.
4. Selected equipment deficiencies.
5. Results of short circuit study.
6. Comments or suggestions.

G. Suggest changes and additions to equipment rating and/or characteristics.

H. Notify Construction Manager in writing of existing circuit protective devices improperly rated for new fault conditions.

I. Revise data for “as-installed” condition.

1.07 PROTECTIVE DEVICE COORDINATION STUDY

A. General:

1. Prepare in accordance with IEEE 242.
2. Proposed protective device coordination time-current curves for distribution system, graphically displayed on conventional log-log curve sheets.
   a. Provide separate curve sheets for phase and ground fault coordination for each scenario.
   b. Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet. Limit number of devices shown to four to six.
   c. Identify device associated with each curve by manufacturer type, function, and, if applicable, recommended tap, time delay, instantaneous and other settings recommended.
   d. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
   e. Apply motor protection methods that comply with NFPA 70.

B. Plot Characteristics on Curve Sheets:

1. Electric utility’s relays.
2. Electric utility’s fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands.
3. Medium-voltage equipment relays.
4. Medium-voltage and low-voltage fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands.
5. Low-voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
6. Pertinent transformer full-load currents at 100 percent.
7. Transformer magnetizing inrush currents.
8. Transformer damage curves; appropriate for system operation and location.
9. ANSI transformer withstand parameters.
10. Significant symmetrical and asymmetrical fault currents.
11. Ground fault protective device settings.
12. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center.

C. Primary Protective Device Settings for Delta-Wye Connected Transformer:

1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within transformer's characteristics curve, including a point equal to 58 percent of IEEE C57.12.00 withstand point.
2. Secondary Line-to-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.

D. Separate medium voltage relay characteristics curves from curves for other devices by at least 0.4-second time margin.

E. Tabulate Recommended Protective Device Settings:

1. Relays:
   a. Current tap.
   b. Time dial.
   c. Instantaneous pickup.
   d. Electronic settings data file.
2. Circuit Breakers:
   a. Adjustable pickups.
   b. Adjustable time-current characteristics.
   c. Adjustable time delays.
   d. Adjustable instantaneous pickups.
   e. $I^2t$ In/Out.
   f. Zone interlocking.
   g. Electronic settings data file.

F. Written Summary:

1. Scope of studies performed.
2. Summary of protective device coordination methodology.
3. Prevailing conditions.
4. Selected equipment deficiencies.
5. Results of coordination study.
6. Appendix of complete relay and circuit breaker electronic setting files, submit electronic data files from manufacturer's software.
7. Comments or suggestions.

## 1.08 ARC FLASH STUDY

A. Perform arc flash hazard study after short circuit and protective device coordination study has been completed, reviewed, and accepted.

B. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.

C. Base Calculation:

1. For each major part of electrical power system, determine the following:
   a. Flash hazard protection boundary.
   b. Limited approach boundary.
   c. Restricted approach boundary.
   d. Incident energy level.
   e. Glove class required.

D. Produce arc flash warning labels that list items in Paragraph Base Calculation and the following additional items.

1. Bus name.
2. Bus voltage.

E. Produce bus detail sheets that list items in Paragraph Base Calculation and the following additional items:

1. Bus name.
2. Upstream protective device name, type, and settings.
3. Bus line-to-line voltage.

F. Produce arc flash evaluation summary sheet listing the following additional items:

1. Bus name.
2. Upstream protective device name, type, settings.
3. Bus line-to-line voltage.
4. Bus bolted fault.
5. Protective device bolted fault current.
6. Arcing fault current.
7. Protective device trip/delay time.
8. Breaker opening time.
9. Solidly grounded column.
10. Equipment type.
11. Gap.
12. Arc flash boundary.
13. Working distance.
14. Incident energy.

G. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 8 cal/cm2. Propose approaches to reduce energy levels.

H. Prepare report summarizing arc flash study with conclusions and recommendations which may affect integrity of electric power distribution system. As a minimum, include the following:

1. Equipment manufacturer's information used to prepare study.
2. Assumptions made during study.
3. Reduced copy of one-line drawing; 11 inches by 17 inches maximum.
4. Arc flash evaluations summary spreadsheet.
5. Bus detail sheets.
6. Arc flash warning labels printed in color on thermally bonded adhesive backed UV and weather-resistant labels.

## PART 2 PRODUCTS

### 2.01 ARC FLASH WARNING LABELS

A. Arc flash warning labels printed in color on thermally bonded adhesive backed, UV- and weather-resistant labels. An example label is located following end of section in Figure 1.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Adjust relay and protective device settings according to values established by coordination study.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify Construction Manager in writing of required major equipment modifications.

D. Provide laminated one-line diagrams (minimum size 11 inches by 17 inches) to post on interior of electrical room doors.

E. Provide arc flash warning labels on equipment as specified in this section.

3.02 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification:

1. Shock and Arc Flash Hazard Label.

**END OF SECTION**

**SHOCK AND ARC FLASH HAZARD: APPROPRIATE PPE REQUIRED, ONLY QUALIFIED PERSONS MAY PERFORM ENERGIZED WORK ON THIS EQUIPMENT**

| SHOCK HAZARD | | ARC FLASH HAZARD | | Incident Energy |
|---|---|---|---|---|
| 208 VAC | With Cover Removed | 18 in | Working Distance | 0.31 cal/cm^2 @ Working Distance |
| 42 in | Limited Approach | 4 in | Arc Flash Boundary | |
| 12 in | Restricted Approach | | | |
| 265-LP-001 | | | | |
| 00 | Glove Class | ch2m. 1100 112th AVE NE, Suite 500 Bellevue, WA (425) 453-5000 | | |
| 2.90 kA | Bus Bolted Fault | | | |
| CH2M ID: | 439172 | | | |

**WARNING: This label is valid for five years after Label Date. Changes to equipment, settings or system configuration will invalidate this information. Calcuation Method IEEE1584.**

| Label Date | Label |
|---|---|
| 18 Jul 2016 | # 0003 |

**SHOCK AND ARC FLASH HAZARD: APPROPRIATE PPE REQUIRED, ONLY QUALIFIED PERSONS MAY PERFORM ENERGIZED WORK ON THIS EQUIPMENT**

| SHOCK HAZARD | | ARC FLASH HAZARD | | Incident Energy |
|---|---|---|---|---|
| 480 VAC | With Cover Removed | 18 in | Working Distance | 1.3 cal/cm^2 @ Working Distance |
| 42 in | Limited Approach | 12 in | Arc Flash Boundary | |
| 12 in | Restricted Approach | | | |
| 265-MCC-001-2 | | | | |
| 00 | Glove Class | ch2m. 1100 112th AVE NE, Suite 500 Bellevue, WA (425) 453-5000 | | |
| 12.86 kA | Bus Bolted Fault | | | |
| CH2M ID: | 439172 | | | |

**WARNING: This label is valid for five years after Label Date. Changes to equipment, settings or system configuration will invalidate this information. Calcuation Method IEEE1584.**

| Label Date | Label |
|---|---|
| 18 Jul 2016 | # 0004-Line |

# SECTION 26 08 00
# COMMISSIONING OF ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D877, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
   b. D923, Standard Practice for Sampling Electrical Insulating Liquids.
   c. D924, Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
   d. D971, Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
   e. D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
   f. D1298, Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
   g. D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
   h. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.
   i. D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.
   j. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.
2. Institute of Electrical and Electronics Engineers (IEEE):
   a. 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.
   b. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminators Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5kV through 500kV.
   c. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
   d. 95, Recommended Practice for Insulation Testing of AC Electric Machinery (2300V and Above) with High Direct Voltage.

e. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
f. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems.
g. 450, Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
h. C2, National Electrical Safety Code.
i. C37.20.1, Standard for Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.
j. C37.20.2, Standard for Metal-Clad Switchgear.
k. C37.20.3, Standard for Metal-Enclosed Interrupter Switchgear.
l. C37.23, Standard for Metal-Enclosed Bus.
m. C62.33, Standard Test Specifications for Varistor Surge-Protective Devices.

3. Insulated Cable Engineers Association (ICEA):
   a. S-93-639, 5-46 kV Shielded Power Cables for Use in the Transmission and Distribution of Electric Energy.
   b. S-94-649, Concentric Neutral Cables Rated 5 through 46 kV.
   c. S-97-682, Standard for Utility Shielded Power Cables Rated 5 through 46 kV.
4. InterNational Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
5. National Electrical Manufacturers Association (NEMA):
   a. AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
   b. PB 2, Deadfront Distribution Switchboards.
   c. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70B, Recommended Practice for Electrical Equipment Maintenance.
   c. 70E, Standard for Electrical Safety in the Workplace.
   d. 101, Life Safety Code.
7. National Institute for Certification in Engineering Technologies (NICET).
8. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.02 SUBMITTALS

A. Informational Submittals:

1. Submit 60 days prior to performing inspections or tests:
   a. Schedule for performing inspection and tests.
   b. List of references to be used for each test.
   c. Sample copy of equipment and materials inspection form(s).
   d. Sample copy of individual device test form.
   e. Sample copy of individual system test form.
2. Energization Plan:
   a. Prior to initial energization of electrical distribution equipment; include the following:
      1) Owner's representative sign-off form for complete and accurate arc flash labeling and proper protective device settings for equipment to be energized.
      2) Staged sequence of initial energization of electrical equipment.
      3) Lock-Out-Tag-Out plan for each stage of the progressive energization.
      4) Barricading, signage, and communication plan notifying personnel of newly energized equipment.
3. Submit test or inspection reports and certificates for each electrical item tested within 30 days after completion of test.
4. Operation and Maintenance Data:
   a. In accordance with Section 01 78 23, Operation and Maintenance Data.
   b. After test or inspection reports and certificates have been reviewed by Construction Manager and returned, insert a copy of each in Operation and Maintenance Manual.
5. Programmable Settings:
   a. At completion of Performance Demonstration Test, submit final hardcopy printout and electronic files on compact disc of as-left setpoints, programs, and device configuration files for:
      1) Protective relays.
      2) Intelligent overload relays.
      3) Variable frequency drives.
      4) Power metering devices.
      5) Uninterruptible power supplies.
      6) Electrical communications modules.

1.03 QUALITY ASSURANCE

A. Testing Firm Qualifications:

1. Corporately and financially independent organization functioning as an unbiased testing authority.
2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
4. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA and having project experience in testing experience on similar projects.
5. Technicians certified by NICET or NETA.
6. Assistants and apprentices assigned to Project at ratio not to exceed two certified to one noncertified assistant or apprentice.
7. Registered Professional Engineer to provide comprehensive Project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
8. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories or a full member company of NETA.

B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.

C. Test instrument calibration shall be in accordance with NETA ATS.

1.04 SEQUENCING AND SCHEDULING

A. Scheduling and sequencing to be performed by Construction Manager.

B. Perform inspection and electrical tests after equipment listed herein has been installed.

C. Perform tests with apparatus de-energized whenever feasible.

D. Inspection and electrical tests on energized equipment shall be:

1. Scheduled with Owner prior to de-energization.
2. Minimized to avoid extended period of interruption to the operating plant equipment.

E. Notify Owner at least 24 hours prior to performing tests on energized electrical equipment.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

3.01 GENERAL

A. Perform tests in accordance with requirements of Section 01 91 14, Testing, Integration, and Startup.

B. Tests and inspections shall establish:

1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
2. Installation operates properly.
3. Equipment is suitable for energization.
4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.

C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

D. Set, test, and calibrate protective relays, circuit breakers, fuses, power monitoring meters, and other applicable devices in accordance with values established by short circuit and coordination studies as specified in Section 26 05 70, Electrical Systems Analysis.

E. Adjust mechanisms and moving parts of equipment for free mechanical movement.

F. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.

G. Verify nameplate data for conformance to Contract Documents and approved Submittals.

H. Realign equipment not properly aligned and correct unlevelness.

I. Properly anchor electrical equipment found to be inadequately anchored.

J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETA ATS.

K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

L. Provide proper lubrication of applicable moving parts.

M. Inform Construction Manager of working clearances not in accordance with NFPA 70.

N. Investigate and repair or replace:

1. Electrical items that fail tests.
2. Active components not operating in accordance with manufacturer's instructions.
3. Damaged electrical equipment.

O. Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Vacuum and wipe clean enclosure interior.
3. Remove corrosion found on metal surfaces.
4. Repair or replace, as determined by Construction Manager, door and panel sections having dented surfaces.
5. Repair or replace, as determined by Construction Manager, poor fitting doors and panel sections.
6. Repair or replace improperly operating latching, locking, or interlocking devices.
7. Replace missing or damaged hardware.
8. Finish:
    a. Provide matching paint and touch up scratches and mars.
    b. If required because of extensive damage, as determined by Construction Manager, refinish entire assembly.

P. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

## 3.02 CHECKOUT AND STARTUP

A. Voltage Field Test:

1. Check voltage at point of termination of power company supply system to Project when installation is essentially complete and is in operation.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.
2. If phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.03 SWITCHGEAR ASSEMBLIES

A. Visual and Mechanical Inspection:

1. Insulator damage and contaminated surfaces.
2. Proper barrier and shutter installation and operation.
3. Proper operation of indicating devices.
4. Improper blockage of air-cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check door and device interlocking system by:
   a. Closure attempt of device when door is in OFF or OPEN position.
   b. Opening attempt of door when device is in ON or CLOSED position.
8. Check key interlocking systems for:
   a. Key captivity when device is in ON or CLOSED position.
   b. Key removal when device is in ON or CLOSED position.
   c. Closure attempt of device when key has been removed.
   d. Correct number of keys in relationship to number of lock cylinders.
   e. Existence of Other Keys Capable of Operating Lock Cylinders: Destroy duplicate sets of keys.
9. Check nameplates for proper identification of:
   a. Equipment title and tag number with latest one-line diagram.
   b. Pushbutton.
   c. Control switch.
   d. Circuit breaker.
   e. Indicating meter.
10. Verify fuse and circuit breaker ratings, sizes, and types conform to those specified.
11. Check bus and cable connections for high resistance by low resistance ohmmeter thermographic survey applied to bolted joints.
    a. Ohmic value to be zero.
    b. Thermographic survey temperature gradient of 2 degrees C or less.

12. Check operation and sequencing of electrical and mechanical interlock systems by:
    a. Closure attempt for locked open devices.
    b. Opening attempt for locked closed devices.
    c. Key exchange to operate devices in OFF-NORMAL positions.
13. Verify performance of each control device and feature.
14. Control Wiring:
    a. Compare wiring to local and remote control and protective devices with elementary diagrams.
    b. Proper conductor lacing and bundling.
    c. Proper conductor identification.
    d. Proper conductor lugs and connections.
15. Exercise active components.
16. Perform phasing check on double-ended equipment to ensure proper bus phasing from each source.

B. Electrical Tests:

1. Insulation Resistance Tests:
    a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
    b. Each phase of each bus section.
    c. Phase-to-phase and phase-to-ground for 1 minute.
    d. With switches and breakers open.
    e. With switches and breakers closed.
    f. Control wiring except that connected to solid state components.
    g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Overpotential Tests:
    a. Applied dc voltage and test procedure in accordance with NETA ATS, Table 100.2.
    b. Each phase of each bus section.
    c. Phase-to-phase and phase-to-ground for 1 minute.
    d. Test results evaluated on a pass/fail basis.
3. Current Injection Tests:
    a. For entire current circuit in each section.
    b. Secondary injection for current flow of 1 ampere.
    c. Test current at each device.
4. Control Wiring:
    a. Apply secondary voltage to control power and potential circuits.
    b. Check voltage levels at each point on terminal boards and each device terminal.

5. Operational Test:
   a. Initiate control devices.
   b. Check proper operation of control system in each section.

3.04 PANELBOARDS

A. Visual and Mechanical Inspection:

1. Include the following inspections and related work:
   a. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
   b. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
   c. Check panelboard mounting, area clearances, and alignment and fit of components.
   d. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
   e. Perform visual and mechanical inspection for overcurrent protective devices.

B. Electrical Tests:

1. Include the following items performed in accordance with manufacturer's instruction:
   a. Insulation Resistance Tests:
      1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
      2) Each phase of each bus section.
      3) Phase-to-phase and phase-to-ground for 1 minute.
      4) With switches and breakers open.
      5) With switches and breakers closed.
      6) Control wiring except that connected to solid state components.
      7) Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
   b. Ground continuity test ground bus to system ground.

## 3.05 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Physical and insulator damage.
2. Proper winding connections.
3. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
4. Defective wiring.
5. Proper operation of fans, indicators, and auxiliary devices.
6. Removal of shipping brackets, fixtures, or bracing.
7. Free and properly installed resilient mounts.
8. Cleanliness and improper blockage of ventilation passages.
9. Verify tap-changer is set at correct ratio for rated output voltage under normal operating conditions.
10. Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.5 for each:
      1) Winding-to-winding.
      2) Winding-to-ground.
   b. Test Duration: 10 minutes with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
   c. Results temperature corrected in accordance with NETA ATS, Table 100.14.
   d. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
   e. Insulation resistance test results to compare within 1 percent of adjacent windings.
2. Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.

## 3.06 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed power cable No. 4 and larger for:
   a. Physical damage.
   b. Proper connections in accordance with single-line diagram.
   c. Cable bends not in conformance with manufacturer’s minimum allowable bending radius where applicable.

d. Color coding conformance with specification.
e. Proper circuit identification.

2. Mechanical Connections for:
   a. Proper lug type for conductor material.
   b. Proper lug installation.
   c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
3. Shielded Instrumentation Cables for:
   a. Proper shield grounding.
   b. Proper terminations.
   c. Proper circuit identification.
4. Control Cables for:
   a. Proper termination.
   b. Proper circuit identification.
5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 4 and Larger:

1. Insulation Resistance Tests:
   a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors.
   b. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
   c. Evaluate ohmic values by comparison with conductors of same length and type.
   d. Investigate values less than 50 megohms.
2. Continuity test by ohmmeter method to ensure proper cable connections.

C. Low-voltage cable tests may be performed by installer in lieu of independent testing firm.

3.07 MEDIUM-VOLTAGE CABLES, 15 KV MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed cable for:
   a. Physical damage plus jacket and insulation condition.
   b. Proper connections in accordance with single-line diagram or approved Submittals.
   c. Proper shield grounding.
   d. Proper cable support.
   e. Proper cable termination.

f. Cable bends not in conformance with manufacturer's minimum allowable bending radius.
g. Proper arc and fireproofing in common cable areas.
h. Proper circuit and phase identification.

2. Mechanical Connections:
   a. Proper lug type for conductor material.
   b. Proper lug installation.
   c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturers.
3. Conductors Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Utilize 5,000-volt megohmmeter for 15 kV conductors.
   b. Test each cable individually with remaining cables and shields grounded.
   c. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
   d. Evaluate ohmic values by comparison with conductors of same length and type.
   e. Investigate values less than 50 megohms.
2. Shield Continuity Tests:
   a. By ohmmeter method on each section of conductor.
   b. Investigate values in excess of 10 ohms per 1,000 feet of conductors.
3. Acceptance Tests:
   a. In accordance with IEEE 400, ICEA S-93-639, NEMA WC 74, ICEA S-94-649, and ICEA S-97-682 for insulated conductors.
   b. Each conductor section tested with:
      1) Splices and terminations in place but disconnected from equipment.
      2) Remaining conductors and shields grounded in accordance with IEEE 400.
   c. Apply maximum test voltage per NETA ATS, Table 100.6, based on method (DC, AC, PD, or VLF) used.
   d. Measure only leakage current associated with conductor.
   e. Utilize guard ring or field reduction sphere to suppress corona at disconnected terminations.
   f. Maximum test voltage shall not exceed limits for terminators specified in IEEE 48, IEEE 386, or manufacturer's specifications.

g. Apply test voltage in a minimum of five equal increments until maximum acceptable test voltage is reached.
   1) Increments not to exceed ac voltage rating of conductor.
   2) Record dc leakage current at each step after a constant stabilization time consistent with system charging current.
h. Raise conductor to specified maximum test voltage and hold for 15 minutes or as specified by conductor manufacturer. Record leakage current at 30 seconds and 1 minute, and at 1-minute intervals, thereafter.
i. Immediately following test, ground conductor for adequate time period to drain insulation stored charge.
j. Test results evaluated on a pass/fail basis.

4. New Conductors Spliced to Existing Conductors:
   a. Prior to performing splices, high potential dc test new conductor sections.
   b. After splicing new conductors to existing conductors, disconnect existing conductors and perform the following tests:
      1) Shield continuity test.
      2) Insulation resistance test.
      3) High potential test with test voltage not to exceed 60 percent of applied acceptance dc test voltage.

## 3.08 SAFETY SWITCHES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Proper blade pressure and alignment.
2. Proper operation of switch operating handle.
3. Adequate mechanical support for each fuse.
4. Proper contact-to-contact tightness between fuse clip and fuse.
5. Cable connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Proper phase barrier material and installation.
7. Verify fuse sizes and types correspond to one-line diagram or approved Submittals.
8. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
   b. Phase-to-phase and phase-to-ground for 1 minute on each pole.

c. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.

2. Contact Resistance Tests:
   a. Contact resistance in microhms across each switch blade and fuse holder.
   b. Investigate deviation of 50 percent or more from adjacent poles or similar switches.

## 3.09 MOLDED AND INSULATED CASE CIRCUIT BREAKERS

A. General: Inspection and testing limited to circuit breakers rated 100 amperes and larger and to motor circuit protector breakers rated 100 amperes and larger.

B. Visual and Mechanical Inspection:

1. Proper mounting.
2. Proper conductor size.
3. Feeder designation according to nameplate and one-line diagram.
4. Cracked casings.
5. Connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Operate breaker to verify smooth operation.
7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.

C. Electrical Tests:

1. Insulation Resistance Tests:
   a. Utilize 1,000-volt dc megohmmeter for 480-volt and 600-volt circuit breakers and 500-volt dc megohmmeter for 240-volt circuit breakers.
   b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
   c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
   d. Test values to comply with NETA ATS, Table 100.1.
2. Contact Resistance Tests:
   a. Contact resistance in microhms across each pole.
   b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.

3. Primary Current Injection Test to Verify:
   a. Long-time minimum pickup and delay.
   b. Short-time pickup and delay.
   c. Ground fault pickup and delay.
   d. Instantaneous pickup by run-up or pulse method.
   e. Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
   f. Trip times shall be within limits established by NEMA AB 4, Table 5-3. Alternatively, use NETA ATS, Table 100.7.
   g. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4. Alternatively, use NETA ATS, Table 100.8.

## 3.10 MEDIUM-VOLTAGE VACUUM CIRCUIT BREAKERS

A. Visual and Mechanical Inspection:

1. Check for proper element alignment.
2. Check for proper operation of cubicle shutters and racking mechanism.
3. Bolt torque level in accordance with NETA ATS, Table 100.12.
4. Perform mechanical operational tests on breaker and its operating mechanism in accordance with manufacturer's instructions, plus check:
   a. Pull rod adjustment.
   b. Trip latch clearance.
   c. Overtravel stops.
   d. Wipe and gap setting.
5. Perform breaker travel and velocity analysis in accordance with manufacturer's instructions; values shall be in accordance with manufacturer's acceptable limits.
6. Check contact erosion indicators in accordance with manufacturer's instructions.
7. With breaker in TEST position:
   a. Trip and close breaker with control switch.
   b. Trip breaker by manually operating each protective relay.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Utilize 2,500V dc megohmmeter for 15 kV circuit breakers.
   b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
   c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.

d. Test values to comply with NETA ATS, Table 100.1.

2. Contact Resistance Tests:
   a. Between the line and load stab of closed contact resistance in microhms across each pole.
   b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
3. Overpotential Tests:
   a. Maximum applied ac or dc voltage in accordance with NETA ATS, Table 100.19.
   b. Each pole-to-ground with other poles grounded and contacts closed for 1 minute.
   c. Test results evaluated on pass/fail basis.
4. Minimum pickup voltage tests on trip and close coils.
5. Control Wiring Tests:
   a. Insulation resistance test at 1,000V dc on control wiring, except that connected to solid state components.
   b. Insulation resistance to be 1 megohm minimum.
6. Vacuum bottle overpotential integrity test across each vacuum bottle with breaker in OPEN position, in accordance with manufacturer's instructions.
7. Power Factor Test (Each Phase):
   a. With breaker in both OPEN and CLOSED position.
   b. Compare power factor and arc chute watt loss with adjacent poles or manufacturer's published data.
8. Power Factor Test (Each Bushing):
   a. Utilize conductive straps and hot collar procedures if bushings are not equipped with power factor tap.
   b. Power factor and capacitance test results within nameplate rating of bushings.

## 3.11 PROTECTIVE RELAYS

A. Visual and Mechanical Inspection:

1. Visually check each relay for:
   a. Tight cover gasket and proper seal.
   b. Unbroken cover glass.
   c. Condition of spiral spring and contacts.
   d. Disc clearance.
   e. Condition of case shorting contacts if present.
2. Mechanically check each relay for:
   a. Freedom of movement.
   b. Proper travel and alignment.

3. Verify Each Relay:
   a. Complies with Contract Documents, approved Submittal, and application.
   b. Is set in accordance with recommended settings from Coordination Study.

B. Electrical Tests:

1. Insulation resistance test on each circuit to frame, except for solid state devices.
2. Test on nominal recommended setting for:
   a. Pickup parameters on each operating element.
   b. Timing at three points on time-current curve.
   c. Pickup target and seal-in units.
   d. Special tests as required to check operation of restraint, directional, and other elements in accordance with manufacturer's instruction manual.
3. Phase angle and magnitude contribution tests on differential and directional relays after energization to vectorially verify proper polarity and connections.
4. Current Injection Tests:
   a. For entire current circuit in each section.
   b. Secondary injection for current flow of 1 ampere.
   c. Test current at each device.

## 3.12 INSTRUMENT TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Visually check current, potential, and control transformers for:
   a. Cracked insulation.
   b. Broken leads or defective wiring.
   c. Proper connections.
   d. Adequate clearances between primary and secondary circuit wiring.
2. Verify Mechanically:
   a. Grounding and shorting connections have good contact.
   b. Withdrawal mechanism and grounding operation, when applicable, operate properly.
3. Verify proper primary and secondary fuse sizes for potential transformers.

B. Electrical Tests:

1. Current Transformer Tests:
   a. Insulation resistance test of transformer and wiring-to-ground at 1,000V dc for 30 seconds.
   b. Polarity test.
2. Potential Transformer Tests:
   a. Insulation resistance test at test voltages in accordance with NETA ATS, Table 100.9, for 1 minute on:
      1) Winding-to-winding.
      2) Winding-to-ground.
   b. Polarity test to verify polarity marks or H1-X1 relationship as applicable.
3. Insulation resistance measurement on instrument transformer shall not be less than that shown in NETA ATS, Table 100.5.

## 3.13 METERING

A. Visual and Mechanical Inspection:

1. Verify meter connections in accordance with appropriate diagrams.
2. Verify meter multipliers.
3. Verify meter types and scales conform to Contract Documents.
4. Check calibration of meters at cardinal points.
5. Check calibration of electrical transducers.

## 3.14 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in switchgear assemblies for proper connection and tightness.
2. Ground bus connections in switchgear assemblies for proper termination and tightness.
3. Effective transformer core and equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-of-Potential Test:
   a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system’s resistance.

b. Main ground electrode system resistance to ground to be no greater than 5 ohm(s).

2. Two-Point Direct Method Test:
   a. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
   b. Equipment ground resistance shall not exceed main ground system resistance by 0.25 ohm.

## 3.15 GROUND FAULT SYSTEMS

A. Inspection and testing limited to:

1. Zero sequence grounding systems.
2. Residual ground fault systems.

B. Visual and Manual Inspection:

1. Neutral main bonding connection to ensure:
   a. Zero sequence sensing system is grounded ahead of neutral disconnect link.
   b. Ground strap sensing system is grounded through sensing device.
   c. Neutral ground conductor is solidly grounded.
2. Verify control power has adequate capacity for system.
3. Manually operate monitor panels for:
   a. Trip test.
   b. No trip test.
   c. Nonautomatic rest.
4. Zero sequence system for symmetrical alignment of core balance transformers about current carrying conductors.
5. Relay check for pickup and time under simulated ground fault conditions.
6. Verify nameplate identification by device operation.

C. Electrical Tests:

1. Test system neutral insulation resistance with neutral ground link removed; minimum 1 megohm.
2. Determine relay pickup by primary current injection at the sensor. Relay pickup current within plus or minus 10 percent of device dial or fixed setting.
3. Test relay timing by injecting 300 percent of pick-up current or as specified by manufacturer. Relay operating time in accordance with manufacturer’s time-current characteristic curves.
4. Test system operation at 55 percent rated control voltage, if applicable.

5. Test zone interlock system by simultaneous sensor current injection and monitoring zone blocking functions.

## 3.16 AC INDUCTION MOTORS

A. General: Inspection and testing limited to motors rated 5 hp and larger.

B. Visual and Mechanical Inspection:

1. Proper electrical and grounding connections.
2. Shaft alignment.
3. Blockage of ventilating air passageways.
4. Operate motor and check for:
   a. Excessive mechanical and electrical noise.
   b. Overheating.
   c. Correct rotation.
   d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionability and proper operation.
   e. Excessive vibration, in excess of values in NETA ATS, Table 100.10.
5. Check operation of space heaters.

C. Electrical Tests:

1. Insulation Resistance Tests:
   a. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 100.1 for:
      1) Motors above 200 hp for 10-minute duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
      2) Motors 200 hp and less for 1-minute duration with resistances tabulated at 30 seconds and 60 seconds.
   b. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.
2. Calculate polarization index ratios for motors above 200 hp. Investigate index ratios less than 1.5 for Class A insulation and 2.0 for Class B insulation.
3. Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.
4. Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes.

## 3.17 LOW-VOLTAGE MOTOR CONTROL

A. Visual and Mechanical Inspection:

1. Proper barrier and shutter installation and operation.
2. Proper operation of indicating and monitoring devices.
3. Proper overload protection for each motor.
4. Improper blockage of air-cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check door and device interlocking system by:
    a. Closure attempt of device when door is in OFF or OPEN position.
    b. Opening attempt of door when device is in ON or CLOSED position.
8. Check nameplates for proper identification of:
    a. Equipment title and tag number with latest one-line diagram.
    b. Pushbuttons.
    c. Control switches.
    d. Pilot lights.
    e. Control relays.
    f. Circuit breakers.
    g. Indicating meters.
9. Verify fuse and circuit breaker sizes and types conform to Contract Documents.
10. Verify current and potential transformer ratios conform to Contract Documents.
11. Check operation and sequencing of electrical and mechanical interlock systems by:
    a. Closure attempt for locked open devices.
    b. Opening attempt for locked closed devices.
    c. Key exchange to operate devices in OFF-NORMAL positions.
12. Exercise active components.
13. Inspect contactors for:
    a. Correct mechanical operations.
    b. Correct contact gap, wipe, alignment, and pressure.
    c. Correct torque of connections.
14. Compare overload heater rating with full-load current for proper size.
15. Compare fuse motor protector and circuit breaker with motor characteristics for proper size.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
   b. Contactor phase-to-ground and across open contacts for 1 minute on each phase.
   c. Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.
   d. Test values to comply with NETA ATS, Table 100.1.
2. Current Injection through Overload Unit at 300 Percent of Motor Full-Load Current and Monitor Trip Time:
   a. Trip time in accordance with manufacturer's published data.
   b. Investigate values in excess of 120 seconds.
3. Control Wiring Tests:
   a. Apply secondary voltage to control power and potential circuits.
   b. Check voltage levels at each point on terminal board and each device terminal.
   c. Insulation resistance test at 1,000V dc on control wiring, except that connected to solid state components; 1 megohm minimum insulation resistance.
4. Operational test by initiating control devices to affect proper operation.

## 3.18 AUTOMATIC TRANSFER SWITCHES

A. Visual and Mechanical Inspection:

1. Check doors and panels for proper interlocking.
2. Check connections for high resistance by low-resistance ohmmeter.
3. Check positive mechanical and electrical interlock between normal and alternate sources.
4. Check for Proper Operation:
   a. Manual transfer function switch.
   b. Generator under load and nonload conditions.
   c. Auto-exerciser of generator under load and no-load conditions.
5. Verify settings and operation of control devices.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1, for each phase with switch CLOSED in both source positions.

b. Phase-to-phase and phase-to-ground for 1 minute.
c. Test values in accordance with manufacturer's published data.

2. Contact Resistance Test:
   a. Contact resistance in microhms across each switch blade for both source positions.
   b. Investigate values exceeding 500 micro-ohms.
   c. Investigate values deviating from adjacent pole by more than 50 percent.
3. Set and calibrate in accordance with Specifications, manufacturer's recommendations, and Coordination Study.
   a. Voltage and frequency sensing relays.
   b. Time delay relays.
   c. Engine start and shutdown relays.
4. Perform automatic transfer tests by:
   a. Simulating loss of normal power.
   b. Return to normal power.
   c. Simulating loss of alternate power.
   d. Simulating single-phase conditions for normal and alternate sources.
5. Monitor and verify operation and timing of:
   a. Normal and alternate voltage sensing relays.
   b. Engine-start sequence.
   c. Timing delay upon transfer and retransfer.
   d. Engine cool down and shutdown.
   e. Interlocks and limit switch functions.
   f. Engine cool down and shutdown feature.

## 3.19 BATTERY SYSTEM

A. Visual and Mechanical Inspection:

1. Physical damage and electrolyte leakage.
2. Evidence of corrosion.
3. Intercell bus link integrity.
4. Battery cable insulation damage and contaminated surfaces.
5. Operating conditions of ventilating equipment.
6. Visual check of electrolyte level.

B. Electrical Tests:

1. Measure:
   a. Bank charging voltage.
   b. Individual cell voltage.
   c. Electrolyte specific gravity in each cell.

d. Measured test values to be in accordance with manufacturer's published data.

2. Verify during recharge mode:
   a. Charging rates from charger.
   b. Individual cell acceptance of charge.
3. Load tests for integrity and capacity; test values in accordance with IEEE 450.

## 3.20 MEDIUM-VOLTAGE SURGE ARRESTORS AND SURGE CAPACITORS

A. Visual Inspection:

1. Ground connections to ground bus or electrode.
2. Shortest practical jumper connections to line.

B. Electrical Tests:

1. Grounding electrode resistance test in accordance with IEEE 81, Section 8.2.1.5 using three-point fall-of-potential method.
2. Insulation power factor.
3. Insulation resistance.
4. RF noise test using Stoddart noise test set with applied voltage of 1.18 times maximum continuous operating voltage.
5. Insulation power factor leakage current, watts loss, and insulation resistance test in accordance with manufacturer's test values. RIV value not to exceed 10 microvolts above background noise.
6. Leakage current and watts loss tests.

## 3.21 GENERATOR SYSTEMS

A. Visual and Mechanical Inspection:

1. Proper grounding.
2. Blockage of ventilating passageways.
3. Proper operation of jack water heaters.
4. Integrity of engine cooling and fuel supply systems.
5. Excessive mechanical and electrical noise.
6. Overheating of engine or generator.
7. Proper installation of vibration isolators.
8. Proper cooling liquid type and level.
9. Operate Engine-generator and check for:
   a. Excessive mechanical and electrical noise.
   b. Overheating.
   c. Correct rotation.

d. Check resistance temperature detectors or generator inherent thermal protectors for functionability and proper operation.
e. Excessive vibration.

10. Verify voltage regulator and governor operation will cause unit speed and output voltage to stabilize at proper values within reasonable length of time.
11. Proper operation of meters and instruments.
12. Compare generator nameplate rating and connection with one-line diagram or approved Submittal.

B. Electrical and Mechanical Tests:

1. Phase rotation tests.
2. Test Engine Protective Shutdown Features (where applicable) for:
   a. Low oil pressure.
   b. Overtemperature.
   c. Overspeed.
3. Load bank test with resistors for each load step. Record voltage, frequency, load current, oil pressure, and engine coolant temperature at 15-minute intervals:
   a. 25 percent applied load for 30 minutes.
   b. 50 percent applied load for 30 minutes.
   c. 75 percent applied load for 30 minutes.
   d. 100 percent applied load for 3 hours.
   e. Load test results to demonstrate ability of unit to deliver rated load for test period.

## 3.22 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

A. UPS Start-up Inspection and Testing:

1. Visual Inspection:
   a. Inspect equipment for signs of damage.
   b. Verify installation per Drawings.
   c. Inspect cabinets for foreign objects.
   d. Verify neutral and ground conductors are properly sized and configured per vendor requirements as noted in vendor drawings supplied with installation manuals or submittal package.
   e. Inspect all battery cell cases.
2. Mechanical Inspection:
   a. Check all control wiring connections for tightness.
   b. Check all power wiring connections for tightness.
   c. Check all terminal screws, nuts, and/or spade lugs for tightness.

3. Electrical Inspection:
   a. Check all fuses for continuity.
   b. Confirm input bypass voltage and phase rotation is correct.
   c. Verify control transformer connections are correct for voltages being used.
   d. Battery inspection and certification according to IEEE standards.
4. Unit Start-Up:
   a. Energize control power.
   b. Perform control/logic checks and adjust to meet manufacturer specification.
   c. Verify dc float and equalize voltage levels.
   d. Verify dc voltage clamp and over-voltage shutdown levels.
   e. Verify battery discharge, low battery warning, and low battery shutdown levels.
   f. Verify fuse monitor alarms and system shutdown.
   g. Verify inverter voltages and regulation circuits.
   h. Verify inverter/bypass sync circuits and set overlap time.
   i. Perform manual transfers and returns.
   j. Simulate utility outage at no load.
   k. Verify proper recharge.

B. Provide test instruments to record elapsed time between transfers, voltage, current, frequency, waveform, and transients.

1. Include services of an experienced technician to make final adjustments, final connections, and perform final testing.
2. Evidence of transients or phase shifts in graphs will be cause for rejection of system.

## 3.23 THERMOGRAPHIC SURVEY

A. Provide thermographic survey per NETA ATS Table 100.18 of connections associated with incoming service conductors, bus work, and branch feeder conductors No. 4 and larger at each:

1. Medium voltage switchgear.

B. Provide thermographic survey of feeder conductors No. 4 and larger terminating at:

1. Engine-generators.
2. Medium voltage switchgear.

C. Remove necessary enclosure metal panels and covers prior to performing survey.

D. Perform with equipment energized during periods of maximum possible loading per NFPA 70B, Section 20.17.

E. Utilize Thermographic Equipment Capable of:

1. Detecting emitted radiation.
2. Converting detected radiation to visual signal.
3. Detecting 1 degree C temperature difference between subject area and reference point of 30 degrees C.

F. Temperature Gradients:

1. 3 degrees C to 7 degrees C indicates possible deficiency that warrants investigation.
2. 7 degrees C to 15 degrees C indicates deficiency that is to be corrected as time permits.
3. 16 degrees C and above indicates deficiency that is to be corrected immediately.

G. Provide written report of:

1. Areas surveyed and the resultant temperature gradients.
2. Locations of areas having temperature gradients of 3 degrees C or greater.
3. Cause of heat rise and actions taken to correct cause of heat rise.
4. Detected phase unbalance.

**END OF SECTION**

# SECTION 26 09 13
# POWER MEASUREMENT AND CONTROL

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. Institute for Electrical and Electronics Engineers, Inc. (IEEE):
   a. C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
   b. C37.90.1, Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
   c. C57.13, Standard Requirements for Instrument Transformers.
3. International Electrotechnical Commission (IEC):
   a. 60255-5, Electrical Relays—Part 5: Insulation Coordination for Measuring Relays and Protection Equipment—Requirements and Tests.
   b. 60255-22-4, Measuring Relays and Protection Equipment—Part 22-4: Electrical Disturbance Tests—Electrical Fast Transient/Burst Immunity Tests.
   c. 60688, Electrical Measuring Transducers for Converting a.c. Electrical Quantities to Analogue or Digital Signals.
   d. 60870-5-104, Telecontrol Equipment and Systems—Part 5-104: Transmission Protocols—Network Access for IEC 60870-5-101 Using Standard Transport Profiles.
   e. 61850, Communication Network and Systems in Substations.
4. National Electrical Manufacturers Association (NEMA):
   a. C12.1, Electric Meters Code for Electricity Metering.
   b. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
5. Telecommunications Industry Association (TIA):
   a. 232-F, Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
   b. 485-A, Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems.

### 1.02 DEFINITIONS

A. ASD: Adjustable Speed Drive.

B. CT: Current Transformer.

C. DNP: Distributed Network Protocol.

D. LCD: Liquid Crystal Display.

E. LED: Light Emitting Diode.

F. MPR: Motor Protection Relay.

G. PLC: Programmable Logic Controller.

H. RTD: Resistance Temperature Detectors.

I. UCA: Utility Communications Architecture.

J. VT: Voltage Transformer.

1.03 SUBMITTALS

A. Action Submittals:

1. Instruction manuals for each type of device.
2. Special features, licensed programming software.
3. Potential and current schematic diagrams.
4. Control and metering schematic diagrams.
5. Interconnection wiring diagrams.
6. Installation and mounting requirements.
7. Complete descriptive literature and renewal parts data.

B. Informational Submittals:

1. Programming software used to configure devices, along with settings files necessary to reload or revise settings as left by Contractor.
2. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

**PART 2 PRODUCTS**

2.01 PRIMARY PROTECTION RELAY (PPR)

A. PPR shall provide primary protection and management of distribution feeders. Protection shall include:

1. Complete time overcurrent (51P, 51G).
2. Complete instantaneous overcurrent (50P, 50G).
3. Directional overcurrent (67P).
4. Bus and Line undervoltage and overvoltage (27/59).
5. Negative sequence voltage (47).

6. Undervoltage automatic restoration (27/79).
7. Bus under-frequency (81U) with voltage and current level monitoring.
8. Bus over-frequency (81O) with voltage and current level monitoring.
9. Frequency rate-of-change (81D) monitoring.
10. Under-frequency automatic restoration (81/79).

B. Operate with either wye-connected (four-wire) or open-delta-connected (three-wire) potential transformers, and three-phase, four-wire connected current transformers.

C. Control shall include manual close control, cold load pickup control, programmable logic inputs, two breaker control relay outputs, internal failure relay output, programmable relay outputs, solid state trip output, analog transducer input, and analog transducer outputs.

D. Monitoring and metering functions shall include:

1. Current: Phase A RMS current, Phase B RMS current, Phase C RMS current.
2. Voltage: Phase A-N (A-B) voltage, Phase B-N (B-C) voltage, Phase C-N (C-A) voltage.
3. Frequency.
4. Symmetrical components.
5. Three-phase power factor.
6. Three-phase real power.
7. Three-phase reactive power.
8. Three-phase apparent power.
9. Watt-hours.
10. VAR-hours.
11. Demand Measurement: Rolling demand, time interval, programmed to 5, 10, 15, 20, 30, or 60 minutes. A fault locator with a record of last 10 faults.
12. Event Recorder: Record last 512 events, time tagged.
13. Waveform Capture: Relay shall store up to 256 cycles of data, captured for analog current and voltage inputs, as well as digital data for output relays and input contact states. Amount of data to capture and trigger point shall be user configurable.
14. Data logger.
15. Latest Trip Report: Containing date and time, cause, phase, ground, sensitive ground, and neutral currents, line-line and line-ground voltages, neutral voltage, frequency, and analog input.
16. Operation counter and accumulated interrupted currents per phase.
17. Coil (trip/close) monitoring inputs for detection of failed circuit regardless of breaker state.

E. User interfaces shall include:

1. Large 40-character display, navigation keys, and keypad.
2. Indicator LEDs on front panel which provide a quick visual indication of status.
3. Front panel RS232 serial port that provides easy computer access.
4. Two rear RS485 ports, one of which can be configured as a RS422 port.
5. Fiber optic port.
6. Relay capable of being programmed and configured via a Windows-based, easy-to-use setup graphical terminal interface.
7. Relay to communicate with a Rockwell Automation Compact Logix PLC.

F. Manufacturer and Product:

1. Schweitzer Engineering Laboratories; SEL-751.
2. Or approved equal.

2.02 INSTRUMENT TRANSFORMERS

A. Current Transformer (CT), Over 600 Volts:

1. Type:
   a. Insulated dry indoor.
   b. Window type for relaying and ground sensing.
   c. Wound type for metering.
2. Transformer Accuracy: In accordance with IEEE C57.13.
3. Class C20 or greater for relaying.
4. Class 1.2 maximum for imposed burden for metering.
5. Rating: 15 kV.
6. Mechanical Rating: Equal to interrupting rating of circuit breakers.
7. Thermal Rating: 100 times normal, 1 second.
8. Size to operate continuously at rated primary current without insulation damage.
9. Identify polarity with standard mark or symbol.
10. Secondary Wiring: Install in conduit, PVC tubing or wiring trough.
11. Isolate from adjacent components and circuits by removable insulating or metal barriers.
12. Window type CTs accessible for replacement without removing high voltage insulated connections.

B. Potential Transformer (PT), Over 600 Volts:

1. Type: Insulated dry, indoor.
2. Rating: 12,000/120-volt, single-phase with 75 kV BIL rating.
3. Two transformers connected phase-to-ground.

4. Thermal Capacity: Minimum 55 degrees rise above 30 degrees C ambient.
5. Mechanical Rating: Equal to short-time current carrying capability of circuit breaker.
6. Accuracy classification in accordance with IEEE C57.13 for connected burden.
7. Primary Protection: Two, integral mounted current-limiting fuses.
8. Secondary Protection: Single, separately mounted current-limiting fuse.
9. Identify polarity with standard marking or symbols.

2.03 TEST SWITCH MODULE

A. Function: Multipole switch bank for instrument transformer testing.

1. Allows current injection for each phase.
2. CT inputs short when current switches are open.
3. Ability to visually isolate (open) trip relay output circuits.
4. Cover provided.

B. Manufacturers and Products:

1. ABB; Type FT-1 Flexitest.
2. GE; Multilin 515.
3. Or approved equal.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. As defined in Section 26 08 00, Commissioning of Electrical Systems, and Section 26 05 70, Electrical Systems Analysis. Provide all programming and settings for protective relays. Prepare configuration files and upload to relays.

3.02 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:

1. Present at distribution equipment factory, Site, and classroom designated by Owner, for the minimum person-days listed below, travel time excluded:
   a. 2 person-days to enter, confirm, and assist in testing protective relay settings and communications configuration at the distribution equipment. Device settings to be based on values generated in the device coordination study.

b. 2 person-days for initial energization and start-up of distribution system equipment.
c. 2 person-days for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the Construction Manager.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Testing, Integration, and Startup.

**END OF SECTION**

# SECTION 26 13 13
# MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C37.04, Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
   b. C37.06, AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis Preferred Ratings and Related Required Capabilities.
   c. C37.09, Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
   d. C37.20.2, Metal-Clad and Station Type Cubicle Switchgear.
   e. C57.13, Standard Requirements for Instrument Transformers.
   f. C62.11, Metal-Oxide Surge Arrestors for Alternating Current Power Circuits (>1KV).
2. National Electrical Manufacturers Association (NEMA):
   a. LA 1, Surge Arrestors.
   b. SG 4, Alternating-Current High-Voltage Circuit Breakers.
   c. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

### 1.02 SUBMITTALS

A. Action Submittals:

1. Descriptive product information.
2. Dimensional drawings.
3. Itemized bill of material.
4. Protective device time-current characteristics on transparencies.
5. Operational description.
6. Installation instructions.
7. Bus data.
8. One-line, three-line, and control schematic drawings.
9. Connection and interconnection drawings.
10. Conduit entrance locations.
11. Mimic bus layout.

12. Anchoring instructions and details.
13. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
3. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
4. Factory test reports.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

B. UL listing mark for Category A enclosure requirements of IEEE C37.20.2.

1.04 SPARE PARTS

A. Provide manufacturer's standard spare parts.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

A. Eaton.

B. Square D.

C. ABB.

D. Or approved equal.

2.02 GENERAL

A. Furnish switchgear that is the product of a single manufacturer. Assembled units with component parts of several manufacturers will not be acceptable with the exception that such minor items as terminal blocks, test switches, fuses, and wiring may be manufactured by others.

B. Design, test, and assemble in accordance with IEEE C37.04, IEEE C37.06, and IEEE C37.20.2, and NEMA SG4.

C. Suitable for 12,000 volts, three-phase, three-wire solid grounded-wye electrical service having an available short-circuit current at line terminals as shown.

D. Rated at 15 kV, 95 kV BIL.

E. Operating Conditions:

1. Ambient Temperature: Maximum 40 degrees C.
2. Equipment shall be fully rated without derating for the above operating conditions.

F. Equipment and devices weighing in excess of 100 pounds shall have lifting lugs.

2.03 STATIONARY STRUCTURE

A. Type: Walk-in, outdoor switchgear consisting of a pull section with cable terminations, SGE&E and CAISO metering, breaker, transition, and auxiliary sections assembled to form a rigid, self-supporting, metal enclosed structure.

B. Material: 11-gauge minimum cold-rolled steel, formed with reinforced steel members.

C. Grounded metal barriers between each breaker, main bus, branch cabling, and instrumentation/control.

D. Breaker compartments to have blocking devices to prevent installation of breaker with lower ampacity or interrupting capacity into compartment designed for a higher rated breaker.

E. Each breaker compartment shall contain:

1. Housing for vacuum circuit breakers.
2. Manually operated drawout mechanism with automatic shutters and safety interlocks.

3. Hinged front panel.
4. Primary and secondary disconnect devices.
5. Control circuit cutout devices.
6. Main bus with connections.
7. Extended ground bus.
8. Terminal block, small wiring, control bus, and cable supports.

F. Each auxiliary compartment shall contain:

1. Front Panel: Hinged.
2. Main bus and connections.
3. Extended ground bus.
4. Drawout potential transformers and associated primary fuses.
5. Relays, meters, and instrumentation.
6. Terminal block, small wiring, control bus, and cable supports.

G. Rear accessible cable compartments shall contain:

1. Provisions for cable entry from bottom.
2. Insulated bushings for primary disconnecting devices.
3. Ground bus extending full width of switchgear.
4. Cable terminators for 15 kV conductors.

H. Main bus compartment, shall contain:

1. Insulated bus and support system.
2. Primary disconnects.

I. Bus transition sections shall be isolated from main bus section.

2.04 ENCLOSURE

A. Finish: Baked enamel applied over rust-inhibiting, phosphated base coating.

1. Color:
   a. Exterior: Gray finish as approved by Owner.
   b. Interior: White.
   c. Unpainted Parts: Plated for corrosion resistance.

B. Walk-in, Outdoor Enclosure:

1. NEMA 250, Type 3R, enclosing NEMA 250, Type 1 enclosed switchgear with single aisle construction.

2. Hinged, full height doors with three-point latch operated by vault type handle with multiple padlocking provisions for each front and rear switchgear section.
3. Minimum 96-inch-wide aisle in front of switchgear, meeting all electrical code working space clearances.
4. Gasketed doors, rear panels, end panels, and sloped roof having 4-inch minimum overhang on all sides.
5. Provide a noncaptive key for utility metering doors.
6. Support assembly on 4-inch modular base.
7. Steel bottom enclosure and support assembly with Roxtec cable transit sealing system.
8. 120-Volt Receptacle: GFCI type, mounted inside each door.
9. Lighting:
    a. Interior: LED strip lights, 30-foot-candle minimum aisle lights, three-way light switches.
    b. Exterior: Photocell controlled LED wall pack, one over each door.
10. Space Heaters: Thermostatically controlled 250-watt, 120-volt, in each switchgear vertical section in accordance with UL 1025.
11. Adjustable thermostat for temperature range of 50 degrees F to 70 degrees F.
12. Air Conditioning: Provide dual two AC units, wall mounted, on exterior of walk-in aisle. Thermostat controlled.
    a. Recommended Set Point: 75 degrees F.

C. Enclosure Transformer and AC Panelboard: Transformer, primary and secondary fuses, and secondary AC panelboard section enclosed in an available switchgear auxiliary section. Alternatively, equipment may be wall mounted in the walk-in aisle.

1. Transformer and Panel Location: In switchgear auxiliary section. Alternatively, equipment may be wall mounted in the walk-in aisle.
2. Self-Cooled, Encapsulated, Dry Type Transformer:
    a. Manufacturer’s standard insulation and temperature rise, in accordance with UL 1561.
    b. Full capacity, 2-1/2 percent voltage taps, two above and two below normal voltage.
    c. Primary Voltage: 12,000, single-phase with current limiting fuses in primary circuit.
    d. Secondary Voltage: 208/120 volts, three-phase, four-wire.
    e. kVA Rating: As required (accounting for necessary air conditioning load), but no less than 15 kVA.

3. AC Panelboard:
   a. Full short-circuit current rated in accordance with UL 489.
   b. Thermal magnetic, quick-make, quick-break, indicating type, noninterchangeable, molded case circuit breaker.
   c. Number and breaker ampere ratings as required.
   d. Interrupting Rating: 10,000 rms symmetrical amperes.
   e. Circuit directory holder inside door surface.
   f. Rating: 100 amperes, 208/120 volts, three-phase, 60-Hz, complete with solid neutral.

## 2.05 BUS BARS AND INTERCONNECTIONS

A. Continuous Current Rating: Ampere rating as shown on Drawings, with sufficient cross-section to limit temperature rise at rated current to 55 degrees C.

B. Phase Arrangement: Phases A-B-C, left-to-right, top-to-bottom, and front-to-rear as viewed from switchgear front.

C. Buses sized for present and anticipated future loads as indicated on one-line diagram with provisions for extension to future switchgear extension.

D. Main Bus:

1. Totally enclosed by metal plates.
2. Material: Bar, rounded edge, flat tin-plated copper. Braced and supported on high dielectric BIL-rated glass polyester flame-retardant and track-resistant insulators.
3. Insulate with molded epoxy, applied by fluidized bed process.

E. Ground Bus:

1. Material: Same as main bus.
2. Current Rating: 25 percent of main bus rating.
3. Length: Extend entire width of switchgear.
4. Bolted to ground contact in each breaker compartment and auxiliary section.
5. Pads or terminals at each end for connection to building ground grid as shown.

F. Control Bus:

1. 600-volt insulated copper conductors.
2. Maximum current rating determined by application.

3. Extend from control power source to terminal boards in each unit of grouped lineup with provisions for extension to future switchgear section.

G. Potential Bus:

1. 600-volt insulated copper conductors.
2. Maximum current rating determined by application.
3. Connected to terminal boards mounted inside enclosure.

H. Bus Bar Connections:

1. Material:
   a. Joints, Splice Plates, and Bar Ends: Silver-plated copper.
   b. High Pressure Line Contacts: Silver-to-silver.
2. Bolts: Steel, with Belleville washers for joints, splice plates, and connections.
3. Insulate bolted connections with preformed, molded, polyvinyl boots held in place with nylon hardware.

## 2.06 CIRCUIT BREAKERS

A. Type: Vacuum. Interrupter equipped with contact erosion indicators.

B. Rating: 15,000 volts, 60-Hz.

C. Continuous Current Rating: As shown.

D. Interrupting Rating: 40 kA.

E. Provide breaker with three-cycle interrupt capability.

F. Drawout Type Breaker:

1. Three-pole, single-throw.
2. Electrically charged.
3. Mechanically and electrically trip-free.
4. Position indicator.
5. Operational counter.
6. Auxiliary switches.
7. Primary and secondary devices.
8. Breaker Operation: dc voltage for close and trip control.
9. Primary Contacts:
   a. Breaker-mounted stud.
   b. Stationary sockets.

c. Silver-plated pressure line contacts.
d. Nonmagnetic, corrosion-resistant leaf springs.

10. Secondary Contacts:
    a. Breaker-mounted multiple plug coupler.
    b. Stationary receptacles.
    c. Silver-to-silver contacts.
11. Auxiliary Contacts:
    a. Rated 5 amperes, 120 volts, ac and dc.
    b. One Type "a" contact to indicate CLOSED position.
    c. Two Type "b" contacts to indicate OPEN position and trip operation.
12. Breaker Status Indicating Lights: Push-to-test type, red for breaker closed, green for breaker open.
13. Contacts closing speed independent of control voltage and operator.
14. Mechanically interlock to prevent breaker movement to or from operating position when primary contacts are engaged.
15. Breakers of equal rating to be completely interchangeable.

G. Placement: Locate breakers in lower sections of switchgear for easier maintenance and access.

H. Interlocking Scheme Between Selected Breakers: Mechanical key and electrical.

## 2.07 PROTECTIVE RELAYS

A. Provide an additional redundant protective relay (total of two) for each main circuit breaker. Refer to Section 26 09 13, Power Measurement and Control.

## 2.08 CURRENT TRANSFORMER (CT)

A. Refer to Section 26 09 13, Power Measurement and Control.

## 2.09 POTENTIAL TRANSFORMER (PT)

A. Refer to Section 26 09 13, Power Measurement and Control.

## 2.10 TERMINAL BLOCKS

A. Rating: 600 volts, 30-ampere minimum.

B. Type:

1. One-piece barrier with strap screws.
2. Shorting type for current transformer leads.

3. Pull-apart control wiring terminal boards on drawout units.

C. Provide for:

1. Conductors connecting to circuits external to switchgear.
2. Internal circuits crossing shipping splits.
3. Equipment parts requiring replacement and maintenance.

D. Spares: Minimum 20 percent spare unused terminals.

E. Grouped together terminal blocks for external circuit wiring leads.

F. 6-inch minimum space between columns of terminal blocks.

G. Permanently identify each terminal and columns of terminal blocks.

H. Manufacturer and Product:

1. G.E.; Type EB-5.
2. Or approved equal.

2.11 CONTROL WIRING

A. NFPA 70, Type SIS, single-conductor, Class B, stranded copper, rated 600 volts for control, instrumentation, and power circuits.

B. Individual seven-strand, copper conductors, twisted and covered with a 100 percent aluminum, polyester shield with tinned copper drain wire and overall outer jacket, rated 600 volts, 90 degrees C minimum for transducer output and analog circuits.

C. Conductor Lugs: Pre-insulated, self-locking, spade type with reinforced sleeves.

D. Wire Markers: Each wire individually identified with permanent markers at each end.

E. Internal circuit wiring crossing shipping splits to have plug connectors.

F. Splices: Not permitted.

## 2.12 METERS AND INSTRUMENTS

A. As specified in Section 26 09 13, Power Measurement and Control.

B. Instrument and Control Switches:

1. Type: Rotary, cam-operated, with two contacts per stage.
2. Silver contacts and maintained positive contact position.
3. Wiping action closing contacts.
4. Adjacent contacts separated by barriers.
5. Contact assembly enclosed in removable cover.
6. Rating: Minimum 20 amperes with 600-volt insulation.
7. Marked escutcheon plates.
8. Operating Handles:
    a. Power Circuit Breaker Control: Pistol grip.
    b. Instrument Switches: Round knurled handles.
    c. Voltmeter Switches: Four-position, phase-to-phase voltage, and OFF.
    d. Ammeter Switches: Four-position, three-phase currents, and OFF.
    e. Transfer and Auxiliary Switches: Oval type with arrow.

C. Provide a remote control panel to allow open/close operation of either breaker, mounted away from the front of the breakers. Control panel to be password protected and include a cover with provision for padlocking.

D. Test Switches for Instrument and Current Sources:

1. Back connected with clear plastic covers.
2. Test jacks in phases for current test switches.
3. Four-pole Units for Both Current and Voltage.
    a. ABB; Flexitest FT.
    b. GE; Multilin 515.
    c. Or approved equal.

## 2.13 BATTERY CONTROL SYSTEM

A. Furnished by switchgear manufacturer and installed in adequate ventilated compartments (with battery and branch circuit protection) as part of switchgear lineup.

B. Overall Battery System: Provide a 125V dc battery system. Wire batteries in parallel and/or series as required to achieve required dc voltage.

C. Battery System Size: Provide battery capacity necessary for 96 hours backup.

D. Automatic Transfer Switch: Provide transfer switch or best-source power selection scheme to provide continuous power to battery charger.

E. Direct Current Distribution Panel:

1. Rating: 100-amp, 250V dc.
2. Branch Circuit Breakers:
   a. Two-pole, thermomagnetic, quick-make, quick-break.
   b. ON, TRIPPED, and OFF indicating handle.
   c. Interrupting rating of 10,000 rms symmetrical amperes.
   d. Amperage: 20.
3. Main circuit breaker sized per manufacturer's recommendation. amperes.
4. Enclosure: NEMA 250, Type 1, for switchgear auxiliary section mounting.
5. Circuit directory holder inside door surface.

F. Control bus as specified under Article Bus Bars and Interconnections.

G. Associated Branch Wiring: Type XHHW.

H. Battery:

1. Cell Type: Pasted plate lead antimony.
2. Size: Manufacturer's recommend cell quantity and voltage.
3. Cell Voltage: Manufacturer's standard.
4. 50 nominal ampere hour capacity.
5. Container: Sealed, plastic or glass-fiber.
6. Bolt Connections: Stainless steel hex headed.
7. Interunit Connections: Lead-plated copper.
8. Ship with electrolyte in fully charged cells.

I. Battery Accessories:

1. Portable hydrometer.
2. Vent hole thermometer.

J. Battery Charger:

1. Type: Industrial float, constant voltage.
2. Recharge after discharge to 1.75 volt(s) each cell in 8 hours.
3. Automatically control charging rates.
4. Output: Full rated for both continuous and intermediate dc loads.
5. Voltage regulation and current limiting.
6. Circuitry: Solid state integrated.

7. Supply Voltage: 120/240 volts, single-phase, 60-Hz.
8. Accessories:
   a. ac ON Indicating Light: Green.
   b. ac Input Breaker: Two-pole, 500 AIC, 100-ampere frame.
   c. dc Output Breaker: Two-pole, 10,000 AIC, 100-ampere frame.
   d. Surge Suppressors: MOV type ac and dc.
   e. dc output ammeter and voltmeter.
   f. 0 hour to 72-hour manual equalize timer.
   g. Float, equalize, and current limit adjustable potentiometer.
   h. dc output blocking and protective diodes.
9. Alarm Relays:
   a. ac power failure.
   b. dc ground detector.
   c. High-low dc voltage.
10. dc Ground Detection for Local Indication:
   a. Switch for dc voltmeter indication.
   b. Indicating lights.
   c. Ground test and lamp test switch.
11. Enclosure: NEMA 250, Type 1, for switchgear auxiliary section mounting.

## 2.14 NETWORK/COMMUNICATION

A. Provide a communications network within switchgear to connect all protective relays to the plant DCS control system.

   1. Communication interface shall be a PLC:
      a. Provide a Rockwell Automation Compact Logix PLC, which shall communicate to individual protective relays. Mount the PLC and any associated network equipment in a NEMA 1 enclosure located in the walk-in aisle way as shown on Drawings.
      b. PLC shall connect to the plant DCS system via Ethernet IP fiber optic connections as shown on Drawings.
   2. Provide power to network equipment from switchgear battery.
   3. Provide network devices, cabling, and connectors for the internal network supplied.

B. Provide a communications network within switchgear to allow for communication of CAISO metering to an external network, by others.

   1. Communication interface shall be a switch:
      a. Provide a managed Ethernet switch with both fiber and copper ports in a NEMA 1 enclosure located in the walk-in aisle way as shown on Drawings.

b. Connect CAISO meters to the switch via copper cabling, or as required by CAISO standards.
c. Coordinate work with CAISO representatives for final switch configuration and other requirements.

C. Provide a communications network within switchgear to allow for communication of SDG&E metering to an external network, by others.

1. Communication interface shall be a switch:
   a. Provide a managed Ethernet switch with both fiber and copper ports in a NEMA 1 enclosure located in the walk-in aisle way as shown on Drawings.
   b. Connect SDG&E meters to the switch via copper cabling, or as required by SDG&E standards.
   c. Coordinate work with SDG&E representatives for final switch configuration and other requirements.

## 2.15 SURGE PROTECTION

A. In accordance with IEEE C62.11 and NEMA LA 1.

B. Connect to line side of main power circuit breakers and ground to switchgear ground bus.

C. Class: Station.

## 2.16 ACCESSORIES

A. Integral racking with remote pendant control.

B. One each, manual racking crank.

C. One each, manual spring charging crank.

D. One each, spanner nut wrench for main contact removal or replacement.

E. One set, test plugs, cables, and jumper for drawout relays, meters, and electrically operated circuit breakers.

F. Breaker Handling Equipment: One each, top-rail-mounted traveling lifter with electric lifting mechanism and yoke.

G. One each, dockable transport dolly.

2.17 MIMIC BUS

A. One-line displaying bus arrangement, circuit protective devices, and branch circuit extensions.

B. Buses: 3/8-inch-wide, with orange colored strips.

C. Devices: 3/8-inch-wide, with orange colored strips.

D. Strips: Self-sticking plastic tape, applied to face of switchgear.

E. Nameplates to identify incoming lines, protective devices, and feeder circuits.

2.18 EQUIPMENT IDENTIFICATION

A. Master Nameplate:

1. Deep etched aluminum with manufacturer's name and model number.
2. Riveted to main vertical section.

B. Section Identification:

1. Stamped metallic, riveted to each vertical section.
2. Serial number, bus rating, and section reference number.
3. Size: Manufacturer's standard.

C. Nameplate: Refer to Section 26 05 02, Basic Electrical Requirements.

D. Cubicle Labels:

1. Nonmetallic, applied inside each cubicle compartment.
2. Device serial number, rating, and description.

E. Control Switches: Deep etched, aluminum escutcheon plate.

F. Relays and Devices:

1. Stamped metallic, riveted to instrument case.
2. Manufacturer's name, model number, relay type, and rating data.

G. Switchgear Signs:

1. Two signs each on front and back of switchgear.
2. Size: Manufacturer's standard. Engraved, acrylic.
3. Color: Red with white.
4. Inscription: DANGER/HIGH VOLTAGE/KEEPOUT.

5. Characters: Gothic type, 2 inches high.
6. Attachment: Four rivets each sign.

2.19 FACTORY TESTING

A. Switchgear assembly production tested in accordance with IEEE C37.20.2.

B. Circuit breakers production tested in accordance with IEEE C37.09.

C. Witnessed Factory Testing:

1. In accordance with Section 40 90 00, Instrumentation and Control.
2. Perform Equipment Communications Test (ECT) at the factory, with the Distributed Control System Provider (DCSP). Test communications from protective relays to switchgear mounted PLC and to DCSP supplied DCS processor.
3. Include Testing and Coordination Activities:
   a. Nodes/addressing coordination.
   b. Functional testing of communications-capable devices mounted in the switchgear.
4. Complete Witnessed Factory Testing prior to shipping substation to the Site.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions and recommendations.

B. Secure equipment to floor with anchor bolts of sufficient size and number adequate for specified seismic conditions.

C. Install equipment plumb and in longitudinal alignment with wall.

D. Tighten current-carrying bolted bus connections and enclosure framing and panel bolts to manufacturer's recommendations.

E. Coordinate terminal connections with installation of secondary feeders.

F. PLC Configuration: Supplier shall provide all PLC configuration and programming required for a complete and functional system.

G. Network/Communication: Final connections to and commissioning of the plant DCS network connection will occur outside of this Work, to be completed in another package as part of the overall Project. Coordinate work with other packages as necessary. DCS communications to this switchgear is not required for startup and acceptance of this equipment as part of this Work.

3.02 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:

1. Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:
   a. 1 person-day for installation assistance and inspection.
   b. 2 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   c. 1 person-day for prestartup classroom or Site training.
   d. 1 person-day for facility startup.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Testing, Integration, and Startup.

**END OF SECTION**

# SECTION 26 20 00
# LOW-VOLTAGE AC INDUCTION MOTORS

## PART 1 GENERAL

### 1.01 RELATED SECTIONS

A. This section applies only when referenced by a motor-driven equipment specification. Application, horsepower, enclosure type, mounting, shaft type, synchronous speed, and deviations from this section will be listed in the equipment specification. Where such deviations occur, they shall take precedence over this section.

### 1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers Association (ABMA):
   a. 9, Load Ratings and Fatigue Life for Ball Bearings.
   b. 11, Load Ratings and Fatigue Life for Roller Bearings.
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   b. 620, Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Machines.
   c. 841, Standard for Petroleum and Chemical Industry—Premium Efficiency Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 370 kW (500 hp).
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. C50.41, Polyphase Induction Motors for Power Generating Stations.
   c. MG 1, Motors and Generators.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. UL:
   a. 83, Standard for Safety for Thermoplastic-Insulated Wire and Cables.
   b. 674, Standard for Safety for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.
   c. 2111, Standard for Safety for Overheating Protection for Motors.

1.03 DEFINITIONS

A. CISD-TEFC: Chemical industry, severe-duty enclosure.

B. DIP: Dust-ignition-proof enclosure.

C. EXP: Explosion-proof enclosure.

D. Inverter Duty Motor: Motor meeting applicable requirements of NEMA MG 1, Section IV, Parts 30 and 31.

E. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.

F. ODP: Open drip-proof enclosure.

G. TEFC: Totally enclosed, fan-cooled enclosure.

H. TENV: Totally enclosed, nonventilated enclosure.

I. WPI: Open weather protected enclosure, Type I.

J. WPII: Open weather protected enclosure, Type II.

1.04 SUBMITTALS

A. Action Submittals:

1. Descriptive information.
2. Nameplate data in accordance with NEMA MG 1.
3. Additional Rating Information:
    a. Service factor.
    b. Locked rotor current.
    c. No load current.
    d. Multispeed load classification (for example, variable torque).
    e. Adjustable frequency drive motor load classification (for example, variable torque) and minimum allowable motor speed for that load classification.
    f. Guaranteed minimum full load efficiency and power factor.
4. Enclosure type and mounting (such as, horizontal, vertical).
5. Dimensions and total weight.
6. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.
7. Bearing type.
8. Bearing lubrication.

9. Bearing life.
10. Space heater voltage and watts.
11. Description, ratings, and wiring diagram of motor thermal protection.
12. Motor sound power level in accordance with NEMA MG 1.
13. Maximum brake horsepower required by the equipment driven by the motor.
14. Description and rating of submersible motor moisture sensing system.

B. Informational Submittals:

1. Factory test reports.
2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
3. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. General Electric.
2. Reliance Electric.
3. MagneTek.
4. Siemens Energy and Automation, Inc., Motors and Drives Division.
5. Baldor.
6. U.S. Electrical Motors.
7. TECO-Westinghouse Motor Co.
8. Toshiba International Corp., Industrial Division.
9. WEG Electric Motors Corp.
10. Or approved equal.

### 2.02 GENERAL

A. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.

B. In order to obtain single source responsibility, use a single supplier to provide drive motor, its driven equipment, and specified motor accessories.

C. Meet requirements of NEMA MG 1.

D. For motors used in hazardous (classified) locations, Class I, Division 1, Groups B, C, and D, and Class II, Division 1, Groups E, F, and G provide motors that conform to UL 674 and have an applied UL listing mark.

E. Motors shall be specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.

F. Lifting lugs on motors weighing 100 pounds or more.

G. Operating Conditions:

1. Maximum ambient temperature not greater than 40 degrees C.
2. Motors shall be suitable for operating conditions without reduction being required in nameplate rated horsepower or exceeding rated temperature rise.
3. Overspeed in either direction in accordance with NEMA MG 1.

2.03 HORSEPOWER RATING

A. As designated in motor-driven equipment specification.

B. Constant Speed Applications: Brake horsepower of driven equipment at any operating condition not to exceed motor nameplate horsepower rating, excluding service factor.

C. Adjustable Frequency and Adjustable Speed Applications (Inverter Duty Motor): Driven equipment brake horsepower at any operating condition not to exceed motor nameplate horsepower rating, excluding service factor.

2.04 SERVICE FACTOR

A. Inverter-duty Motors: 1.0 at rated ambient temperature, unless otherwise noted.

B. Other Motors: 1.15 minimum at rated ambient temperature, unless otherwise noted.

2.05 VOLTAGE AND FREQUENCY RATING

A. System Frequency: 60-Hz.

B. Voltage Rating: Unless otherwise indicated in motor-driven equipment specification:

| Voltage Rating | | |
|---|---|---|
| **Size** | **Voltage** | **Phase** |
| 1/2 hp and smaller | 115 | 1 |
| 3/4 hp through 400 hp | 460 | 3 |

C. Suitable for full voltage starting.

D. 100 hp and larger also suitable for reduced voltage starting with 65 percent or 80 percent voltage tap settings on reduced inrush motor starters.

E. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.

2.06 EFFICIENCY AND POWER FACTOR

A. For all motors except single-phase, under 1 hp, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:

1. Efficiency:
   a. Tested in accordance with NEMA MG 1, Paragraph 12.59.
   b. Guaranteed minimum at full load in accordance with NEMA MG 1 Table 12-12, Full-load Efficiencies for NEMA Premium Efficiency Electric Motors Rated 600 Volts or Less (Random Wound), or as indicated in motor-driven equipment specification.
2. Power Factor: Guaranteed minimum at full load shall be manufacturer's standard or as indicated in motor-driven equipment specification.

2.07 LOCKED ROTOR RATINGS

A. Locked rotor kVA Code F or lower, if motor horsepower not covered by NEMA MG 1 tables.

B. Safe Stall Time: 12 seconds or greater.

2.08 INSULATION SYSTEMS

A. Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system.

B. Three-phase and Integral Horsepower Motors: Unless otherwise indicated in motor-driven equipment specification, Class F with Class B rise at nameplate horsepower and designated operating conditions, except EXP motors which must be Class B with Class B rise.

2.09 ENCLOSURES

A. Enclosures to conform to NEMA MG 1.

B. TEFC and TENV: Furnish with drain hole with porous drain/weather plug.

C. Explosion-Proof (EXP):

1. TEFC listed to meet UL 674 and NFPA 70 requirements for Class I, Division 1, Group D hazardous locations.
2. Drain holes with drain and breather fittings.
3. Integral thermostat opening on excessive motor temperature in accordance with UL 2111 and NFPA 70.
4. Terminate thermostat leads in terminal box separate from main terminal box.

D. Submersible: In accordance with Article Special Motors.

E. Chemical Industry, Severe-Duty (CISD-TEFC): In accordance with Article Special Motors.

2.10 TERMINAL (CONDUIT) BOXES

A. Oversize main terminal boxes for motors.

B. Diagonally split, rotatable to each of four 90-degree positions. Threaded hubs for conduit attachment.

C. Except ODP, furnish gaskets between box halves and between box and motor frame.

D. Minimum usable volume in percentage of that specified in NEMA MG 1, Section 1, Paragraph 4.19 and NFPA 70, Article 430:

| Terminal Box Usable Values | | |
|---|---|---|
| **Voltage** | **Horsepower** | **Percentage** |
| Below 600 | 15 through 125 | 500 |
| Below 600 | 150 through 300 | 275 |

E. Terminal for connection of equipment grounding wire in each terminal box.

F. Coordinate motor terminal box conduit entries versus size and quantity of conduits shown on Drawings.

2.11 BEARINGS AND LUBRICATION

A. Horizontal Motors:

1. 3/4 hp and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
2. 1 hp through 400 hp: Regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
3. Above 400 hp: Split sleeve, oil insulated bearings.
4. Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.

B. Vertical Motors:

1. Thrust Bearings:
   a. Antifriction bearing.
   b. Manufacturer's standard lubrication 200 hp and smaller.
   c. Oil lubricated 125 hp and larger.
   d. Minimum 50,000 hours L-10 bearing life.
2. Guide Bearings:
   a. Manufacturer's standard bearing type.
   b. Manufacturer's standard lubrication 200 hp and smaller.
   c. Oil lubricated 250 hp and larger.
   d. Minimum 100,000 hours L-10 bearing life.

C. Regreasable Antifriction Bearings:

1. Readily accessible, grease injection fittings.
2. Readily accessible, removable grease relief plugs.

D. Oil Lubrication Systems:

1. Oil reservoirs with sight level gauge.
2. Oil fill and drain openings with opening plugs.
3. Provisions for necessary oil circulation and cooling.

E. Inverter Duty Rated Motors, Bearing Isolation: Motors larger than 50 hp shall have electrically insulated ceramic coated bearings to prevent stray current damage.

2.12 NOISE

A. Measured in accordance with NEMA MG 1.

B. Motors controlled by adjustable frequency drive systems shall not exceed sound levels of 3 dBA higher than NEMA MG 1.

2.13 BALANCE AND VIBRATION CONTROL

A. In accordance with NEMA MG 1, Part 7.

2.14 EQUIPMENT FINISH

A. External Finish: Prime and finish coat manufacturer's standard. Finish color manufacturer's standard.

B. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

2.15 SPECIAL FEATURES AND ACCESSORIES

A. Screen Over Air Openings: Stainless steel on motors with ODP, WPI, and WPII enclosures meeting requirements for guarded machine in NEMA MG 1 and attached with stainless steel screws.

B. Winding Thermal Protection:

1. Thermostats:
   a. Provide where indicated on motor control diagrams on Drawings.
   b. Bi-metal disk or rod type thermostats embedded in stator windings.
   c. Automatic reset contacts rated 120 volts ac, 5 amps minimum, opening on excessive temperature (Provide manual reset at motor controller).
   d. Leads extending to separate terminal box for motors 100 hp and larger.

C. Space Heaters:

1. Provide winding space heaters with leads wired out to separate condulet or terminal box.
2. Provide extra hole or hub on motor terminal box as required.
3. Unless shown otherwise, heater shall be suitable for 120V ac supply, with wattage suitable for motor frame size.

D. Nameplates:

1. Raised or stamped letters on stainless steel or aluminum.
2. Display motor data required by NEMA MG 1, Paragraph 10.39 and Paragraph 10.40 in addition to bearing numbers for both bearings.
3. Premium efficiency motor nameplates to display NEMA nominal efficiency, guaranteed minimum efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.

E. Anchor Bolts: Provide meeting manufacturer's recommendations and of sufficient size and number for specified seismic condition.

## 2.16 SPECIAL MOTORS

A. Requirements in this article take precedence over conflicting features specified elsewhere in this section.

B. Chemical Industry, Severe-Duty (CISD-TEFC):

1. In accordance with IEEE 841.
2. TEFC in accordance with NEMA MG 1.
3. Suitable for indoor or outdoor installation in severe-duty applications including high humidity, chemical (corrosive), dirty, or salty atmospheres.
4. Motor Frame, End Shields, Terminal Box, and Fan Cover: Cast iron.
5. Ventilating Fan: Corrosion-resistant, nonsparking, external.
6. Drain and Breather Fittings: Stainless steel.
7. Nameplate: Stainless steel.
8. Gaskets between terminal box halves and terminal box and motor frame.
9. Extra slinger on rotor shaft to prevent moisture seepage along shaft into motor.
10. Double shielded bearings.
11. 125,000 hours minimum L-10 bearing life for direct-connected loads.
12. External Finish: Double-coated epoxy enamel.
13. Coated rotor and stator air gap surfaces.
14. Insulation System, Windings, and Connections:
    a. Class F insulation, Class B rise or better at 1.0 service factor.
    b. Multiple dips and bakes of nonhygroscopic polyester varnish.

15. Service Factor:
    a. At 40 Degrees C Ambient: 1.15.
    b. At 65 Degrees C Ambient: 1.00.
16. Safe Stall Time Without Injurious Heating: 20 seconds minimum.

C. Severe-duty Explosion-proof: Meet requirements for EXP enclosures and CISD-TEFC motors.

D. Severe-duty, Dust-ignition-proof: Meet requirements for DIP enclosures and CISD-TEFC motors.

E. Multispeed: Meet requirements for speeds, number of windings, and load torque classification indicated in motor-driven equipment specification.

F. Inverter Duty Motor:

1. Motor supplied power by adjustable voltage and adjustable frequency drives shall be inverter duty rated.
2. Suitable for operation over entire speed range indicated.
3. Provide forced ventilation where speed ratio is greater than published range for motor provided.
4. When installed in Division 1 hazardous (classified) location shall be identified as acceptable for variable speed when used in Division 1 location.
5. Shaft Grounding Device: Motors larger than 50 hp shall be provided with shaft grounding brush or conductive micro fiber shaft grounding ring. Shaft grounding device shall be solidly bonded to grounded motor frame per manufacturer's recommendations.
    a. Manufacturers:
        1) Grounding Brush:
            a) Sohre Turbomachinery, Inc.
            b) Or approved equal.
        2) Grounding Ring:
            a) EST-Aegis.
            b) Or approved equal.

G. Submersible Pump Motor:

1. Manufacturers:
    a. Reliance Electric.
    b. ITT Flygt Corp.
    c. Or approved equal.

2. At 100 Percent Load:

| Submersible Pump Motors | | |
|---|---|---|
| **Horsepower** | **Guaranteed Minimum Efficiency** | **Guaranteed Minimum Power Factor** |
| 5 through 10 | 80 | 82 |
| 10.1 through 50 | 85 | 82 |
| 50.1 through 100 | 87 | 82 |
| Over 100 | 89 | 82 |

3. Insulation System: Manufacturer's standard Class B or Class F.
4. Motor capable of running dry continuously.
5. Enclosure:
   a. Hermetically sealed, watertight, for continuous submergence up to 65-foot depth.
   b. Listed to meet UL 674 and NFPA 70 requirements for Class I, Division 1, Group D hazardous atmosphere.
   c. Seals: Tandem mechanical.
6. Bearing and Lubrication:
   a. Permanently sealed and lubricated, replaceable antifriction guide and thrust bearings.
   b. Minimum 15,000 hours L-10 bearing life.
7. Inrush kVA/horsepower no greater than NEMA MG 1 and NFPA 70, Code F.
8. Winding Thermal Protection:
   a. Thermal sensor and switch assembly, one each phase, embedded in stator windings and wired in series.
   b. Switches normally closed, open upon excessive winding temperature, and automatically reclose when temperature has cooled to safe operating level.
   c. Switch contacts rated at 5 amps, 120V ac.
9. Motor Seal Failure Moisture Detection:
   a. Probes or sensors to detect moisture beyond seals.
   b. Probe or sensor monitoring module for mounting in motor controller, suitable for operation from 120V ac supply.
   c. Monitoring module with control power transformer, probe test switch and test light, and two independent 120V ac contacts, one opening and one closing when flux of moisture is detected.

10. Winding thermal protection, moisture detection, and bearing overtemperature specified above may be monitored by single device providing two independent 120V ac contacts, one closing and one opening on malfunction.
11. Connecting Cables:
    a. One cable containing power, control, and grounding conductors.
    b. Each cable suitable for hard service, submersible duty with watertight seal where cable enters motor.
    c. Length: As required.
    d. UL 83 listed and sized in accordance with NFPA 70.

H. Inclined Motors:

1. Motors suitable for operation only in horizontal position not acceptable.
2. Bearings designed for thrust imposed by driven equipment and by motor rotor when motor is in inclined position.
3. Lubrication system designed to provide adequate bearing lubrication when motor is in inclined position.

## 2.17 FACTORY TESTING

A. Tests:

1. In accordance with IEEE 112 for polyphase motors.
2. Routine (production) tests in accordance with NEMA MG 1. Test multispeed motors at all speeds.
3. For energy efficient motors, test efficiency and power factor at 50 percent, 75 percent, and 100 percent of rated horsepower:
    a. In accordance with IEEE 112, Test Method B, and NEMA MG 1, Paragraph 12.59 and Paragraph 12.60.
4. Provide test reports for polyphase motors 100 hp and larger.

B. Test Report Forms:

1. Routine Tests: IEEE 112, Form A-1.
2. Efficiency and power factor by Test Method B, IEEE 112, Form A-2, and NEMA MG 1, Table 12-12.
3. Temperature Test: IEEE 112, Form A-2.

## PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's instructions and recommendations.

B. Align motor carefully and properly with driven equipment.

C. Secure equipment to mounting surface with anchor bolts.

3.02 MANUFACTURER'S SERVICES

A. Manufacturer's Certificate of Proper Installation.

**END OF SECTION**

# SECTION 26 23 00
# LOW-VOLTAGE SWITCHGEAR

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI): C37.50, Switchgear—Low-Voltage AC Power Circuit Breakers Used in Enclosures—Test Procedures.
2. Institute of Electrical and Electronics Engineers (IEEE):
   a. C37.13, Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
   b. C37.16, Standard for Preferred Ratings, Related Requirements, and Application Recommendation for Low-Voltage AC (635V and below) and DC (3200V and below) Power Circuit Breakers.
   c. C37.20.1, Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.
   d. C37.20.3, Standard for Metal Enclosed Interrupter Switchgear.
   e. C37.100, Standard Definitions for Power Switchgear.
3. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. UL:
   a. 489, Standard for Safety for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
   b. 1558, Standard for Safety for Metal-Enclosed, Low-Voltage Power Circuit Breaker Switchgear.

### 1.02 SUBMITTALS

A. Action Submittals:

1. Descriptive product information.
2. Itemized bill of material.
3. Dimensional drawings.
4. Operational description.
5. Anchoring instructions and details.
6. One-line, three-line, and control schematic drawings.
7. Connection and interconnection drawings.
8. Circuit Breakers: Copies of time-current characteristics.
9. Ground Fault Protection: Relay time-current characteristics.

10. Bus data.
11. Incoming line section equipment data.
12. Transformer section equipment data.
13. Conduit entrance locations.
14. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's installation instructions.
3. Factory Test Report.
4. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
5. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
6. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

## PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Eaton.
2. General Electric.
3. Siemens.
4. Square D.
5. ABB.

6. Or approved equal.

2.02 GENERAL REQUIREMENTS

A. Service: 480 volts, three-phase, three-wire solid grounded wye, having an available short circuit current at line terminals as shown. Provide neutral lugs as required for termination of neutral conductors.

B. Designed and assembled in accordance with IEEE C37.20.3, IEEE C37.100, ANSI C37.50, and UL 1558.

C. Switchgear and its major components shall be end products of one manufacturer in order to achieve standardization for appearance, operation and maintenance, spare parts replacement, and manufacturer's services.

D. Operating Conditions:

1. Ambient Temperature: Maximum 40 degrees C.
2. Equipment shall be fully rated without derating for operating conditions.

E. Lifting lugs on equipment and devices weighing over 100 pounds.

F. Anchor Bolts: Sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications.

2.03 STATIONARY STRUCTURE

A. Type: ANSI C37.50 switchgear construction, consisting of pull section with cable terminations, metering, breaker, transition, and auxiliary sections assembled to form a rigid, self-supporting, metal enclosed structure.

B. Material: 11-gauge minimum cold-rolled steel, formed with reinforced steel members.

C. Grounded metal barriers between each breaker, main bus, branch cabling, and instrumentation/control.

D. Modular-designed steel frame with removable plates and individual, bolted, steel-framed vertical sections.

E. Individual, hinged doors over each breaker, metering, and auxiliary compartments.

F. Cable Installation and Termination Compartments:

1. Rear hinged doors, capable of being bolted closed.
2. Cable bending space in accordance with NFPA 70.

3. Cable supports in each vertical section.

G. Breaker Compartments:

1. Individual, grounded compartments, with:
   a. Sheet steel, top, bottom, sides, and ventilated compartment door with padlocking features.
   b. Flame-retardant, arc track-resistant nonmetallic rear barrier.
   c. Drawout rails, stationary breaker contacts, interlocks, and necessary control and indicating devices.
   d. Shutters over stationary contacts when breaker is in TEST or DISCONNECT position.
   e. Padlocking provision on rackout rails for locking breaker in TEST or DISCONNECT position.
2. Drawout Mechanism:
   a. Shall retain removable element in connected position.
   b. Mechanical interlocks to ensure breaker is open before moved from a position, or when between positions.
   c. Four Distinct Breaker Positions: CONNECTED, TEST, DISCONNECTED, and WITHDRAW.
   d. Indicators to display breaker position.
   e. Capable of being operated without opening breaker door.
3. Breaker frame grounded to steel frame throughout travel of drawout mechanism.
4. Each compartment designed for specific breaker frame size.
5. Future breaker compartments fully equipped with electrical connections, bolted metal barrier across compartment face, and compartment door.

H. Slide-Out Instrument Tray:

1. Mount above associated breaker.
2. Accessible from front of switchgear.
3. For control circuitry, breaker close and trip fuses, and indicating lights.

I. Auxiliary sections equipped with devices shown on Drawings, potential transformers, control transformers, and fuses with hinged door over each compartment.

2.04 ENCLOSURE

A. Finish: Baked enamel applied over rust-inhibiting phosphated base coating.

1. Color:
   a. Exterior: Provide gray finish as approved by Owner.
   b. Interior: White.
   c. Unpainted Parts: Plated for corrosion resistance.

B. Indoor Enclosure:

1. NEMA 250, Type 1, with formed edges on hinged and nonhinged panels.
2. Rear, full-height, bolt-on panels for each enclosure section.
3. Cable Termination Access: Padlock provision.

C. Walk-in Outdoor Enclosure:

1. NEMA 250, Type 3R, enclosing NEMA 250, Type 1 enclosed switchgear.
2. Hinged, full-height doors with three-point latch operated by vault type handle with multiple padlocking provisions for each rear switchgear section.
3. Minimum 42-inch-wide aisle in front of switchgear.
4. Access Door: With panic hardware at each end of aisle.
5. Latch Mechanism: Inside quick-release, to allow opening of door from inside even when locked on outside.
6. Gasketed doors, rear panels, end panels, and sloped roof having 4-inch minimum overhang on all sides.
7. Support assembly on 4-inch modular base.
8. Steel bottom enclosure and support assembly undercoated with coal tar emulsion.
9. Ventilating louvers with filters in rear panels and at end of each aisle.
10. Lighting: LED 30-foot-candle minimum aisle lights, three-way light switches.
11. Receptacles: Minimum of two, grounding type, 120 volts, 20 amperes, at each end of aisle.
12. Space Heaters: Thermostatically controlled 250-watt, 120-volt, in each switchgear vertical section.
13. Adjustable thermostat for temperature range of 50 degrees F to 70 degrees F.

D. Enclosure Transformer and Panelboard:

1. Transformer, primary and secondary main circuit breakers, and secondary panelboard section enclosed in a NEMA 250, Type 1 enclosure.
2. Transformer and Panel Location: In auxiliary section.
3. Self-Cooled, Encapsulated, Dry Type Transformer:
   a. Manufacturer’s standard insulation and temperature rise, in accordance with UL 1561.
   b. Full-capacity, 2-1/2 percent voltage taps, two above and two below normal voltage.

c. Primary Voltage: 480 three-phase with current limiting fuses in primary circuit.
d. Secondary Voltage: 208/120-volt, three-phase, four-wire.
e. kVA Rating: As required.
f. Primary circuit extended from branch breaker installed in switchgear.

4. Panelboard:
   a. Full, short-circuit current rated, in accordance with UL 489.
   b. Thermal magnetic, quick-make, quick-break, indicating type, noninterchangeable, molded case circuit breaker.
   c. Number and breaker ampere ratings as required with 25 percent spare.

## 2.05 BUSWORK

A. Material: Phase isolated and insulated tin-plated copper throughout entire length of sufficient cross section to limit temperature rise at rated current to 55 degrees C.

B. Bus Arrangement: A-B-C, left-to-right, top-to-bottom, and front-to-rear, as viewed from front.

C. Brace for short circuit currents as shown.

D. Main Horizontal Bus: Nontapered, continuous current rating as shown.

E. Neutral Bus: Service entrance rated neutral connection in main breaker compartment, no neutral bus in other sections.

F. Ground Bus:

1. Material: Tin-plate copper.
2. Rating: 800 amperes.
3. Bolted to each vertical section.
4. Ground lug for 4/0 copper conductor on each end of bus.
5. Bus Connections and Joints: Bolted, with Belleville washers.

G. Extend each bus entire length of switchgear.

## 2.06 PROTECTIVE DEVICES

A. Power Air Circuit Breakers:

1. Main tie and feeder breakers in accordance with IEEE C37.13 and IEEE C37.16.
2. Arrangement: Fully rated main and branch feeder.

3. Three-pole electrically and mechanically trip-free with:
   a. Self-aligning primary and secondary contacts.
   b. Integral, solid state, over-current trip programmer.
   c. Arc quenchers.
   d. Closing Mechanism: Electric.
   e. Stored energy mechanism with maximum five-cycle closing.
   f. Solid state trip device.
4. Individually mounted, drawout breaker listed for 100 percent continuous ampere rating.
5. Frame Size: As shown.
6. Interrupting Rating: Provide same rating as main bussing short circuit current bracing rating, as shown on Drawings.

B. Electrical Operation:

1. Motor or solenoid automatic charging, plus manual charging.
2. Electrically closing, escutcheon mounted pushbutton with mechanical closing upon loss of control power.
3. Electrical trip, escutcheon mounted, trip pushbutton.
4. Control Power Voltage: 120V ac.

C. Color-Coded Visual Indicators: Contacts OPEN and CLOSED, plus mechanism CHARGED and DISCHARGED.

D. Accessories:

1. Provide breaker remote racking device to allow maintenance personnel to rack the breaker from a distance of 30 feet. Provide portable drive unit, control unit, control cable, and power cable.
2. Slow breaker closing handle for contact adjustments.
3. Breaker lifting hoist and travel rail on top of switchgear.
4. Auxiliary a/b contacts on main breakers.

E. Test Facilities:

1. Breakers with integral external test points for portable test kit.
2. Handheld test kit for functional testing of trip circuitry of each breaker.

F. Solid State Trip Units: Flux-shift trip and current sensors.

1. Protective Programmers:
   a. Self-powered, automatic rms sensing micro-electronic processor.
   b. No external relays or accessories.
   c. Printed circuit cards with gold-plated contacts.

d. Programmable Controls:
   1) Fixed-point, with repetitive accuracy and precise unit settings.
   2) Trip adjustments made by nonremovable, discrete step switching.
e. Field-Installable Rating Plugs:
   1) Long-time pickup LED indicator and test receptacle.
   2) Matching load and cable requirements.
   3) Interlocked with tripping mechanism.
   4) Breaker to remain trip-free with plug removed.
   5) Keyed rating plugs to prevent incorrect application.
f. Long-time pickup light.
g. Selective coordination time/current curve shaping adjustable functions:
   1) Current setting.
   2) Long-time pickup.
   3) Long-time delay.
   4) Instantaneous pickup with short-time for main and tie.
   5) Short-time pickup for main, tie and feeders.
   6) Short-time delay for main tie and feeders.
   7) Ground fault pickup.
   8) Ground fault delay with I2T function.
   9) High instantaneous pickup with short-time delay.
   10) Zone selective interlock.
h. Fault Trip Indicators: Mechanical push-to-reset type for overload and short circuit overload plus ground fault trip.
i. Rejection Pins: For each programmer frame size.

2. Phase Current Sensors:
   a. Multi ratio type.
   b. Fixed, mounted on breaker frame.
   c. Molded epoxy construction.
   d. One toroidal type for each phase.
3. Ground Fault Sensor:
   a. Neutral bar single-ratio CT mounted in cable compartment.
   b. Molded epoxy construction.
   c. Shorting bar.
4. Portable Test Set: ac/dc static, full function unit for checking programmer's time-current characteristics of programmer.

G. Arc Reduction Maintenance System (ARMS): Design for the temporary arc-flash incident energy reduction during maintenance activities.

   1. For each feeder circuit breaker, provide a manual switch on the compartment door to switch the circuit breaker short time tripping

characteristics to instantaneous with minimum pick-up setting, in order to reduce the danger from potential arc-flash at downstream equipment.
2. Provide a lock feature for the ARMS switch so that it may be locked in either the OFF or ON maintenance mode position.
3. Provide a blue LED indicating light to indicate ARMS switch is in the maintenance mode.
4. Wire contacts on all ARMS switches to a common alarm contact that shall close for remote indication.
5. Approved equal to Eaton's Magnum DS Breaker's Digitrip 520MC trip unit.

H. Remote Circuit Breaker Operation Panel:

1. Provide remote control panel capable of operating all main, tie and feeder circuit breakers.
2. Provide in a NEMA 4 enclosure, to be mounted on an accessible external portion of the unit substation switchgear enclosure.
3. Each circuit breaker shall be provided with a CLOSE/TRIP control switch at the remote control panel. Switches shall have provisions for padlocking.
4. Each circuit breaker shall be provided with a red "CLOSED" indicating light.
5. Remote control panel shall be hardwired to the switchgear in order facilitate Open/Close operations. Provide necessary terminals for landing field wiring. Provide all necessary conduit and wiring connections between switchgear and remote control panel.

2.07 CONTROL WIRING

A. NFPA 70, Type SIS, single-conductor, Class B, stranded copper, rated 600 volts for control, instrumentation, and power/current circuits.

B. Shielded cable rated 600 volts for transducer output and analog circuits.

C. Enclosed in top and vertical steel wiring troughs, and front-to-rear in nonmetallic wiring troughs.

D. Conductor Lugs: Preinsulated, self-locking, spade type, with reinforced sleeves.

E. Identification: Individually, with permanent wire markers at each end.

F. Splices: Not permitted in switchgear wiring.

2.08 TERMINAL BLOCKS

A. Enclosed in steel wiring troughs.

B. Rated 600 volts, 30 amperes minimum, one-piece barrier type with strap screws.

C. Shorting type for current transformer leads.

D. Provide terminal blocks for:

1. Conductors connecting to circuits external to switchgear.
2. Internal circuits crossing shipping splits.
3. Equipment parts requiring replacement and maintenance.

E. Spare Terminals: Not less than 20 percent.

F. Group terminal blocks for external circuit wiring leads.

G. Maintain 6-inch minimum space between columns of terminal blocks.

H. Identification: Permanent, for each terminal and columns of terminals blocks.

I. Manufacturer and Product:

1. General Electric; Type EB-5.
2. Or approved equal.

2.09 TEST FACILITIES

A. Breakers with integral external test points for portable test kit.

B. Handheld test kit for functional testing of trip circuitry of each breaker.

2.10 INSTRUMENTATION AND METERING

A. As specified in Section 26 09 13, Power Measurement and Control.

2.11 POWER METER

A. Provide where shown on Drawings, and as specified in Section 26 09 13, Power Measurement and Control.

## 2.12 EQUIPMENT IDENTIFICATION

A. Master Nameplate:

1. Deep-etched aluminum with manufacturer's name and model number.
2. Riveted to main vertical section.

B. Section Identification:

1. Engraved metallic, riveted to each vertical section.
2. Serial number, bus rating, and section reference number.
3. Size: Manufacturer's standard.

C. Nameplate:

1. Engraved, acrylic or phenolic for each circuit breaker cubicle and door-mounted device.
2. Black with white block type characters.
3. Character Height: 1/4-inch.
4. Size: Manufacturer's standard.
5. Inscriptions: As shown on one-line diagram. Where none are shown, use manufacturer's standard.
6. Blank plates for future spaces.
7. Attachment Screws: Stainless steel panhead.

D. Cubicle Labels:

1. Nonmetallic, applied inside each cubicle compartment.
2. Device serial number, rating, and description.
3. Size: As required.

E. Metering Instruments: Meter type identified on meter face below pointer or dial.

F. Control Switches: Deep-etched, aluminum escutcheon plate.

G. Relays and Devices:

1. Stamped metallic, riveted to instrument case.
2. Manufacturer's name, model number, relay type, and rating data.

H. Switchgear Signs:

1. Two signs each on front and back of switchgear.
2. Size: Manufacturer's standard.
3. Engraved, acrylic or phenolic.
4. Color: Red with white.

5. Inscription: DANGER/HIGH VOLTAGE/KEEP OUT.
6. Characters: Gothic type, 2 inches high.
7. Attachment: Four rivets each sign.

2.13 KEY INTERLOCKS

A. Mechanical lock cylinder, located as shown on Drawings.

B. Key and Lock Cylinder Type: Kirk.

C. Keys to be captive when breakers are closed.

D. Two keys available for each group of three locks.

2.14 FACTORY TESTING

A. In accordance with IEEE C37.20.1.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions and recommendations.

B. Secure equipment to mounting pads with anchor bolts.

C. Install equipment plumb and in longitudinal alignment with pad or wall.

D. Coordinate terminal connections with installation of secondary feeders.

3.02 MANUFACTURER'S SERVICES

A. Furnish manufacturer's representative in accordance with Section 01 43 33, Manufacturers' Field Services, for the following services at Site or classroom as designated by Owner, for minimum person-days listed below, travel time excluded:

1. 1 person-day for installation assistance and inspection.
2. 1 person-day for functional and performance testing.
3. 1 person-day for prestartup classroom or Site training.

B. Furnish startup services and training of Owner's personnel at such times as requested by Owner.

C. Provide Manufacturer's Certificate of Proper Installation in accordance with Section 01 43 33, Manufacturers' Field Services.

**END OF SECTION**

# SECTION 26 24 19
# LOW-VOLTAGE MOTOR CONTROL

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which shall be followed for this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Electrical Contractors Association (NECA): 402, Standard for Installing and Maintaining Motor Control Centers.
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 volts maximum).
   b. ICS 1, Industrial Control and Systems: General Requirements.
   c. ICS 2, Controllers, Contactors, and Overload Relays Rated 600 Volts.
   d. ICS 2.3, Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600V.
   e. ICS 18, Motor Control Centers.
   f. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. UL:
   a. 98, Enclosed and Dead-Front Switches.
   b. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   c. 845, Motor Control Centers.

### 1.02 DEFINITIONS

A. ASD: Adjustable Speed Drive.

B. LCD: Liquid Crystal Display.

C. N.C.: Normally Closed.

D. N.O.: Normally Open.

E. SPD: Surge Protection Device.

1.03 SUBMITTALS

A. Action Submittals:

1. Descriptive information.
2. Itemized Bill of Material.
3. Dimensional drawings.
4. Front Panel Elevations.
5. Conduit entrance locations.
6. Bus data.
7. Protective Devices: Copies of time-current characteristics.
8. Operational description. Interior Network/Communication cabling and components.
9. PLC and network equipment descriptive information.
10. Communications protocol setup and parameter setting information for plant control system communication programming.
11. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
12. Anchoring instructions and details.
13. Typed Tabulation:
    a. Motor name; tag (equipment) numbers as shown on Drawings.
    b. Motor horsepower.
    c. Nameplate full load current.
    d. Measured load current and voltage.
    e. Overload model number.
    f. Protective device trip settings.
    g. Manufacturer’s solid state starter switch, dip switch, or program settings.
    h. Attach above typed, tabulated data to a copy of starter manufacturer’s overload relay or setting selection tables for starters provided.
14. Control diagrams.
15. One-line diagrams.
16. Schematic (elementary) diagrams.
17. Outline diagrams.
18. Network block diagrams showing connection of individual ASD and intelligent overloads to PLC, and PLC connection to Plant Control System.
19. Interconnection diagrams.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer’s installation instructions.

3. Factory test reports, certified.
4. Control System Network Interface Testing Report, in accordance with the Equipment Communications Testing (ECT) section of Section 40 90 00, Instrumentation and Control.
5. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

1.04 QUALITY ASSURANCE

A. Provide products manufactured within scope of UL that conform to UL Standards and have applied UL listing mark.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Eaton Electrical/Cutler-Hammer.
2. Schneider Electric/Square D Services.
3. Allen-Bradley.
4. Siemens.
5. Or approved equal.

2.02 GENERAL

A. Like Items of Equipment: End product of one manufacturer and same manufacturer as low voltage switchgear/switchboard and panelboards for standardization.

B. Make adjustments necessary to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate motors actually provided under this Contract.

C. Controllers: NEMA ICS 1, NEMA ICS 2, Class A.

D. Control Transformer:

1. Two winding, 120-volt secondary, primary voltage to suit.
2. Two current-limiting fuses for primary circuit.
3. One fuse in secondary circuit with blown fuse indicator.
4. Mount within starter unit.

E. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

F. Lifting lugs on equipment and devices weighing over 100 pounds.

G. Anchor Bolts: As specified in the Area Classification and Materials Selection Table on Drawings, and as specified in Section 05 50 00, Metal Fabrications.

H. Seismic Zone and Importance Factor as specified in Section 01 61 00, Common Product Requirements.

I. Operating Conditions:

1. Ambient Temperature: Maximum 40 degrees C.
2. Altitude: Zero feet.
3. Equipment to be fully rated.

J. Enclosures: In accordance with NEMA 250.

K. Equipment Finish:

1. Electrocoating process applied over rust-inhibiting phosphated base coating.
2. Exterior Color: Manufacturer's standard.

## 2.03 SEPARATELY MOUNTED MOTOR CONTROL

A. Combination Full-Voltage, Magnetic Starter:

1. Rating: Horsepower rated at 600 volts, UL labeled for 22,000 amperes at 480 volts short circuit capacity with overload protection.
2. Three-phase, nonreversing, full voltage.
3. Control: As shown on Drawings.
4. Disconnect Type: Motor circuit protector.
5. Enclosure: As shown on Drawings.
6. Padlockable operating handle, capable of up to three locks.

B. Thermal Motor Overload Protection:

1. Inverse-time-limit characteristic.
2. Heater: Bimetallic overload, adjustable trip, or directly heated melting alloy, ratchet principle type element.
3. Relay Trip: Quick, Class 10.
4. Manual reset.
5. Provide in each ungrounded phase.
6. Mount within starter unit.

## 2.04 MOTOR CONTROL CENTERS

A. General:

1. Work shown on existing motor control centers shall be based on non-communicating, non-intelligent motor control construction, matching the existing installation. Do not provide communications networks for existing motor control centers. All new motor control centers provided shall adhere to the requirements for intelligent communication as specified herein.
2. In accordance with NEMA ICS 1, NEMA ICS 2, NEMA ICS 18, and UL 845.
3. Voltage Rating: 600 volts.
4. Provide an Ethernet/IP communications network within the motor control center to interconnect all overloads and adjustable speed drives equipped with communications.
5. Ethernet/IP equipped MCCs shall be provided with a Rockwell Automation CompactLogix PLC, which shall communicate to individual MCC components and provide a single radial network connection to the Plant Control System external network.
6. An HMI/panelview shall be provided that gives operators access to maintenance and troubleshooting information. Direct control of motors shall NOT be possible via the panelview. Mount panelview in readily accessible bucket for ease of use. Do not mount panelview above 5 feet AFF. Mount PLC in adjacent bucket space.
7. PLC and network equipment will receive 120V power from an external UPS, provided outside this section.
8. Provide network devices, cabling, and connectors for network provided.
9. Short Circuit Rating: Amperes rms symmetrical at 480 volts for entire motor control center as a complete assembly, as shown on Drawings.
10. Main and branch circuit breakers, controllers, wire connections, and other devices to be front mounted and accessible, unless otherwise noted.
11. NEMA ICS 18, Part 3.
    a. Class: IS.
    b. Type: B.

B. Enclosure:

1. Type: NEMA 250 Type 1, indoor gasketed.
2. Vertical Section Standard Indoor Dimensions for NEMA 1 Type:
    a. Nominal, 90 inches high, 20 inches wide, 21 inches deep.
    b. Alternative width dimensions of 24 inches and 30 inches are acceptable for oversize devices or panels.
    c. Do not exceed space shown.

3. Construction:
   a. Sheet steel reinforced with channel or angle irons.
   b. Butt sections flush, end-to-end against similar section without bolts, nuts, or cover plates causing interference.
   c. Removable top cover plates and bottom cover plates.
4. Section Mounting: Removable formed-steel channel sills and lifting angles to meet specified seismic requirements.
5. Horizontal Wiring Compartments: Accessible from front, full width, top and bottom.
6. Vertical Wiring Compartment:
   a. Full height, isolated from unit starters with separate hinged door and tie supports.
   b. No terminal blocks allowed in vertical wireway compartment.
   c. Provide separate low level signal/network raceway in wireway.
7. Terminal board compartment at unit space indicated with 10 percent spare terminals.
8. Unit Compartment: Individual compartments separated by steel barriers for each starter, feeder, or other unit capable of being wired from front without unit removal.
9. Compartment Doors: Separate hinged doors for each starter, feeder, or other unit.
10. Door Interlocking: Mechanically interlock starter and feeder doors so doors cannot be opened with unit energized. Provide defeater mechanism to allow intentional access and energizing at any time by qualified individual.
11. External disconnect handles with ON/OFF and trip positions showing, padlockable in OFF position with up to three-lock capability.
12. Cable Entrance: Main leads enter from bottom; control and feeder circuits enter from top and bottom.

C. Bus:

1. Horizontal Power Bus:
   a. Three-phase tin-plated, fully insulated, copper, entire width of control center, rated as shown.
   b. Tin or silver-plated at joints.
   c. Construct to allow future extension of additional sections.
   d. Pressure type solderless lugs for each incoming line cable.
   e. Isolated from top horizontal wireway.
   f. Provide Belleville washers on bus connection bolts.
2. Vertical Power Bus:
   a. Three-phase tin-plated, fully-insulated, copper, full height of section, rated 300 amperes.
   b. Tin-plated at joints.

c. Sandwich type bus insulation providing deadfront construction with starter units removed except for bus stab openings.
d. Insulated and isolated barrier, complete with shutters.
e. Provide Belleville washers on bus connection bolts.

3. Neutral Bus: None.
4. Ground Bus:
   a. Copper, bare tin-plated, rated 300 amperes, entire width of control center and in each vertical wireway.
   b. Provide Belleville washers on bus connection bolts.
5. Bus Bracing: Amperes rms symmetrical as shown on Drawings.

D. Motor Controller Unit:

1. Provide indicated individual components and control devices including pushbuttons, selector switches, indicating lights, control relays, time delay relays, and elapsed time meters as specified in Section 26 05 04, Basic Electrical Materials and Methods.
2. Construction:
   a. Drawout combination type with stab connections for starters NEMA ICS, Size 5 and smaller.
   b. Bolt-on combination type with cable connection to riser for starters NEMA ICS, Size 6 and larger.
   c. Readily interchangeable with starters of similar size.
   d. Pull-apart unit control wiring terminal boards capable of accepting up to two No. 14 AWG wires minimum on all units.
3. Starters:
   a. NEMA ICS 18, standard rating, except none smaller than NEMA ICS, Size 1.
   b. Rating: Horsepower rated at 600 volt, UL labeled for short circuit capacity as shown on Drawings. Provide with overload protection.
   c. Three-phase, nonreversing, unless specified otherwise.
   d. Disconnect Type: Motor circuit protector.
   e. Combination Full Voltage, Magnetic Starter:
      1) Control: As shown on Drawings.
   f. Combination Reduced Voltage, Solid State Starter:
      1) Control: As shown on Drawings.
      2) Bypass contactor.
      3) Class 10/20/30 electronic overload relay, switch, or dip switch selectable.
      4) Kick start, with adjustable torque and time settings.
      5) Ramp start, selectable current or torque, and adjustable time.
      6) Smooth stop ramp, adjustable time.
      7) Phase loss unbalance and phase reversal protection.
      8) LED display or LCD of fault, N.O. contact to communicate fault condition.

9) Communications: Ethernet/IP, as required to connect to and communicate with internal motor control center network.

g. Combination Reversing, Magnetic Starter:
1) Control: As shown on Drawings.
2) Suitable for squirrel cage motors.

h. Combination Adjustable Speed Drive, Solid State Starter: Drives as specified in Section 26 29 23, Low-Voltage Adjustable Speed Drive System.

i. Communications: Provide motor control network as required, connected to Plant Control System to establish control and monitoring features specified.

j. Padlockable operating handle when de-energized with up to three-lock capability.

k. Unit door interlocked to prevent opening when disconnect is in closed position.

l. Mechanical interlocked to prevent placing disconnect in ON position when unit door is open.

m. Minimum Dimensions: 12 inches high by full section width, less vertical wireway.

4. Disconnecting Device:
a. In each starter, control circuit disconnect to de-energize circuits in unit which are not de-energized by starter power disconnect device.
b. Padlockable in OPEN position for up to three locks.

5. Circuit Breaker:
a. Meet requirements of UL 489.
b. Molded case with manufacturer's recommended trip setting for maximum motor protection.
c. Thermal-magnetic trip.
d. Tripping indicated by operating-handle position.
e. Interrupting capacity required for connection to system with short-circuit capacity indicated.

6. Thermal Motor Overload Protection:
a. Provide only for existing motor control centers.
b. Inverse-time-limit characteristic.
c. Heater: Bimetallic overload, adjustable trip, or directly heated melting alloy, ratchet principle type element.
d. Relay Trip: Quick, Class 10.
e. Manual reset.
f. Provide in each ungrounded phase.
g. Mount within starter unit.

7. Solid State Motor Overload Protection:
a. Provide for new motor control centers.
b. Inverse-time-limit characteristic.
c. Phase loss, phase unbalance, and Class II ground fault protection.

d. Current operated electronic circuitry with adjustable trip.
e. Class 10/20/30 relay trip, switch selectable.
f. One N.O. auxiliary contact for remote monitoring.
g. Manual reset.
h. Provide in each ungrounded phase.
i. Mount within starter unit.
j. Communications: Ethernet/IP capability as required to establish motor control network. Provide additional switches or interface modules as needed to meet requirements.

8. Motor Thermal Protector Interface: Manual-reset interposing relay for connection to motor-mounted thermal protector system.

E. Control Unit:

1. Disconnecting Device: Pull-apart terminal blocks capable of de-energizing external source control circuits in unit.
2. Control Devices: As indicated and as specified in Section 26 05 04, Basic Electrical Materials and Methods.
3. Control Wiring:
   a. Copper, 14 AWG, minimum.
   b. Permanent sleeve type markers with wire numbers applied to each end of wires.
   c. Terminate wires using insulated locking fork or ring type crimp terminals.
   d. Terminate current transformer leads on shorting type terminal blocks.

F. Incoming Line Terminal:

1. Construction: As specified in Paragraph Motor Controller Unit.

G. Incoming Service Feeder: Cable. Main Protective Device and Feeder Unit:

1. Construction: As specified in Paragraph Motor Controller Unit.
2. Incoming Service Feeder: Cable.
3. Solid State Trip Circuit Breaker:
   a. In accordance with UL 489.
   b. Main and feeder protective device where indicated.
   c. Insulated or molded case breakers with ambient insensitive solid-state trips and having current sensors and logic circuits integral in breaker frame.
   d. Solid-state current control with adjustable ampere setting, adjustable long-time delay, adjustable short-time trip and delay band, fixed or adjustable instantaneous trip, and adjustable ground fault trip and delay band.

e. Setting adjustments to be covered by a sealable, tamper-proof, transparent cover (insulated case breakers only) or by compartment door for other breakers).
f. Locate trip button on front cover of breaker to permit mechanical simulation overcurrent tripping for test purposes and to trip breaker quickly in emergency situation.

4. Molded Case Circuit Breaker:
   a. In accordance with UL 489.
   b. Main and feeder protective device.
   c. Thermal-magnetic trip and interrupting capacity required for connection to system with short circuit capacity indicated.
   d. Indicate tripping by operating-handle position.
   e. Suitable for use with 75 degrees C wire at full NEC 75 degrees C ampacity.
5. Key Interlocking:
   a. Mechanical lock cylinders within main and tie breaker compartments as shown.
   b. Key and Lock Cylinder Type: Kirk.
   c. Keys to be captive when breakers are closed.
   d. Two Main and One Tie Breaker Arrangement:
      1) Two keys available for each group of three locks.
      2) Two out of three breakers closed at any time.

H. Digital Instruments:

1. Digital Power Meter: As specified in Section 26 09 13, Power Measurement and Control.

I. SPD: As specified in Section 26 43 00, Surge Protection Devices (SPD).

J. Pushbuttons, Indicating Lights, Selector Switches, Elapsed Time Meters, Control Relays, Time-Delay Relays, and Reset Timers: As specified in Section 26 05 04, Basic Electrical Materials and Methods.

K. Nameplates:

1. Laminated plastic; white, engraved to black core.
2. Provide for each motor control center and each unit.
3. Engrave with inscription shown on single-line diagram.
4. Provide blank nameplates on spaces for future units.
5. Attach with stainless steel panhead screws on face of control center.

L. Space Heaters: Thermostatically controlled. Locate in bottom of each vertical section for operation from 120-volt power source derived internal to MCC.

## 2.05 SOURCE QUALITY CONTROL

A. Factory Testing:

1. Applicable Standards: NEMA ICS 18, UL 845, and NEC Article 430, Part VIII.
2. Perform standard factory inspection and tests in accordance with NEMA requirements to verify components have been designed to Specification, assembled in accordance with applicable standards, and each unit functions in accordance with electrical diagrams.
3. Actual operation shall be performed wherever possible. Otherwise, inspect and perform continuity checks.
4. Verify component devices operated correctly in circuits as shown on diagrams or as called for in Specification.
5. Control Circuits and Devices:
   a. Energize circuit at rated voltage.
   b. Operate control devices.
   c. Perform continuity check.
6. Instruments, Meters, Protective Relays, and Equipment:
   a. Verify devices functioned by energizing potential to rated values with connection to devices made at outgoing terminal blocks.
   b. Verify protective relays operated for functional checks and trips manually initiated to verify functioning of operation for indicator and associated circuits.
7. Perform dielectric tests on primary circuits and equipment, except potential transformers. Tests: Phase-to-phase and phase-to-around with 60-cycle test voltages applied for 1 second at 2,640 volts.
8. Verify equipment passed tests and inspection.
9. Provide standard factory inspection and test checklists, and final certified and signed test report.

B. Witnessed Factory Testing:

1. In accordance with Section 40 90 00, Instrumentation and Control.
2. Perform Equipment Communications Test (ECT) at the factory, with the PICS Subcontractor. Test communications from individual components to MCC mounted PLC.
3. Include testing and coordination activities:
   a. Drive parameter verification.
   b. Nodes/Addressing coordination.
   c. Functional testing of communications-capable devices mounted in the MCC.
4. Complete Witnessed Factory Testing prior to shipping MCC to the Site.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. General:

1. Install equipment in accordance with NEMA ICS 2.3, IEEE C2, NECA 402, Submittals, and manufacturer's written instructions and recommendations.
2. Secure equipment to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions.
3. Install equipment plumb and in longitudinal alignment with pad or wall.
4. Coordinate terminal connections with installation of secondary feeders.
5. Grout mounting channels into floor or mounting pads.
6. Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.
7. Motor Data:
    a. Provide typed, self-adhesive label attached inside each motor starter enclosure door displaying the following information:
        1) Motor served by tag number and equipment name.
        2) Nameplate horsepower.
        3) Motor code letter.
        4) Full load amperes.
        5) Service factor.
        6) Installed overload relay heater catalog number.

B. Circuit Breakers:

1. Field adjust trip settings of motor starter magnetic-trip-only circuit breakers.
2. Adjust to approximately 11 times motor rated current.
3. Determine motor rated current from motor nameplate following installation.

C. Overload Relay: Select and install overload relay heaters and switch settings after actual nameplate full-load current rating of motor has been determined.

D. Solid State Overload Relay:

1. Select and install overload relay and apply settings based upon actual full-load current of motor. At a minimum, the following settings shall be made.
    a. Motor FLA: Set as recommended by manufacturer.
    b. Jam: 400 percent of FLA, 4-second time delay.
    c. Current Unbalance: 15 percent, 10-second time delay.

d. Ground Fault: Set per manufacturer's recommendations, 2-second time delay.
e. Phase Reversal: Set per manufacturer's recommendations, use default time delay. Set to alarm only, no trip.
f. Overvoltage: 550V, 10-second time delay. Set to alarm only, no trip.
g. Undervoltage: 410V, 10-second time delay. Set to alarm only, no trip.
h. Voltage Unbalance: 6 percent, 10-second time delay. Set to alarm only, no trip.
i. Trip Class: Quick, Class 10.
j. Fault Reset No: 3. This is the number of auto-reset attempts after a motor fault. Any fault (not just overload) shall trigger the fault counter.

2. The following parameters shall be setup to communicate on the network to the Plant Control System:
a. Run Forward Command.
b. Run Reverse Command (where applicable).
c. Local/Remote Status.
d. Motor Running Status (Forward direction).
e. Motor Running Status (Reverse direction, where applicable).
f. Overload Tripped Status.
g. Ground Fault Trip.
h. Single Phase Trip.
i. Current Unbalance Trip.
j. Contactor Failure.
k. Remote Trip Active.
l. Phase A Current.
m. Phase B Current.
n. Phase C Current.
o. Average Current.
p. Average Percentage of full load amps.
q. Phase A Voltage (L1-L2).
r. Phase B Voltage (L2-L3).
s. Phase C Voltage (L3-L1).
t. Average Voltage Reading.
u. Motor Power (kW).
v. Apparent Power Factor.

E. Reduced Voltage Soft Start:

1. The following parameters shall be setup to communicate on the network to the Plant Control System:
a. Line current.
b. Average current.

c. Average percentage of full load amps.
d. Thermal capacity.
e. Status (Run/Fault/Warn/Control/Aux).

3.02 MANUFACTURER'S SERVICES

A. Furnish manufacturer's representative in accordance with Section 01 43 33, Manufacturers' Field Services, for the following services at Job Site or classroom as designated by Owner, for minimum person-days listed below, travel time excluded:

1. 2 person-days for installation assistance, and inspection of installation.
2. 3 person-days for functional and performance testing.
3. 1 person-day for plant startup.
4. 1 person-day for training of Owner's personnel.

**END OF SECTION**

# SECTION 26 29 23
# LOW-VOLTAGE ADJUSTABLE FREQUENCY DRIVE SYSTEM

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Electronic Industries Alliance (EIA): 359-A-1, Special Colors.
2. Hydraulic Institute Standards (HIS).
3. Institute of Electrical and Electronics Engineers (IEEE):
   a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   b. 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
   c. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
4. National Electrical Manufacturer's Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. CP 1, Shunt Capacitors.
   c. MG 1, Motors and Generators.
   d. WC 57, Standard for Control, Thermocouple Extensions, and Instrumentation Cables.
5. National Fire Protection Association (NFPA): 79, Electrical Standard for Industrial Machinery.

### 1.02 DEFINITIONS

A. Terms that may be used in this section:

1. ASD: Adjustable speed drive.
2. CMOS: Complementary metal oxide semiconductor.
3. CSI: Current source inverter.
4. EMU: Energy monitoring unit.
5. GTO: Gate turn-off thyristor.
6. MPR: Motor protection relay.
7. MTBF: Mean time between failure.
8. PWM: Pulse width modulation.
9. ROM: Read only memory.
10. RTD: Resistance temperature detector.
11. RTU: Remote Telemetry Unit.
12. Rated Load: Load specified for equipment.

13. Rated Speed: Nominal rated (100 percent) speed specified for equipment.
14. TDD: Total demand distortion.
15. THD: Total harmonic distortion.
16. TTL: Transistor logic.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Rated Continuous Operation Capacity: Not less than 1.15 times full load current rating of driven motor, as indicated on motor nameplate, and suitable for continuous operation at continuous overload which may be imposed on motor by driven pump operating over specified speed range.
2. Furnish isolation transformers or series reactors, harmonic filters, or other devices necessary for proper system operation. Furnish necessary devices and circuits to prevent operation of one drive from adversely affecting operation of other drives supplied from same transformer or same bus.

B. Design Requirements:

1. Furnish ASD rated on basis of actual motor full load nameplate current rating times the service factor.
2. Drive System: Convert incoming three-phase, 60-Hz ac power to variable voltage, adjustable frequency output for adjustable speed operation of a standard ac induction squirrel-cage motor, using pulse-width-modulation (PWM) technique to produce adjustable frequency output.
3. System rated for continuous industrial duty and suitable for use with NEMA MG 1, Design B motors.
4. Incoming Line Circuit Breaker: Provide positive means of disconnecting incoming power, and overcurrent protection for drive system.

1.04 SUBMITTALS

A. Action Submittals:

1. Overall drive system operating data, including efficiencies, input currents, and power factors, at driven equipment actual load and rated system input voltage, at 0 percent, 40 percent, 60 percent, 80 percent, 100 percent, and 110 percent of rated speed.

2. ASD output pulse maximum peak voltage, pulse rise time, and pulse rate of rise including justification for proposed deviation from specified values. Include motor manufacturer's certification motor insulation will withstand long-term overvoltages caused at motor terminals due to specified output pulse data or proposed deviation from this data.
3. Complete system rating, including nameplate data, continuous operation load capability throughout speed range of 0 percent to 120 percent of rated speed.
4. Complete adjustable frequency controller rating coordinated with motor full load nameplate current rating; list controller special features being supplied.
5. Controller, reactor, harmonic filter, and isolating transformer (if applicable) dimensional drawings; information on size and location of space for incoming and outgoing conduit.
6. Maximum heat dissipation from enclosures.
7. Should separate enclosures and equipment be necessary for filter elements or isolation transformers, provide 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 for required interconnecting circuits.
8. Layout of controller face showing pushbuttons, switches, instruments, and indicating lights.
9. Complete system operating description.
10. Complete system schematic (elementary) wiring diagrams.
11. Complete system interconnection diagrams between controller, drive motor, and related components or controls external to system, including wire numbers and terminal board point identification.
12. One-line diagram of system, including component ratings.
13. Description of diagnostic features being provided.
14. Descriptive literature for control devices such as relays and timers.
15. Itemized bill-of-materials listing system components.
16. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Special shipping, storage and protection, and handling instructions.
3. Manufacturer's installation instructions.
4. Factory functional test reports.
5. Field test reports.

6. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
7. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
8. For ASDs larger than 300 hp, provide Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.05 QUALITY ASSURANCE

A. Supplier: Provide project experience in furnishing similar size and type adjustable frequency, controlled speed, drive systems.

1.06 WARRANTY

A. Warranty period shall cover 24 months from date of startup, not to exceed 30 months from date of shipment. During this period repairs, including parts and labor, shall be provided at no cost to the Owner.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS AND PRODUCTS

A. Components and accessories specified in this section shall be provided as described below.

1. All ASDs larger than 200 hp shall be active front-end type and shall be separately mounted:
   a. ABB; Model ACS880-37.
   b. Allen-Bradley; Powerflex 755TL.
   c. Or approved equal.
2. All ASDs 200 hp or smaller shall be six-pulse type and provided integral with motor control centers unless otherwise indicated:
   a. Eaton.
   b. Schneider Electric/Square D Services.
   c. Allen-Bradley.
   d. Siemens.
   e. Or approved equal.

2.02 SERVICE CONDITIONS

A. Ambient Operating Temperature: 32 degrees F to 104 degrees F.

B. Storage Temperature: Minus 40 degrees F to 158 degrees F.

C. Humidity: 0 percent to 95 percent relative (noncondensing).

D. Altitude: 0 feet to 3,300 feet.

E. Frequency Stability: Plus or minus 0.1 percent of maximum frequency.

2.03 COMPONENTS

A. Drive Units:

1. Incorporate switching power supply operating from dc bus, to produce PWM output waveform simulating sine wave and providing power loss ride through of 2 milliseconds at full load, full speed.
2. Current-limiting semiconductor fuses for protection of internal power semiconductors.
3. Provide constant displacement power factor of 0.95 minimum at all operating speeds and loads.
4. Output Section: Provide a minimum 97 percent drive efficiency at full speed, full load.
5. Employ dc power discharge circuit so that after removal of input power dc link capacitor voltage level will decay below 50V dc within 1 minute after de-energizing following NEMA CP 1 and NFPA 79. Operate with open circuited output.
6. Input Voltage: 480V ac plus or minus 10 percent.
7. Output Voltage: 0 volt to 480 volts, three-phase, 0-Hz to 66-Hz, minimum.
8. Maximum peak voltage of PWM ASD output pulse of 1,000 volts, with pulse rise time of not less than 2 microseconds, and maximum rate of rise of 500 volts per microsecond. Maximum frequency of PWM ASD output pulse (carrier) frequency of 3,000-Hz. Should magnitudes of these characteristics be more stressful to motor insulation than specified values, furnish insulation systems on motors suitable for proposed values.
9. Motor Audible Noise Level: When operating throughout speed range of PWM ASD, no more than 3 dBA above that designated in NEMA MG 1 for same motor operated at constant speed with a 60-Hz supply voltage.
10. Short-Time Overload Capacity: 115 percent of rated load in rms current for 1 minute following full load, full speed operation.
11. Equipment Short-Circuit Rating:
    a. Six-pulse Drives: Suitable for connection to system with maximum source three-phase, bolted fault, short-circuit available of 42,000 amps rms symmetrical at 480 volts.

b. Active Front-end Drives: Suitable for connection to system with maximum source three-phase, bolted fault, short-circuit available of 65,000 amps rms symmetrical at 480 volts.

12. Furnish drives with output current-limiting reactors mounted within equipment enclosure.
13. Diagnostics: Comprehensive for drive adjustment and troubleshooting:
    a. Memory battery backup; 100-hour minimum during power loss.
    b. Status messages will not stop drive from running but will prevent it from starting.
    c. Fault Condition Messages and History:
        1) First fault protection function to be activated, ability to store six successive fault occurrences in order. Minimum faults numerically:
            a) Overcurrent (time and instantaneous).
            b) Overvoltage.
            c) Undervoltage (dc and ac).
            d) Overtemperature (drive, motor windings, motor bearing, pump bearing).
            e) Serial communication fault.
            f) Short-circuit/ground fault (motor and drive).
            g) Motor stalled.
            h) Semiconductor fault.
            i) Microprocessor fault.
            j) Single-phase voltage condition.
14. Drive Protection:
    a. Fast-acting semiconductor fuses.
    b. Overcurrent, instantaneous overcurrent trip.
    c. Dc undervoltage protection, 70 percent dropout.
    d. Dc overvoltage protection, 130 percent pickup.
    e. Overtemperature, drive, inverter, converter, and dc link components.
    f. Overtemperature, motor, and pump.
    g. Single-phase protection.
    h. Reset overcurrent protection (manual or automatic reset).
    i. Active current limit/torque limit protection.
    j. Semiconductor fault protection.
    k. Short-circuit/ground fault protection.
    l. Serial communication fault protection.
    m. Microprocessor fault.
    n. Surge protection for transient overvoltage (6,000 volts, 80 joule surge, tested per IEEE C62.41).
    o. Visual display of specific fault conditions.

15. Operational Features:
    a. Use manufacturer's standard unless otherwise indicated.
    b. Sustained power loss.
    c. Momentary power loss.
    d. Power interruption.
    e. Power loss ride through (0.1 second).
    f. Start on the fly.
    g. Electronic motor overload protection.
    h. Stall protection.
    i. Slip compensation.
    j. Automatic restart after power return (ability to enable/disable function).
    k. Critical frequency lockout (three selectable points minimum, by 1.5-Hz steps in 10-Hz bands, to prevent resonance of system).
    l. Drive maintenance system software for complete programming and diagnostics.
    m. Ground fault protection, drive, and motor.
    n. Operate with no motor connected to output terminals.

B. Rectifier:

1. Active Front-End Drives: Three-phase, active front end.
2. Six Pulse Drives: Six pulse rectifier with minimum overall input impedance of 3 percent. Provide additional input reactors if required.

C. Harmonics (active front-end drives only):

1. All harmonic management devices must be internal to the VFD enclosure and supplied as a complete solution.
2. Drive shall have an active line supply unit which controls the waveform of the input current and reduces the low order harmonic current drawn from the power line. Line currents and voltages shall be nearly sinusoidal. IGBTs shall be used in the rectified and inverter circuits.
3. Each input phase of the drive shall incorporate a symmetrical LCL filter arranged in a T-configuration. The inductors are to be series power components that carry the full current of the drive.
4. The input current to the drive shall have a total harmonic content less than 5 percent of full rated capability at the input terminals of the drive on power system sized according to IEEE 519 at line voltage unbalance up to 3 percent and under all motor load conditions.
5. The drive shall operate at fundamental power factor 1.0 on the supply side under all motor load conditions.

6. The input power factor shall be programmable from 0.8 lagging to 0.8 leading, allowing the drive to be used as a compensating device for installations that are excessively inductive or excessively capacitive in reactive power.

D. Controller: Microprocessor-controller PWM inverter to convert to dc voltage to variable voltage, adjustable frequency, three-phase ac output. Output voltage shall vary proportionally with frequency to maintain constant ratio of volts to hertz up to 60-Hz; above 60-Hz, voltage shall remain constant with drive operating in constant horsepower output mode.

E. Enclosure:

1. Separately Mounted: NEMA 250, Type 1, gasketed, freestanding, enclosure for mounting against wall, completely front accessible, and hinged doors. Properly sized to dissipate heat generated by controller within limits of specified operating conditions (including ambient temperature and ambient airflow).
2. MCC Mounted: Where indicated on Drawings, mount ASDs integral with motor control center lineups.
3. Door Mounted Equipment/features:
    a. Door mounted handle interlocked to main circuit breaker/ disconnect, defeatable.
    b. Control switches and indicating lights as indicated on Drawings.
    c. Emergency stop pushbutton (where required).
    d. Keypad and display.
    e. Components and controls specified in Section 26 05 04, Basic Electrical Materials and Methods.
4. Wire drive from below for power and control wiring.
5. Size forced-ventilation for periodic operation to cool each unit with maximum room ambient temperature of 95 degrees F. Furnish redundant fans such that if one fan fails remaining fans furnish adequate ventilation for drive when operating at maximum capacity. Furnish filters on ventilation intakes.
6. Wiring:
    a. Bundle stranded copper wiring neatly with nylon tie wraps or with continuous plastic spiral binding.
    b. Label each terminal for permanent identification of leads.
    c. Identify each wire at each end with imprinted mylar adhesive-back wire markers.
    d. Incorporate in as-installed wiring diagrams for wire and terminal numbers shown.
    e. Wiring across door hinge, use 19-strand, NEMA WC 57 Class C stranding looped for proper twist rather than bending at hinge.

f. Wire connections internal to panels by crimp-on terminal types.
g. For multiple enclosure systems, complete interconnection wiring with gasketed enclosure openings for wiring.
h. Multipoint plug receptacles for control wiring crossing equipment shipping splits.

7. Selector switches, indicating lights, potentiometers, instruments, protective devices, and major system components identified by means of mechanically attached, engraved, laminated nameplates.

F. Operator Interface:

1. Controls:
   a. Mount drive local control on front door of enclosure and include control switch and membrane type keypad for the following operator functions:
      1) Start (when in local mode).
      2) Stop (when in local mode).
      3) Speed increase (when in local mode).
      4) Speed decrease (when in local mode).
      5) Parameter mode selection (recall programmed parameters).
      6) LOCAL/OFF/REMOTE control selection (in remote, furnish for remote RUN command digital input and speed increase/decrease via remote 4 mA to 20 mA analog signal).
      7) Fault reset, manual for faults, except loss of ac voltage which is automatic upon return.
      8) RUN/preset speed.
      9) Parameter lock, password or key switch lockout of changes to parameters.
      10) Start disable, key switch or programmed code.
2. Control circuit disconnect shall de-energize circuits in units that are not de-energized by main power disconnect device as required by California Administrative Code.
3. 120 volts, single-phase, 60-Hz circuits for control power and operator controls from internal control power transformer. Furnish power for motor space heaters rated 120 volts where indicated.
4. Arrange component and circuit such that failure of a single component cannot cause cascading failure(s) of other component(s).
5. Alphanumeric Display:
   a. During normal operation and routine test, the following parameters shall be available:
      1) Motor current (percent of drive rated current).
      2) Output frequency (Hertz).
      3) Output voltage.
      4) Running time.

5) Local/remote indicator.
6) Status of digital inputs and outputs.
7) Analog input and output values.
8) Output motor current per leg.
9) All test points.

6. Adjustable Parameters:
   a. Set drive operating parameters and indicate in numeric form. Potentiometers may not be used for parameter adjustment. Minimum setup parameters available:
      1) Frequency range, minimum, maximum.
      2) Adjustable acceleration/deceleration rate.
      3) Volts per Hertz (field weakening point).
      4) Active current limit/torque limit, 0 percent to 140 percent of drive rating.
      5) Adjustable voltage boost (IR compensation).
      6) Preset speed (adjustable, preset operating point).
      7) Provision for adjustment of minimum and maximum pump speed to be furnished as function of 4 mA to 20 mA remote speed signal.

G. Signal Interface:

1. Digital Input:
   a. Accept a remote RUN command contact closure input.
   b. High temperature contact closure input from field mounted motor temperature monitoring relay.
2. Digital Output: Furnish three discrete output dry contact closures rated 5 amps at 120V ac.
   a. DRIVE RUNNING.
   b. DRIVE FAULT (with common contact closure for all fault conditions).
   c. DRIVE IN REMOTE MODE.
3. Analog Input: When LOCAL/OFF/REMOTE switch is in REMOTE, control drive speed from remote 4 mA to 20 mA dc signal.
   a. Make provisions for adjustment of minimum and maximum motor speed which shall result from this signal.
   b. Factory set this adjustment to comply with operating speed range designated in driven equipment specifications.
   c. Frequency resolution shall be 0.1 percent of base speed.
   d. Accept second analog input from speed transmitter located on motor shaft.
4. Analog Output: Furnish two 4 mA to 20 mA dc signals for actual frequency, actual load.

5. Network Communications: Ethernet/IP and ModBus TCP.
   a. Provide the following parameters/information to the plant control system via the network connection:
      1) Run Forward Command.
      2) Run Reverse Command.
      3) Local/Remote Status.
      4) Motor Running Status – Forward Direction.
      5) Motor Running Status – Reverse Direction.
      6) Drive Fault.
      7) Motor Current.
      8) Motor Voltage.
      9) Motor Power (kW).
      10) Power Factor Applied to Motor.
      11) Motor Speed Command (0 percent to 100 percent).
      12) Motor Speed Command (0 percent to 100 percent).

H. Accessories:

1. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in readily visible location.
2. Lifting Lugs: Equipment weighing over 100 pounds.
3. Anchor Bolts: Sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications.

## 2.04 FACTORY FINISHING

A. Enclosure:

1. Primer: One coat of rust-inhibiting coating.
2. Finish:
   a. Interior: One coat white enamel.
   b. Exterior: One coat manufacturer's standard gray enamel or EIA 359-A-1, No. 61.

## 2.05 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments: Test all control panels actually furnished.

C. Record test data for report.

D. Functional Test: Perform manufacturer's standard.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

### 3.02 FIELD QUALITY CONTROL

A. Functional Test:

1. Conduct on each controller.
2. Inspect controller for electrical supply termination connections, interconnections, proper installation, and quiet operation.
3. Vibration Test:
   a. Complete assembly, consisting of motor, load, and flexible shafting, connected and in normal operation shall not develop amplitudes of vibration exceeding limits recommended by HIS.
   b. Where loads and drives are separated by intermediate flexible shafting, measure vibration both at top motor bearing and at two points on top pump bearing, 90 degrees apart.
4. Record test data for report.

B. Network and Communication Test:

1. Coordinate with plant control system and/or MCC mounted PLC to ensure that all specified data points are communicated over the network.
2. Conduct on each drive unit.

C. Performance Test:

1. Conduct on each controller.
2. Perform under actual or approved simulated operating conditions.
3. Test for continuous 6-hour period without malfunction.
4. Demonstrate performance by operating continuous period while varying application load, as input conditions allow, to verify system performance.
5. Record test data for report.

D. Test Equipment: Provide diagnostic plug-in test card complete with instructions, multiposition selector switch, and meters or built-in diagnostic control panel or ROM-based processor for monitoring ac, dc, and digital signals to assist in troubleshooting and startup of drive.

3.03 MANUFACTURERS' SERVICES

A. Manufacturer's Representative:

1. Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:
   a. 2 person-days for installation assistance and inspection.
   b. 2 person-days for programming of network connection and coordination of required data exchange with plant control system.
   c. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   d. 1 person-day for facility startup.
   e. 1 person-day for post-startup training.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Testing, Integration, and Startup.

**END OF SECTION**

# SECTION 26 43 00
# SURGE PROTECTION DEVICES (SPD)

## PART 1 GENERAL

### 1.01 WORK INCLUDED

A. This section includes specifications and requirements for surge protection devices (SPDs).

### 1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C62.41.1, Guide on the Surge Environment in Low-Voltage (1,000V and less) AC Power Circuits.
   b. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1,000V and less) AC Power Circuits.
   c. C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000V and less) AC Power Circuits.
2. UL:
   a. 1283, Standard for Electromagnetic Interference Filters.
   b. 1449, Standard for Surge Protective Devices.

### 1.03 SUBMITTALS

A. Product data on each suppressor type, indicating component values, part numbers, and conductor sizes. Include dimensional drawing for each, showing mounting arrangements.

B. Manufacturer’s UL certified test data and nameplate data for each SPD.

### 1.04 QUALITY ASSURANCE

A. UL Compliance and Labeling: For power and signal circuits, SPD devices shall comply with UL 1449 and complimentary listed to UL 1283 as an electromagnetic interference filter. Provide units that are listed and labeled by UL.

B. ANSI Compliance: Use SPD devices in compliance with the recommendations of IEEE C62.41.1, IEEE C62.41.2, and IEEE C62.45.

## PART 2 PRODUCTS

2.01 GENERAL

A. SPD devices shall be capable of performance at ambient temperatures between minus 40 degrees C and 60 degrees C, at relative humidity ranging from 0 percent to 95 percent, and at altitudes ranging from sea level to 12,000 feet.

B. SPD devices shall be fused to disconnect the suppressor from the electrical source should the suppressor fail. The fusing shall allow full surge handling capabilities and to afford safety protection from thermal overloads and short circuits.

C. Design SPD devices for the specific type and voltage of the electrical service. Single-phase and three-phase wye-configured systems shall have L-N, L-G, and N-G protection. Grounded delta-configured systems shall have L-L and L-G protection.

D. Power Filter: The SPD shall include a high frequency extended range power filter complimentary listed to UL 1283 as an electromagnetic interference filter.

2.02 MANUFACTURERS

A. Innovative Technology; VanGuard Series.

B. Advanced Protection Technologies, Inc.

C. General Electric.

D. Eaton.

E. Or approved equal.

2.03 MAIN DISTRIBUTION SPD

A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category C.

B. Surge current capacity shall be not less than the following:

1. L-N Capacity: 200 kA.
2. L-G Capacity: 120 kA.
3. N-G Capacity: 120 kA.

C. Suppressor housing shall be in an enclosure that has the same NEMA rating as the equipment it protects and painted to match.

D. UL 1449 maximum suppression voltage shall not be more than:

| System Voltage | Phase | L-L or L-N Suppression Voltage |
|---|---|---|
| 120 | 1 | 400 |
| 208Y/120 | 3 | 400 |
| 240 | 3 | 800 |
| 480Y/277 | 3 | 800 |

2.04 PANELBOARD SPD

A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location Category B.

B. Surge current capacity shall be not less than the following:

1. L-L Capacity: 80 kA.
2. L-N Capacity: 80 kA.
3. L-G Capacity: 80 kA.
4. N-G Capacity: 80 kA.

C. Suppressor shall be in an enclosure that has the same NEMA rating as the panel it protects or the SPD may be integral to a panelboard.

D. UL 1449 maximum clamp voltage shall not be more than:

| System Voltage | Phase | L-L or L-N Clamp Voltage |
|---|---|---|
| 120 | 1 | 400 |
| 208Y/120 | 3 | 400 |
| 240 | 3 | 800 |
| 480Y/277 | 3 | 800 |

2.05 ANNUNCIATION

A. Provide unit or separately mounted LED-type indication lights to show the normal and failed status of each module. Provide one normally open and one normally closed contacts which operate when the unit fails.

2.06 SURGE COUNTER

A. Provide each SPD rated above 100 kA with a counter displaying the number of voltage transients that have occurred on the unit input. The counter shall be battery backed and retain the count through system power outages.

**PART 3 EXECUTION**

3.01 APPLICATION REQUIREMENTS

A. Install SPD when indicated on Drawings and:

1. Main Distribution SPD in or near each low-voltage switchgear, switchboard, or other major load center.
2. Main Distribution SPD in or near each motor control center.
3. Panelboard SPD in or near each 480V distribution panelboard unless otherwise indicated.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install suppressors according to manufacturer's recommendations.

B. Install suppressors directly to the cabinet which houses the circuit to be protected so that the suppressor leads are straight and short, with all conductors laced, running directly to the point of connection within the panel, without loops or bends. If bends are unavoidable, no bend may exceed 90 degrees and bending radius may not be less than 6 inches.

C. Connecting wires shall be as short as possible with gently twisted conductors, tied together, to prevent separation. Connecting wires shall not exceed 24 inches in length at any point.

D. Field installed conductors shall be the same as specified for building wire, not smaller than No. 8 AWG and not larger than No. 4 AWG. Device leads shall not be longer than the length recommended by the manufacturer, unless specifically reviewed and approved by the manufacturer.

E. Provide dedicated disconnecting means for SPD devices installed at main service entrance location, switchgear, and motor control centers. Provide dedicated 30-60-ampere circuit breakers (size dependent upon wire size used) with number of poles as required, as disconnecting means for SPD devices installed at panelboards. The interrupting capacity of the circuit breakers shall be that specified for the other breakers at that location.

**END OF SECTION**

# SECTION 26 50 00
# LIGHTING

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   c. A572/A572A, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
   d. A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel, with 50 ksi [345 MPa] Minimum Yield Point to 4-in. [100-mm] Thick.
   e. A595/A595M, Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
   f. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   g. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   h. D6576, Standard Specification for Flexible Cellular Rubber Chemically Blown.
2. California Energy Code, Part 6 (Title 24).
3. Canadian Standards Association (CSA).
4. Certified Ballast Manufacturer (CBM).
5. Federal Communications Commission (FCC).
6. Illuminating Engineering Society of North America (IESNA):
   a. HB-9, Lighting Handbook.
   b. LM-79, IES Electrical and Photometric Measurements of Solid-State Lighting Products.
   c. LM-80, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.
   d. RP (Recommended Practices) Series.
   e. TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources.

7. Institute of Electrical and Electronics Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
8. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. ICS 6, Industrial Control and Systems: Enclosures.
9. National Energy Policy Act.
10. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
11. UL:
   a. 773, UL Standard for Safety Plug-In Locking Type Photocontrols for Use with Area Lighting - Fourth Edition; Reprint with Revisions Through and Including March 08, 2002.
   b. 844, Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
   c. 924, Emergency Lighting and Power Equipment.
   d. 1598, UL Standard for Safety Luminaires.
   e. 2108, UL Standard for Safety Low Voltage Lighting Systems - First Edition; Reprint with Revisions through and Including February 24, 2014.
   f. 8750, UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products - First Edition; Reprint with Revisions Through and Including April 1, 2015.
12. U.S. Environmental Protection Agency and U.S. Department of Energy: Energy Star.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. General:
      1) Provide catalog data sheets and pictures for all products listed below.
      2) Proposed Luminaire Substitutions (Interior and Exterior): Provide an electronic photometric file in standard '.ies' file format per the Illumination Engineering Society of North America (IESNA) for any proposed luminaire substitution not identified on the project Luminaire Schedule on Drawings. Obtain file from the luminaire manufacturer or approved independent photometric testing laboratory. Include the proposed substitute luminaire with all options identified on the Project Luminaire Schedule on Drawings.

b. Interior Luminaires:
   1) Catalog data sheets with pictures.
   2) Luminaire material, finish, dimensions, and metal gauge.
   3) Lens material, pattern, and thickness.
   4) Candle power distribution curves in two or more planes.
   5) Candle power chart 0 degree to 90 degrees.
   6) Lumen output chart.
   7) Average maximum brightness data in foot lamberts.
   8) Coefficients of utilization for zonal cavity calculations.
   9) Mounting or suspension details.

c. Exterior Luminaires:
   1) Catalog data sheets with pictures. Luminaire material, finish, dimensions, and metal gauge.
   2) Lens material, pattern, and thickness. Filters.
   3) IESNA lighting classification (BUG rating).
   4) Isolux diagram.
   5) Lighting distribution data and lighting distribution classification type as defined in IESNA HB 9.
   6) Fastening details to wall, pendant, or pole.
   7) Ballast type, location, and method of fastening.
   8) For light poles, submit catalog sheet, wind loading, pole deflection with fixture attached, total weight, all accessories, complete dimensions, and finish.
   9) Brackets and supports.

d. LED Source Systems:
   1) General:
      a) IESNA LM-80 test reports.
      b) IESNA TM-21 ratings.
      c) Operating temperature range. Data sheet (chart/graph) describing life as a function of temperature.
      d) Warranty: Light engine and driver.
      e) Rated life.
      f) Surge protection.
      g) Thermal control device, heat sink.
      h) Enclosure and wiring information.
      i) Operating voltage range.
   2) Electronic Module/Light Engine:
      a) Correlated Color Temperature (CCT).
      b) Color Rendering Index (CRI).
   3) Drivers:
      a) Input Current Total Harmonic Distortion.
      b) Power factor.
      c) Sound rating.

e. Time Switches:
   1) Wiring diagram.
   2) Contact ratings.
   3) Functional features.
   4) Programmable capabilities.
   5) Enclosure type, dimensions.
f. Lighting Contactor:
   1) Type (mechanically or electrically held).
   2) Enclosure.
   3) Contact ratings and configuration.
   4) Coil operating voltage.
g. Photoelectric Switches (Photocells):
   1) Voltage.
   2) Power consumption.
   3) Load capacity (watts).
   4) Contact ratings and configuration.
   5) Time delay.
   6) Light operating level controls.
   7) Enclosure type and dimensions.
   8) Mounting type.
   9) Temperature range.
   10) Features and options.
h. Wall box dimmers.
i. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's printed installation instructions.
3. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.

2. Provide materials and equipment manufactured within the scope of standards published by UL in conformance with those standards and with an applied UL listing mark.

B. Standard Products:

1. Provide materials and equipment of manufacturers regularly engaged in the production of products specified in this section and that are of equal material, design, and workmanship.
2. Provide products that have been in satisfactory commercial or industrial use for 2 years prior to Bid opening in similar applications under similar circumstances and of similar size. Provide products that have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
3. Material and Equipment Manufacturing Date: Do not use products manufactured more than 3 years prior to date of delivery to Site.
4. Provide assembled fixture, complete with lamps, in accordance with California Code of Regulations Title 24 requirements.

## PART 2 PRODUCTS

### 2.01 LUMINAIRES

A. Specific requirements relative to execution of the Work of this section are located in Luminaire Schedule on Drawings.

B. Provide luminaires and components tested, listed, and labeled by UL, or other approved testing agency.

C. Provide luminaires with Illumination Engineering Society of North America (IESNA) formatted photometric files, ".ies" format, certified by the luminaire manufacturer for use with lighting software.

D. Luminaire Labels:

1. External label per ANSI C136.15.
2. Internal label per ANSI C136.22.

E. Provide luminaires rated by the manufacturer to start and operate to their full lumen capacity for rated life of the luminaire at the minimum low and maximum high ambient temperatures as defined in the Contract Documents at their installation location.

F. Feed-through type, or separate junction box.

G. Wire Leads: Minimum 18 AWG.

H. Component Access: Accessible and replaceable without removing luminaire from ceiling.

I. Exterior Installations:

1. UL Labeled: SUITABLE FOR WET LOCATIONS.
2. Ballast: Removable, prewired.
3. When factory-installed photocells are provided, entire assembly shall have UL label.

2.02 LAMPS

A. General:

1. Refer to Luminaire Schedule on Drawings for specific lamp descriptions.
2. Lamps shall pass the Federal TCLP test in force at the time of manufacture.

2.03 LED SOURCE SYSTEMS

A. General:

1. Provide IESNA LM-80 test reports.
2. Provide Energy Star compliance for solid state luminaires.
3. Listed To: UL 8750 Standard for Safety for Light Emitting Diode (LED) Equipment for use in Lighting Products.
4. Provide RoHS compliant LED light source(s) and driver(s).
5. Warranty: 5 years minimum.

B. Electronic Module/Light Engine:

1. Mount all components to a single plate and factory prewired with quick-disconnect plugs.
2. Include a driver, thermal control device, thermal protector device, and surge protector device.
   a. Provide surge protector tested in accordance with IEEE/ANSI C62.41.2 to Category C Low.
3. Provide LEDs mounted to a metal-core circuit board and aluminum heat sink for optimal thermal management and long life.
4. Light Engine Rating per TM-21: 100,000 at 25 degrees C, L70.
5. Correlated Color Temperature (CCT): 4000K.
6. Color Rendering Index (CRI): Minimum of 80.

C. Drivers:

1. Expected life of 100,000 hours at 25 degrees C.
2. Provide drivers mounted in an all metal can.
3. Operating Voltage Range: 50/60-Hz input source, voltage range as indicated on the Luminaire Schedule on Drawings with sustained variations of plus or minus 10 percent voltage with no damage to the driver.
4. Input Current Total Harmonic Distortion: Less than 20 percent up to 50 percent of full load rating.
5. Power Factor: Greater than 0.90 for primary application up to 50 percent of full load rating.
6. Sound rating: Class A.
7. Comply with NEMA 410 for inrush current limits.
8. Dimming:
   a. Continuously dimmable from 0 percent to 100 percent.
   b. Provide driver compatible with standalone dimming controls and/or dimming systems used.

## 2.04 LIGHTING CONTROL

A. Time Switch, Electronic Programmable Type:

1. Provide digital electronic time switch with number of channels indicated on Drawings.
2. Programming: Each channel shall be independently programmable and include:
   a. A Form C dry contact, output rated for 20 amps at 120V to 240V ac for operation on LED driver loads.
   b. Provide channels with two ON/OFF set points in a 24-hour period for each day or the week.
   c. Skip-a-day weekly schedule.
   d. 365-day capability.
   e. Astronomic time functionality.
   f. Holiday override capability.
   g. Four seasonal schedule capabilities.
   h. User-programmable daylight savings time adjustment option.
   i. Automatic daylight savings changeover.
   j. Automatic leap year compensation.
3. Time Switch Minimum Features:
   a. Selectable am/pm or 24-hour format.
   b. 1-minute time resolution.
   c. Control Inputs: Up to 2 control inputs capable of connection to input devices including photoelectric relays, discrete input devices, etc., for use in programming output channels.

d. Battery backup with rechargeable batteries and 72-hour capacity.
e. Individual manual ON/OFF override control for each channel.

4. Manufacturers:
   a. Tork.
   b. Intermatic.
   c. Paragon Electric Company.
   d. Or approved equal.

B. Lighting Contactor:

1. Features:
   a. Electrically held contactor.
   b. Contacts Rating: As shown on Drawings.
   c. Enclosure: NEMA 4 conforming to NEMA ICS 6.

C. Photoelectric Switch (Photocell):

1. Automatic Solid State ON/OFF Switching Photo Control:
   a. Dry Contacts:
      1) Configuration: DPST.
      2) Rating: 1,000VA inductive.
      3) Compatible with connected load device indicated on Drawings.
2. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.
3. Mounting Type: Twist lock plug.
4. Setting: ON at dusk and OFF at dawn.
5. Time delay feature to prevent false switching.
6. Field adjustable to control operating light levels.
7. Integral surge protection.
8. Manufacturers:
   a. Tork.
   b. Intermatic.
   c. Paragon Electric Company.
   d. Or approved equal.

## 2.05 POLES

A. General:

1. Design for wind load as specified in Section 01 61 00, Common Product Requirements, while supporting luminaires and other appurtenances. Use effective projected areas (EPA) of luminaires and appurtenances in calculations specific to the actual products proposed on each pole.
2. Poles 40 feet and Shorter: One-piece construction.
3. Pole Height: As indicated on Luminaire Schedule on Drawings.

4. Handhole:
   a. Provide oval-shaped handhole having a minimum clear opening of 2.5 inches by 5 inches.
   b. Secure cover with stainless steel captive screws.
   c. Metal Poles: Provide an internal grounding connection accessible from handhole near bottom of each pole.
5. Do not install scratched, stained, chipped, or dented poles.

B. Aluminum Poles:

1. Manufactured of corrosion-resistant aluminum alloys. Seamless extruded or spun seamless type with minimum 0.188-inch wall thickness.
2. Shape: As indicated on Luminaire Schedule on Drawings.
3. Provide pole grounding connection designed to prevent electrolysis when used with copper ground wire.
4. Shaft Top: Fitted with cap.
5. Base:
   a. Anchor bolt mounted and machined to receive lower end of shaft.
   b. Welded joint between shaft and base.
   c. Base Cover: Cast aluminum alloy.
   d. Hardware, Except Anchor Bolts: Either anodized aluminum alloy or stainless steel.
   e. Handhole.
6. Provide pole cast-in-place foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end.
7. Provide base covers to match pole and galvanized nuts and washers for anchor bolts.
8. Pole and Bracket Finish: Dark anodic bronze finish to match fixture.

## 2.06 BRACKETS AND SUPPORTS

A. Features:

1. Not less than 1-1/4-inch aluminum secured to pole.
2. Slip-fitter or pipe-threaded brackets may be used but coordinate brackets to luminaires provided. Provide identical brackets for use with one type of luminaire.
3. Select brackets for pole-mounted street lights to correctly position luminaire no lower than mounting height indicated.
4. Mount brackets not less than 24 feet above street.
5. Provide special mountings or brackets as indicated on Drawings fabricated of metal which will not promote galvanic reaction with luminaire head.

2.07 POLE FOUNDATIONS

A. Anchor Bolts: Steel rod having a minimum yield strength of 50,000 psi; at minimum, galvanize the top 12 inches of the rod.

B. Concrete: As specified in Section 03 30 10, Structural Reinforced Concrete.

2.08 IN-LINE FUSE HOLDER AND FUSE

A. Fuse Holder:

1. General: Waterproof, of corrosion-resistant material.
2. Rating: 600 volts.

B. Fuse:

1. General: Midget, dual element.
2. Rating: 5-amp, voltage as required by application.

C. Manufacturer:

1. Methods Electronics Inc. Network, Buss Div.
2. Or approved equal.

2.09 EQUIPMENT IDENTIFICATION

A. Manufacturer's Nameplate: Provide each item of equipment with a nameplate bearing manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; nameplate of distributing agent will not be acceptable.

B. Provide clear markings located to be readily visible to service personnel.

2.10 FACTORY FINISH

A. Provide electrical equipment with factory-applied painting systems that, at minimum, meet the requirements of NEMA 250 corrosion-resistance test.

**PART 3 EXECUTION**

3.01 LUMINAIRES

A. General:

1. Install in accordance with manufacturer's recommendations.
2. Provide proper hangers, pendants, and canopies as necessary for complete installation and meeting specified seismic requirements.

3. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building and to concrete pole bases required to safely mount.
4. Install plumb and level.
5. Install each luminaire outlet box with galvanized stud.

B. Mounting:

1. General:
   a. Coordinate mounting, fastening, and environmental conditions with Section 26 05 02, Basic Electrical Requirements.
   b. Refer to Fastener Schedule in Section 05 50 00, Metal Fabrications.
2. Wall Mounted: Measure mounting heights from center of mounting plate to finished floor or finished grade, whichever is applicable.
3. Pendant Mounted:
   a. Provide swivel type hangers and canopies to match luminaires, unless otherwise noted.
   b. Space single-stem hangers on continuous-row fluorescent luminaires nominally 48 inches apart.
   c. Provide twin-stem hangers on single luminaires.
   d. Measure mounting heights from bottom of luminaire to finished floor or finished grade, whichever is applicable.
4. Pole Mounted:
   a. Provide precast concrete base.
   b. Provide branch circuit in-line fuses in pole base handhole.

C. Swinging Type: Provide, at each support, safety cable capable of supporting four times vertical load from structure to luminaire.

D. Finished Areas:

1. Install symmetrically with tile pattern.
2. Locate with centerlines either on centerline of tile or on joint between adjacent tile runs.
3. Install recessed luminaires tight to finished surface such that no spill light will show between ceilings and sealing rings.
4. Combustible Low Density Cellulose Fiberboard: Provide spacers and mount luminaires 1-1/2 inches from ceiling surface or use fixtures suitable for mounting on low density ceilings.
5. Junction Boxes:
   a. Flush and Recessed Luminaires: Locate minimum 1-foot from luminaire.
   b. In concealed locations, install junction boxes to be accessible by removing luminaire.

6. Wiring and Conduit:
   a. Provide wiring of temperature rating required by luminaire.
   b. Provide flexible steel conduit.
7. Provide plaster frames when required by ceiling construction.
8. Independent Supports:
   a. Provide each recessed fluorescent luminaire with two safety chains or two No. 12 soft-annealed galvanized steel wires of length needed to secure luminaire to building structure independent of ceiling structure.
   b. Select chain or wire with tensile strength and method of fastening to structure adequate to support luminaire weight.
   c. Fasten chain or wire to each end of luminaire.

E. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.

1. Fixture Suspension: Provide 1/4-inch threaded steel hanger rods. Scissor type hangers not permitted.
2. Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.

F. Building Exterior: Flush-mounted back box and concealed conduit, unless otherwise indicated.

3.02 LIGHTING CONTROL

A. Outdoor Luminaires: Photocells switch time clock ON at dusk with time clock switching lights OFF at preset time.

3.03 POLES

A. Electrical Installations: Conform to IEEE C2 and requirements specified herein.

B. Pole Setting:

1. Depth: As indicated on Drawings or footing detail.
2. Install poles in straight runs in a straight line.

C. Aluminum Poles: Install according to pole manufacturer's instructions.

1. Provide precast concrete base.
2. Provide branch circuit in-line fuses in pole base handhole.

D. Photocell Switch Aiming: Mount and aim switch according to manufacturer's recommendations.

E. Grounding: Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 26 05 26, Grounding and Bonding for Electrical Systems. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.04 FIELD FINISHES

A. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Paint as specified in Section 09 90 00, Painting and Coating.

3.05 FIELD QUALITY CONTROL

A. Upon completion of installation, verify equipment is properly installed, connected, and adjusted. Conduct an operating test to show equipment operates in accordance with the requirements of this section.

B. Coordinate lighting and controls installation and testing with commissioning as specified in Section 01 91 14, Testing, Integration, and Startup.

3.06 CLEANING

A. Remove labels and markings, except UL listing mark.

B. Wipe luminaires inside and out to remove construction dust.

C. Clean luminaire plastic lenses with antistatic cleaners only.

D. Touch up painted surfaces of luminaires and poles with matching paint ordered from manufacturer.

E. Replace defective lamps at time of Substantial Completion.

**END OF SECTION**

PURE WATER PROGRAM
FOR
THE CITY OF SAN DIEGO, CALIFORNIA

# BIDDING REQUIREMENTS
# AND
# CONTRACT DOCUMENTS

for the construction of the

## NCWRP EXPANSION AND NCPWF
## INFLUENT PUMP STATION AND PIPELINE

## PACKAGE 4

## EARLY SITE WORK AND OZONE/BAC RELOCATION

VOLUME 3
SPECIFICATIONS
DIVISIONS 31 THROUGH 49

****

*Issued for Construction*

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CH2M HILL
San Diego, CA
September 2018

Project No. 684476

**SECTION 00 01 07**
**SEALS PAGE**

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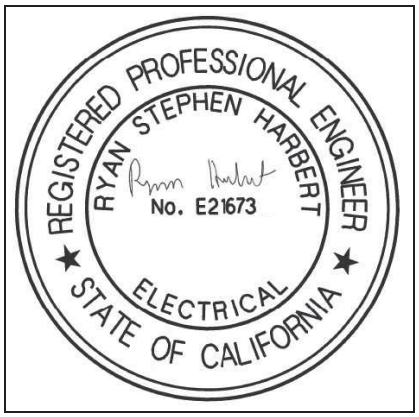


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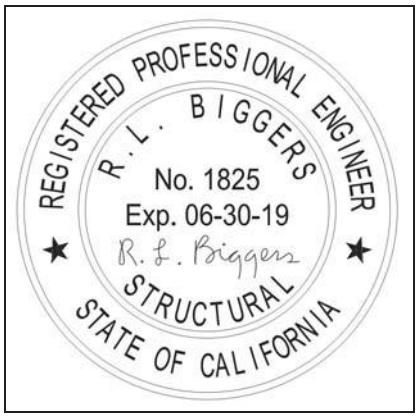


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**END OF SECTION**

# SECTION 31 10 00
# SITE CLEARING

## PART 1 GENERAL

### 1.01 DEFINITIONS

A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 6 inches below subgrade.

D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.

E. Stripping: Removal of topsoil remaining after applicable scalping is completed.

F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

### 1.02 SUBMITTALS

A. Action Submittals: Drawings clearly showing clearing, grubbing, and stripping limits.

### 1.03 QUALITY ASSURANCE

A. Obtain Construction Manager’s approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

### 1.04 SCHEDULING AND SEQUENCING

A. Prepare Site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

3.01 GENERAL

A. Clear, grub, and strip areas actually needed for Site improvements within limits shown or specified.

B. Do not injure or deface vegetation that is not designated for removal.

3.02 LIMITS

A. As follows, but not to extend beyond Project limits.

1. Excavation Excluding Trenches: 5 feet beyond top of cut slopes.
2. Trench Excavation: 10 feet from trench centerline, regardless of actual trench width.
3. Fill:
   a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
   b. Stripping and Scalping: 5 feet beyond toe of permanent fill.
4. Structures: 15 feet outside of new structures.
5. Roadways: Clearing, grubbing, scalping, and stripping 5 feet from roadway shoulders.
6. Other Areas: As shown.

B. Remove rubbish, trash, and junk from entire area within Project limits.

3.03 CLEARING

A. Clear areas within limits shown or specified.

B. Fell trees so that they fall away from facilities and vegetation not designated for removal.

C. Cut stumps not designated for grubbing flush with ground surface.

D. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

3.04 GRUBBING

A. Grub areas within limits shown or specified.

3.05 SCALPING

A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.

B. Scalp areas within limits shown or specified.

3.06 STRIPPING

A. Do not remove topsoil until after scalping is completed.

B. Strip areas within limits to minimum depths shown or specified. Do not remove subsoil with topsoil.

C. Stockpile strippings for topsoil, separately from other excavated material.

3.07 TREE REMOVAL OUTSIDE CLEARING LIMITS

A. Remove Within Project Limits: Dead, dying, leaning, or otherwise unsound trees that may strike and damage Project facilities in falling.

B. Cut stumps off flush with ground, remove debris, and if disturbed, restore surrounding area to its original condition.

3.08 DISPOSAL

A. Clearing and Grubbing Debris:

1. Dispose of debris offsite.
2. Burning of debris onsite will not be allowed.
3. Woody debris may be chipped. Chips cannot be used anywhere for landscaping in this Project and they may be sold to Contractor's benefit. Dispose of chips that are unsaleable with unchipped debris.
4. Limit offsite disposal of clearing and grubbing debris to locations that are approved by federal, state, and local authorities, and that will not be visible from Project.

B. Scalpings: As specified for clearing and grubbing debris.

C. Strippings:

1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil offsite or in waste disposal areas shown or approved by Construction Manager.
2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

**END OF SECTION**

# SECTION 31 23 13
# SUBGRADE PREPARATION

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D1557, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft$^3$).
   b. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

### 1.02 DEFINITIONS

A. Optimum Moisture Content: As defined in Section 31 23 23, Fill and Backfill.

B. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

C. Relative Compaction: As defined in Section 31 23 23, Fill and Backfill.

D. Relative Density: As defined in Section 31 23 23, Fill and Backfill.

E. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil or excavating prior to placement of fill, backfill, roadway structure or base for floor slab.

F. Proof-Rolling: Testing of subgrade by compactive effort to identify areas that will not support the future loading without excessive settlement. Proof-rolling can be completed with a fully loaded ten-wheel dump truck or water truck making a minimum of two complete passes.

G. Unsuitable Material: As defined in Section 31 23 23.15, Trench Backfill.

### 1.03 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 02 41 00, Demolition; Section 31 10 00, Site Clearing; and Section 31 23 16, Excavation, prior to subgrade preparation.

1.04 QUALITY ASSURANCE

A. Notify Construction Manager when subgrade is ready for compaction or proof-rolling or whenever compaction or proof-rolling is resumed after a period of extended inactivity.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

3.01 GENERAL

A. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.

B. Bring subgrade to proper grade and cross-section and uniformly compact surface.

C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.

D. Maintain prepared ground surface in finished condition until next course is placed.

3.02 COMPACTION

A. Under Earthfill: Scarify and compact upper 6 inches to minimum of 90 percent relative compaction as determined in accordance with ASTM D1557.

B. Under Pavement Structure, Floor Slabs On Grade, or Granular Fill Under Structures: Compact the upper 6 inches to minimum of 95 percent relative compaction as determined in accordance with ASTM D1557.

C. Pipe Trench Subgrade: Make three complete passes using hand guided vibratory plate compactors, under observation by Construction Manager. Operate at a slow walking pace as coordinated with the Construction Manager.

3.03 MOISTURE CONDITIONING

A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.

B. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten drying process.

3.04 TESTING

A. Proof-roll subgrade (except in pipe trenches) to detect soft or loose subgrade or unsuitable material, as determined by Construction Manager.

B. Detect soft or loose pipe trench subgrade by observation of the vibratory plate compactors in Article Compaction, above.

C. In-Place Density Tests: In accordance with ASTM D6938. A minimum of one density test for every 50-foot by 50-foot subgrade area is required.

3.05 CORRECTION

A. Soft or Loose Subgrade:

1. Adjust moisture content and recompact.
2. Over excavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

B. Unsuitable Material: Over excavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

**END OF SECTION**

# SECTION 31 23 16
# EXCAVATION

## PART 1 GENERAL

### 1.01 DEFINITIONS

A. Common Excavation: Removal of material not classified as rock excavation.

B. Rock Excavation:

1. General: Removal of solid material which by actual demonstration cannot, in Construction Manager's opinion, be reasonably loosened or ripped by single-tooth, hydraulically operated ripper mounted on crawler tractor in good condition and rated at minimum 300 flywheel horsepower; and which must be systematically drilled or broken by power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means prior to removal.
2. Trench: Removal of solid material which by actual demonstration cannot, in Construction Manager's opinion, be reasonably excavated with minimum 135 hp backhoe in good condition and equipped with manufacturer's standard boom, two rippers, and rock points or similar approved equipment; and which must be systematically drilled or broken by power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means prior to removal.
3. Term "rock excavation" indicates removal of solid material, as specified above, and does not necessarily correspond to "rock" as implied by names of geologic formations. Material that for convenience or economy is loosened by drilling or the use of pneumatic tools is not considered rock excavation.
4. Removal of boulders larger than 1/2 cubic yard will be classified as rock excavation, if drilling or breaking them apart with power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means is both necessary and actually used for their removal.

C. Influence Area:

1. Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:
   a. 1 foot outside outermost edge at base of foundation or slabs.
   b. 1 foot outside outermost edge at surface of roadways or shoulder.
   c. 0.5 foot outside exterior at spring line of pipes or culverts.

D. Unsuitable Material: Excavated material that is unsuitable for use as backfill material as specified in Section 31 23 23.15, Trench Backfill.

1.02 SUBMITTALS

A. Informational Submittals:

1. Excavation Plan, Detailing:
   a. Methods and sequencing of excavation.
   b. Proposed locations of stockpiled excavated material.
   c. Proposed onsite and offsite spoil disposal sites.
   d. Numbers, types, and sizes of equipment proposed to perform excavations.
   e. Anticipated difficulties and proposed resolutions.
2. Required excavation permits from applicable governing agencies.

1.03 QUALITY ASSURANCE

A. Provide adequate survey control to avoid unauthorized overexcavation.

1.04 WEATHER LIMITATIONS

A. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.05 SEQUENCING AND SCHEDULING

A. Demolition: Complete applicable Work specified in Section 02 41 00, Demolition, prior to excavating.

B. Clearing, Grubbing, and Stripping: Complete applicable Work specified in Section 31 10 00, Site Clearing, prior to excavating.

C. Dewatering: Conform to applicable requirements of Section 31 23 19.01, Dewatering, prior to initiating excavation.

D. Excavation Support: Install and maintain, as specified in Section 31 41 00, Shoring, as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

3.01 GENERAL

A. Comply with applicable excavation permits.

B. Prior to excavating, install erosion and sediment control measures as specified with required permits.

C. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 0.1 foot, except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth. Furnish, place, and maintain supports and shoring that may be required for the sides of the excavations.

D. Use of Excess Excavated Materials:

1. Use of excess excavated materials to complete fills or produce granular rock products required for the Work is permitted under the following conditions:
   a. Process excavated materials to meet specified material requirements.
   b. In the event that excavated materials or processed materials do not meet the specified material requirements, import the specified material.
   c. Only use excavated materials from excavations actually required for the Work for generating fills or other granular rock products required for the Work. No borrow excavations intended solely to generate materials for processing are allowed.

E. Removal and Exclusion of Water: Remove and exclude water, if encountered, from open excavations, including stormwater, groundwater, irrigation water, and wastewater as specified in Section 31 23 19.01, Dewatering.

F. Do not overexcavate without written authorization of Construction Manager.

G. Remove or protect obstructions as shown and as specified in Section 01 50 00, Temporary Facilities and Controls, Article Protection of Work and Property.

H. Use of explosives for blasting to assist rock excavation is not allowed.

## 3.02 CLASSIFIED EXCAVATION

A. Excavation is classified; see Article Definitions, for classifications of common excavation and rock excavation. Notify Construction Manager whenever rock is encountered.

B. Before beginning rock excavation, comply with following requirements:

1. Remove overlying material as common excavation and expose rock surface for examination by Construction Manager.
2. Demonstrate that removal of remaining material classifies as rock excavation unless waived by Construction Manager.
3. Assist Construction Manager with measurement and documentation of rock excavation.

C. Predrilling may be allowed prior to removal of overburden if, in Construction Manager's opinion, top-of-rock line can be clearly defined after excavation. Acceptance of this method will be based on the following demonstration:

1. Predrill and excavate initial 100-foot long test section.
2. Excavate minimum of two 20-foot long trenches to apparent rock line immediately adjacent to predrilled section for comparison.

D. In event of disputed quantities, excavate additional correlation trenches to apparent rock as considered necessary by Construction Manager to resolve dispute. Construction Manager reserves right to stop predrilling if, in Construction Manager's opinion, experience indicates that accurate determination of rock quantities is not possible by this method.

## 3.03 TRENCH WIDTH

A. Minimum Width of Trenches:

1. For sewers, potable water mains, irrigation, recycled water mains, and storm drains, refer to Drawing No. SDS-110, SDW-110, SDI-110, SDRW-101, and SDD-110, respectively, of the City of San Diego Standard Drawings.
2. For other Single Pipe, Conduit, Direct-Buried Cable, and Duct Bank:
   a. Less than 4-inch Outside Diameter or Width: 18 inches.
   b. Greater than 4-inch Outside Diameter or Width: 24 inches greater than outside diameter or width of pipe, conduit, direct-buried cable, or duct bank.
3. For other Multiple Pipes, Conduits, Cables, or Duct Banks in Single Trench: 24 inches greater than aggregate width of pipes, conduits, cables, duct banks, plus space between.
4. Increase trench widths by thicknesses of shoring.

B. Maximum Trench Width:

1. For sewers, potable water mains, irrigation, recycled water mains, and storm drains, refer to Drawing No. SDS-110, SDW-110, SDI-110, SDRW-101, and SDD-110, respectively, of the City of San Diego Standard Drawings.
2. For Other Pipes: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to existing facilities, adjacent property, or completed Work.

## 3.04 PIPE AND UTILITY TRENCH EXCAVATION

A. Perform in accordance with the safety requirements of the California Occupational Safety and Health Administration, latest edition.

B. General: Unless otherwise indicated or ordered, open-cut trenches with widths as indicated for excavation for pipelines and utilities.

C. Open Trench Length: Unlimited.

D. Trench Bottom: Uniformly excavate and smooth the bottom of the trench to the grade of the bottom of the pipe bedding. Remove loose or disturbed material from the bottom of the trench, including excavator ridges.

E. Overexcavation: Overexcavate where required by Construction Manager. Backfill excavation below the grade ordered with the indicated material and compaction specified in Section 31 23 23.15, Trench Backfill.

F. Trench Overexcavation: Where trenches are indicated to be overexcavated, excavate to the depth indicated, and install backfill to the grade of the bottom of the pipe bedding.

G. Where pipelines are to be installed in embankments, fills, or structure backfills, construct the fill in accordance with Section 31 23 23, Fill and Backfill, to a level at least 2 feet above the top of the proposed pipe elevation before the trench is excavated.

H. If a moveable trench shield is used during excavation operations, construct the trench width wider than the shield so that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls. Remove the trench shield and stabilize the trench if the trench walls cave in or slough.

## 3.05 STRUCTURE, EMBANKMENT, AND CUT SLOPE EXCAVATION

A. Foundation Preparation Beneath Structure and Embankments:

1. Except where otherwise ordered by Construction Manager, clear, grub, and strip areas beneath structure and embankment in accordance with Section 31 10 00, Site Clearing. After clearing is completed, scarify entire areas that underlie fill sections to a depth of 6 inches and until surface is free of ruts, excessive water, and other features which would prevent uniform compaction by equipment to be used. Recompact areas to specified density before placing of fill material as specified in Section 31 23 13, Subgrade Preparation. Where cemented rock, cobbles, or boulders compose a large portion of foundation material underlying structures, it may not be advisable to scarify the top 6 inches prior to compaction. If Construction Manager deems it advisable not to scarify existing natural ground, then moisten the native soil and compact it as indicated.
2. Overexcavate 2 feet within the influence area under the retaining wall foundation along the east side of the secondary clarifiers and backfill with recompacted excavated materials over undisturbed earth or prepared subgrade as specified in Section 31 23 23, Fill and Backfill.

B. Surveying of Excavation Slopes: Place survey stakes or other identification at vertical intervals of 5 feet from the top of the excavation to the bottom of cut slope. Set stakes at 50-foot maximum intervals around the excavation perimeter. Stakes shall indicate the deviation from the grade indicated on Drawings. Maintain the specified cut slope at points along the slope.

C. Excavated Materials: Place excavated material within Work Limits at designated locations identified by the Construction Manager and as further specified in Article Stockpiling Excavated Material. Separate materials that are usable as backfill or fill from unsuitable material and as further specified in Part 3, Article General.

D. Notification: Notify Construction Manager at least 3 working days in advance of placing any embankment on prepared subgrade or as backfill in an excavation and allow Construction Manager a review period of at least 1 day before the exposed foundation is scarified and compacted or is covered with backfill or with any other materials.

E. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.

F. Remove stones and rock that exceed 3-inch diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.

G. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite, or adversely impacts existing facilities, adjacent property, or completed Work.

## 3.06 STOCKPILING EXCAVATED MATERIAL

A. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.

B. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.

C. Confine stockpiles to within approved work areas. Do not obstruct roads or streets.

D. Do not stockpile excavated material adjacent to trenches and other excavations, unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.

E. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

F. Stockpile excavated material on the downhill side of the excavation where practicable.

## 3.07 INSPECTION AND TESTING

A. Grading and excavation will be performed under the observation and testing of the Construction Manager. The Construction Manager must be notified at the following stages:

1. Upon completion of site clearing.
2. During excavation and backfill placement and compaction.
3. After completion of foundation excavations and prior to placement of concrete.
4. When any unusual or unexpected geotechnical conditions are encountered.

## 3.08 DISPOSAL OF SPOIL

A. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, offsite.

B. Dispose of debris resulting from removal of underground facilities as specified in Section 02 41 00, Demolition, for demolition debris.

C. Dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in Section 31 10 00, Site Clearing, for clearing and grubbing debris.

**END OF SECTION**

# SECTION 31 23 19.01
# DEWATERING

## PART 1 GENERAL

### 1.01 SUBMITTALS

A. Informational Submittals:

1. Water control plan.
2. Well permits.
3. Discharge permits.

### 1.02 WATER CONTROL PLAN

A. As a minimum, include:

1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply, means of measuring inflow to excavations, pollution control facilities, discharge locations to be utilized, and provisions for immediate temporary water supply as required by this section.
2. Drawings showing locations, dimensions, and relationships of elements of each system.
3. Design calculations demonstrating adequacy of proposed dewatering systems and components.

B. Water Control Plan and Dewatering Systems shall be prepared by a Groundwater Control Specialist: A licensed professional engineer currently registered in the State of California, with a list of projects and references designing dewatering plans and systems. Design Engineer's review and acceptance of submittal does not imply approval by Design Engineer of the associated Water Control Plan and Dewatering Systems. Contractor shall be solely responsible for designing, installing, operating and maintaining the system(s) required to satisfactorily perform all necessary dewatering.

C. If system is modified during installation or operation revise or amend and resubmit Water Control Plan.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

3.01 GENERAL

A. If groundwater is encountered at or above the base of any excavation, groundwater control will be required to limit disturbance of the subgrade soil and instability of the excavation bottom, sides, and face.

B. Continuously control water during course of construction, including weekends and holidays and during periods of work stoppages, and provide adequate backup systems to maintain control of water.

3.02 SURFACE WATER CONTROL

A. See Section 01 50 00, Temporary Facilities and Controls, Article Temporary Controls.

B. Remove surface runoff controls when no longer needed.

3.03 SITE CONDITIONS

A. Subsurface Information: The Contract Documents indicate information available relative to subsurface conditions at the Site. Such information and data are not intended as a representation or warranty of continuity of conditions between soil borings, nor of groundwater levels at dates and times other than date and time when measured, nor that purpose of obtaining the information and data were appropriate for use by Contractor. Design Engineer will not be responsible for interpretations or conclusions drawn therefore by Contractor. Refer to Special Provisions for additional information.

3.04 DEWATERING SYSTEMS

A. Evaluate groundwater data, design, and implement most efficient dewatering methods while meeting Project requirements.

B. Provide, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry and to lower and maintain groundwater level a minimum of 2 feet below the lowest point of excavation. Continuously maintain excavations free of water, regardless of source, and until backfilled to final grade.

C. Dewatering systems shall include wells or well points, and other equipment and appurtenances installed outside limits of excavations and sufficiently below lowest point of excavation, or to maintain specified groundwater elevation.

D. Design and Operate Dewatering Systems:

1. To prevent loss of ground as water is removed.
2. To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.
3. To relieve artesian pressures and resultant uplift of excavation bottom.
4. To prevent instability of faces of excavation.

E. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.

F. Provide 100 percent emergency power backup with automatic startup and switchover in event of electrical power failure.

G. Provide supplemental ditches and sumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering.

H. Stormwater Control:

1. Use diversion berms, ditches, or other means to reduce stormwater flow into excavations or other construction areas.
2. Implement best management practices to reduce erosion and sedimentation during construction.

## 3.05 DISPOSAL OF WATER

A. Obtain discharge permit for water disposal from authorities having jurisdiction.

B. Treat water collected by dewatering operations, as required by regulatory agencies, prior to discharge.

C. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.

D. Remove solids from treatment facilities and perform other maintenance of treatment facilities as necessary to maintain their efficiency.

3.06 PROTECTION OF PROPERTY

A. Make assessment of potential for dewatering induced settlement. Provide and operate devices or systems, including but not limited to reinjection wells, infiltration trenches and cutoff walls, necessary to prevent damage to existing facilities, completed Work, and adjacent property.

B. Securely support existing facilities, completed Work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

3.07 REMEDIATION OF GROUNDWATER DEPLETION

A. If dewatering reduces quantity or quality of water produced by existing wells, temporarily supply water to affected well owners from other sources. Furnish water of a quality and quantity equal to or exceeding the quality and quantity available to well owner prior to beginning the Work or as satisfactory to each well owner.

**END OF SECTION**

# SECTION 31 23 23
# FILL AND BACKFILL

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C117, Standard Test Method for Materials Finer Than 75-Micrometers (No. 200) Sieve in Mineral Aggregates by Washing.
   b. C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
   c. D422, Standard Test Method for Particle-Size Analysis of Soils.
   d. D1557, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft$^3$).
   e. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   f. D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   g. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
2. 2015 “Greenbook” Standard Specifications for Public Works Construction.
3. 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

### 1.02 DEFINITIONS

A. Relative Compaction:

1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D1557.
2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by Construction Manager.

B. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

C. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.

D. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.

E. Prepared Subgrade: Subgrade preparation in accordance with Section 31 23 13, Subgrade Preparation.

F. Completed Course: A course or layer that is ready for next layer or next phase of Work.

G. Lift: Loose (uncompacted) layer of material.

H. Geosynthetics: Geotextiles.

I. Well-Graded:

1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.
2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

J. Influence Area:

1. Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:
   a. 1 foot outside outermost edge at base of foundations or slabs.
   b. 1 foot outside outermost edge at surface of roadways or shoulder.
   c. 0.5 foot outside exterior at spring line of pipes or culverts.

K. Borrow Material: Material from required excavations on or near Site.

L. Selected Backfill Material: Materials available onsite that Construction Manager determines to be suitable for specific use.

M. Imported Material: Materials obtained from sources offsite, suitable for specified use.

N. Structural Fill: Fill materials as required under structures, pavements, and other facilities.

O. Embankment Material: Fill materials required to raise existing grade in areas other than under structures.

P. Standard Specifications: When referenced in this section, shall mean the latest editions of the "Greenbook" Standard Specifications for Public Works Construction and the City of San Diego Supplement "Whitebook" Standard Specifications for Public Works Construction.

1.03 SUBMITTALS

A. Informational Submittals:

1. Manufacturer's data sheets for compaction equipment.
2. Certified test results from independent testing agency.

1.04 QUALITY ASSURANCE

A. Notify Construction Manager and Design Engineer when:

1. Structure or tank is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
2. Soft or loose subgrade materials are encountered wherever site fill is to be placed.
3. Fill material appears to be deviating from Specifications.

B. Quality Control and Acceptance for Biofiltration Soil Media (BSM): Close adherence to the material quality controls herein are necessary in order to assure sufficient permeability to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility, and to support healthy vegetation. Amendments may be included to adjust agronomic properties. Acceptance of the material will be based on test results conducted no more than 120 days prior to delivery of the blended BSM to the Project Site and certified to be representative. For projects installing more than 100 cubic yards of BSM, batch-specific tests of components and blended mix are required and locations of material batches shall be provided to the Construction Manager.

1.05 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 02 41 00, Demolition; Section 31 10 00, Site Clearing; Section 31 23 16, Excavation; and Section 31 23 13, Subgrade Preparation, prior to placing fill or backfill.

B. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03 30 10, Structural Reinforced Concrete. Obtain Construction Manager's acceptance of concrete work and attained strength prior to placing backfill.

C. Backfill around water-holding structures only after completion of satisfactory leakage tests as specified in Section 03 30 10, Structural Reinforced Concrete.

D. Do not place granular base, subbase, or surfacing until after subgrade has been prepared as specified in Section 31 23 13, Subgrade Preparation.

E. Delivery, Storage, and Handling of Biofiltration Soil Media (BSM):

1. The Contractor shall not deliver or place soils in frozen, wet, or muddy conditions.
2. The Contractor shall protect soils and mixes from absorbing excess water and from erosion at all times. The Contractor shall not store materials unprotected from large rainfall events. The Contractor shall not allow excess water to enter Site prior to compaction. If water is introduced into the material after grading, the Contractor shall allow material to drain or aerate to optimum compaction moisture content.

**PART 2 PRODUCTS**

2.01 SOURCE QUALITY CONTROL

A. Gradation Tests:

1. As necessary to locate acceptable sources of imported material.
2. During production of imported material, test per ASTM D422 or ASTM C136 as follows:
   a. Granular Fill: Minimum one test per day or every 2,000 cubic yards.
   b. Sand: Minimum one test per day or every 2,000 cubic yards.
   c. Granular Drain Material: Minimum one test per day or every 1,000 cubic yards.
   d. Gravel Surfacing and Base Course Rock: Minimum one test per day or every 1,000 cubic yards.
   e. Foundation Stabilization Rock: Minimum one test per day or every 1,000 cubic yards.

f. Soil Cover Over Geotextiles: Minimum one test per day or every 2,000 cubic yards.

2.02 EARTHFILL

A. Excavated material from required excavations and designated borrow sites, free from rocks larger than 6 inches, from roots and other organic matter, trash, debris, and other deleterious materials.

B. Provide imported material of equivalent quality, if required to accomplish Work.

2.03 GRANULAR FILL

A. 1-inch minus crushed gravel or crushed rock.

B. Free from dirt, clay balls, and organic material.

C. Well-graded from coarse to fine and containing sufficient fines to bind material when compacted, but with maximum 8 percent by weight passing No. 200 sieve.

2.04 SAND

A. Free from clay, organic matter, or other deleterious material.

B. Gradation as determined in accordance with ASTM C117 and ASTM C136:

| Sieve Size | Percent Passing by Weight |
|---|---|
| 1/4-inch | 100 |
| No. 4 | 95 - 100 |
| No. 200 | 0 - 8 |

C. See Section 200-1.5 of 2015 “Greenbook” Standard Specifications for Public Works Construction.

D. See Table 200-1.5.5 and Section 200-1.5.7 of the 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

2.05 GRANULAR DRAIN MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

2.06 WATER FOR MOISTURE CONDITIONING

A. Free of hazardous or toxic contaminates, or contaminants deleterious to proper compaction.

2.07 GRAVEL SURFACING AND BASE COURSE ROCK

A. As specified in Section 32 11 23, Aggregate Base Courses.

2.08 FOUNDATION STABILIZATION ROCK

A. Crushed rock or pit run rock.

B. Uniformly graded from coarse to fine.

C. Free from excessive dirt and other organic material.

D. Maximum 2-1/2-inch particle size.

2.09 SOIL COVER OVER GEOTEXTILES

A. Particle Size: Maximum 1 inch.

B. Free of sharp angular pieces that may damage geotextile.

2.10 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

A. As specified in Section 31 23 23.15, Trench Backfill.

2.11 BIORETENTION SOIL MEDIA (BSM) MIX

A. Bioretention Soil Media (BSM) shall conform to Appendix F.4 of the 2016 City of San Diego BMP Handbook with the following modifications:

1. BSM shall conform to the following saturation extract or SPLP criteria:
   a. Nitrate less than 0.68 mg/L.
   b. Phosphorous less than 1 mg/L.
   c. Zinc less than 0.1 mg/L.
   d. Copper less than 0.025 mg/L.
2. Instead of typical sand/compost mix, refer to Appendix F.4.1.3 of the 2016 City of San Diego BMP Handbook, a mix of 40 percent sand, 20 percent granular activated carbon (GAC), and 40 percent zeolite.
3. The GAC shall meet the following criteria:
   a. VCC 8 by 30 virgin coconut shell activated.
   b. Carbon; Double Acid Washed.
   c. 29 lbs/$ft^3$ (1.8 g/$cm^3$ to 2.1 g/$cm^3$).

4. The zeolite shall meet the following criteria:
   a. Zeolite shall be naturally occurring granular zeolite that has a minimum 75 percent clinoptilolite purity by weight.
   b. Zeolite shall be washed.
   c. Zeolite shall be free of organic material, debris and other similar foreign objects and free of particles larger than the maximum specified mesh size.
   d. Zeolite shall have a minimum cation exchange capacity of 1.0 meg/g.
   e. Zeolite shall have an 8 by 14 mesh gradation, or alternative gradation approved by the Design Engineer.

## 2.12 GRADED AGGREGATE CHOKER STONE

A. See Section 301-8 of the 2015 City of San Diego "Whitebook" Standard Specifications for Public Works Constructions.

## 2.13 STONE FOR RIPRAP

A. See Section 200-1.6 of the 2015 "Greenbook" Standard Specifications for Public Works Construction and Section 200-1.7 of the 2015 City of San Diego "Whitebook" Standard Specifications for Public Works Construction.

## 2.14 VEGETATIVE SUPPORT MATERIAL (VSM)

A. The VSM shall consist of 75 percent sand and 25 percent well-aged coconut coir pith (if coconut coir pith is not available, compost may be substituted at low amounts and if included according to City of San Diego BMP Manual Appendix E.14 BF-2, Nutrient Sensitive Media Design.

   1. Coconut coir pith shall conform to the following requirements:
      a. Be aged a minimum of 6 months.
      b. Be rinsed and washed during production.
      c. Shall be sieved to remove coarse coconut husk fibers and other debris materials.
      d. Shall be delivered to the site in loose decompressed form and not in compressed bricks but must be delivered to the site as loose, prewetted material.
      e. Achieve the following laboratory results:
         1) Electrical conductivity less than 1 milliequivalent per liter.
         2) Organic matter content greater than 70 percent.
   2. Sand shall conform to the specification for sand within Article Bioretention Soil Media.
   3. No topsoil shall be allowed within the VSM.
   4. VSM shall have a pH range between 5.5 to 7.0.

5. VSM shall have a hydraulic conductivity of at least 20 inches per hour at a relative compaction of 85 percent standard proctor as defined in ASTM D698.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.

B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

C. During filling and backfilling, keep level of fill and backfill around each structure even.

D. If pipe, conduit, duct bank, or cable is to be laid within fill or backfill:

1. Fill or backfill to an elevation 2 feet above top of item to be laid.
2. Excavate trench for installation of item.
3. Install bedding, if applicable, as specified in Section 31 23 23.15, Trench Backfill.
4. Install item.
5. Backfill envelope zone and remaining trench, as specified in Section 31 23 23.15, Trench Backfill, before resuming filling or backfilling specified in this section.

E. Tolerances:

1. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

F. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

### 3.02 BACKFILL UNDER AND AROUND STRUCTURES

A. Under Facilities: Within influence area beneath structures, slabs, pavements, footings, curbs, piping, conduits, duct banks, and other facilities, backfill with

granular fill, unless otherwise shown. Place a 6-inch minimum thickness of granular fill unless otherwise shown in lifts of 6-inch maximum thickness and compact each lift to minimum of 95 percent relative compaction as determined in accordance with ASTM D1557.

B. Use granular fill or CLSM where shown or specified and for wall backfill below the influence area of overlying structures, slabs, and footings.

C. Subsurface Drainage: Backfill with granular drain material, where shown. Place granular drain material in lifts of 6-inch maximum thickness and compact each lift to minimum of 90 percent relative density.

D. Other Areas: Backfill with earthfill to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of 8-inch maximum thickness and compact each lift to minimum 90 percent relative compaction as determined in accordance with ASTM D1557.

3.03 FILL

A. Outside Influence Areas beneath Structures, Tanks, Pavements, Curbs, Slabs, Piping, and Other Facilities:

1. Unless otherwise shown, place earthfill as follows:
   a. Allow for 6-inch thickness of topsoil where required.
   b. Maximum 8-inch thick lifts.
   c. Place and compact fill across full width of embankment.
   d. Compact to minimum 90 percent relative compaction as determined in accordance with ASTM D1557.
   e. Dress completed embankment with allowance for topsoil, crest surfacing, slope protection, and lining, where applicable.

3.04 SITE TESTING

A. Gradation:

1. One sample from each 1,500 tons of finished product or more often as determined by Construction Manager, if variation in gradation is occurring, or if material appears to depart from Specifications.
2. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.
3. Remove material placed in Work that does not meet Specification requirements.

B. In-Place Density Tests:

1. In accordance with ASTM D6938. During placement of materials, test as follows:
   a. Granular Fill: Minimum one test per location or every 200 cubic yards.
   b. Sand: Minimum one test per location or every 200 cubic yards.
   c. Granular Drain Material: Minimum one test per location or every 100 cubic yards.
   d. Gravel Surfacing and Base Course Rock: Minimum one test per location or every 100 cubic yards.
   e. Foundation Stabilization Rock: Minimum one test per location or every 200 cubic yards.
   f. Soil Cover Over Geotextiles: Minimum one test per location or every 200 cubic yards.
   g. Earthfill: Minimum one test per location or every 200 cubic yards.
   h. Bedding and Pipe Zone Material: Minimum one test per lift every 50 linear feet of trench.

## 3.05 SAND BLANKET OVER VAPOR RETARDER

A. Place sand in manner that avoids damage to underlying vapor retarder.

B. Moisten sand and thoroughly compact it with a vibratory plate compactor.

## 3.06 GRANULAR BASE, SUBBASE, AND SURFACING

A. Place and compact as specified in Section 32 11 23, Aggregate Base Courses.

## 3.07 REPLACING OVEREXCAVATED MATERIAL

A. Replace excavation carried belowgrade lines shown or established by Construction Manager as follows:

1. Beneath Footings: Granular fill.
2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
3. Beneath Slabs-On-Grade: Granular fill.
4. Trenches:
   a. Unauthorized Overexcavation: Either trench stabilization material or granular pipe base material, as specified in Section 31 23 23.15, Trench Backfill.
   b. Authorized Overexcavation: Trench stabilization material, as specified in Section 31 23 23.15, Trench Backfill.

## 3.08 PLACING FILL OVER GEOSYNTHETICS

A. General:

1. Place fill over geosynthetics with sufficient care so as not to damage them.
2. Place fill only by back dumping and spreading only.
3. Dump fill only on previously placed fill.
4. While operating equipment, avoid sharp turns, sudden starts or stops that could damage geosynthetics.

B. Hauling: Operate hauling equipment on minimum of 3 feet of covering.

C. Spreading:

1. Spreading equipment shall be track mounted low ground pressure, D-6 or lighter.
2. Operate spreading equipment on minimum of 12 inches of fill over geosynthetics.
3. Spread fill in same direction as unseamed overlaps to avoid separation of seams and joints.
4. Never push fill downslope. Spread fill over side slopes by pushing up from slope bottom.
5. Maintain proper overlap of unseamed geosynthetics.
6. Avoid overstressing geosynthetics and seams.

D. Compaction: Compact fill only after uniformly spread to full thickness shown.

E. Geosynthetic Damage:

1. Mark punctures, tears, or other damage to geosynthetics, so repairs may be made.
2. Clear overlying fill as necessary to repair damage.
3. Repairs to geosynthetics shall be made by respective installers as specified in respective specification section for each geosynthetic.

## 3.09 ACCESS ROAD SURFACING

A. Place and compact as specified in Section 32 11 23, Aggregate Base Courses.

## 3.10 BIOFILTRATION SOIL MEDIA (BSM)

A. Biofiltration Soil Media (BSM) shall conform to Appendix F.4 of the 2016 Storm Water Standards, Part 1 BMP Design Manual.

B. Payment: BSM shall be measured and paid per cubic yard installed. The installation of the pervious backfill material as specified in the Contract Documents and as directed by the Construction Manager shall be included in the payment.

3.11 GRADED AGGREGATE CHOKER STONE

A. See Section 301-8 of the City of San Diego “Whitebook” Standard Specifications for Public Works Construction.

**END OF SECTION**

# SECTION 31 23 23.15
# TRENCH BACKFILL

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Public Works Association (APWA): Uniform Color Code.
2. ASTM International (ASTM):
   a. C33, Standard Specification for Concrete Aggregates.
   b. C94, Standard Specification for Ready-Mixed Concrete.
   c. C117, Standard Test Method for Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.
   d. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   e. C150, Standard Specification for Portland Cement.
   f. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
   g. C1012, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
   h. D1140, Standard Test Methods for Amount of Material in Soils Finer than No. 200 Sieve.
   i. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft$^3$).
   j. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
   k. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   l. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   m. D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   n. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
3. National Electrical Manufacturers Association (NEMA): Z535.1, Safety Colors.

### 1.02 DEFINITIONS

A. Base Rock: Granular material upon which manhole bases and other structures are placed.

B. Bedding Material: Granular material upon which pipes, conduits, cables, or duct banks are placed.

C. Imported Material: Material obtained by Contractor from source(s) offsite.

D. Lift: Loose (uncompacted) layer of material.

E. Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable, or duct bank.

F. Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.

G. Relative Compaction: As defined in Section 31 23 23, Fill and Backfill.

H. Relative Density: As defined by ASTM D4253 and ASTM D4254.

I. Selected Backfill Material: Material available onsite that Construction Manager determines to be suitable for a specific use.

J. Unsuitable Materials: Soil containing peat, organics compost, other compressible materials or highly plastic clays that cannot be placed and compacted to an unyielding condition when proof rolled.

K. Standard Specifications: When referenced in this section, shall mean the latest editions of the “Greenbook” Standard Specifications for Public Works Construction and the City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

L. Well-Graded:

1. A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes producing a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids. Satisfying both of the following requirements, as defined in ASTM D2487:
    a. Coefficient of Curvature: Greater than or equal to 1 and less than or equal to 3.
    b. Coefficient of Uniformity: Greater than or equal to 4 for materials classified as gravel, and greater than or equal to 6 for materials classified as sand.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Manufacturer's descriptive literature for marking tapes and tracer wire.

B. Informational Submittals:

1. Catalog and manufacturer's data sheets for compaction equipment.
2. Certified Gradation Analysis: Submit not less than 30 days prior to delivery for imported materials or anticipated use for excavated materials, except for trench stabilization material that will be submitted prior to material delivery to Site.
3. Controlled Low Strength Material: Certified mix design and test results to demonstrate that the CLSM mix meets the requirement. Include material types and weight per cubic yard for each component of mix.
4. Description and location of proposed sources of imported material. Include documentation that imported materials are free of hazardous substances.
5. Certification and test records of processed materials showing that they meet the applicable requirements prior to commencing permanent placement of the materials for the Work.
6. Certification from each geotextile manufacturer that furnished products have specified property values. Certified property values shall be either minimum or maximum average roll values, as appropriate, for geotextiles furnished.

**PART 2 PRODUCTS**

2.01 MARKING TAPE

A. Detectable:

1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.
2. Foil Thickness: Minimum 0.35 mils.
3. Laminate Thickness: Minimum 5 mils.
4. Width: 6 inches.
5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
6. Joining Clips: Tin or nickel-coated furnished by tape manufacturer.
7. Manufacturers and Products:
   a. Reef Industries; Terra Tape, Sentry Line Detectable.
   b. Mutual Industries; Detectable Tape.

c. Presco; Detectable Tape.
d. Or approved equal.

B. Color: In accordance with APWA Uniform Color Code.

| Color* | Facility |
|---|---|
| Red | Electric power lines, cables, conduit, and lightning cables |
| Orange | Communicating alarm or signal lines, cables, or conduit |
| Yellow | Gas, oil, steam, petroleum, or gaseous materials |
| Green | Sewers and drain lines |
| Blue | Potable water |
| Purple | Reclaimed water, irrigation, and slurry lines |
| *As specified in NEMA Z535.1, Safety Color Code. | |

2.02 TRACER WIRE

A. Material: Minimum 12-gauge solid copper or copper jacket with a steel core, with high-density polyethylene (HDPE) or high-molecular weight polyethylene (HMWPE) insulation suitable for direct bury.

B. Splices: Use wire nut or lug suitable for direct burial as recommended by tracer wire manufacturer.

C. Manufacturers:

1. Copperhead Industries, LLC.
2. Performance Wire & Cable Inc.
3. Pro-line Safety Products Company.
4. Or approved equal.

2.03 TRENCH STABILIZATION MATERIAL

A. Foundation Stabilization Rock: As defined in Section 31 23 23, Fill and Backfill.

2.04 BEDDING MATERIAL AND PIPE ZONE MATERIAL

A. For sewers, potable water mains, irrigation, recycled water mains, and storm drains, refer to Drawing No. SDS-110, SDW-110, SDI-110, SDRW-101, and SDD-110, respectively, of the City of San Diego Standard Drawings.

B. For other type of pipelines, use clean or gravelly sand with less than 5 percent passing No. 200 sieve, as determined in accordance with ASTM D1140, or gravel or crushed rock within maximum particle size and other requirements as follows unless otherwise specified.

1. Duct Banks: 3/4-inch maximum particle size.
2. PVC Irrigation System Piping: 3/8-inch maximum particle size.
3. Pipe Under 18-Inch Diameter: 3/4-inch maximum particle size, except 1/4 inch for stainless steel pipe, copper pipe, tubing, and plastic pipe under 3-inch diameter.
4. Pipe 18-Inch Diameter and Greater: 1-1/4-inch maximum particle size for FRP pipe, concrete pipe, and pretensioned or prestressed concrete cylinder pipe.
5. Welded steel pipe, ductile iron pipe, and other pipe with tape wrapping, liquid epoxy, polyurethane coating, and other corrosion protection coatings: 3/4-inch maximum particle size.
6. Perforated Pipe: Granular drain material.
7. Conduit and Direct-Buried Cable:
   a. Sand, clean or clean to silty, less than 12 percent passing No. 200 sieve.
   b. Individual Particles: Free of sharp edges.
   c. Maximum Size Particle: Pass a No. 4 sieve.
   d. If more than 5 percent passes No. 200 sieve, the fraction that passes No. 40 sieve shall be nonplastic as determined in accordance with ASTM D4318.

## 2.05 GRANULAR DRAIN MATERIAL

A. Furnish rounded, hard, durable pit run (uncrushed) gravel free of clay balls or other organic or deleterious matter that meets the gradation specified.

B. Gradation: ASTM C117 and ASTM C136.

| Sieve Size | Percent Passing By Weight |
|---|---|
| 1-1/2 inches | 100 |
| 1 inch | 95 - 100 |
| 1/2 inch | 25 - 60 |
| No. 4 | 0 - 10 |
| No. 8 | 0 - 5 |

## 2.06 GRANULAR FILL

A. As specified in Section 31 23 23, Fill and Backfill.

2.07 EARTHFILL

A. As specified in Section 31 23 23, Fill and Backfill.

2.08 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

A. Select and proportion ingredients to obtain compressive strength between 50 psi at 4 days and 150 psi at 28 days in accordance with ASTM D4832.

B. Materials:

1. Cement: ASTM C150, Type I or Type II.
2. Aggregate: ASTM C33, Size 7.
3. Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618, except as modified herein:
   a. ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
   b. Test in accordance with ASTM C1012 to verify sulfate resistance is acceptable.
4. Water: Clean, potable, containing less than 500 ppm of chlorides.

2.09 GRAVEL SURFACING ROCK

A. As specified in Section 32 11 23, Aggregate Base Courses.

2.10 SOURCE QUALITY CONTROL

A. Perform gradation analysis in accordance with ASTM C136 for:

1. Earthfill.
2. Trench stabilization material.
3. Bedding and pipe zone material.

B. Certify Laboratory Performance of Mix Designs: Controlled low strength material.

**PART 3 EXECUTION**

3.01 TRENCH PREPARATION

A. Water Control:

1. Promptly remove and dispose of water entering trench as necessary to grade trench bottom and to compact backfill and install manholes, pipe, conduit, direct-buried cable, or duct bank. Do not place concrete, lay pipe, conduit, direct-buried cable, or duct bank in water.

2. Remove water in a manner that minimizes soil erosion from trench sides and bottom.
3. Provide continuous water control until trench backfill is complete.

B. Remove foreign material and backfill contaminated with foreign material that falls into trench.

3.02 TRENCH BOTTOM

A. Prepare subgrade in accordance with the requirements of Section 31 23 13, Subgrade Preparation.

B. Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for bedding material if shown or specified.

C. Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify Construction Manager. Construction Manager will determine depth of overexcavation, if any required.

3.03 GEOTEXTILE INSTALLATION

A. Where shown and as specified in Section 31 32 19.16, Geotextile, except as follows:

1. Extend geotextile for full width of trench bottom and up the trench wall to the top of the pipe zone, or base material for manholes and miscellaneous structures.
2. Anchor geotextile trench walls prior to placing trench stabilization or bedding material.
3. Provide 24-inch minimum overlap at joints.

3.04 TRENCH STABILIZATION MATERIAL INSTALLATION

A. When, in judgment of Construction Manager, the existing material at the bottom of the trench is unsuitable for supporting the pipe, excavate belowgrade, as directed. Rebuild trench bottom with trench stabilization material.

B. Place material over full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.

C. Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

## 3.05 BEDDING

A. Furnish imported bedding material where, in the opinion of Construction Manager, excavated material is unsuitable for bedding or insufficient in quantity.

B. Place over full width of prepared trench bottom in two equal lifts when required depth exceeds 8 inches.

C. Hand grade and compact each lift to provide a firm, unyielding surface.

D. Minimum Thickness:

1. For sewers, potable water mains, irrigation, recycled water mains, and storm drains, refer to Drawing No. SDS-110, SDW-110, SDI-110, SDRW-101, and SDD-110, respectively, of the City of San Diego Standard Drawings.
2. For other type of pipelines, refer to the following, except increase depths listed by 2 inches in areas of rock excavation:
    a. Pipe 15 Inches and Smaller: 4 inches.
    b. Pipe 18 Inches to 36 Inches: 6 inches.
    c. Pipe 42 Inches and Larger: 8 inches.
    d. Conduit: 3 inches.
    e. Direct-Buried Cable: 3 inches.
    f. Duct Banks: 3 inches.

E. Check grade and correct irregularities in bedding material. Loosen top 1 inch to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe, conduit, direct-buried cable, or duct bank.

F. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.

G. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

## 3.06 BACKFILL PIPE ZONE

A. Upper limit of pipe zone shall not be less than following:

1. Pipe: 12 inches, unless shown otherwise.
2. Conduit: 3 inches, unless shown otherwise.
3. Direct-Buried Cable: 3 inches, unless shown otherwise.
4. Duct Bank: 3 inches, unless shown otherwise.

B. Restrain pipe, conduit, cables, and duct banks as necessary to prevent their movement during backfill operations.

C. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and duct banks installed in same trench.

1. Pipe 10-Inch and Smaller Diameter: First lift less than or equal to 1/2 pipe diameter.
2. Pipe Over 10-Inch Diameter: Maximum 6-inch lifts.

D. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a shovel to ensure voids are completely filled before placing each succeeding lift.

E. Compact pipe zone material to at least 90 percent relative compaction and within 2 percent of the optimum moisture content as determined in accordance with ASTM D1557.

F. Do not use power-driven impact compactors to compact pipe zone material. After full depth of pipe zone material has been placed as specified, compact material by a minimum of three passes with a vibratory plate compactor only over area between sides of pipe and trench walls. Take care to avoid damaging pipe and pipe coating.

## 3.07 MARKING TAPE INSTALLATION

A. Continuously install detectable marking tape along centerline of buried piping on top of last lift of pipe zone material. Coordinate with piping installation drawings.

## 3.08 TRACER WIRE INSTALLATION AND TESTING

A. Install tracer wire continuously along centerline of nonmetallic buried piping.

B. Attach wire to top of pipe using tape at maximum of 10-foot intervals. In areas where depth of cover is excessive for allowing detection of tracer wire with electronic pipe locator, install tracer wire within pipe backfill directly above pipe centerline at a minimum depth of 3 feet.

C. Install splices in accordance with manufacturer’s instructions for direct bury applications. Tie ends of wire to be joined in a knot as required to reduce tension on splice.

D. Bring tracer wire to surface at each valve box, curb box, vault, air valve, blowoff valve, hydrant, and pipeline marker. Tracer wire shall be brought to surface at least every 1,000 feet. If distance between pipe appurtenances exceeds 1,000 feet, install valve box to allow access to tracer wire. Mark valve box cover with the word “TRACER”. Coil enough excess tracer wire at each appurtenance to extend wire 12 inches aboveground.

E. Test continuity of tracer wire using electronic pipe locator in presence of Construction Manager.

## 3.09 BACKFILL ABOVE PIPE ZONE

A. For sewers, potable water mains, irrigation, recycled water mains, and storm drains, refer to Drawing No. SDS-110, SDW-110, SDI-110, SDRW-101, and SDD-110, respectively, of the City of San Diego Standard Drawings, for backfill material and compaction requirement.

B. For other type of pipelines, refer to the following:

1. Use earthfill as specified in Section 31 23 23, Fill and Backfill.
2. Adjust moisture content as necessary to obtain specified compaction.
3. Do not allow backfill to free fall into trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over top of pipe.
4. Do not use power driven impact type compactors for compaction until at least 4 feet of backfill is placed over top of pipe.
5. Backfill to grade with proper allowances for gravel surfacing rock and pavement thicknesses, wherever applicable.
6. Backfill around structures with same type backfill as specified for adjacent trench, unless otherwise shown or specified.

C. Earthfill:

1. Place in lifts not exceeding thickness of 8 inches.
2. For areas outside of structure influence zone or roadway, use earthfill and compact each lift to a minimum of 90 percent relative compaction as determined in accordance with ASTM D1557.

D. Granular Fill:

1. Place in lifts not exceeding thickness of 8 inches.
2. For areas under structure influence zone or roadway, use granular fill and compact each lift to a minimum of 95 percent relative compaction as determined in accordance with ASTM D1557.

E. Controlled Low Strength Material:

1. Discharge from truck mounted drum type mixer into trench.
2. Place in lifts as necessary to prevent uplift (flotation) of new and existing facilities.
3. In traveled areas fill entire trench section to pavement finish grade for a temporary driving surface, and screed off excess and finish with a float.
4. In other areas fill trench section as shown.

3.10 SITE TESTING

A. As specified in Section 31 23 23, Fill and Backfill.

3.11 MAINTENANCE OF TRENCH BACKFILL

A. After each section of trench is backfilled, maintain surface of backfilled trench even with adjacent ground surface until final surface restoration is completed.

B. Gravel Surfacing Rock: Add gravel surfacing rock where applicable and as necessary to keep surface of backfilled trench even with adjacent ground surface, and grade and compact as necessary to keep surface of backfilled trenches smooth, free from ruts and potholes, and suitable for normal traffic flow.

C. Topsoil: Add topsoil where applicable and as necessary to maintain surface of backfilled trench level with adjacent ground surface.

D. Other Areas: Add excavated material where applicable and keep surface of backfilled trench level with adjacent ground surface.

3.12 SETTLEMENT OF BACKFILL

A. Settlement of trench backfill, or of fill, or facilities constructed over trench backfill will be considered a result of defective compaction of trench backfill.

**END OF SECTION**

# SECTION 31 32 19.16
# GEOTEXTILE

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ASTM International (ASTM):
   a. D3786, Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method.
   b. D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
   c. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
   d. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   e. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   f. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
   g. D4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
   h. D4884, Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles.
   i. D5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
   j. D6193, Standard Practice for Stitches and Seams.
   k. D6241, Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile Related Products.

### 1.02 DEFINITIONS

A. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.

B. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile furnished.

C. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile furnished.

D. Nondestructive Sample: Sample representative of finished Work, prepared for testing without destruction of Work.

E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.

F. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D4884.

G. MD: Machine Direction; CD: Cross Machine Direction.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Manufacturer material specifications and product literature.
   b. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.
   c. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.
2. Samples:
   a. Geotextile: One-piece, minimum 18 inches long, taken across full width of roll of each type and weight of geotextile furnished for Project. Label each with brand name and furnish documentation of lot and roll number from which each Sample was obtained.
   b. Field Sewn Seam: 5-foot length of seam, 12 inches wide with seam along center, for each type and weight of geotextile.
   c. Securing Pin and Washer: One each.

B. Informational Submittals:

1. Certifications from each geotextile manufacturer that furnished products have specified property values. Certified property values shall be either minimum or maximum average roll values, as appropriate, for geotextiles furnished.
2. Field seam efficiency test results.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver each roll with sufficient information attached to identify it for inventory and quality control.

B. Handle products in manner that maintains undamaged condition.

C. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

1.05 SCHEDULING AND SEQUENCING

A. Where geotextile is to be laid directly upon ground surface, prepare subgrade as specified in Section 31 23 13, Subgrade Preparation, first.

B. Notify Construction Manager whenever geotextiles are to be placed. Do not place geotextile without Construction Manager's approval of underlying materials.

## PART 2 PRODUCTS

2.01 NONWOVEN GEOTEXTILE

A. Pervious sheet of polyester, polypropylene, or polyethylene fabricated into stable network of fibers that retain their relative position with respect to each other. Nonwoven geotextile shall be composed of continuous or discontinuous (staple) fibers held together through needle-punching, spun-bonding, thermal-bonding, or resin-bonding.

B. Geotextile Edges: Selvaged or otherwise finished to prevent outer material from pulling away from geotextile.

C. Unseamed Sheet Width: Minimum 12 feet.

D. Nominal Weight per Square Yard: 10 ounces per ASTM D5261.

E. Physical Properties: Conform to requirements in Table No. 1.

**Table No. 1**
**Physical Property Requirements for Nonwoven Geotextile**

| Property | Requirement | Test Method |
|---|---|---|
| Water Permittivity | 1.2 $sec.^{-1}$, MinARV | ASTM D4491 (Falling Head) |
| Water Flow Rate | 80 gal/min/sq ft, MinARV | ASTM D4491 |
| Apparent Opening Size (AOS) | 100 U.S. Standard Sieve Size | ASTM D4751 |
| Grab Tensile Strength | 250 lb/in (MD), MinARV | ASTM D4632 |

**Table No. 1**
**Physical Property Requirements for Nonwoven Geotextile**

| Property | Requirement | Test Method |
|---|---|---|
| Grab Tensile Elongation | 50 percent (MD), MaxARV | ASTM D4632 |
| Puncture Strength | 155 lb, MinARV | ASTM D4833 |
| CBR Puncture | 700 lb, MinARV | ASTM D6241 |
| Trapezoid Tear Strength | 100 lb, MinARV | ASTM D4533 |
| Mullen Burst Strength | 500 psi, MinARV | ASTM D3786 |
| Ultraviolet Radiation Resistance | 70 percent strength retention, MinARV after 500 hours | ASTM D4355 |

2.02 SEWING THREAD

A. Polypropylene, polyester, or Kevlar thread.

B. Durability: Equal to or greater than durability of geotextile sewn.

2.03 SECURING PINS

A. Steel Rods or Bars:

1. 3/16-inch diameter.
2. Pointed at one end.
3. With head on other end sufficiently large to retain washer.
4. Minimum Length: 12 inches.

B. Steel Washers for Securing Pins:

1. Outside Diameter: Not less than 1.5 inches.
2. Inside Diameter: 1/4 inch.
3. Thickness: 1/8 inch.

C. Steel Wire Staples:

1. U-shaped.
2. 10-gauge.
3. Minimum Length: 6 inches.

2.04 IMPERMEABLE LINER

A. See Section 213-6 of the 2015 City of San Diego Supplement "Whitebook" Standard Specifications for Public Works Construction.

**PART 3 EXECUTION**

3.01 LAYING GEOTEXTILE

A. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

3.02 SHEET ORIENTATION ON SLOPES

A. Orient geotextile with long dimension of each sheet parallel to direction of slope.

3.03 JOINTS

A. Unseamed Joints:

1. Overlapped.
2. Overlap, unless otherwise shown:
   a. Foundation/Subgrade Stabilization: Minimum 18 inches.
   b. Riprap: Minimum 18 inches.
   c. Drain Trenches: Minimum 18 inches, except overlap shall equal trench width if trench width is less than 18 inches.
   d. Other Applications: Minimum 12 inches.

B. Sewn Seams: Made wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by Construction Manager, also may be used instead of overlap at joints for applications that do not require stress transfer.

1. Seam Efficiency:
   a. Minimum 70 percent.
   b. Verified by preparing and testing minimum of one set of nondestructive Samples per acre of each type and weight of geotextile installed.
   c. Tested according to ASTM D4884.
2. Types:
   a. Preferred: "J" type seams.
   b. Acceptable: Flat or butterfly seams.
3. Stitch Count: Minimum three to maximum seven stitches per inch.
4. Stitch Type: Double-thread chainstitch according to ASTM D6193.
5. Sewing Machines: Capable of penetrating four layers of geotextile.

6. Stitch Location: 2 inches from geotextile sheet edges, or more, if necessary to develop required seam strength.

## 3.04 SECURING GEOTEXTILE

A. Secure geotextile during installation as necessary with sandbags or other means approved by Construction Manager.

B. Secure Geotextile with Securing Pins or Staples:

1. Insert securing pins with washers through geotextile.
2. Securing Pin Alignment:
   a. Midway between edges of overlaps.
   b. 6 inches from free edges.
3. Spacing of Securing Pins:

| Slope | Maximum Pin Spacing |
|---|---|
| Steeper than 3:1 | 2 feet |
| 3:1 to 4:1 | 3 feet |
| Flatter than 4:1 | 5 feet |

4. Install additional pins across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.
5. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.
6. Where staples are used instead of securing pins, install in accordance with alignment and spacing above. Push in to secure geotextile firmly to subgrade.

## 3.05 PLACING PRODUCTS OVER GEOTEXTILE

A. Before placing material over geotextile, notify Construction Manager. Do not cover installed geotextile until after Construction Manager provides authorization to proceed.

B. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as specified in Article Repairing Geotextile.

## 3.06 INSTALLING GEOTEXTILE IN TRENCHES

A. Place geotextile in a way to completely envelope granular drain material to be placed in trench and with specified overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.

B. After granular drain material is placed to required grade, fold geotextile over top of granular drain material, unless otherwise shown. Maintain overlap until overlying fill or backfill is placed.

## 3.07 RIPRAP APPLICATIONS

A. Overlap geotextile at each joint with upstream sheet of geotextile overlapping downstream sheet.

B. Sew joints where water run-up may occur.

C. Limit height of riprap fall onto geotextile to prevent damage.

1. Drop Height: 0 foot for greater than 200-pound rock. 3 feet for less than 200-pound rock.

## 3.08 GEOTEXTILE-REINFORCED EARTH WALL APPLICATIONS

A. Sew exposed joints; extend sewn seams minimum 3 feet behind face of wall.

B. Protect exposed geotextile from damage, ultraviolet light exposure, and deterioration until permanent facing is applied.

## 3.09 SILT FENCE APPLICATIONS

A. Install geotextile in one piece, or continuously sewn to make one piece, for full length and height of fence, including portion of geotextile buried in toe trench.

B. Install bottom edge of sheet in toe trench and backfill in a way that securely anchors geotextile in trench.

C. Securely fasten geotextile to each support post in a way that will not result in tearing of geotextile when fence is subjected to service loads.

D. Promptly repair or replace silt fence that becomes damaged.

## 3.10 REPAIRING GEOTEXTILE

A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile.

B. Repair Procedure:

1. Place patch of undamaged geotextile over damaged area and at least 18 inches in all directions beyond damaged area.
2. Remove interfering material as necessary to expose damaged geotextile for repair.
3. Sew patches or secure them with heat fusion tacking or with pins and washers, as specified above in Article Securing Geotextile, or by other means approved by Construction Manager.

## 3.11 REPLACING CONTAMINATED GEOTEXTILE

A. Protect geotextile from contamination that would interfere, in Construction Manager's opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

**END OF SECTION**

# SECTION 31 41 00
# SHORING

## PART 1 GENERAL

### 1.01 SUBMITTALS

A. Informational Submittals:

1. Qualifications of:
   a. Contractor's excavation support system designer.
   b. Contractor's excavation support system installer.
2. Excavation support plan.
3. Movement monitoring plan.
4. Trench excavation plan.
5. Movement measurement and data and reduced results indicating movement trends.

### 1.02 QUALITY ASSURANCE

A. Provide surveys to monitor movements of critical structures and facilities located within 100 feet of excavation.

B. Conform to the requirements of the Cal OSHA Standards and Interpretations: "Subchapter 4, Construction Safety Orders, Article 6 - Excavations" and all other applicable laws, regulations, rules, and codes.

C. Prepare design, including calculations and drawings, under the direction of a Professional Engineer registered in the State of California and having the following qualifications:

1. Provide a list of projects and references in the design of specific temporary excavation support systems to be used.
2. Completed not less than five successful temporary excavation support system projects of equal type, size, and complexity within the last 5 years.

D. Temporary Excavation Support System Installer's Qualifications:

1. Provide a list of projects and references in the installation of similar types and equal complexity as the proposed system.
2. Completed not less than three successful excavation support systems of similar type and equal complexity as the proposed system.

E. Install all temporary excavation support systems under the supervision of a supervisor having the following qualifications:

1. Provide a list of projects and references in installation of systems of similar type and equal complexity as the proposed system.
2. Completed at least five successful temporary excavation support systems of similar type and equal complexity as the proposed system.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 GENERAL

A. Design, provide, and maintain shoring, sheeting, and bracing as necessary to support the sides of excavations and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

B. Shoring system shall provide suitable room for installing pipe, structures, and appurtenances.

### 3.02 EXCAVATION SUPPORT PLAN AND TRENCH EXCAVATION PLAN

A. Prepare and submit an excavation support plan and a trench excavation plan signed and sealed by a Professional Engineer registered in the State of California, for information only. The Contractor shall remain responsible for the adequacy and safety of the means, methods, and sequencing of construction. The plans shall include and address the following topics as a minimum:

1. Proposed excavation support systems, details of shoring, bracing, sloping, layout, depths, extent of different types of support relative to existing features and the permanent structures to be constructed and other provisions for worker protection from hazards of caving ground.
2. Design assumptions and calculations.
3. Methods and sequencing of installing excavation support.
4. Proposed locations of stockpiled excavated material.
5. Minimum lateral distance from the edge of the excavation support systems or the crest of slopes for vehicles, construction equipment, and stockpiled excavated materials.
6. List of equipment used for installing the excavation support systems.
7. Anticipated difficulties and proposed resolutions.

3.03 MOVEMENT MONITORING PLAN

A. Prepare movement monitoring plan addressing following topics:

1. Survey control.
2. Location of monitoring points.
3. Plots of data trends.
4. Interval between surveys.

3.04 INSTALLATION

A. Installation of excavation support systems shall not commence until the related submittals have been reviewed by the Design Engineer, and all comments are satisfactorily addressed.

B. Install excavation support systems in accordance with the excavation support plan and the trench excavation plan.

C. Carry out program of temporary excavation support in such a manner as to prevent undermining or disturbing foundations of existing structures of work ongoing or previously completed.

3.05 REMOVAL OF EXCAVATION SUPPORT

A. Remove excavation support in a manner that will maintain support as excavation is backfilled.

B. Do not begin to remove excavation support until support can be removed without damage to existing facilities, completed Work, or adjacent property.

C. Remove excavation support in a manner that does not leave voids in the backfill.

3.06 TRENCHES

A. For trench excavation exceeding 5 feet in depth, provide adequate safety system meeting requirements of California Labor Code Section 6707, applicable local construction safety orders, and federal requirements.

**END OF SECTION**

# SECTION 31 63 29
# DRILLED CONCRETE PIERS AND SHAFTS

## PART 1 GENERAL

### 1.01 DEFINITIONS

A. The words and terms used in these Specifications conform with the definitions given in ACI 336.1.

B. The terms drilled pier, drilled shaft, and cast in drilled hole (CIDH) piles, are used interchangeably.

C. Bearing Stratum: Formations or layers of soil or rock that support shaft and loads imposed on it.

D. Casing: Protective steel casing usually of cylindrical shape, lowered into excavated shaft to prevent collapse or cave-in of sidewalls and for purpose of excluding soil and water from excavation.

E. Design Position: The location of the centroid of the shaft at cutoff elevation (x, y, and z coordinates) as shown.

F. Deviation: Difference between actual as-constructed horizontal location of center of shaft from required location.

G. Drilling Slurry: A mixture of water and mineral such as bentonite in suspension used with or without casing to stabilize excavated shaft until casing has been installed or concrete has been placed.

H. Plumbness: Difference in horizontal location of center of shaft measured at top and at bottom.

### 1.02 REFERENCES

A. ADSC: Association of Drilled Shaft Contractors; Standards and Specifications for the Foundation Drilling Industry.

B. American Concrete Institute (ACI): 336.1, Reference Specification for the Construction of Drilled Piers.

C. American Society for Testing and Materials (ASTM): D1143, Method of Testing Piles Under Static Axial Compressive Load.

## 1.03 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, for Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Concrete Reinforcement: Provide submittals in accordance with the requirements of Section 03 30 10, Structural Reinforced Concrete.

C. Qualifications of Welders and Welding Procedures: Provide submittals in accordance with requirements of Section 03 30 10, Structural Reinforced Concrete, for reinforcing steel, and with requirements of Section 05 05 23, Welding, for casing steel.

D. Qualifications of Installer: Past successful experience on ten projects of drilled concrete shaft installation.

E. Portland Cement Concrete: Provide submittals in accordance with the requirements of Section 03 30 10, Structural Reinforced Concrete. Include submittal for tremie concrete equipment and placement method.

F. Drilling Equipment: Submit description of equipment including but not limited to power rating, torque, downward thrust, and type and size of drilling tools to be used.

G. Records and Reports: Submit daily reports and shaft record reports or logs as required by ADSC's Standards and Specifications, using ADSC formats for forms.

## 1.04 QUALITY ASSURANCE

A. Construction Standards: Drilled shaft foundations shall be constructed in accordance with applicable requirements of ACI 336.1 and ADSC's Standards and Specifications for the Foundation Drilling Industry.

B. Design Criteria:

1. Drilled shaft foundations shall consist of monolithically cast-in-place concrete piles of the sizes indicated.
2. Shaft foundations shall be straight cylindrical shaft type as indicated.
3. Shaft foundations shall extend from the indicated concrete cutoff elevation to the indicated tip elevation.

C. Tolerances:

1. Maximum variation of the center of any shaft foundation from the required location: 3 inches, measured at the ground surface.
2. Bottom Diameter: Minus zero, plus 6 inches, measured in any direction.
3. Maximum Variation from Plumb: 1:40.
4. Maximum Bottom Level Tolerance: Plus or minus 2 inches.

D. Inspection of Shaft Excavations:

1. The Contractor shall provide equipment for checking the dimensions and alignment of each shaft excavation. Dimensions and alignment shall be determined jointly by the Contractor and the Construction Manager. Final shaft depths shall be measured with an appropriate weighted tape measure or other approved method after final cleaning.
2. The base of each shaft shall have less than 1/2 inch of sediment at the time of placement of concrete. Shaft cleanliness will be determined by the Construction Manager by visual inspection.
3. If visual inspection requires downhole inspection, the Contractor shall provide a secure cage and crane system to lower the properly trained Inspector down the hole supported by temporary casing. Downhole inspection shall be limited to no more than 10 percent of the drilled shafts and shall be selected from the initial boreholes.

1.05 SEQUENCING AND SCHEDULING

A. Complete earthwork in vicinity of shafts to top elevation of drilled shafts prior to commencing shaft drilling.

B. Unless otherwise permitted by the Construction Manager, the Contractor shall schedule drilling or excavating, installation of reinforcing steel, and concrete placement so that each excavated shaft is poured the same day that the drilling is performed.

C. Do not permit vibration or excessive wheel loads within the immediate vicinity of any shaft excavation until placement of concrete is complete. Maintain excavation stability at all times.

## PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete Reinforcement: Conform with applicable requirements of Section 03 30 10, Structural Reinforced Concrete, of grades and sizes indicated.

B. Concrete: Conform with applicable requirements of Section 03 30 10, Structural Reinforced Concrete. Provide class of concrete indicated on Contract Drawings.

1. Prepare separate mix designs for each class of concrete.
2. Slump for Concrete: Slump shall be 5 inches plus or minus 1-inch for dry shafts without temporary casing, and 7 inches plus or minus 1-inch for dry shafts with temporary casing.

C. Bentonite Slurry:

1. Mix design by Contractor with the following minimum requirements:
   a. Viscosity (Measured by March Funnel, Seconds): 30 to 60.
   b. Sand Content by Volume (Percent): 6, maximum.
   c. pH: 8 to 12.
   d. Density: Not less than that required to maintain positive head within excavation and prevent sidewall sloughing and such to allow proper displacement during concreting.
   e. Slurry shall be desanded and/or recirculated prior to and continuously during placement of concrete. The slurry shall become the property of the contractor and shall be disposed of properly.

D. Steel Casing:

1. Where earth wall of drilled shaft is unstable or has a tendency to slough, crumble, or fall away, provide temporary steel casing to stabilize the shaft wall.
2. Inside diameter of the casing shall be the full diameter of the drilled shaft foundation as indicated, plus or minus 1/2 inch.
3. Steel casing shall have adequate strength to withstand the pressure of concrete placement without distortion.
4. Inside surfaces of steel casing shall be smooth and coated to facilitate easy lifting and removal during placement of concrete.
5. Steel casing is not permitted to leave in place.

## 2.02 EXCAVATING AND DRILLING EQUIPMENT

A. Excavating and drilling equipment shall have adequate capacity, including power, torque, and down thrust to excavate a hole of the maximum diameter and to a depth of 20 percent beyond the depth indicated. Excavation and over reaming tools shall be of adequate design, size, and strength to perform the work indicated.

B. When the material encountered cannot be drilled using conventional earth augers or over reaming tools, special drilling equipment shall be provided, including rock core barrels, rock tools, air tools, and other equipment as necessary to construct the shaft excavation to the size and depth indicated.

## PART 3 EXECUTION

### 3.01 METHOD TEST SHAFTS

A. The Contractor shall demonstrate the adequacy of the methods and equipment to be employed for excavating shafts by successfully constructing method test shafts. A minimum of one test shaft shall be constructed. The method test shafts shall include drilling, reinforcing steel, thread bars, and concrete placement.

B. Method test shafts shall be positioned away from the drilled shafts in the location indicated or where approved by the Construction Manager in writing. Method test shafts shall be drilled to the maximum depth of any drilled shaft indicated.

C. Failure to demonstrate the adequacy of methods and equipment shall be sufficient reason for the Construction Manager to require alterations in equipment and methods by the Contractor to eliminate unsatisfactory results.

D. Once approval has been given to construct drilled shafts, no change will be permitted in the methods or equipment used to construct the satisfactory method test shaft without the written approval of the Construction Manager.

### 3.02 LOAD TESTS

A. Requirements:

1. The Contractor shall perform compression load tests as required to determine whether the shafts can carry and withstand the imposed loads. Tests shall be performed on the method test shafts. Except for shafts required for testing, additional shaft construction will not be permitted until the load tests are completed.
2. The Contractor shall provide all equipment and apparatus as required to conduct the tests.
3. The Contractor shall install, remove, relocate, and reinstall weights and components as necessary to perform and complete the tests.
4. Tests can be conducted as soon as practicable after the concrete in each drilled shaft has attained the specified 28-day compressive strength, but not until at least 10 days have elapsed after placing the concrete.

B. Compression Load Tests: Tests shall be performed in accordance with ASTM D1143. Method of load test shall follow Quick Load Test Method for Individual Piles as specified in ASTM D1143, Section 5.6. The maximum test load shall be at least twice the design load as prescribed by the Design Engineer. Apply the load in increments equal to 10 percent of the maximum test load, with a constant time interval between increments of 5 minutes. Maintain the maximum test load for not less than 15 minutes, unless the shaft has failed as determined by the Design Engineer. Remove the test load in increments equal to 25 percent of the maximum test load, with a constant time interval between increments of 5 minutes.

## 3.03 EXCAVATION

A. General:

1. Excavate for shaft foundations by drilling or by other methods, as approved by method test shafts, to advance the excavation to the required bottom elevation. Avoid overexcavation. Excavation shall be performed through whatever materials are encountered to the dimensions, depths, and tolerances indicated. Bottoms of excavations shall be level and flat.
2. When required by the Construction Manager, drill and core an exploratory hole, approximately 3 inches to 4 inches in diameter, to a depth of 15 feet below the excavation invert and backfill with grout. The total number of the exploratory drilling and coring, if required by the Construction Manager, shall be limited to no more than 5 percent of the drilled shafts.
3. Protect excavated walls with temporary steel casing as necessary to prevent cave-ins, displacement of the surrounding earth, water incursion, injury to personnel, and damage from construction operations. Maintain indicated neat lines of excavation for cased areas.
4. Make bottom surfaces level within the tolerances specified herein. Remove loose material, debris, and muck with cleaning buckets.

B. Ground Water Control:

1. Notify the Construction Manager immediately when ground water is encountered.
2. Suitable steel casings shall be furnished and placed when necessary to control water. Drilling mud or chemical stabilizers shall not be used unless permitted by the Construction Manager.

C. Inspection: After completion of excavation and prior to placement of reinforcing steel, the condition of the excavation will be inspected by the Construction Manager. Use clean-out buckets or air-lifts to remove any sloughage or other loose material from the shaft prior to placing reinforcing steel and concrete. An accumulation of soil or rock in the bottom of the excavation will not be permitted.

3.04 INSTALLATION OF CONCRETE REINFORCEMENT

A. Where it is not practicable to deliver the cage assembly to the Job Site as a complete unit ready for installation, make the remaining connections or splices, as indicated on the approved Shop Drawings, at-grade prior to lowering the assembly into the hole.

B. Lower reinforcing steel into the hole in such a manner as to prevent damage to the walls, and place and tie or clip symmetrically about the axis of the shaft. Use centering devices, securely attached to the cage, to clear the shaft walls and to maintain the cage in place throughout the concrete placement.

C. All reinforcement shall be placed and secured prior to concrete placement.

3.05 CONCRETE PLACEMENT

A. Place concrete in dry excavations whenever practicable. Use all practicable means to obtain a dry excavation before and during concrete placement.

B. If slurry installation method is used, cross-hole sonic logging (CSL) tubes and testing shall be included to inspect the structural integrity of each drilled shaft installed.

C. Place concrete continuously in one pour to top elevation using a hopper with a spout that directs concrete down middle of shaft. Extend rigid tremie pipe spout from hopper to beyond bottom of reinforcement steel cage to direct concrete down shaft center to prevent concrete from hitting sides of excavation.

D. Adjust rigid pipe spout length as shaft is being filled such that maximum drop from bottom of rigid pipe to fresh concrete surface is no greater than 10 feet.

E. Vibrate concrete within top 10 feet of drilled shafts with mechanical tools as specified in Section 03 30 10, Structural Reinforced Concrete.

F. Excess Concrete: Remove accumulation at top of shaft so shaft has a uniform diameter throughout.

G. After concrete has attained an initial set as evidenced by absence of bleed water, place a suitable cover that prevents drying of top or contamination with foreign material. A curing compound may be used.

3.06 WITHDRAWAL OF TEMPORARY STEEL CASING

A. Where temporary steel casings are used to support the excavation walls, withdraw the casing as the concrete is being placed, unless otherwise indicated or unless the Construction Manager requires that the casing be permanently grouted in place. Remove the steel casing in such a manner so that the lower edge of the steel liner will always remain a minimum of 5 feet below the surface of the concrete as placed to prevent water from entering the casing from the bottom. Vibrate concrete during withdrawal of the steel casing.

3.07 FIELD QUALITY CONTROL

A. Do not start reinforcing steel or concrete placement until shaft excavation has been successfully inspected and accepted by Construction Manager.

B. Inspections and Tests: The Contractor shall perform inspections and tests of concrete as specified in Section 03 30 10, Structural Reinforced Concrete.

C. CSL Testing: for shafts installed using slurry installation method, a minimum four preformed access tubes shall be installed within a shaft, and CSL tests on all possible tube pairings or profiles (a total of six) shall be performed for each shaft by a certified professional testing company in accordance with FHWA GEC 10 Drilled Shafts Manual. A CSL testing report shall be submitted to the Design Engineer for review and approval.

D. Records and Reports: Keep a record, on an approved form, for each drilled shaft foundation installed. Record on the form the location, dimensions, elevations of top and bottom, depth of stratum penetration, condition of bottom of excavation, concrete placement data, a continuous record of actual concrete volume placed versus theoretical volume, and any other data called for on the approved report form or pertinent to the foundation.

**END OF SECTION**

# SECTION 32 11 23
# AGGREGATE BASE COURSES

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. T11, Standard Method of Test for Materials Finer Than 75µm (No. 200) Sieve in Mineral Aggregates by Washing.
   b. T27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates.
   c. T89, Standard Specification for Determining the Liquid Limit of Soils.
   d. T90, Standard Specification for Determining the Plastic Limit and Plasticity Index of Soils.
   e. T96, Standard Specification for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   f. T99, Standard Specification for the Moisture-Density Relations of Soils Using a 2.5 kg (5.5 pound) Rammer and a 305 mm (12 in) Drop.
   g. T180, Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18-in) Drop.
   h. T190, Standard Specification for Resistance R-Value and Expansion Pressure of Compacted Soils.
   i. T265, Standard Method of Test for Laboratory Determination of Moisture Content of Soils.
   j. T310, Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
2. ASTM International (ASTM):
   a. C88, Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
   b. D1883, Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
   c. D2419, Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
   d. D4791, Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

3. The 2015 “Greenbook” Standard Specifications for Public Works Construction.
4. The 2015 City of San Diego “Whitebook” Standard Specifications for Public Works Construction.

1.02 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross-section.

B. Completed Lift: Compacted with uniform cross-section thickness.

C. Standard Specifications: When referenced in this section, shall mean 2015 “Greenbook” Standard Specifications for Public Works Construction.

1.03 SUBMITTALS

A. Action Submittals:

1. Samples:
   a. Submit for Specified Materials: 20 days prior to delivery to Site.

B. Informational Submittals: See Section 2-5 of the 2015 “Greenbook” Standard Specifications for Public Works Construction and 2-5.3 of the City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

**PART 2 PRODUCTS**

2.01 BASE COURSE

A. As specified in Section 200 of the Standard Specifications and Section 200-2.9 of the 2015 City of San Diego Supplemental “Whitebook” Standard Specifications for Public Works Construction.

2.02 SOURCE QUALITY CONTROL

A. See Section 200-2 of the 2015 “Greenbook” Standard Specifications for Public Works Construction and Section 200-2.9.3 of the City of San Diego 2015 Supplement “Whitebook” Standard Specification for Public Works Construction for quality requirement tests.

**PART 3 EXECUTION**

3.01 SUBGRADE PREPARATION

A. As specified in Section 31 23 13, Subgrade Preparation.

3.02 EQUIPMENT

A. Compaction Equipment: Adequate in design and number to provide compaction and to obtain specified density for each layer as required by Section 301-1 of the Standard Specifications and Section 301 of the 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

3.03 HAULING AND SPREADING

A. In accordance with Section 301-2 of the Standard Specifications.

3.04 CONSTRUCTION OF COURSES

A. Construction of Courses: In accordance with Section 301 of the Standard Specifications and Section 301 of the 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

3.05 ROLLING AND COMPACTION

A. Subgrade and base material shall be compacted per Section 301-1 and Section 301-2 of the Standard Specifications and Section 301-1.3 of the 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

3.06 SURFACE TOLERANCES

A. See Section 301-2 of the Standard Specifications for compaction and surface tolerance of aggregate base.

3.07 CLEANING

A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate.

**END OF SECTION**

# SECTION 32 12 16
# ASPHALT PAVING

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. M17, Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
   b. M81, Standard Specification for Cut-Back Asphalt (Rapid Curing Type).
   c. M82, Standard Specification for Cut-Back Asphalt (Medium Curing Type).
   d. M140, Standard Specification for Emulsified Asphalt.
   e. M208, Standard Specification for Cationic Emulsified Asphalt.
   f. T166, Standard Method of Test for Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens.
   g. T176, Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test.
   h. T230, Standard Method of Test for Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures.
   i. T245, Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
   j. T246, Standard Method of Test for Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus.
   k. T247, Standard Method of Test for Preparation of Test Specimens of Bituminous Mixtures by Means of California Kneading Compactor.
   l. T283, Standard Method of Test for Resistance of Compacted Bituminous Mixture to Moisture Induced Damage.
   m. T304, Standard Method of Test for Uncompacted Void Content of Fine Aggregate (Method A).
2. Asphalt Institute (AI):
   a. Manual Series No. 2 (MS-2), Mix Design Methods for Asphalt Concrete.
   b. Superpave Series No. 2 (SP-2), Superpave Mix Design.
3. ASTM International (ASTM):
   a. D2041, Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.

b. D4318, Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
c. D4791, Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
d. D5821, Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.
e. E329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

4. 2015 "Greenbook" Standard Specifications for Public Works Construction.
5. 2015 City of San Diego Supplement "Whitebook" Standard Specifications for Public Works Construction.

1.02 DEFINITIONS

A. Combined Aggregate: All mineral constituents of asphalt concrete mix, including mineral filler and separately sized aggregates.

B. RAP: Reclaimed asphalt pavement.

C. Standard Specifications: 2015 "Greenbook" Standard Specifications for Public Works Construction and 2015 City of San Diego Supplement "Whitebook" Standard Specifications for Public Works Construction.

1.03 SUBMITTALS

A. Informational Submittals: See Section 2-5 of the Standard Specifications and Section 203-6.3.1 of the City of San Diego Supplement Standard Specifications.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Temperature: Do not apply asphalt materials or place asphalt mixes when ground temperature is lower than 10 degrees C (50 degrees F) or air temperature is lower than 4 degrees C (40 degrees F). Measure ground and air temperature in shaded areas away from heat sources or wet surfaces.

B. Moisture: Do not apply asphalt materials or place asphalt mixes when application surface is wet.

**PART 2 PRODUCTS**

2.01 MATERIALS

A. Tack Coat: Emulsified asphalt, conform to Section 302-5.4 of the Standard Specifications.

B. Sand (Blotter Material): As specified in Section 200-1.5.5 of the Standard Specifications.

2.02 ASPHALT CONCRETE MIX

A. See Section 203-6 of the Standard Specifications.

**PART 3 EXECUTION**

3.01 GENERAL

A. Traffic Control:

1. In accordance with Section 01 50 00, Temporary Facilities and Controls.
2. Minimize inconvenience to traffic, but keep vehicles off freshly treated or paved surfaces to avoid pickup and tracking of asphalt.

B. Driveways: Repave driveways from which pavement was removed. Leave driveways in as good or better condition than before start of construction.

3.02 LINE AND GRADE

A. Provide and maintain intermediate control of line and grade, independent of underlying base, to meet finish surface grades and minimum thickness.

B. Shoulders: Construct to line, grade, and cross-section shown.

3.03 PREPARATION

A. Prepare subgrade as specified in Section 301-1 of the Standard Specifications.

B. Existing Roadway: Cold milling of existing pavement in accordance with Section 302-1 of the Standard Specifications.

C. Thoroughly coat edges of contact surfaces (curbs, manhole frames) with emulsified asphalt or asphalt cement prior to laying new pavement. Prevent staining of adjacent surfaces.

3.04 PAVEMENT APPLICATION

A. General: Place asphalt concrete mixture on approved, prepared base in conformance with Section 302-5 of the Standard Specifications.

B. Compaction: See Section 302-5 of the Standard Specifications.

C. Tolerances:

1. General: Conduct measurements for conformity with crown and grade immediately after initial compression. Correct variations immediately by removal or addition of materials and by continuous rolling.
2. Completed Surface or Wearing Layer Smoothness see Section 302-5 of Standard Specifications.
3. Transverse Slope Maximum Deviation: 6.4 millimeters (1/4 inch) in 3 meters (10 feet) from rate of slope shown.
4. Finished Grade:
   a. Perform field differential level survey on maximum 15-meter (50-foot) meter grid and along grade breaks.
   b. Maximum Deviation: 6 millimeters (0.02 foot) from grade shown.

D. Seal coat in accordance of with Section 302-5 of the Standard Specifications.

3.05 PAVEMENT OVERLAY

A. For Cold Milling of Existing Pavement see Section 302-1 of the Standard Specifications.

B. Application: See Section 302-5 of the Standard Specifications.

3.06 PATCHING

A. See Section 302-3 of the 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

**END OF SECTION**

# SECTION 32 13 13
# CONCRETE PAVING

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. M6, Standard Specification for Fine Aggregate for Portland Cement Concrete.
   b. M80, Standard Specification for Coarse Aggregate for Portland Cement Concrete.
   c. M153, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
   d. M157, Standard Specification for Ready-Mixed Concrete.
   e. M213, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   f. M227/M227M, Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
2. American Concrete Institute (ACI):
   a. 305R, Hot Weather Concreting.
   b. 306R, Cold Weather Concreting.
   c. 308, Standard Practice for Curing Concrete.
   d. 318/318R, Building Code Requirements for Structural Concrete and Commentary.
   e. 325.9R, Guide for Construction of Concrete Pavements and Concrete Bases.
3. ASTM International (ASTM):
   a. A615/A615M, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   b. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   c. C33, Specification for Concrete Aggregates.
   d. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   e. C42/C42M, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   f. C78, Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).

g. C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
h. C94/C94M, Standard Specification for Ready-Mixed Concrete.
i. C143/C143M, Standard Test Method for Slump of Hydraulic Cement Concrete.
j. C150, Specification for Portland Cement.
k. C172, Standard Practice for Sampling Freshly Mixed Concrete.
l. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
m. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
n. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
o. C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
p. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
q. C803/C803M, Test Method for Penetration Resistance of Hardened Concrete.
r. C805, Test Method for Rebound Number of Hardened Concrete.
s. C1330, Specification for Cylindrical Seal Backing for Use With Cold Liquid Applied Sealants.
t. D920, Standard Specification for Elastomeric Joint Seals.
u. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
v. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
w. D1752, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
x. D2628, Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete.
y. D2828, Specification for Non-Bituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type.
z. D3406, Specification for Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements.
aa. D3569, Specification for Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant Type for Portland Cement Concrete Pavements.
bb. D3581, Specification for Joint Sealant, Hot-Applied, Jet-Fuel-Resistant-Type, for Portland Cement and Tar-Concrete Pavements.

cc. D5249, Specification for Backer Material for Use With Cold- and Hot-Applied Joint Sealants in Portland Cement Concrete and Asphalt Joints.
dd. D5893, Specification for Cold-Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
ee. E329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

4. National Ready Mixed Concrete Association (NRMCA).
5. 2015 “Greenbook” Standard Specifications for Public Works Construction.
6. 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

## 1.02 DEFINITIONS

A. Standard Specification: 2015 “Greenbook” Standard Specifications for Public Works Construction and 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

## 1.03 SUBMITTALS

A. Action Submittals:

1. Product Data: Admixtures.
2. Design Data:
   a. Concrete mix design signed by concrete mix designer.
   b. Minimum Information:
      1) Name of ready-mix plant.
      2) Project.
      3) Engineer.
      4) Contractor.
      5) Mix design number.
      6) Specified concrete strength.
      7) Water-cement-fly ash ratio.
      8) Maximum aggregate size.
      9) Cement content.
      10) Fly ash content.
      11) Water content.
      12) Type, name, and amount of admixtures.
      13) Unit weight.
      14) Slump.
      15) Ingredient proportions corrected for average moisture content for particular times of year.
3. Jointing Drawings: Identify location and spacing of each type of joint.

4. Gradation for coarse and fine aggregates, and combined gradation. List percent passing each sieve size.
5. Detailed plan for cold weather placements, including curing and protection.
6. Detailed plans for hot weather placements, including curing and protection.

B. Informational Submittals shall be in accordance with Section 2-5 of the Standard Specifications.

C. Hot Weather Concreting: Conform to ACI 305R.

D. Cold Weather Concreting: Conform to ACI 306R.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Transporting of ready-mix concrete shall be in accordance with Section 201-4 of the Standard Specifications.

## PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement shall be in accordance with Section 201-1 of the Standard Specifications.

B. Aggregates shall be in accordance with Section 200-1 of the Standard Specifications.

1. Fine Aggregates shall be in accordance with Section 200-1.5 of the Standard Specifications.
2. Coarse Aggregate shall be in accordance with Section 200-1.4 of Standard Specifications.

C. Physical Properties: In accordance with Section 201-1 of the Standard Specifications.

D. Water shall be in accordance with Section 201-1 of the Standard Specifications.

E. Admixtures shall be in accordance with Section 201-1 of the Standard Specifications.

2.02 ANCILLARY MATERIALS

A. Reinforcement for Concrete in accordance with Section 201-2 of the Standard Specifications.

B. Joint Filler in accordance with Section 201-3 of the Standard Specifications.

C. Joint Sealant in accordance with Section 201-3 of the Standard Specifications.

D. Backer Rod:

1. Backer material conforming to ASTM D5249.
2. Cylindrical sealant backing conforming to ASTM C1330.

E. Curing Compound shall be in accordance with Section 201-4 of the Standard Specifications.

F. Curing Membranes shall be in accordance with Section 201-4 of the Standard Specifications.

G. Evaporation Retardant:

1. Confilm as manufactured by:
   a. Master Builders Company.
   b. Or approved equal.

2.03 EQUIPMENT

A. Ready-Mix Concrete Batch Plants: Certified by NRMCA.

B. Batch Plants: Conform to requirements of Section 201-1.4 of the Standard Specifications.

C. Ready-Mix Concrete Trucks: As specified in Section 201-1.4 of the Standard Specifications.

D. Hauling Equipment: As specified in Section 201-1.5 of the Standard Specifications.

E. Paving Equipment: As specified in Section 302-6 of the Standard Specifications.

2.04 CONCRETE MIX DESIGN

A. Shall be in accordance with Section 201-1 of the Standard Specifications.

B. If Contractor proposes to use a current mix design that meets these Specifications, has been used on previous City of San Diego projects, and less than 1 year has elapsed since it was last used; Contractor shall submit documentation of production of concrete produced from that mix design to Design Engineer for review. If review verifies concrete produced meets these Specifications and strength requirements, and establishes a correlation between compressive strength and flexural strength, no trial batches for proposed mix design will be required.

## PART 3 EXECUTION

3.01 WEATHER LIMITATIONS

A. Concrete placement shall be in accordance with Section 302-6 of the Standard Specifications.

3.02 PREPARATION

A. Prepare base as specified in Sections 301-1 and 301-2 of the Standard Specifications.

3.03 FORMS AND HEADERS

A. Shall be in accordance with Section 302-6 of the Standard Specifications.

3.04 JOINTS

A. Joints shall be installed in accordance with Section 302-6.5 of the Standard Specifications.

3.05 SURFACE FINISHING

A. Shall be in accordance with Section 302-6 of the Standard Specifications.

3.06 CURING OF PORTLAND CEMENT CONCRETE

A. Shall be in accordance with Section 302-6 of the Standard Specifications.

3.07 CLEANING

A. Clean concrete splatter from exposed surfaces.

B. Thoroughly broom and wash concrete surfaces before opening to traffic.

3.08 PROTECTION OF CONCRETE

A. Shall be in accordance with Section 302-6 of the Standard Specifications.

**END OF SECTION**

# SECTION 32 16 00
# CURBS, GUTTERS, AND SIDEWALKS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): T 99, Standard Specification for the Moisture-Density Relations of Soils Using a 2.5 kg (5.5 pound) Rammer and a 305 mm (12 in.) Drop.
2. American Concrete Institute (ACI): 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
3. ASTM International (ASTM):
   a. C94, Standard Specification for Ready-Mixed Concrete.
   b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   c. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
4. Standard Specification: 2015 “Greenbook” Standard Specifications for Public Works Construction and 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

### 1.02 SUBMITTALS

A. Action Submittals:

1. Form Material: Information on metal forms, if used, including type, condition, surface finish, and intended function.
2. Complete data on concrete mix, including aggregate gradations and admixtures in accordance with requirements of ASTM C94.

B. Informational Submittals: See Section 2-5 of the 2015 “Greenbook” Standard Specifications for Public Works Construction and Section 2-5.3 of the City of San Diego “Whitebook” Standard Specifications for Public Works Construction.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Material to conform to Section 201-1 of the 2015 “Greenbook” Standard Specifications for Public Works Construction and Section 201 of the 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction. Installation methods to conform to Section 303-5 of the 2015 “Greenbook” Standard Specifications for Public Works Construction and Section 303-5 of the City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

**PART 2 PRODUCTS**

2.01 MATERIALS

A. See Section 201-1 Portland Cement Concrete of 2015 “Greenbook” Standard Specifications for Public Works Construction and 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

2.02 EXPANSION JOINT FILLER

A. See Section 303-5.4 of the 2015 “Greenbook” Standard Specifications for Public Works Construction.

2.03 CONCRETE

A. See Section 201-1 Portland Cement Concrete of 2015 “Greenbook” Standard Specifications for Public Works Construction and 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

2.04 CURING COMPOUND

A. See Section 201-4 of 2015 “Greenbook” Standard Specifications for Public Works Construction.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. See Section 303-5 of the 2015 “Greenbook” Standard Specifications for Public Works Construction.

3.02 PLACING CONCRETE

A. See Section 303-5 of the 2015 “Greenbook” Standard Specifications for Public Works Construction.

3.03 CURB AND GUTTER CONSTRUCTION

A. See Section 303-5 of the 2015 “Greenbook” Standard Specifications of Public Works Construction, and 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction. Cleanup and Backfill per Section 303-5 of the 2015 “Greenbook” Standard Specifications for Public Works Construction.

**END OF SECTION**

# SECTION 33 05 01
# CONVEYANCE PIPING—GENERAL

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 301, Specifications for Structural Concrete.
2. American Water Works Association (AWWA):
   a. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
   b. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   c. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm).
   d. C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
   e. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   f. C217, Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
   g. C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
   h. C221, Fabricated Steel Mechanical Slip-Type Expansion Joints.
   i. C606, Grooved and Shouldered Joints.
3. ASTM International (ASTM):
   a. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
   b. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   c. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   d. C150/C150M, Standard Specification for Portland Cement.
   e. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
4. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.02 SUBMITTALS

A. Action Submittals:

1. Detailed pipe fabrication drawings showing pipe details, special fittings and bends, dimensions, coatings, and other pertinent information.
2. Layout drawing showing location of each pipe section and each special length.
3. Pipe pressure class.
4. Wall thickness, reinforcing, and strength calculations.
5. Product Data: Manufacturer's data for couplings, saddles, gaskets, and other pipe accessories. Indicate maximum rated working pressure and test pressure for each item.

B. Informational Submittals: Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

1.03 DELIVERY, STORAGE, AND HANDLING

A. In accordance with manufacturer's recommendations and as specified in Section 40 27 00, Process Piping—General, and accompanying data sheets.

B. Marking at Plant: Mark each pipe and fitting at plant. Include date of manufacture, manufacturer's identification, specification standard, diameter of pipe dimension ratio, pipe class, pipe number for laying purposes, and other information required for type of pipe.

C. Pipe, specials, and fittings received at Project Site in damaged condition will not be accepted.

D. Gasket Storage: Store rubber gaskets in cool, well ventilated place, and do not expose to direct rays of sun. Do not allow contact with oils, fuels, petroleum, or solvents.

E. Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.

F. Handling:

1. Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.
2. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.

3. Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted using one sling near center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workers. Slings shall bear uniformly against pipe.
4. Pipe and fittings shall not be stored on rocks or gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.

## PART 2 PRODUCTS

### 2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

### 2.02 PIPE AND JOINTS

A. As specified in the sections listed in Piping Schedule as shown on Drawings.

### 2.03 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Modular Mechanical Seal:

1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
2. Assemble interconnected rubber links with Type 316 stainless steel bolts, nuts, and pressure plates.
3. Size modular mechanical seals according to manufacturer’s instructions for the size of pipes shown to provide a watertight seal between pipe and wall sleeve opening.
4. Manufacturers and Products:
   a. Thunderline/LinkSeal, Div. of PSI, Houston, TX; Link Seal.
   b. Calpico, Inc., South San Francisco, California; Sealing Linx.
   c. Advance Products and Systems, Lafayette, Louisiana; Innerlynx.
   d. Or approved equal.

B. Wall Sleeves:

1. Diameter, ends, and length shall be as shown on Drawings.
2. Shall include integral seep ring to minimize seepage between metal sleeve and concrete.

C. Wall Couplings: See Section 40 27 01, Process Piping Specialties.

D. If core drilling is required for penetrations of existing concrete walls or slabs, locations of drilling shall be determined by radiograph to avoid damage to reinforcing steel and conduits.

2.04 FLANGES, FLANGE GASKETS, AND BOLTING MATERIALS

A. As specified in individual specifications following this section.

B. Flanges, bolting materials, and flange gaskets for steel flanges shall conform to AWWA C207.

C. Flanges, bolting materials, and flange gaskets for ductile iron flanges shall conform to AWWA C110 and AWWA C115.

D. Stainless steel bolting material shall conform to ASTM F593, Type 304 stainless steel, Group 1, Condition SH1, 2, 3, or 4.

E. If the flanges are coated, provide two washers for each bolt on each side of the flange to minimize damage to the coating as the nuts are tightened. Provide bolts of the proper length to accommodate the washers.

2.05 CONCRETE FOR THRUST BLOCKS

A. Thrust Block Concrete: As specified in Section 03 30 10, Structural Reinforced Concrete.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 deformed bars.

C. Welded Wire Fabric: ASTM A497/A497M.

D. Formwork: Plywood; earth cuts may be used as approved by Construction Manager.

2.06 PIPE LOCATING TAPE

A. As specified in Section 31 23 23.15, Trench Backfill.

2.07 PIPE BEDDING AND PIPE ZONE MATERIAL

A. Granular material or controlled low strength material as specified in Section 31 23 23.15, Trench Backfill.

2.08 TRENCH STABILIZATION MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

**PART 3 EXECUTION**

3.01 GENERAL

A. Notify Construction Manager at least 2 weeks prior to field fabrication of pipe or fittings.

B. Furnish feeler gauges of proper size, type, and shape for use during installation for each type of pipe furnished.

C. Distributing Materials: Place materials along trench only as will be used each day, unless otherwise approved by Construction Manager. Placement of materials shall not be hazardous to traffic or to general public, obstruct access to adjacent property, or obstruct others working in area.

3.02 EXAMINATION

A. Verify size, material, joint types, elevation, and horizontal location of existing pipeline to be connected to new pipeline or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Damaged Coatings and Linings: Repair using coating and lining materials in accordance with manufacturer’s instructions.

3.03 PREPARATION OF TRENCH

A. Prepare trench as specified in Section 31 23 16, Excavation.

3.04 INSTALLATION

A. General:

1. Join pipe and fittings in accordance with manufacturer’s instructions, unless otherwise shown or specified.
2. Install individual pipe lengths in accordance with approved lay diagram. Misplaced pipe shall be removed and replaced.

3. Inspect pipe and fittings before installation, clean ends thoroughly, remove foreign matter and dirt from inside.
4. Flanged Joints:
   a. Install perpendicular to pipe centerline.
   b. Bolt Holes: Straddle vertical centerline, aligned with connecting equipment flanges or as shown on Drawings.
   c. Use torque-limiting wrenches to provide uniform bearing and proper bolt tightness.
   d. Flange Type: Use flat-faced flange when joining with flat-faced ductile or cast iron flange.
5. Couplings: See Section 40 27 01, Process Piping Specialties.

B. Buried Pressure Pipe:

1. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown on Drawings.
2. Placement:
   a. Keep trench dry until pipe laying and joining is completed.
   b. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
   c. Measure for grade at pipe invert, not at top of pipe.
   d. Excavate trench bottom and sides of ample dimensions to permit proper joining, welding, visual inspection, and testing of entire joint.
   e. Prevent foreign material from entering pipe during placement.
   f. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
   g. In general, lay pipe upgrade with bell ends pointing in direction of laying.
   h. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
      1) Shorter pipe lengths.
      2) Special mitered joints.
      3) Standard or special fabricated bends.
   i. Check gasket position with feeler gauge to assure proper seating.
   j. After joint has been made, check pipe alignment and grade.
   k. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
   l. Prevent uplift and floating of pipe prior to backfilling.
3. Tolerances:
   a. Deflection from Horizontal Line: Maximum 2 inches.
   b. Deflection from Vertical Line: Maximum 1 inch.

c. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.
d. Horizontal position of pipe centerline on alignment around curves maximum variation of 1 foot from position shown.

4. Cover Over Top of Pipe: Minimum 3 feet, unless otherwise shown.
5. Disposal of Excess Excavated Material: As specified in Section 31 23 16, Excavation.

## 3.05 THRUST RESTRAINT

A. Location: At pipeline tees, plugs, caps, bends, and locations where unbalanced forces exist.

B. Thrust Blocking:

1. Place only where shown on Drawings.
2. Quantity of Concrete: Sufficient to cover bearing area of pipe and provide required soil bearing area as shown on Drawings.
3. Place blocking so pipe and fitting joints are accessible for repairs.
4. Place concrete in accordance with Section 03 30 10, Structural Reinforced Concrete.

## 3.06 CORROSION PROTECTION

A. Buried Pipe: As specified in the individual specifications following this section.

B. Petrolatum Wax Tape: All metallic buried pipe, pipe sections, specials, fasteners, and fittings surfaces that are not tape wrapped or epoxy coated or polyurethane coated shall be wrapped with a petrolatum wax tape coating according to Greenbook Section 212-2.9.

C. Notify Construction Manager at least 3 days prior to start of surface preparation, coating application, and corrosion protection work.

## 3.07 PLACEMENT OF PIPE LOCATING TAPE

A. Place pipe locating tape in accordance with Section 31 23 23.15, Trench Backfill.

## 3.08 PIPE BEDDING AND ZONE MATERIAL

A. Place pipe bedding and pipe zone material in accordance with Section 31 23 23.15, Trench Backfill.

## 3.09 FIELD QUALITY CONTROL

A. Pressure Leakage Testing: As specified in the individual specification(s) following this section.

## 3.10 CLEANING AND DISINFECTION

A. Following assembly and testing, and prior to disinfection and final acceptance, flush pipelines with water at 2.5 fps minimum flushing velocity until foreign matter is removed. Dispose of water and flushed foreign matter.

B. If impractical to flush large diameter pipe at 2.5 fps, clean pipe in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

C. Remove accumulated debris through blowoffs 2 inches and larger or by removing spools and valves from piping.

D. Disinfection:

1. Contractor's Equipment: Furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.
2. Conform to AWWA C651 for pipes and pipelines, except as modified in these Specifications.
3. Disinfect the following items installed or modified under this Project, intended to hold, transport, or otherwise contact potable water:
    a. Pipelines: Disinfect new pipelines that connect to existing pipelines up to point of connection.
4. Allow freshwater and disinfectant solution to flow into pipe or vessel at a measured rate so chlorine-water solution is at specified strength. Do not place concentrated liquid commercial disinfectant in pipeline or other facilities to be disinfected before it is filled with water.
5. Disposal of Chlorinated Water:
    a. Do not allow flow into a waterway without neutralizing disinfectant residual.
    b. See appendix of AWWA C651 for acceptable neutralization methods.

**END OF SECTION**

# SECTION 33 05 01.09
# POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   a. C110, Ductile-Iron and Gray-Iron Fittings.
   b. C605, Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
   c. C900-16, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inches Through 60 Inches (100 mm Through 1500 mm), for Water Transmission and Distribution.
2. ASTM International (ASTM):
   a. D2241, Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
   b. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
   c. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   d. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   e. D2672, Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.
   f. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
   g. D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
3. NSF International (NSF).
4. The 2015 “Greenbook” Standard Specifications for Public Works Construction.
5. The 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

1.02 SUBMITTALS

A. Informational Submittals: Manufacturer's Certification of Compliance. See Section 2-5 of the 2015 "Greenbook" Standard Specifications for Public Works Construction and Section 2-5.3 of the City of San Diego "Whitebook" Standard Specifications for Public Works Construction.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Solvent Cement: Store in accordance with ASTM D2855.

**PART 2 PRODUCTS**

2.01 MATERIALS

A. Pipe, Joints, Fittings, and Corrosion Protection:

1. In accordance with the 2015 "Greenbook" Standard Specifications for Public Works Construction Section 209-4 and City of San Diego Supplement "Whitebook" Standard Specifications for Public Works Construction Section 209.
2. Restrained Joints:
   a. Provide pipe restraint by system designed specifically for use with PVC pipe using wedges. Do not use systems with set screws, gripper rings, or gripper gaskets.
   b. Minimum Pressure Rating: 150 psi.

B. Service Saddles:

1. Double strap type with minimum strap width of 2 inches.
2. Straps: Type 304 stainless steel.
3. Saddles: Ductile iron, epoxy-coated, 10 mils minimum thickness.
4. Minimum Pressure Rating: 150 psi.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. In accordance with AWWA C605.

B. Joints:

1. Rubber Gasketed: In accordance with manufacturer's written instructions.

2. Restrained Joint Systems: In accordance with manufacturer's written instructions.

C. Pipe Bending for Horizontal or Vertical Curves:

1. Bending of pipe barrels larger than 12 inches in diameter is not allowed.
2. Radius of curves shall not exceed 50 percent of manufacturer's recommended values.
3. Use blocks or braces at pipe joints to ensure axial deflection in gasketed or mechanical joints does not exceed allowable deflection.

D. Maximum Joint Deflection at Mechanical Joint: 50 percent of manufacturer's recommended values.

E. No deflection is allowed at push-on joints.

## 3.02 INSPECTION AND HYDROSTATIC TESTING

A. General:

1. Notify Construction Manager in writing at least 5 days in advance of testing. Perform testing in presence of Construction Manager.
2. Using water as test medium, all newly installed pipelines must successfully pass hydrostatic leakage test prior to acceptance.
3. Conduct field hydrostatic test on buried piping after trench has been completely backfilled and compacted. Testing may, as approved by Design Engineer, be done prior to placement of asphaltic concrete or roadway structural section.
4. Contractor may, if field conditions permit and as approved by Construction Manager, partially backfill trench and leave joints open for inspection and conduct an initial informal service leak test. Final field hydrostatic test shall not, however, be conducted until backfilling has been completed as specified above.
5. Supply of Temporary Water: In accordance with Section 01 50 00, Temporary Facilities and Controls.
6. Dispose of water used in testing in accordance with federal, state, and local requirements.
7. Install temporary thrust blocking or other restraint as necessary to prevent movement of pipe and protect adjacent piping or equipment. Make necessary taps in piping prior to testing.
8. Wait a minimum of 5 days after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 2 days.

9. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
10. New Piping Connected to Existing Piping:
    a. Isolate new piping with grooved-end pipe caps, blind flanges, or other means as acceptable to Construction Manager.
    b. Provide appropriate thrust blocking.

B. Hydrostatic Testing Procedure: As directed in Section 40 80 01, Process Piping Leakage Testing.

**END OF SECTION**

# SECTION 33 05 01.12
# GRAVITY SEWER PIPE AND FITTINGS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   a. C105, Polyethylene Encasement for Ductile Iron Pipe Systems.
   b. C110, Ductile-Iron and Gray-Iron Fittings.
   c. C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   d. C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger - Shop Applied.
   e. C208, Dimensions for Fabricated Steel Water Pipe Fittings.
   f. C302, Reinforced Concrete Pressure Pipe, Noncylinder Type.
2. ASTM International (ASTM):
   a. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   b. A746, Standard Specification for Ductile Iron Gravity Sewer Pipe.
   c. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   d. C150, Standard Specification for Portland Cement.
   e. C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
   f. C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
   g. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
   h. C596, Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement.
   i. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
   j. D16, Standard Terminology for Paint, Related Coatings, Materials, and Applications.
   k. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
   l. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   m. D2241, Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

n. D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
o. D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
p. D3212, Standard Specification for Joints For Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
q. D3262, Standard Specification for “Fiberglass” (Glass-Fiber Reinforced Thermosetting-Resin) Sewer Pipe.
r. D4161, Standard Specification for “Fiberglass” (Glass-Fiber Reinforced Thermosetting-Resin) Pipe Joints using Flexible Elastomeric Seals.
s. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special inspection.
t. F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
u. F679, Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

1.02 DEFINITIONS

A. CCTV: Closed-Circuit Television.

B. DIP: Ductile Iron Pipe.

C. GRP: Glass-Fiber-Reinforced Thermosetting-Resin Pipe.

D. Pipe Stiffness Classification: Referred to as SN.

E. Pressure Class: Referred to as PN.

F. PVC: Polyvinyl Chloride Pipe.

G. RCP: Reinforced Concrete Pipe.

H. SDR: Standard Dimension Ratio.

I. VCP: Vitrified Clay Pipe.

1.03 DESIGN REQUIREMENTS

A. Where SN, PN, or SDR is not indicated, design piping system for maximum stress base on earth and traffic loads.

1.04 SUBMITTALS

A. Action Submittals:

1. Information on gasket polymer properties.
2. Tee fabrication details.
3. Application methods, application requirements, and chemical resistance data for coating and lining products.
4. GRP:
   a. Detailed pipe fabrication drawings showing pipe details, special fittings and bends, dimensions, coatings, standards for design, and other pertinent information.
   b. Pipe stiffness.
5. Complete Shop Drawings and laying diagrams showing location of each pipe section and, if special sections are provided, each special length.

B. Informational Submittals:

1. Certificates:
   a. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that products furnished meet requirements of this section.
   b. Certification of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
   c. Certified statement from manufacturer of gaskets, setting forth that basic polymer used in gaskets and test results of physical properties of compound are in accordance with ASTM F477 for PVC pipe.
2. Manufacturer's Written In-Plant Quality Control Program: Quality control procedures and materials testing to be used throughout manufacturing process. Submit prior to manufacture of any pipe for this Project.
3. Test or historical performance data to verify that joint design meets requirements of these Specifications.
4. Provide pipe test results with delivery of pipe. Do not deliver pipe not meeting test requirements to Project Site.
5. Manufacturer's written recommendations for pipe handling and installation.
6. Field Leakage Testing Plan:
   a. Submit at least 15 days in advance of testing and include at least the following:
      1) Testing dates.
      2) Piping systems and sections to be tested.

3) Test type.
4) Method of isolation.
5) Method of conveying water from source to system being tested.
6) Calculation of maximum allowable leakage for piping section(s) to be tested.
7) Method for disposal of test water, if applicable.

7. CCTV Inspection Equipment in accordance with Article Inspection of this section.
8. Leakage test results.
9. Pipe deflection test results.
10. CCTV inspection in accordance with Article Inspection of this section.

1.05 QUALIFICATIONS

A. In accordance with Article Inspection of this section.

1.06 SEQUENCING AND SCHEDULING

A. The Contractor shall submit work plan for review and approval by Design Engineer.

**PART 2 PRODUCTS**

2.01 PIPING

A. As specified in Piping Schedule as shown on Drawings.

2.02 GASKET LUBRICANT

A. Lubricant shall be supplied by pipe manufacturer and no substitute or approved equal will be allowed.

2.03 LATERAL SERVICE CONNECTION PIPE AND FITTINGS

A. As specified in Piping Schedule as shown on Drawings.

B. Use one type of service connection pipe material throughout. No interchanging of pipe and fittings allowed.

C. Size shall be as determined by Design Engineer.

2.04 PIPE FOR WATERLINE CROSSINGS

A. PVC Pressure Pipe: Conform to AWWA C900 or AWWA C905 (DR18).

B. Ductile Iron Pipe: Conform to AWWA C151 and have a thickness Class 51.

C. HDPE: Conform to AWWA C905 HDPE, SDR 11.

D. PVC Pipe 15-inch Diameter and Under: Conform to ASTM D3034, SDR 26.

E. PVC Pipe 18-inch Through 24-inch Diameter: Conform to ASTM F679, SDR 26.

2.05 PIPE TO MANHOLE CONNECTOR

A. Provide manhole connector per SDRSD No. SM-04.

2.06 FLEXIBLE COMPRESSION COLLAR

A. Mechanical joint coupling with No. 305 stainless steel bands.

B. Manufacturers:

1. Calder, Inc., Bellflower, CA.
2. Fernco Inc., Davison, MI.
3. Pipeconx Division of Uniseal; Evansville, IN.
4. Or approved equal.

**PART 3 EXECUTION**

3.01 EXAMINATION

A. Notify Construction Manager immediately of manufacturing imperfections or damage caused by improper handling.

B. Verify size, pipe condition, and pipe class prior to installation of pipe.

C. Repairs to RCP pipe section will be allowed only if approved, in writing, by Construction Manager. Damaged pipe which, in opinion of Construction Manager, cannot be repaired, will be rejected and removed from Project Site.

3.02 PREPARATION

A. Pipe Distribution: Do not distribute more than 1 week's supply of materials in advance of laying, unless otherwise approved by Construction Manager.

B. Inspect pipe and fittings prior to lowering into trench to ensure no cracked, broken, or otherwise defective materials are being used.

C. Remove foreign matter and dirt from inside of pipe and fittings and keep clean during and after laying. Wash ends of section clean with wet brush prior to joining sections of pipe.

## 3.03 INSTALLATION

A. General:

1. Install pipe sections in accordance with manufacturer's recommendations.
2. Provide and use proper implements, tools, and facilities for safe and proper prosecution of Work.
3. Lower pipe, fittings, and appurtenances into trench, piece by piece, by means of crane, slings, or other suitable tools and equipment, in such a manner as to prevent damage to pipe materials, protective coatings, and linings. Do not drop or dump pipe into trenches.

B. Line and Grade:

1. Establish line and grade for pipe by use of lasers.
2. Measure for grade at pipe invert, not at top of pipe.
3. Do not deviate from line or grade, as shown on Drawings, more than 1/2 inch, provided that such variation does not result in a level or reverse sloping invert.

C. Laying and Jointing:

1. Use gasket lubricant as recommended by gasket manufacturer.
2. Lay pipe upgrade with bell ends pointing in direction of laying.
3. When field cutting or machining pipe is necessary, use only tools and methods recommended by pipe manufacturer and approved by Construction Manager.
4. After section of pipe has been placed in its approximate position for jointing, clean end of pipe to be joined, inside of joint, and rubber ring immediately before joining pipe.
5. Assemble joint in accordance with recommendations of manufacturer.
6. Apply sufficient pressure in making joint to assure that joint is correctly assembled as defined in standard installation instructions provided by pipe manufacturer. Inside joint space shall not exceed 50 percent of pipe manufacturer's recommended maximum allowance.
7. Place pipe to specified line and grade to form smooth flow line.
8. Ensure that bottom of pipe is in contact with bottom of trench for full length of each section.
9. Check for alignment and grade after joint has been made.
10. Place sufficient pipe bedding material to secure pipe from movement before next joint is installed.
11. When pipe is laid within movable trench shield, take precautions to prevent pipe joints from pulling apart when moving shield ahead.

12. When laying operations are not in progress, and at close of day's work close and block open end of last laid section of pipe to prevent entry of foreign material or creep of gasketed joints.
13. Take precautions to prevent "uplift" or floating of line prior to completion of backfill operation.
14. Connections between one pipe material and another shall be by means of flexible compression collar, installed in accordance with manufacturer's recommendations, or concrete closure collar.

D. Gasketed Joint Protection:

1. Point (fill with joint cement mortar) 360 degrees of circumference. Quick setting grout may be substituted for joint cement mortar when approved by Construction Manager.
   a. Thoroughly clean joint of lubricant materials and dirt.
   b. Prewet joint before applying mortar.
   c. Pointing shall be done in such a manner that there are no bulges, ridges, or other irregularities.
   d. Pointing shall be flush with interior of pipe.
   e. Do not point joints closer than three pipe joints from next pipe section to be placed.

E. Connection to Structure or Manhole:

1. Locate standard pipe joint within 1.5 feet of outside face of structure for pipe 18 inches and smaller and within one pipe diameter for pipe 21 inches and larger.
2. Plug or close off pipe stubbed with watertight plug.
3. Connect pipe to manhole with pipe to manhole connector in accordance with manufacturer's recommendations.

F. Crossing Waterlines: Where sewer crosses less than 18 inches below waterline, use ductile iron or PVC pressure pipe for crossing or encase in concrete envelope for a minimum distance of 9 feet on each side of waterline.

G. Ductile Iron Pipe:

1. Cutting and Dressing of Ductile Iron Pipe Ends:
   a. Cut at right angles to centerline of pipe to leave smooth end, without damage to pipe.
   b. Use only approved mechanical cutter.
   c. Taper cut end of pipe to be used with rubber gasket joints by grinding or filing 1/8 inch back at an angle of approximately 30 degrees with centerline of pipe.
   d. Remove sharp or rough edges.

e. Abrade cut ends with grinding wheel and apply lining repair material. Use only compatible repair materials provided by pipe lining manufacturer. Allow repair lining to harden and cure before installation.

2. Polyethylene Wrap:
   a. Before installing wrap, clean pipe exterior of foreign material.
   b. Cut wrap approximately 2 feet longer than pipe section.
   c. Overlap wrap approximately 1 foot; seal joints with adhesive tape.
   d. Tape entire circumference of pipe at 3-foot intervals along pipe.
   e. Repair rips, punctures, or other damage to polyethylene with adhesive tape.
   f. When fittings cannot be practically wrapped in a tube, use a flat sheet or split tube of polyethylene. Securely tape seams.

## 3.04 CONCRETE CLOSURE COLLAR

A. Use only when approved by Construction Manager, and then only to make connections between dissimilar pipe or where standard rubber gasketed joints or flexible compression collars are impractical or unavailable.

B. Procedure:

1. Remove water from excavation. Placement of concrete in standing water will not be allowed.
2. Wash pipe to remove loose material.
3. Wrap and securely fasten light gauge sheet metal or building felt around pipe joint to ensure that concrete does not enter line.
4. Wet nonmetallic pipe thoroughly prior to concrete placement.
5. Placement shall be monolithic for each collar.
6. Place to minimum 6-inch thickness around outside diameter of pipe.
7. Extend concrete minimum of 12 inches on each side of joint.
8. Cure concrete, after initial set, by covering with well moistened earth.

## 3.05 SERVICE CONNECTION TEES

A. Install prior to leakage testing.

B. Install caps or plugs on tees.

C. Install approved tee outlets with gasketed type joint or adapter to join service connection pipe.

## 3.06 SERVICE CONNECTION INSTALLATION

A. In general, service connections shall extend to street or alley right-of-way line, easement line, or as directed by Construction Manager.

B. Minimum Slope: 1/4 inch per foot, unless otherwise noted.

C. Minimum Trench Depth: 3 feet at property line or on private property within permanent sewer easement. Construction Manager will determine required depth at end of line in each case.

D. Progress of Construction: Unless otherwise approved by Construction Manager, install service connection not more than 5 days after backfilling of sewer trench in block or equivalent 400-foot section of sewer.

E. Laying and Jointing of Service Connection Pipe and Fittings:

1. Maximum deflection permissible with any one fitting shall not exceed 45 degrees, except by permission of Construction Manager.
2. Make service connection to sewer system at manhole when directed by Construction Manager. Where service connection pipe is connected to manhole or concrete structure, make connection so standard pipe joint is located not more than 1.5 feet from structure unless PVC is used.
3. Provide end of service connection line and fittings with standard watertight plug, cap, and stopper, suitably braced to prevent blow-off during hydrostatic or air testing.

F. First length of pipe out from tee on lateral or main shall not be greater than 3 feet in length unless PVC pipe is used.

G. Line and Grade for Service Connection Pipe and Fittings: When possible, lay pipe uniformly between tee or top of riser section and end of service connection. If a field conflict prevents uniform installation, propose an alternative method of installation to Design Engineer for approval. Where minimum slopes are used, confirm accuracy of pipe grade with a good quality builder's level not less than 24 inches long.

H. Existing Service Connections:

1. Locate by potholing prior to constructing tee in new sewer pipeline.
2. Disconnect from existing pipelines to be abandoned and reconnect them to new sewer pipeline.

## 3.07 CLEANING

A. Clean each section of completed sewer pipeline prior to testing.

B. Place screen or dam in downstream manhole of section being cleaned to catch debris.

C. Remove material from each manhole section before cleaning next section downstream.

D. Method: High velocity hydro-cleaning equipment.

E. Cleaning water may be discharged into existing sewer system after screening and removal of debris.

3.08 TESTING

A. General:

1. Notify Construction Manager in writing 5 days in advance of testing. Perform testing in presence of Construction Manager.
2. Test pipe 18 inches in diameter and smaller for leakage using Hydrostatic Exfiltration or Pneumatic Test Methods at Contractor's option.
3. Test pipe over 18 inches in diameter for leakage using Hydrostatic Exfiltration Test Method.
4. Individual joints may be tested on pipe 36 inches in diameter and larger at Contractor's option.
5. Pipe shall successfully pass leakage test prior to acceptance.
6. Test sections of constructed sewer between stations only after service connections, manholes, and backfilling are completed.
7. Isolate new pipelines that are connected to existing pipelines for testing. Install pipe plugs as required to allow section of new pipe to be pressure tested.
8. Furnish testing equipment and perform tests as approved by Design Engineer. Testing equipment shall provide observable and accurate measurement of test pressure and amount of water needed to maintain specified conditions.
9. Supply of Temporary Water: As stated in Section 01 50 00, Temporary Facilities and Controls.
10. Dispose of water used in testing in accordance with federal, state, and local requirements.
11. Conduct initial leakage test after five sections of pipe have been installed to confirm integrity of pipe and joints.
12. Contractor may, if field conditions permit and as determined by Construction Manager, partially backfill trench and leave joints open for inspection and conduct an initial service leak test. Hydrostatic acceptance test shall not be conducted until backfilling has been completed.

B. Hydrostatic Exfiltration Test:

1. Measurement Accuracy: Plus or minus 1/8-gallon of water leakage under specified conditions.
2. PVC Pipe and Joints: Maximum allowable water loss is 0.8 gallon(s) per inch diameter per 1,000 feet of pipe, including service connections within test section per 2 hours. Modify allowable leakage as stated below if hydrostatic head is other than 6 feet.
3. Hydrostatic Head:
   a. At least 4 feet above maximum estimated groundwater level in section being tested, but no less than 6 feet above inside top of highest section of pipe in test section, including service connections.
   b. In every case, determine height of water table at time of test by exploratory holes or such other methods approved by Construction Manager. Construction Manager will make final decision regarding test height for water in pipe section being tested.
   c. If hydrostatic head is other than 6 feet, adjust allowable leakage as computed by criteria above by dividing square root of actual head by square root of 6 and multiplying result by allowable leakage stated above.
4. Length of Pipe Tested: Limit length such that pressure on invert of lower end of section does not exceed 16 feet of water column. In no case shall length be greater than 700 feet or distance between manholes when greater than 700 feet.
5. Dispose of test water in a manner that will not damage or interfere with adjacent property and in a manner acceptable with Construction Manager and regulatory agencies.

C. Pneumatic Testing for 18-Inch and Smaller Diameter Pipe:

1. Equipment:
   a. Calibrate gauges with standardized test gauge provided by Contractor at start of each testing day will witness calibration.
   b. Install compressor, air piping manifolds, gauges, and valves at ground surface.
   c. Provide pressure release device, such as rupture disc or pressure relief valve, to relieve pressure at 6 psi or less.
   d. Restrain plugs used to close sewer lines to prevent blowoff.
2. Procedure:
   a. No person shall enter manhole or structure, or occupy area above opening of manhole or structure where pipe is under pressure.
   b. Determine height of groundwater table at time of test.

c. Slowly introduce air into pipe section until internal air pressure reaches 4 psi greater than average backpressure of groundwater submerging pipe.
d. Allow 2 minutes minimum for air temperature to stabilize.
e. Allowable leakage for sewers constructed of air-permeable materials, such a concrete or clay:
   1) When pressure is decreased to 3.5 psig, air pressure test shall begin.
   2) Test shall consist of measuring time in seconds for pressure in pipe to drop from 3.5 psig to 2.5 psig.
   3) Pipe leakage shall be considered acceptable if time in seconds for pressure drop is equal to or greater than required time as calculated below:

$K = 0.0111d^2L$
$C = 0.000392dL$

If $C_t$ is less than or equal to 1.0, then time = $K_t$
If $C_t$ is between 1.0 and 1.75, then time = $K_t/C_t$
If $C_t$ is greater than or equal to 1.75, then time = $K_t/1.75$

   a) Where: d = pipe diameter in inches
      L = pipe length in feet
      K = value for each length of pipe of a specific diameter
      C = value for each length of pipe of a specific diameter
      $K_t$ = Sum of all K values
      $C_t$ = Sum of all C values

f. This method is based on allowable air loss rate of 0.003 cubic foot per minute (cfm) per square foot of internal pipe surface, with total air loss rate not less than 2.0 cfm nor greater than 3.5 cfm.
g. Allowable leakage for sewers constructed of nonair-permeable materials such as ductile iron, and polyvinyl chloride (PVC).
   1) When nonair-permeable pipe is subjected to low pressure air test, time in seconds for pressure drop shall be equal to or greater than three times required time calculated using procedure above.
   2) Defective Piping Sections: Replace and retest as specified.

D. Hydrostatic Joint Testing:

1. If pipe fails to pass hydrostatic test and location of leak cannot be readily identified, conduct individual joint tests. After leaking joints have been located and repaired, retest pipeline. As alternative to filling entire pipe and measuring leakage, test each individual joint for leakage.
2. Conduct testing prior to installing PVC liner patch at joints.
3. Provide device specifically designed for testing of pipe joints and consisting of a metal cylinder, seal ring on each side of joint, and method of applying pressure to joint.
    a. Manufacturers:
        1) Mechanical Research and Design, Inc., Manitowoc, WI.
        2) Cherne Industries, Inc., Minneapolis, MN.
        3) Or approved equal.
4. Measurement Accuracy: Plus or minus 0.05 gallon(s) of water leakage under specified conditions.
5. Determine height of groundwater table at time of test.
6. Minimum Pressure, Each Joint: 2.5 psi above backpressure of groundwater.
7. Minimum Test Duration, Each Joint:
    a. 20 minutes for 60-inch diameter pipe and smaller.
    b. 10 minutes for pipe larger than 60-inch diameter.
8. Maximum Leakage Per Joint: 0.0008 gallon(s) per hour per inch-diameter times length of distance between pipe joints.

E. Test Report Documentation:

1. Test date.
2. Pipe section tested.
3. Test method.
4. Test pressure.
5. Length of test.
6. Pressure or water loss.
7. Remarks, including:
    a. Leaks (type, location).
    b. Repair/replacement performed to remedy excessive leakage.
8. Signed by Contractor and Construction Manager to represent that test has been satisfactorily completed.

F. Subsequent Failure: Visible infiltration of groundwater following successful test shall be considered evidence that original test was in error or that subsequent failure of pipeline has occurred.

G. PVC Pipe Deflection Test:

1. Contractor is responsible for providing all labor and equipment for deflection testing.
2. Test deflection of pipe by manually pulling, with twine, a one-piece, nine-arm, go/no-go mandrel (sized in accordance with ASTM D3034) through pipe. Within 24 hours after compaction of backfill is complete, line shall be tested using 5 percent deflection mandrel. If line is satisfactory, it shall be retested using 7.5 percent deflection mandrel no less than 30 days following completion of compaction.
3. Correcting Deficiencies or Obstructions:
   a. Excavate to springline of pipeline and replace and recompact pipe zone material.
   b. Internal pipe rerounding or vibration will not be allowed.
   c. If pipe does not pass mandrel test after replacement of pipe zone material and trench backfill, re-excavate and replace pipeline.

## 3.09 INSPECTION

A. Television Pipeline Inspection:

1. General:
   a. Internally inspect sewer pipelines by closed circuit television (CCTV) after completion of pipeline cleaning and testing.
   b. Conduct inspection in presence of Construction Manager.
2. Procedure:
   a. Provide complete and continuous taped record and written log of inspection.
   b. HD format.
   c. Television Camera Equipment:
      1) Rotating lens or pan and tilt.
      2) Resolution: Minimum 460 lines per inch.
      3) Focal Distance: Adjustable through a range of 6 inches to infinity.
      4) Remote-Reading Footage Counter: Accurate to less than 1 percent error.
      5) Lighting: Sufficient to provide clear, in-focus picture of entire inside periphery of pipe, and minimizes reflection.
   d. Pull camera at uniform rate, stopping to properly document defects. Maximum pull of camera shall not exceed 30 feet per minute.

3. Quality Standard:
   a. Provide clear, sharp image when played back on conventional television receiver.
   b. Neatly label HD showing contents, project title, HD number, pipe structure identification numbers, date HD was made, and inspection company.
   c. Tapes to Include:
      1) Opening Screen:
         a) Date of inspection.
         b) Pipe structure identification number.
         c) Upstream and downstream node identification numbers.
         d) Street address.
         e) Pipe size.
         f) Normal (upstream to downstream) or reverse (downstream to upstream) pull.
      2) Continuous View: Current distance along reach (tape counter footage).
   d. Log sheets to show time and date of inspection, location, upstream and downstream manholes, direction of pull, pipeline length, pipe size, pipe material, location of lateral connections, video tape number, and detail of defects encountered.
   e. Show sufficient detail to determine cracks in pipe, offset joints, leaking joints, sags, and other flaws in pipeline installation. Record location of deficiencies by distance from center of reference manhole.
   f. Upon completion, playback video in presence of Construction Manager. Any video not meeting quality standard will be rejected and videoing process repeated.
   g. Correct deficiencies found as a result of video replay and repeat CCTV inspection.

B. Manual Inspection:

1. Pipe 36 inches and larger.
2. Provide any specialized equipment required for inspection for Owner and Construction Manager.
3. Maintain voice communications between in-pipe and aboveground personnel at all times during in-pipe inspection.
4. Record inspection on VHS-formatted videotape and inspection logs. Provide digital, color, still photographs of defects or other features as requested by Construction Manager.

5. Log Sheets: Show time and date of inspection, location, upstream and downstream structure numbers, pipeline length, pipe size, pipe segment length, pipe material, lateral connections located by pipe segment number, and location and detail of defects encountered.

C. Deficiencies Requiring Correction:

1. Variations in alignment greater than specified herein.
2. Joint separations greater than allowed by pipe manufacturer.
3. Visible infiltration.
4. Presence of debris or foreign objects.
5. Obvious damage or defects in pipeline.
6. Sags, bellies, or negative slopes.
7. Slope less than minimum allowable.

**END OF SECTION**

# SECTION 33 13 00
# DISINFECTION OF WATER UTILITY DISTRIBUTION FACILITIES

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA): C651, Disinfecting Water Mains.
2. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
3. Standard Methods for the Examination of Water and Wastewater, as published by American Public Health Association, American Water Works Association, and the Water Environment Federation.

### 1.02 SUBMITTALS

A. Informational Submittals:

1. Plan describing and illustrating conformance to appropriate AWWA standards and this Specification.
2. Procedure and plan for cleaning system.
3. Procedures and plans for disinfection and testing.
4. Proposed locations within system where Samples will be taken.
5. Type of disinfecting solution and method of preparation.
6. Method of disposal for highly chlorinated disinfecting water.
7. Independent Testing Agency: Certification that testing agency is qualified to perform bacteriological testing in accordance with AWWA standards, agency requirements, and this Specification.
8. Certified Bacteriological Test Results:
   a. Facility tested is free from coliform bacteria contamination.
   b. Forward results directly to Owner.

### 1.03 QUALITY ASSURANCE

A. Independent Testing Agency: Certified in the State of California, provide project experience and references in field of water sampling and testing. Agency shall use calibrated testing instruments and equipment, and documented standard procedures for performing specified testing.

1.04 SEQUENCING

A. Commence initial disinfection after completion of following:

1. Hydrostatic and pneumatic testing, pressure testing, functional and performance testing and acceptance of pipelines, pumping systems, structures, and equipment.
2. Disinfection of pumps and associated system piping.

**PART 2 PRODUCTS**

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 WATER FOR DISINFECTION AND TESTING

A. Clean, uncontaminated, and potable.

B. Owner will supply potable quality water. Contractor shall convey in disinfected pipelines or containers.

**PART 3 EXECUTION**

3.01 GENERAL

A. Conform to AWWA C651 for pipes and pipelines, except as modified in these Specifications.

B. Contractor’s Equipment:

1. Furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.
2. Water used to fill pipeline may be supplied using a temporary connection to existing distribution system. Provide protection against cross-connections as required by AWWA C651.

C. Disinfect the following items installed or modified under this Project, intended to hold, transport, or otherwise contact potable water.

1. Disinfect new pipelines that connect to existing pipelines up to point of connection.
   a. Potable water piping.
   b. Fire protection water.

D. Prior to application of disinfectants, clean pump, tank, filters, and pipelines of loose and suspended material.

E. Allow freshwater and disinfectant solution to flow into pipe or vessel at a measured rate so chlorine-water solution is at specified strength. Do not place concentrated liquid commercial disinfectant in pipeline or other facilities to be disinfected before it is filled with water.

## 3.02 TURBIDITY

A. Cleaning of equipment and facilities shall include removal of materials that result in a turbidity exceeding limits stated in Article Testing.

## 3.03 PIPING AND PIPELINES

A. Cleaning:

1. Before disinfecting, clean foreign matter from pipe in accordance with AWWA C651.
2. If continuous feed method or slug method of disinfection, as described in AWWA C651, are used flush pipelines with potable water until clear of suspended solids and color. Provide hoses, temporary pipes, ditches, and other conduits as needed to dispose of flushing water without damage to adjacent properties.
3. Flush service connections and hydrants. Flush distribution lines prior to flushing hydrants and service connections. Operate valves during flushing process at least twice during each flush.
4. Flush pipe through flushing branches and remove branches after flushing is completed.
5. Pipeline shall be cleaned by use of a pipe pig specifically designed for cleaning. Observe material removed by pig on each pass. Repeat process until pipe has been cleaned to the satisfaction of Construction Manager.

B. Disinfecting Procedure: In accordance with AWWA C651, unless herein modified.

## 3.04 BAC FILTER TANKS

A. Disinfecting Solutions: Minimum free chlorine concentration of 100 ppm.

B. Application:

1. Before installation of BAC media, inject disinfecting solution into the BAC backwash supply tank or other viable location upstream of the BAC filters. Pump to fill BAC filters with disinfecting solution and soak for a minimum 24-hour period of time. At the end of the 24-hour period, backwash filters and measure residual chlorine. Backwash effluent shall have a strength of at least 100 ppm free chlorine.
2. Operate valves and BAC filter appurtenances during disinfection to ensure disinfecting solution is dispersed into all parts of BAC filter and lines.
3. If disinfecting solution contained in BAC filter has a residual free chlorine concentration less than 100 ppm after the 24-hour retention period, reapply disinfecting solution and retest until a satisfactory test result is obtained.
4. After chlorination, flush water from BAC filter until water through unit is chemically and bacteriologically equal to permanent source of supply.

## 3.05 PUMPS

A. Disinfecting Solutions: Minimum free chlorine concentration of 100 ppm.

B. Application:

1. Inject disinfecting solution into pump and associated piping and circulate for a minimum 3-hour period of time. At end of 3-hour period, solution shall have a strength of at least 50 ppm free chlorine.
2. Operate valves and pump appurtenances during disinfection to ensure disinfecting solution is dispersed into all parts of pump and lines.
3. If disinfecting solution contained in pump has a residual free chlorine concentration less than 50 ppm after the 3-hour retention period, reclean pump, reapply disinfecting solution, and retest until a satisfactory test result is obtained.
4. After chlorination, flush water from pump until water through unit is chemically and bacteriologically equal to permanent source of supply.

## 3.06 DISPOSAL OF CHLORINATED WATER

A. Do not allow flow into a waterway without neutralizing disinfectant residual.

B. See appendix of AWWA C651, C652 for acceptable neutralization methods.

## 3.07 TESTING

A. Collection of Samples:

1. Coordinate activities to allow Samples to be taken in accordance with this Specification.
2. Provide valves at sampling points.
3. Provide access to sampling points.

B. Test Equipment:

1. Clean containers and equipment used in sampling and make sure they are free of contamination.
2. Obtain sampling bottles with instructions for handling from an independent testing laboratory.

C. Chlorine Concentration Sampling and Analysis:

1. Collect and analyze Samples in accordance with AWWA C651.
2. Sampling Frequency for Disinfecting Solution: Sample in accordance with AWWA 651.
3. Sampling Locations: All new potable water piping and potable water systems installed under this Contract at the Treatment Plant Site.
4. Analysis to be performed by an independent test laboratory. Samples will be analyzed using amperometric titration method for free chlorine as described in latest edition of Standard Methods for Examination of Water and Wastewater.

D. After piping and pipelines have been cleaned, disinfected, and refilled with potable water, Owner will take water Samples and have them analyzed for conformance to bacterial limitations for public drinking water supplies.

1. Collect Samples in accordance with applicable AWWA Standard.
2. Analyze Samples for coliform concentrations in accordance with latest edition of Standard Methods for the Examination of Water and Wastewater.
3. Obtain and analyze a minimum of two Samples on each of 2 consecutive days from each separable structure and every 1,000 feet of pipeline by standard procedures outlined by state and local regulatory agencies.
4. Sampling points shall be representative and accepted by Construction Manager.

E. Turbidity Sampling and Analysis:

1. After piping and pipelines have been cleaned, disinfected, and refilled with potable water, Owner will take water Samples and have them analyzed for conformance to turbidity limitations for public drinking water supplies. Turbidity shall not exceed 0.3 NTU.
2. If turbidity is in excess of the limit, dispose of the water in accordance with this Specification and applicable regulations, take action to remove source of turbidity, refill system, and retest.

F. If minimum Samples required above are bacterially positive, disinfecting procedures and bacteriological testing shall be repeated until bacterial limits are met.

**END OF SECTION**

# SECTION 33 16 13.13
# HORIZONTAL WELDED STEEL TANK

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Petroleum Institute (API): STD 650, Welded Steel Tanks for Oil Storage.
2. American Society of Civil Engineers (ASCE): ASCE 7, Minimum Design Loads for Buildings and Other Structures.
3. American Society of Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Non-Destructive Testing.
4. American Water Works Association (AWWA): D100, Welded Steel Tanks for Water Storage.
5. American Welding Society (AWS):
   a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   b. A3.0, Standard Welding Terms and Definitions; Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying.
   c. D1.1/D1.1M, Structural Welding Code - Steel.
   d. QC 1, Standard for AWS Certification of Welding Inspectors.
6. ASTM International (ASTM):
   a. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   b. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
   c. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   d. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   e. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
   f. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
   g. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure of High-Temperature Service, or Both.

h. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
i. A307, Standard Specification for Carbon Steel Bolts and Studs 60,000 PSI Tensile Strength.
j. A516/A516M, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
k. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

7. California Building Code (CBC).
8. National Association of Corrosion Engineers (NACE): RP0178, Fabrication Details, Surface Finish Requirements, and Proper Design Consideration for Tanks and Vessels to be Lined for Immersion Service.
9. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
10. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.
11. UL: 142, Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids.

1.02 DEFINITIONS

A. CJP: Complete Joint Penetration.

B. CWI: Certified Welding Inspector.

C. Freeboard: Vertical distance from top of liquid to top of tank.

D. MT: Magnetic Particle Testing.

E. NDT: Nondestructive Testing.

F. PJP: Partial Joint Penetration.

G. PQR: Procedure Qualification Record.

H. PT: Liquid Penetrant Testing.

I. RT: Radiographic Testing.

J. UT: Ultrasonic Testing.

K. VT: Visual Testing.

L. WPQ: Welder Performance Qualification.

M. WPS: Welding Procedure Specification.

1.03 SYSTEM DESCRIPTION

A. Steel Tank System: Horizontal welded steel tank and accessories, as specified herein, and shown on Drawings.

1.04 DESIGN REQUIREMENTS

A. Design, as specified herein, a horizontal welded steel potable water tank and associated accessories.

B. Tank Dimensions:

1. Storage Capacity: 40,000 U.S. gallons.
2. Elevations and Dimensions: As shown on Drawings.

C. Design Loads:

1. Gravity loads design shall be in accordance with UL 142.
2. Horizontal Wind Velocity and Loads: For overall stability and anchorage of tanks, calculate wind pressures in accordance with ASCE 7 and CBC.
3. Seismic Design Loads and Factors:
   a. Risk Category IV.
   b. Seismic Design Category D.
   c. Site Class D.
   d. Seismic Importance Factor $I_e = 1.50$.
   e. $S = 1.065g$, $S_1 = 0.409g$.
   f. $S_{DS} = 0.763g$, $S_{D1} = 0.434g$.
   g. Seismic loads shall be determined and applied in conformance with Chapter 13 of ASCE 7.

D. Welds Joining Tank Shells and Heads: Only shell joints No. 1 and No. 2 of Figure 6.1 and Figure 6.2 of UL 142.

1.05 SUBMITTALS

A. Action Submittals:

1. Tank fabrication drawings and calculations of steel tank system and accessories. Calculations shall be signed and sealed by Contractor's tank designer. All details shall satisfy the minimum requirements, sizes, factors herein specified or shown.

2. Welding Data (Shop and Field):
   a. Show on a weld map, complete information regarding base metal specification designation, location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tail of welding symbol.
   b. Clearly distinguish between shop and field welds.
   c. Welding and NDE Symbols: In accordance with AWS A2.4.
   d. Welding Terms and Definitions: In accordance with AWS A3.0.
   e. Submit welding data together with Shop Drawings as a complete package.
3. Notch-Tough WPSs:
   a. Notch-tough welding shall be required for welding of tank shells.
   b. WPSs: Provide heat-input table on WPSs for welder guidance.
   c. PQRs for notch-tough welding shall document heat-input control by monitoring volts, amps, and travel speed or time-rate of change of weld metal volume as calculated by measuring change in electrode length over a period of time.
   d. Charpy V-notch tests shall be conducted on weld metal and heat affected zone. Test coupons shall be oriented transverse to final direction of rolling. Full size Charpy specimen test acceptance shall be same as base metal specified herein.

B. Informational Submittals:

1. Manufacturer's instructions for coating systems.
2. Manufacturer's Certificate of Compliance in accordance with UL 142.
3. Manufacturer's Test Reports:
   a. Mill certifications for steel tank plates.
   b. Mill certifications for structural steel.
4. Credentials and Statements of Qualification of Contractor's Personnel and Subcontractors:
   a. Tank designer.
   b. Tank manufacturer.
   c. Tank installer.
   d. Welder/welder operator.
   e. Weld testing agency.
   f. Welding inspector.
   g. NDT personnel.
   h. Nonshrink grout manufacturer's representative.
   i. Painting Subcontractor.
5. Welding Documentation:
   a. Shop and field WPSs and supporting PQRs.
   b. NDT procedure specifications.
   c. Shop and field CWI reports.
   d. Shop and field NDT reports.

6. Performance Test Results:
   a. Tank leakage test in conformance with UL 142.
   b. Hydrostatic strength test in conformance with UL 142.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Tank Designer: Registered civil or structural engineer licensed to perform specified Work in the State of California.
2. Tank Installer: Certified by Tank Manufacturer as qualified to perform specified Work.
3. Experience requirements for Tank Manufacturer, Tank Designer, and Tank Installer shall include five or more steel tanks presently in service, of similar size and character to specified Work, all in satisfactory operation for minimum of 5 years.
4. Welder/Welding Operator: Qualified by Tank Manufacturer or Contractor in accordance with referenced welding codes.
5. CWI: Certified in accordance with AWS QC 1, and having prior inspection experience with specified welding codes.
6. Nondestructive Testing Personnel: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.
7. Nonshrink Grout Manufacturer's Representative: Authorized and trained representative of grout manufacturer provide project experience and references in successful installation on steel tank projects. See additional requirements of Section 03 62 00, Grouting.
8. Painting Subcontractor: Provide project experience and references in lining and coating of welded steel tanks for water storage.

B. Welding Documentation:

1. WPSs.
2. WPQs: Qualified by tank fabricator in accordance with AWS D1.1 (Annex N Forms) for field welding.
3. CWI certificate(s).
4. NDT personnel certifications.

C. Regulatory Requirements:

1. Tank Accessories: In accordance with applicable safety and building codes, including Code of Federal Regulations, 29 CFR 1910.27.

## PART 2 PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 MATERIALS

A. Steel: Shall be in accordance with Section 5 of UL 142 with a minimum yield of 50,000 psi.

2.03 ACCESSORIES

A. Shell Manholes: Shall be accordance with Section 9 of UL 142.

B. Pipe Connections: Shall be in accordance with Section 7 of UL 142.

1. Inlet-outlet and drain connections as shown on Drawings.

C. Reinforcing Plates at Shell Openings: In accordance with UL 142.

2.04 CONCRETE

A. As specified in Section 03 30 10, Structural Reinforced Concrete.

2.05 FABRICATION

A. General:

1. UL 142.
2. Shell Plate: Shop bent to radius shown.

B. Welding: Shall be in accordance with UL 142 and AWS D1.1.

C. Finish: Shall be in accordance with Section 09 97 13, Steel Tank Coatings.

2.06 SOURCE QUALITY CONTROL

A. CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals prior to assembly, during assembly, during welding, and after welding. CWI duties include:

1. Verifying conformance of specified job material and proper storage.
2. Monitoring conformance with approved WPS.
3. Monitoring conformance of WPQ.
4. Inspecting weld joint fit-up and in-process inspection.
5. Providing 100 percent visual inspection of welds.
6. Supervising nondestructive testing personnel and evaluating test results.
7. Maintaining records and preparing report confirming results of inspection and testing comply with the Work.

**PART 3 EXECUTION**

3.01 GROUT

A. As specified in Section 03 62 00, Grouting.

3.02 CONCRETE

A. Placement: As specified in Section 03 30 10, Structural Reinforced Concrete.

3.03 TANK INSTALLATION

A. General:

1. Install complete as shown on Drawings.
2. Connect to anchor bolts of saddle piers shown on Drawings.

3.04 FIELD WELDING

A. General:

1. Perform in accordance with AWS D1.1 (field welding), except as modified herein.
2. Perform only in presence of CWI.

B. Accessories and Attachments:

1. Joints: Seal welded, as minimum.
2. Steel Piping: In accordance with UL 142.

3.05 WELD DEFECT REPAIR

A. Repair and retest rejectable weld defects until sound weld metal has been deposited in accordance with weld acceptance indicated herein.

3.06 FINISHING

A. As specified in Section 09 97 13, Steel Tank Coatings.

3.07 FIELD QUALITY CONTROL

A. CWI shall be present whenever field welding is performed. CWI shall perform inspection at suitable intervals prior to assembly, during assembly, during welding, and after welding. CWI duties include:

1. Verifying conformance of specified job material and proper storage.
2. Monitoring conformance with approved WPS.
3. Monitoring conformance of WPQ.
4. Inspecting weld joint fitup and in-process inspection.
5. Providing 100 percent visual inspection of welds.
6. Supervising nondestructive testing personnel and evaluating test results.
7. Maintaining records and preparing report confirming results of inspection and testing comply with the Work.

B. Weld NDT: 100 percent VT by CWI of all welds for acceptance in accordance with AWS D1.1/D1.1M, Table 6.1 for Statically Loaded Nontubular Connections, unless more stringent NDT is required in this section.

**END OF SECTION**

# SECTION 33 41 01
# STORM AND SANITARY DRAIN CONVEYANCE

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:

1. ASTM International (ASTM):
   a. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
   b. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   c. C150, Standard Specification for Portland Cement.
   d. C311, Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete.
   e. C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
   f. C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
   g. C443, Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
   h. C497, Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
   i. C507, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
   j. C595, Standard Specification for Blended Hydraulic Cements.
   k. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
   l. C655, Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe.
   m. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
   n. C1012, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
   o. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

p. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
q. D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
r. D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
s. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
t. F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
u. F679, Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
v. F794, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
w. F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.

2. The 2015 “Greenbook” Standard Specifications for Public Works Construction.
3. The 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

1.02 SUBMITTALS

A. Informational Submittals: Manufacturer’s Certification of Compliance. See Section 2-5 of the 2015 “Greenbook” Standard Specifications for Public Works Construction and Section 2-5.3 of the City of San Diego “Whitebook” Standard Specifications for Public Works Construction.

**PART 2 PRODUCTS**

2.01 STORM DRAIN PIPE AND FITTINGS

A. 2015 “Greenbook” Standard Specifications for Public Works Construction Section 207-3 and 208-3 and City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction Section 207.

2.02 OPEN CHANNEL CONCRETE CONVEYANCE

A. Air-placed concrete per 2015 “Greenbook” Standard Specifications for Public Works Construction Section 303-1.

2.03 SANITARY DRAIN PIPE AND FITTINGS

A. 2015 “Greenbook” Standard Specifications for Public Works Construction Section 207-17 and City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction Section 207.

## PART 3 EXECUTION

3.01 INSTALLATION OF PIPE, FITTINGS, AND APPURTENANCES

A. General:

1. See Section 306-7 of the “Greenbook” Standard Specifications for Public Works Construction.
2. Plug or close off pipes that are stubbed off for manhole, concrete structure, or for connection by others, with temporary watertight plugs.

3.02 INSTALLATION OF CONCRETE OPEN CHANNEL CONVEYANCES

A. See Section 303-2 of 2015 “Greenbook” Standard Specifications for Public Works Construction.

3.03 DEMOLITION

A. Removal and Abandonment of Existing Conduits and Structures: See Section 300-1.3, Section 300-3 and Section 306-3.3 of 2015 “Greenbook” Standard Specifications for Public Works Construction and Section 300 of the City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

**END OF SECTION**

# SECTION 33 44 13.13
# STORM DRAIN STRUCTURES

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Welding Society (AWS): Code for Welding in Building Construction.
2. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48, Standard Specification for Gray Iron Castings.
   c. A615/A615M, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   e. C387, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
   f. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
3. 2015 “Greenbook” Standard Specifications for Public Works Construction and the 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

## PART 2 PRODUCTS

### 2.01 CONCRETE

A. See Section 201-1 of the 2015 “Greenbook” Standard Specifications for Public Works Construction and Section 201-1 of the 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

### 2.02 FORMS

A. See Section 303-1 of the 2015 “Greenbook” Standard Specifications for Public Works Construction.

### 2.03 REINFORCING STEEL

A. See Section 201-2 of the 2015 “Greenbook” Standard Specifications for Public Works Construction.

2.04 MORTAR

A. See Sections 201-1 and 201-5 of the 2015 “Greenbook” Standard Specifications for Public Works Construction.

2.05 FRAMES AND GRATES

A. Frames and grates for storm drain structures shall conform to the standard details.

**PART 3 EXECUTION**

3.01 EXCAVATION AND BACKFILL

A. See Section 300-3 of the 2015 “Greenbook” Standard Specifications for Public Works Construction and Section 300-3.5 of the 2015 City of San Diego “Whitebook” Standard Specifications for Public Works Construction.

3.02 CONSTRUCTION OF STORM DRAIN STRUCTURES

A. See Section 303-1 of the 2015 “Greenbook” Standard Specifications for Public Works Construction, and Section 303-1 of the 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

3.03 INSTALLATION OF FRAMES AND GRATES

A. Set frames and grates at elevations indicated or as determined in field and in conformance with Drawings.

B. Frames may be cast in, or shall be set in mortar.

3.04 CLEANING

A. Upon completion, clean each structure of all silt, debris, and foreign matter.

**END OF SECTION**

# SECTION 33 46 00
# SUBSURFACE DRAINAGE

## PART 1 GENERAL

### 1.01 GENERAL

A. This section covers requirements for subsurface drainage piping used to control shallow groundwater elevations within the Biofiltration areas.

### 1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. M252, Standard Specification for Corrugated Polyethylene Drainage Pipe.
   b. M294, Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter.
2. ASTM International (ASTM):
   a. A48/A48M, Standard Specification for Gray Iron Castings.
   b. C387/C387M, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
   c. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
   d. D75, Standard Practice for Sampling Aggregates.
   e. D422, Standard Test Method for Particle-Size Analysis of Soils.
   f. D1140, Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-µm) Sieve.
   g. F405, Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings.
   h. F449, Standard Practice for Subsurface Installation of Corrugated Polyethylene Pipe for Agricultural Drainage or Water Table Control.
   i. F667, Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.
3. Natural Resources Conservation Service (NRCS): Conservation Practice Standard 606, Subsurface Drain.
4. 2015 “Greenbook” Standard Specifications for Public Works Construction.
5. 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

1.03 DEFINITIONS

A. Cleanouts: Surface access ports used to access drain lines and constructed of solid corrugated piping.

B. Drain Lines: Buried perforated pipe providing collection and conveyance of drain water from saturated soils to Drainage Management Unit (DMU).

C. Granular Drain Material: Granular (sand or gravel) material used as an envelope around drain lines to provide pipe bedding, a permeable drainage zone, and stabilization of base soils to prevent migration of fines into drain lines.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product Data:
      1) Drain line pipe and fittings.
      2) Drain line installation equipment.
      3) High-pressure water jet cleaning equipment.
      4) Drain line sock; include manufacturer's recommendation for length of time UV-resistant sock may be left exposed.
   b. Precast Base, Cone, and Top Slab Manhole Sections: Details of construction.
   c. Level Check Box, Stop Logs, Cover, and Pipe Boots: Details of construction.

B. Informational Submittals:

1. Granular Drain Material:
   a. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
   b. Test results from approved commercial testing laboratory before delivering material to Site and at least 10 days before material is required for use.
2. Surveys:
   a. Survey plan to collect drain line grade QA/QC information, including methods and schedule.
   b. Field Survey:
      1) Information consisting of stationing and ground surface elevation for each drain line prior to installation.
      2) Information consisting of stationing and installed invert elevation of drain pipe for drain line grade QA/QC.
3. Final drain line inspection and cleaning certification of compliance.

## 1.05 QUALITY ASSURANCE

A. Granular Drain Material Source:

1. Sampling:
   a. Conduct sampling of granular drain material source under supervision of Construction Manager in accordance with ASTM D75.
   b. Samples shall be representative and be clearly marked to show source of the material.
   c. Testing:
      1) In accordance with ASTM D1140 to determine percentage of fines.
      2) In accordance with ASTM D422 to determine gradation of particles larger than No. 200 sieve.
   d. Acceptance:
      1) Based on inspection of source by Construction Manager.
      2) Certified test results.
   e. Provide additional sampling, testing, and certification for every 500 cubic yards of material and when there is a change in granular drain material.
   f. Upon Construction Manager's request, supply supplemental samples of granular drain material to a testing laboratory designated by Owner during installation of drain lines. Owner will bear costs of testing.

## 1.06 DOCUMENTATION

A. Survey Plan:

1. Submit prior to beginning Work.
2. Update on a weekly basis through final drain line inspection and cleaning.

B. Surveying:

1. At least 10 days prior to installation, provide Construction Manager with the following information for each drain line:
   a. Field survey ground surface elevations at 250-foot increments.
   b. Calculated cut depth from ground surface to drain line invert elevation.
2. Provide surveyed drain line grades to Construction Manager no more than 5 days following installation of drain line section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Drain Sock:

1. Free of tears or other damage. Replace damaged sock.
2. Protect polyethylene drain lines with geotextile sock from UV light while stored onsite, unless geotextile sock is certified UV resistant.
3. UV-resistant Sock Stored Onsite Uncovered:
   a. Mark date of first sunlight exposure for each roll at factory.
   b. Do not allow UV-resistant sock to remain uncovered for more time than recommended by manufacturer.

**PART 2 PRODUCTS**

2.01 DRAIN LINES

A. Drain lines shall be perforated, unless otherwise noted on Drawings.

B. Perforated Drain Lines:

1. Heavy-duty corrugated polyethylene pipe meeting NRCS Conservation Practice Specification 606.
2. Conforming to ASTM F405 for 3-inch to 6-inch diameter pipe.
3. Conforming to ASTM F667 for 8-inch to 15-inch diameter pipe.
4. Water Inlet:
   a. Area of at least 1 square inch per foot of length.
   b. Dimensions of water inlet area shall be measured on a straight specimen with no external forces applied. Make measurements with instruments accurate to 0.01 inch.
   c. Perforations:
      1) Locate at least one perforation in the middle of corrugation so there is a shoulder on each side of perforation.
      2) Pipe 4 Inches to 12 Inches in Diameter:
         a) Slotted perforations shall be no wider than 1/8 inch or no longer than 1-1/4 inches.
         b) Slotted perforations equally spaced along length and circumference of tubing in not less than three rows.
      3) Pipe 15 inches in Diameter: Circular perforations will be accepted.
5. Biofiltration Underdrain, see Section 207-17.7 of the 2015 City of San Diego Supplement “Whitebook” Standard Specifications for Public Works Construction.

C. Nonperforated Drain Lines:

1. Heavy-duty corrugated polyethylene pipe with smooth interior walls.

2. Conforming to AASHTO M252 for 3-inch to 10-inch pipe.
3. Conforming to AASHTO M294 for 12-inch to 15-inch pipe, Type S.

D. Drain Sock: Provide geotextile fabric material (sock) surrounding perforated drain lines.

E. Drain Line Fittings:

1. Includes cleanouts, elbows, tees, branch connections, snap end caps, and reducing couplers.
2. Conforming to ASTM F405 and ASTM F667 as appropriate.
3. Cleanout snap end cap shall have a metal locating plate attached as shown on Drawings.
4. Diameter of cleanout fittings shall be as shown on Drawings.
5. Fittings installed as part of a continuous operation shall be clamp type rather than snap type. Fittings installed after pipe is in place may be either type.

## 2.02 GRANULAR DRAIN MATERIAL

A. In accordance with Section 31 23 23.15, Trench Backfill.

B. Composed of hard, durable, natural mineral particles free from organic matter, clay balls, soft particles, or other impurities or foreign matter.

## 2.03 TRENCH BACKFILL

A. Above pipe zone shall be in accordance with Section 31 23 23.15, Trench Backfill.

B. Within pipe zone shall be in accordance with Section 31 23 23.15, Trench Backfill.

C. Native backfill free from organic matter and other impurities or foreign matter and free from rocks larger than 3 inches in diameter.

## 2.04 BASE ROCK

A. In accordance with Section 31 23 23.15, Trench Backfill.

B. Base rock shall be clean 3/4-inch minus crushed granular or crushed rock uniformly graded from coarse to fine and with sufficient fines for proper compaction.

## PART 3 EXECUTION

### 3.01 TRENCH EXCAVATION

A. Trenching Equipment:

1. Automatic laser-guided grade control.
2. Shoe (or boot) that allows granular fill to be placed uniformly around perforated drain lines in a continuous operation during installation.
3. Equipped with specially lengthened shield.
4. Capable of operating at sufficient speed to ensure drain lines can be laid and blinded with granular drain material before groundwater or soil-water slurry moves into trench and into direct contact with drain line.

B. In accordance with Section 31 23 16, Excavation.

C. Excavate to lines and grades shown on Drawings, allowing required thickness of granular fill to be placed around drain lines as shown on Drawings.

D. Installation of Drain Lines below Water Table: Install with trenching machine specifically designed for fluid soil conditions.

### 3.02 DRAIN LINE INSTALLATION

A. Pipe Installation:

1. Handle and install in conformance with ASTM F449.
2. Lay drain lines and appurtenances to lines and grades shown on Drawings.
3. Take special precautions on hot days to ensure stretch limit is not exceeded and excessive deflection is not caused by premature backfilling.

B. Fitting Installation:

1. Standard connections shall be in conformance with ASTM F449.
2. For nonstandard connections, join drain lines using manufacturer's printed recommended methods to complete connection.
3. Drain lines that are exposed to make a connection after trench backfilling shall have 4 inches of granular drain material replaced around drain line and connection.
4. Wrap connections and fittings with geotextile sock.

## 3.03 GRANULAR DRAIN MATERIAL INSTALLATION

A. Place granular drain material around perforated drain lines as shown on Drawings.

B. Place granular drain material around perforated drain lines in a continuous operation during placement of drain lines.

C. Place granular drain material with spreader boxes or other equipment in a manner to minimize segregation.

## 3.04 TRENCH BACKFILL

A. Trench shall not be left open overnight; plug end of drain lines and backfill trench to prevent animals, sediment, or debris from entering pipe.

B. Perform in a manner that shall minimize settlement.

C. Backfill may be placed automatically by trencher.

D. Where backfill material is placed in drain line trenches mechanically, backfill material shall be pushed onto slope of backfill previously placed and allowed to slide down into trench. Backfill shall not be pushed into trench in such a way as to permit free fall of material until at least 2 feet of cover has been provided over the top of drain line.

E. Place in such a manner to prevent displacement of drain line and granular fill after backfilling.

F. Trench Compaction:

1. After initial backfilling to final grade, a rubber-tired tractor shall be driven a minimum of two passes with tires running parallel on top of trench to facilitate compaction.
2. Additional mechanical backfilling shall be done to leave trench with 4-inch to 6-inch elevated mound on trench.

G. Unless otherwise directed by Construction Manager, procedures for compaction of trench backfill material shall be accomplished by close of each day’s work.

## 3.05 CLEANING ACCESS INSTALLATION

A. Install inline cleanouts and end-of-line caps as shown on Drawings.

B. Install end-of-line caps at upstream end of drain lines.

## 3.06 FIELD QUALITY CONTROL

A. Drain Line Grade:

1. Measure by excavating down to drain every 250 feet and at the beginning and end of each line.
2. Measure drain invert elevation with a survey method accurate to 0.01 foot vertical.
3. Measure for grade at the top of pipe.
4. Drain lines with grades less than 1 percent shall be placed to the design grade within a tolerance of plus or minus 0.1 foot of design invert elevation.
5. Grades of 1 percent or steeper shall be placed to the design grade within a tolerance of plus or minus 0.2 foot of design invert elevation.
6. No reversal in grade of the drain lines shall be permitted.

B. Drain Line Stretching:

1. Drain lines shall not be stretched more than 5 percent during installation.
2. Measure stretch by measuring the distance across a minimum of 10 corrugations and comparing to manufacturer's standard corrugation dimensions.

## 3.07 FINAL INSPECTION AND CLEANING

A. Preparation:

1. Do not begin jet washing until subsurface drainage work within a DMU is complete.
2. Stage the Work to provide adequate supply of water for jet washing to allow inspection and cleaning of each section of drain line in one continuous operation.
3. Access to drain lines shall be through drain line cleanouts.

B. High Pressure Jet Washing Equipment:

1. Suitable type and size to perform cleaning specified herein.
2. Cleaning nozzle capable of jet washing 6-inch diameter to 15-inch diameter drain lines in sections up to 1,000 feet long.
3. Capable of negotiating 4-inch diameter cleaning access point.
4. Jet mechanism shall have a forward-piercing jet with trailing side jets that propel mechanism forward.
5. Operating pressures at pump shall not exceed a maximum of 2,300 psi.
6. Operate in accordance with manufacturer's printed instructions, recommendations, and best practice of the trade.

C. Pass high-pressure water jet cleaner through entire length of each drain line no sooner than 10 calendar days after installation of drain line.

D. When drain lines must be jet washed in sections, upstream sections shall be jet washed before connecting section downstream.

E. If tail water produced is not clear, run jet cleaner through drain line section up to two more passes.

F. Obstructions within drain lines, collapsed drain line sections, or sections outside allowable tolerances for grade that are identified during final inspection and cleaning shall be repaired and corrected to meet Specification.

G. Complete final drain line inspection and cleaning certification of compliance addressing the following items:

1. Dates of work, equipment, and personnel performing work.
2. Locations and descriptions of obstructions, collapsed sections, out-of-grade sections, and actions taken to repair problems.
3. Locations of sections where tail water did not run clear after three passes.

H. After completing jet washing for a drain line, restore area to a neat and finished appearance.

**END OF SECTION**

# SECTION 40 05 15
# PIPING SUPPORT SYSTEMS

## PART 1 GENERAL

### 1.01 DEFINITIONS

A. Wetted or Submerged: Within tank or existing channel, or in other damp locations.

### 1.02 SUBMITTALS

A. Action Submittals:

1. Catalog information and drawings of piping support system, locating each support, sway brace, seismic brace, hanger, guide, component, and anchor for all piping. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.
2. Calculations for each type of pipe support, attachment, and anchor.
3. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.
4. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
3. Maintenance information on piping support system.

### 1.03 QUALIFICATIONS

A. Piping support systems shall be designed and Shop Drawings prepared and sealed by a Registered Professional Engineer in the State of California.

### 1.04 DESIGN REQUIREMENTS

A. General:

1. Design, size, and locate piping support systems throughout facility, whether shown or not.

2. Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.
3. Piping 30 Inches and Larger: Support systems have been designed for piping shown.
4. Meet requirements of MSS SP 58 and ASME B31.1 or as modified by this section.

B. Pipe Support Systems:

1. Design pipe support systems for gravity and thrust loads imposed by weight of pipes or internal pressures, including insulation and weight of fluid in pipes.
2. Seismic loads in accordance with governing codes and as shown on Structural General Drawings.
3. Wind loads in accordance with governing codes and as shown on Structural General Drawings.
4. Maximum Support Spacing and Minimum Rod Size: In accordance MSS SP 58 Table 3 and Table 4.
   a. Ductile Iron Pipe 8 Inches and Under: Maximum span limited to that for standard weight steel pipe for water service.
   b. Ductile Iron Pipe 10 Inches and Larger: Maximum span limited to 20 feet.

C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

D. Vertical Sway Bracing: 10-foot maximum centers or as shown.

E. Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show they are adequate for additional load, or if they are strengthened to support additional load.

## PART 2 PRODUCTS

### 2.01 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated.

B. Special support and hanger details may be required for cases where standard catalog supports are not applicable.

C. Materials: For pipe support materials in the Early Site Work Project, refer to the Area Classification and Materials Selection Table on Drawings. Pipe support materials to be galvanized or precoated steel for the Demonstration Pure Water Facility Ozone and Biologically Active Carbon Relocation Project unless called out on Drawings as Hastelloy C-276 alloy and FRP pipe support materials.

2.02 HANGERS

A. Clevis:

1. MSS SP 58, Type 1:
   a. Anvil; Figure 260 for steel pipe and Figure 590 for ductile iron pipe, sizes 1/2-inch through 30 inches.
   b. Insulated Steel Pipe: Anvil; Figure 260 with insulated saddle system (ISS), sizes 1/2-inch through 16 inches.
   c. B-Line; Figure B3100, sizes 1/2-inch through 30 inches.

B. Adjustable Swivel Split-Ring Pipe Clamp:

1. MSS SP 58, Type 6:
   a. Anvil; Figure 104, sizes 3/4-inch through 8 inches.
   b. B-Line; Figure B3171, sizes 3/4-inch through 8 inches.

C. Steel Yoke Pipe Rolls and Roller Supports:

1. MSS SP 58, Type 41 or Type 43:
   a. Anvil; Figure 181 for sizes 2-1/2 inches through 24 inches, and Figure 171 for sizes 1-inch through 30 inches.
   b. B-Line; Figure B3110 for sizes 2 inches through 24 inches and Figure B3114 for 30 inches.

D. Pipe Rollers and Supports:

1. MSS SP 58, Type 44:
   a. Anvil; Figure 175, sizes 2 inches through 30 inches.
   b. B-Line; Figure B3120, sizes 2 inches through 24 inches.

2.03 WALL BRACKETS, SUPPORTS, AND GUIDES

A. Welded Steel Wall Bracket:

1. MSS SP 58, Type 33 (heavy-duty):
   a. Anvil; Figure 199, 3,000-pound rating.
   b. B-Line; Figure B3067, 3,000-pound rating.

B. Adjustable “J” Hanger:

1. MSS SP 58, Type 5:
   a. Anvil; Figure 67, sizes 1/2-inch through 8 inches.
   b. B-Line; Figure B3690, sizes 1/2-inch through 8 inches.

C. Offset Pipe Clamp: Anvil; Figure 103, sizes 3/4-inch through 8 inches.

D. Channel Type:

1. Unistrut.
2. Anvil; Power-Strut.
3. B-Line; Strut System.
4. Aickinstrut (FRP).
5. Or approved equal.

## 2.04 PIPE SADDLES

A. Provide 90-degree to 120-degree pipe saddle for pipe 6 inches and larger with baseplates drilled for anchors bolts.

1. In accordance with Standard Detail 4005-515.
2. Sizes 20 inches though 60 inches, Piping Technology & Products, Inc.; Figure 2000.

B. Saddle Supports, Pedestal Type:

1. Minimum standard weight pipe stanchion, saddle, and anchoring flange.
2. Nonadjustable Saddle: MSS SP, Type 37 with U-bolt.
   a. Anvil; Figure 259, sizes 4 inches through 36 inches with Figure 63C base.
   b. B-Line; Figure B3095, sizes 1 inch through 36 inches with B3088S base.
3. Adjustable Saddle: MSS SP 58, Type 38 without clamp.
   a. Anvil; Figure 264, sizes 2-1/2 inches through 36 inches with Figure 62C base.
   b. B-Line; Figure B3092, sizes 3/4-inch through 36 inches with Figure B3088S base.

## 2.05 CHANNEL TYPE SUPPORT SYSTEMS

A. Channel Size: 12-gauge, 1-5/8-inch-wide minimum stainless steel, or 1-1/2-inch minimum FRP.

B. Members and Connections: Design for loads using one-half of manufacturer’s allowable loads.

C. Fasteners: Stainless steel fasteners.

D. Manufacturers and Products:

1. B-Line; Strut System.
2. Unistrut.
3. Anvil; Power-Strut.
4. Aickinstrut (FRP System).
5. Enduro-Durostrut (FRP Systems).
6. Or approved equal.

2.06 FRP PIPE SUPPORTS SYSTEMS

A. General:

1. FRP with UV additive, protective veil, and vinyl ester resins resistance to chemicals listed in Supplement at end of section.
2. Fire Retardant: ASTM E84.
3. Include hangers, rods, attachments, and fasteners.

B. Clevis Hangers:

1. Factor of Safety: 3 to 1.
2. Minimum Design Load: 200 pounds.

C. Design:

1. Design pipe supports spacing, hanger rod sizing based upon manufacturer’s recommendations.
2. Identify and highlight non-FRP fasteners or components on Shop Drawings.

D. Manufacturers:

1. Aickinstrut.
2. Enduro.
3. Century Composite.
4. Or approved equal.

2.07 PIPE CLAMPS

A. Riser Clamp: MSS SP 58, Type 8.

1. Anvil; Figure 261, sizes 3/4-inch through 24 inches.
2. B-Line; Figure B3373, sizes 1/2-inch through 30 inches.

2.08 ELBOW AND FLANGE SUPPORTS

A. Elbow with Adjustable Stanchion: Sizes 2 inches through 18 inches, Anvil; Figure 62C base.

B. Elbow with Nonadjustable Stanchion: Sizes 2-1/2 inches through 42 inches, Anvil; Figure 63A or Figure 63B base.

C. Flange Support with Adjustable Base: Sizes 2 inches through 24 inches, Standon; Model S89.

2.09 INTERMEDIATE PIPE GUIDES

A. Type: Hold down pipe guide.

1. Manufacturer and Product:
   a. B-Line; Figure B3552, 1-1/2 inches through 30 inches.
   b. Or approved equal.

B. Type: U-bolts with double nuts to provide nominal 1/8-inch to 1/4-inch clearance around pipe; MSS SP 58, Type 24.

1. Manufacturers and Products:
   a. Anvil; Figure 137 and Figure 137S.
   b. B-Line; Figure B3188 and Figure B3188NS.
   c. Or approved equal.

2.10 PIPE ALIGNMENT GUIDES

A. Type: Spider.

B. Manufacturers and Products:

1. Anvil; Figure 255, sizes 1/2-inch through 24 inches.
2. B-Line; Figure B3281 through Figure B3287, sizes 1/2-inch through 24 inches.
3. Or approved equal.

2.11 PIPE ANCHORS

A. Type: Anchor chair with U-bolt strap.

B. Manufacturer and Product:

1. B-Line; Figure B3147A or Figure B3147B.
2. Or approved equal.

## 2.12 SEISMIC RESTRAINTS

A. Solid pipe bracing attachment to pipe clevis with clevis cross brace and angle rod reinforcement.

B. Manufacturers:

1. Mason Industries.
2. B-Line.
3. Anvil.
4. Or approved equal.

## 2.13 ACCESSORIES

A. Anchor Bolts:

1. Size and Material: Sized by Contractor for required loads, 1/2-inch minimum diameter, and as specified in Section 05 50 00, Metal Fabrications.
2. Bolt Length (Extension Above Top of Nut):
   a. Minimum Length: Flush with top of nut preferred. If not flush, shall be no more than one thread recessed below top of nut.
   b. Maximum Length: No more than a full nut depth above top of nut.

B. Dielectric Barriers:

1. Plastic coated hangers, isolation cushion, or tape.
2. Manufacturer and Products:
   a. B-Line; B1999 Vibra Cushion.
   b. B-Line; Iso Pipe, Isolation Tape.
   c. Or approved equal.

C. Plastic Pipe Support Channel:

1. Type: Continuous support for plastic pipe and to increase support spacing.
2. Manufacturer and Product:
   a. B-Line; Figure Series B3106V, sizes 1/2-inch through 6 inches with Figure B3106 Vee bottom hanger.
   b. Or approved equal.

D. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. General:

1. Install support systems in accordance with MSS SP 58, unless shown otherwise.
2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
3. Support piping connections to equipment by pipe support and not by equipment.
4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
5. Support no pipe from pipe above it.
6. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
7. Do not use adhesive anchors for attachment of supports to ceiling or walls.
8. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
9. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
10. Install lateral supports for seismic loads at changes in direction.
11. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
12. Repair mounting surfaces to original condition after attachments are completed.

B. Standard Pipe Supports:

1. Horizontal Suspended Piping:
   a. Single Pipes: Clevis hangers or adjustable swivel split-ring.
   b. Grouped Pipes: Trapeze hanger system.
2. Horizontal Piping Supported from Walls:
   a. Single Pipes: Wall brackets, or attached to wall, or to wall mounted framing with anchors.
   b. Stacked Piping: Wall mounted framing system and “J” hangers acceptable for pipe smaller than 3-inch.
   c. Pipe clamp that resists axial movement of pipe through support is not acceptable. Use pipe rollers supported from wall bracket.
3. Horizontal Piping Supported from Floors:
   a. Saddle Supports:
      1) Pedestal type, elbow and flange.
      2) Provide minimum 1-1/2-inch grout beneath baseplate.

b. Floor Mounted Channel Supports:
   1) Use for pipe smaller than 3-inch running along floors and in trenches at pipe elevations lower than can be accommodated using pedestal pipe supports.
   2) Attach channel framing to floors with baseplate on minimum 1-1/2-inch nonshrink grout and with anchor bolts.
   3) Attach pipe to channel with clips or pipe clamps.
c. Concrete Cradles: Use for pipe larger than 3 inches along floor and in trenches at pipe elevations lower than can be accommodated using stanchion type.
d. Wall-mounted pipe clips not acceptable for insulated piping.

4. Vertical Pipe: Support with wall bracket and elbow support, or riser clamp on floor penetration.

C. Standard Attachments:

1. Steel Beams: I-beam clamp or welded attachments.
2. Concrete Walls: Concrete inserts or brackets or clip angles with concrete anchors.
3. Concrete Beams: Concrete inserts, or if inserts are not used attach to vertical surface similar to concrete wall. Do not drill into beam bottom.

D. Intermediate and Pipe Alignment Guides:

1. Provide pipe alignment guides, or pipe supports that provide same function, at expansion joints and loops.
2. Guide pipe on each side of expansion joint or loop at four pipe and 14 pipe diameters from each joint or loop.
3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

E. Accessories:

1. Dielectric Barrier:
   a. Provide between painted or galvanized carbon steel members and copper or stainless steel pipe or between stainless steel supports and nonstainless steel ferrous metal piping.
   b. Install rubber wrap between submerged metal pipe and oversized clamps.

3.02 FIELD FINISHING

A. Paint atmospheric exposed surfaces hot-dip galvanized steel components as specified in Section 09 90 00, Painting and Coating.

**END OF SECTION**

# SECTION 40 27 00
# PROCESS PIPING—GENERAL

## PART 1 GENERAL

### 1.01 DEFINITIONS

A. Submerged or Wetted: Within tank or in other damp location.

### 1.02 DESIGN REQUIREMENTS

A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:

1. Process Piping: ASME B31.3, normal fluid service unless otherwise specified.
2. Buried Piping: H20-S16 traffic load with 1.5 impact factor, AASHTO HB-17, as applicable.

### 1.03 SUBMITTALS

A. Action Submittals:

1. Shop Fabricated Piping:
   a. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
   b. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
2. Pipe Wall Thickness: Identify wall thickness and rational method or standard applied to determine wall thickness for each size of each different service including exposed, submerged, buried, and concrete-encased installations for Contractor-designed piping.
3. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.
4. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.
5. Pipe Corrosion Protection: Product data.
6. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Manufacturer's Certification of Compliance, in accordance with Section 01 61 00, Common Product Requirements:
   a. Pipe and fittings.
   b. Factory applied resins and coatings.
2. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
3. Flanged Pipe and Fittings: Manufacturer's product data sheets for gaskets including torqueing requirements and bolt tightening procedures.
4. Qualifications:
   a. Nondestructive Testing Personnel: SNT-TC-1A Level II certification and qualifications.
   b. AWS QC1 Certified Welding Inspector: Submit evidence of current certification prior to commencement of welding activities.
   c. Welders:
      1) Continuity log for welders and welding operators.
      2) Welder qualification test records conducted by Contractor or manufacturer.
5. Welding Procedures: Qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
6. Nondestructive inspection and testing procedures.
7. Test logs.
8. Pipe coating applicator certification.
9. Laboratory Testing Equipment: Certified calibrations, manufacturer's product data, and test procedures.
10. CWI inspection records and NDE test records.
11. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.

## 1.04 QUALITY ASSURANCE

A. Qualifications:

1. Inspection and Testing Agency:
   a. Provide project experience and references in field of welding and welded pipe and fittings' testing required for this Project.
   b. Calibrated instruments and equipment, and documented standard procedures for performing specified testing.
   c. Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Project.
   d. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

e. Verification Welding Inspector: AWS QC1 Certified.

2. Welding Procedures: In accordance with ASME BPVC SEC IX (Forms QW-482 and QW-483) or AWS D1.1/D1.1M (Annex N Forms).
3. Welder Qualifications: In accordance ASME BPVC SEC IX (Form QW-484) or AWS D1.1/D1.1M (Annex N Forms).
4. Contractor's CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require approval by Construction Manager.

1.05 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements, and:

1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
3. Linings and Coatings: Prevent excessive drying.
4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

## PART 2 PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 PIPING

A. As specified on Piping Data Sheet(s) located at the end of this section as Supplement and on Piping Schedule as shown on Drawings.

B. Diameters Shown:

1. Standardized Products: Nominal size.
2. Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.
3. Cement-Lined Steel Pipe: Lining inside diameter.

2.03 JOINTS

A. Grooved End System: Use of grooved joints only allowed for specific locations with prior approval by Construction Manager.

B. Flanged Joints:

1. Flat-faced, carbon steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.
2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

C. Threaded Joints: NPT taper pipe threads in accordance with ASME B1.20.1.

D. Mechanical Joint Anchor Gland Follower:

1. Ductile iron anchor type, wedge action, with break-off tightening bolts.
2. Thrust rated to 250 psi minimum.
3. Rated Operating Deflection Not Less than:
   a. 3 degrees for sizes through 12 inches.
   b. 2 degrees for sizes 14 inches through 16 inches.
   c. 1.5 degrees for sizes 18 inches through 24 inches.
   d. 1 degree for sizes 30 inches through 48 inches.
4. UL and FM approved.

E. Flexible Mechanical Compression Joint Coupling:

1. Stainless steel, ASTM A276, Type 305 bands.
2. Manufacturers:
   a. Pipeline Products Corp.
   b. Fernco Joint Sealer Co.
   c. Or approved equal.

F. Mechanical connections of high-density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through-flanged connections consisting of the following:

1. Polyethylene stub end thermally butt-fused to end of pipe.

2. ASTM A240/A240M, Type 304 stainless steel backing flange, 125-pound, ASME B16.1 standard. Use insulating flanges where shown.
3. Bolts and nuts of sufficient length to show a minimum of three complete threads when joint is made and tightened to manufacturer's standard. Retorque nuts after 4 hours.
4. Gaskets as specified on Data Sheet.

2.04 GASKET LUBRICANT

A. Lubricant shall be supplied by pipe manufacturer and approved by gasket manufacturer.

2.05 DOUBLE WALL CONTAINMENT PIPING SYSTEM

A. System components shall be pre-engineered, factory fabricated, tested, and assembled such that field assembly is minimized to primarily that of straight joints.

2.06 PIPE CORROSION PROTECTION

A. Coatings: See Section 09 90 00, Painting and Coating, for details of coating requirements.

B. Heat Shrink Wrap:

1. Type: Cross-linked polyolefin wrap or sleeve with mastic sealant.
2. Manufacturer and Product:
   a. Raychem; WPC or TPS.
   b. Or approved equal.

C. Polyethylene Encasement (Bagging):

1. Encasement Tube: Black polyethylene encasement tube, 8 mils minimum thickness, conforming to AWWA C105/A21.5, free of gels, streaks, pinholes, foreign matter, undispersed raw materials, and visible defects such as tears, blisters, and thinning at folds.
2. Securing Tape: Thermoplastic tape, 8 mils minimum thickness, 1 inch wide, pressure sensitive adhesive face capable of bonding to metal, bituminous coating, and polyethylene encasement tube.

D. Insulating Flanges, Couplings, and Unions:

1. Materials:
   a. In accordance with applicable piping material specified in Pipe Data Sheet. Complete assembly shall have ASME B31.3 working pressure rating equal to or higher than that of joint and pipeline.
   b. Galvanically compatible with piping.
   c. Resistant for intended exposure, operating temperatures, and products in pipeline.
2. Union Type, 2 Inches and Smaller:
   a. Screwed or solder-joint.
   b. O-ring sealed with molded and bonded insulation to body.
3. Flange Type, 2-1/2 Inches and Larger:
   a. Flanged, complete with bolt insulators, dielectric gasket, bolts, and nuts.
   b. Bolt insulating sleeves shall be provided full length between insulating washers.
   c. Ensure fit-up of components of insulated flange assembly to provide a complete functioning installation.
   d. AWWA C207 steel flanges may be drilled oversize up to 1/8-inch to accommodate insulating sleeves.
   e. No less than minimum thread engagement in accordance with specified bolting standards will be permitted to accommodate thicknesses of required washers, flanges, and gasket.
4. Flange Insulating Kits:
   a. Gaskets: Full-face, Type E with elastomeric sealing element. Sealing element shall be retained in a groove within retainer portion of gasket.
   b. Insulating Sleeves: Full-length fiberglass reinforced epoxy (NEMA LI-1, G-10 grade).
   c. Insulating Washers: Fiberglass-reinforced epoxy (NEMA LI-1, G-10 grade).
   d. Steel Washers: Hardened steel, ASTM F436, 1/8 inch thick.
      1) Flange Diameters 36 Inches or Less: Provide two washers per bolt.
      2) Flange Diameters Larger Than 36 Inches: Provide four washers per bolt.
5. Manufacturers and Products:
   a. Dielectric Flanges and Unions:
      1) PSI, Houston, TX.
      2) Advance Products and Systems, Lafayette, LA.
      3) Or approved equal.

b. Insulating Couplings:
   1) Dresser; STAB-39.
   2) Baker Coupling Company, Inc.; Series 216.
   3) Or approved equal.

2.07 THRUST TIES

A. Steel Pipe: Fabricated lugs and rods in accordance with details shown on Drawings.

B. Buried Ductile Iron Pipe and Fittings: Unless restraint is otherwise specified or shown, conform to NFPA 24. Tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.

2.08 VENT AND DRAIN VALVES

A. Pipeline 2-Inch Diameter and Smaller: 1/2-inch vent, 1-inch drain, unless shown otherwise.

B. Pipelines 2-1/2-Inch Diameter and Larger: 3/4-inch vent, 1-inch drain, unless shown otherwise.

2.09 FABRICATION

A. Mark each pipe length on outside with the following:

1. Size or diameter and class.
2. Manufacturer’s identification and pipe serial number.
3. Location number on laying drawing.
4. Date of manufacture.

B. Code markings according to approved Shop Drawings.

C. Shop fabricate flanged pipe in shop, not in field, and delivered to Site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by manufacturer.

2.10 FINISHES

A. Factory prepare, prime, and finish coat in accordance with Piping Data Sheet(s) and Piping Schedule as shown on Drawings.

B. Galvanizing:

1. Hot-dip applied, meeting requirements of ASTM A153/A153M.
2. Electroplated zinc or cadmium plating is unacceptable.
3. Stainless steel components may be substituted where galvanizing is specified.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

### 3.02 PREPARATION

A. See Piping Schedule as shown on Drawings and Section 09 90 00, Painting and Coating, for additional requirements.

B. Notify Construction Manager at least 2 weeks prior to field fabrication of pipe or fittings.

C. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

D. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

### 3.03 WELDING

A. Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.3 for Pressure Piping, as may be specified on Piping Data Sheets, and if recommended by piping or fitting manufacturer.

B. Weld Identification: Keep paper record of which welder welded each joint.

C. Pipe End Preparation:

1. Machine Shaping: Preferred.
2. Oxygen or Arc Cutting: Smooth to touch, true, and slag removal by chipping or grinding.
3. Beveled Ends for Butt Welding: ASME B16.25.

D. Surfaces:

1. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
2. Clean stainless steel joints with stainless steel wire brushes or stainless steel wool prior to welding.
3. Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

E. Alignment and Spacing:

1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
2. Root Opening of Joint: As stated in qualified welding procedure.
3. Minimum Spacing of Circumferential Butt Welds: Minimum four times pipe wall thickness or 1 inch, whichever is greater.

F. Climatic Conditions:

1. Do not perform welding if there is impingement of any rain, snow, sleet, or wind exceeding 5 mph on the weld area, or if ambient temperature is below 32 degrees F.
2. Stainless Steel and Alloy Piping: If ambient is less than 32 degrees F, local preheating to a temperature warm to the hand is required.

G. Tack Welds: Performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

H. Surface Defects: Chip or grind out those affecting soundness of weld.

I. Weld Quality: Meet requirements of governing welding codes.

## 3.04 INSTALLATION—GENERAL

A. Join pipe and fittings in accordance with manufacturer’s instructions, unless otherwise shown or specified.

B. Remove foreign objects prior to assembly and installation.

C. Flanged Joints:

1. Install perpendicular to pipe centerline.
2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
5. Grooved Joint Flange Adapters: Include stainless steel washer plates as required for mating to serrated faces and lined valves and equipment.
6. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.
7. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
8. Flange fillers are to be avoided, but if necessary, may be used to make up for small angles up to 6 degrees and for filling gaps up to 2 inches between flanges. Stacked flange fillers shall not be used.
9. Threaded flanged joints shall be shop fabricated and delivered to Site with flanges in-place and properly faced.
10. Manufacturer: Same as pipe manufacturer or grooved joint flange adapter manufacturer.

D. Threaded and Coupled Joints:

1. Conform to ASME B1.20.1.
2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
3. Countersink pipe ends, ream and clean chips and burrs after threading.
4. Make connections with not more than three threads exposed.
5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

E. Soldered Joints:

1. Use only solder specified for particular service.
2. Cut pipe ends square and remove fins and burrs.
3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
4. Wipe excess solder from exterior of joint before hardened.
5. Before soldering, remove stems and washers from solder joint valves.

F. Pipe Connections at Concrete Structures: As specified in Article Piping Flexibility Provisions in Section 40 27 01, Process Piping Specialties.

G. PVC Piping:

1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
3. Do not thread Schedule 40 pipe.

3.05 INSTALLATION—EXPOSED PIPING

A. Piping Runs:

1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports: As specified in Section 40 05 15, Piping Support Systems.

C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

F. Piping clearance, unless otherwise shown:

1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
3. From Adjacent Work: Minimum 1 inch from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.

5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

## 3.06 INSTALLATION—BURIED PIPE

A. Joints:

1. Dissimilar Buried Pipes:
   a. Provide flexible mechanical compression joints for pressure pipe.
   b. Provide concrete closure collar for gravity and low pressure (maximum 10 psi) piping or as shown.
2. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown.

B. Placement:

1. Keep trench dry until pipe laying and joining are completed.
2. Pipe Base and Pipe Zone: As specified in Section 31 23 23.15, Trench Backfill.
3. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
4. Measure for grade at pipe invert, not at top of pipe.
5. Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.
6. Prevent foreign material from entering pipe during placement.
7. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day’s work.
8. Lay pipe upgrade with bell ends pointing in direction of laying.
9. Install closure sections and adapters for gravity piping at locations where pipe laying changes direction.
10. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
    a. Shorter pipe lengths.
    b. Special mitered joints.
    c. Standard or special fabricated bends.
11. After joint has been made, check pipe alignment and grade.
12. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.

13. Prevent uplift and floating of pipe prior to backfilling.

C. PVC Pipe Placement:

1. Lay pipe snaking from one side of trench to other.
2. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and during operation.
3. Do not lay pipe when temperature is below 40 degrees F, or above 90 degrees F when exposed to direct sunlight.
4. Shield ends to be joined from direct sunlight prior to and during the laying operation.

D. Tolerances:

1. Deflection from Horizontal Line, Except PVC: Maximum 2 inches.
2. Deflection from Vertical Grade: Maximum 1/4 inch.
3. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.
4. Horizontal position of pipe centerline on alignment around curves maximum variation of 1.75 feet from position shown.
5. Pipe Cover: Minimum 3 feet, unless otherwise shown.

## 3.07 INSTALLATION—CONCRETE ENCASED

A. Provide reinforced concrete pipe encasement where shown on Drawings and where otherwise required. Some piping may be required to be concrete encased for pipe strength requirements that are included in the Specifications. Piping under and within the influence of buildings, utility trenches, vaults, slabs, and other structures shall be concrete encased. See details on Drawings for encasement requirements.

B. Where concrete encased piping crosses structure construction and expansion joints, provide flexible piping joints to coincide with structure joints to prevent excessive pipe stress and breakage.

## 3.08 INSTALLATION—DOUBLE WALL CONTAINMENT PIPING SYSTEM

A. Install according to manufacturer's instructions.

B. Valves and equipment shall be supported independently from pipe. Anchor valves such that turning moment resulting from their operation will not be transmitted to pipe.

C. Centering Devices for Double Wall Containment Piping:

1. Center and support carrier pipe within the containment pipe with centering devices. Locate not less than every 9 feet, or within 24 inches of the termination of containment pipe on fabricated pieces.
2. Install centering devices such that system maintains free drainage.

D. Following Installation and Testing:

1. Flush clean carrier and containment piping system.
2. Purge annular space of moisture with clean, dry air.

## 3.09 PIPE CORROSION PROTECTION

A. Carbon Steel Pipe:

1. Exposed: As specified in Section 09 90 00, Painting and Coating.
2. Buried:
   a. Pipe: Wrap with tape coating system as specified in Section 09 90 00, Painting and Coating.
   b. Joints: Wrap with tape coating system as specified in Section 09 90 00, Painting and Coating, or heat shrink wrap as specified herein.
3. Submerged or Embedded: Shop coat with coal-tar epoxy as specified in Section 09 90 00, Painting and Coating. If in potable water service, use NSF/ANSI 61 approved epoxy.

B. Copper Pipe:

1. Exposed: As specified in Section 09 90 00, Painting and Coating.
2. Buried:
   a. Pipe: Tape Wrap.
   b. Joints: Tape Wrap.

C. PVC Pipe, Exposed: As specified in Section 09 90 00, Painting and Coating.

D. Piping Accessories:

1. Exposed:
   a. Field paint black and galvanized steel, brass, copper, and bronze piping components as specified in Section 09 90 00, Painting and Coating, as applicable to base metal material.
   b. Accessories include, but are not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves, and fasteners.

2. Buried:
   a. Ferrous Metal and Stainless Steel Components: Coat with coal-tar epoxy as specified in Section 09 90 00, Painting and Coating.
   b. Bolts, Nuts, and Similar Items: Coat with bituminous paint.
   c. Flexible Couplings and Similar Items: Wrap with heat shrink wrap or coat with cement.
   d. Buried Valves and Similar Elements on Wrapped Pipelines: Coat with bituminous paint and wrap entire valve in polyethylene encasement.

E. Tape Coating System: As specified in Section 09 90 00, Painting and Coating.

F. Heat Shrink Wrap: Apply in accordance with manufacturer's instructions to surfaces that are cleaned, prepared, and primed.

G. Insulating Flanges, Couplings, and Unions:

1. Applications:
   a. Dissimilar metal piping connections.
   b. Cathodically protected piping penetration to buildings and watertight structures.
   c. Submerged to unsubmerged metallic piping connections.
   d. Connections to existing metallic pipe.
   e. Where required for electrically insulated connection.
2. Pipe Installation:
   a. Insulating joints connecting immersed piping to nonimmersed piping shall be installed above maximum water surface elevation.
   b. Submerged carbon steel, ductile iron, or galvanized piping in reinforced concrete shall be isolated from the concrete reinforcement steel.
   c. Align and install insulating joints as shown on Drawings and according to manufacturer's recommendations. Bolt lubricants that contain graphite or other metallic or electrically conductive components that can interfere with the insulating capabilities of the completed flange shall not be used.

## 3.10 THRUST RESTRAINT

A. Location:

1. Buried Piping: Where shown and where required to restrain force developed at pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist because of hydrostatic testing and normal operating pressure.
2. Exposed Piping: At all joints in piping.

B. Thrust Ties:

1. Steel Pipe: Attach with lugs fabricated in accordance with details shown on Drawings.

## 3.11 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Application and Installation: As specified in Section 40 27 01, Process Piping Specialties.

## 3.12 BRANCH CONNECTIONS

A. Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including first block valve in the line carrying the lower pressure, unless otherwise shown.

C. Threaded Pipe Tap Connections:

1. Ductile Iron Piping: Connect only with service saddle or at tapping boss of a fitting, valve body, or equipment casting.
2. Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.
3. Limitations: Threaded taps in pipe barrel are unacceptable.

## 3.13 VENTS AND DRAINS

A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines as shown and at all low and high point locations.

## 3.14 DISINFECTION

A. See Section 33 13 00, Disinfection of Water Utility Distribution Facilities.

## 3.15 FIELD FINISHING

A. Notify Construction Manager at least 3 days prior to start of surface preparation or coating application work.

B. As specified in Section 09 90 00, Painting and Coating.

## 3.16 PIPE IDENTIFICATION

A. As specified in Section 10 14 00, Signage, Section 31 23 23.15, Trench Backfill, and Section 09 90 00, Painting and Coating.

## 3.17 FIELD QUALITY CONTROL

A. Pressure Leakage Testing: As specified in Section 40 80 01, Process Piping Leakage Testing.

B. Minimum Duties of Welding Inspector:

1. Job material verification and storage.
2. Qualification of welders.
3. Certify conformance with approved welding procedures.
4. Maintenance of records and preparation of reports in a timely manner.
5. Notification to Construction Manager of unsatisfactory weld performance within 24 hours of weld test failure.

C. Required Weld Examinations:

1. Perform examinations in accordance with Piping Code ASME B31.3 for Normal Fluid Service, except that 5 percent of circumferential butt welds shall be random radiographed.
2. Perform examinations for every pipe thickness and for each welding procedure, progressively, for piping covered by this section.
3. Examine at least one of each type and position of weld made by each welder or welding operator.
4. For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the applicable Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two additional welds for each tracer examination found to be unsatisfactory.

## 3.18 CLEANING

A. Following assembly and testing, and prior to disinfection and final acceptance, flush pipelines, except as stated below, with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

B. Blow clean of loose debris natural gas, and instrument air lines with compressed air at 4,000 fpm; do not flush with water.

C. If impractical to flush large diameter pipe at 2.5 fps or blow at 4,000 fpm velocity, clean in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

D. Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.

E. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

## 3.19 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Data Sheets.

| Number | Title |
|---|---|
| 40 27 00.03 | Carbon Steel Pipe and Fittings—General Service |
| 40 27 00.09 | Stainless Steel Pipe and Fittings |
| 40 27 00.10 | Polyvinyl Chloride (PVC) Pipe and Fittings |
| 40 27 00.13 | Copper and Copper Alloy Pipe, Tubing, and Fittings |
| 40 27 00.15 | Double Wall Containment Piping |
| 40 27 00.19 | Polyethylene (PE) Pipe and Fittings—Natural Gas Service |

**END OF SECTION**

| SECTION 40 27 00.03<br>CARBON STEEL PIPE AND FITTINGS—GENERAL SERVICE | | |
|---|---|---|
| **Item** | **Size** | **Description** |
| Pipe | All<br><br><br><br>Screwed:<br>2” & smaller | Black carbon steel, ASTM A106/A106M, Grade B seamless or ASTM A53/A53M, Grade B seamless or ERW. Threaded, butt-welded, grooved end, and flanged joints.<br><br><br>Schedule XS. |
| Joints | 2” & smaller | Welded in accordance to standards outlined in Section 40 27 00, Process Piping—General. Threaded or flanged at valves and equipment or grooved end meeting the requirements of AWWA C606. |
| Branch Connections | 2” & smaller | For Threaded Pipe: Threaded, straight, or reducing tees in conformance with fittings specified above. |
| Flanges | 2” & smaller | Forged carbon steel, ASTM A105/A105M, Grade II, ASME B16.5 Class 150 threaded, 1/16-inch raised face. |
| Unions | 2” & smaller | Threaded malleable iron, ASTM A197/A197 or ASTM A47/A47M, 150-pound or 300-pound WOG, meeting the requirements of ASME B16.3. |
| Couplings | 2-1/2” & larger | Grooved End: Rigid joint malleable iron, ASTM A47/A47M or ductile iron, ASTM A536. Victaulic Co.; Anvil International, Inc., Gruvlok; Shurjoint Piping Products, or approved equal.<br>Screwed End: Malleable iron, ASTM A197/A197M or ASTM A47/A47M. |
| Gaskets | All Flanges | 1/8-inch-thick, homogeneous black rubber (EPDM), Hardness 60 (Shore A), rated 250 degrees F continuous and conforming to ASME B16.21 and ASTM D1330, Steam Grade. |

| SECTION 40 27 00.03<br>CARBON STEEL PIPE AND FITTINGS—GENERAL SERVICE | | |
|---|---|---|
| **Item** | **Size** | **Description** |
| Thread Lubricant | 2” & smaller | General Service: 100 percent virgin PTFE Teflon tape. |

**END OF SECTION**

| SECTION 40 27 00.09<br>STAINLESS STEEL PIPE AND FITTINGS | | |
|---|---|---|
| **Item** | **Size** | **Description** |
| Action Submittal | N/A | Workplan: Contractor shall submit a workplan detailing the codes, standards, and procedures that will be followed for completing the work on the Landfill Gas Line. Workplan shall include but is not limited to: Schedule, sequencing, owner and 3rd party operator coordination, isolation and purging plan, and other required elements. |
| Pipe | All | ASTM A312/A312M Type 316/316L seamless annealed pipe. All stainless steel pipe and fittings for landfill gas and ozone service, regardless of joint type, shall be pickled and passivated, inside and out, in accordance with ASTM A380.<br><br>Prior to delivery onsite, all stainless steel piping and fittings for ozone off-gas/vent gas and associated equipment shall be cleaned and packaged in accordance with CGA G-4.1, and the approved procedure to be submitted as specified in this section. All pipe for these services shall be delivered to the Site free of hydrocarbons. Exterior contaminated surfaces shall be cleaned in accordance with ASTM A380.<br><br>Once installed, piping systems for ozone off-gas/vent gas shall be cleaned in accordance with approved field cleaning procedure submitted per this section. The Contractor shall submit a field cleaning procedure for all pipe, fittings, and associated equipment that will come into contact with ozone off-gas. The procedure shall ensure hydrocarbon and welding residue decontaminations of the system in accordance with CGA G-4.1 and shall be as approved by the Design Engineer. The Contractor shall also submit a field cleaning procedure for exterior contaminated surfaces in accordance with ASTM A380 as approved by the Design Engineer. |

| SECTION 40 27 00.09<br>STAINLESS STEEL PIPE AND FITTINGS | | |
|---|---|---|
| **Item** | **Size** | **Description** |
| | 2” & smaller | Schedule 40S. Schedule 80S if threaded. |
| | 2-1/2” & larger | Schedule 10S. |
| Pipe Joints | All | All welding of ozone off-gas/vent gas and associated equipment that is exposed to an ozone/oxygen environment shall be completed in the factory to the greatest extent possible. |
| | 3/4” & smaller | Socket weld, threaded, or flanged at equipment as required or shown. Threaded only where required to connect to existing equipment. |
| | 1” to 2” | Socket weld or flanged at equipment as required or shown. |
| | 2 1/2” & larger | Butt-welded or flanged at valves and equipment as required or shown. |
| Pipe Fittings | 3/4” & smaller | Threaded or Socket Weld Forged: ASTM A182/A182M, Grade F316/316L, Class 3000 (socket weld) or Class 2000 (threaded) conforming to ASME B16.11. Threaded fittings allowed only where required to connect to existing fittings. |
| | 1” to 2” | Socket Weld Forged: ASTM A182/A182M, Grade F316/316L, Class 3000 (socket weld) conforming to ASME B16.11. |
| | 2” & larger | Butt Welded: ASTM A403/A403M, Grade WP316/316L conforming to ASME B16.9, annealed, pickled and passivated; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise. |
| Pipe Branch Connections | 3/4” & smaller | Tee or reducing tee in conformance with fittings above. |
| | 2” & smaller | 2-Inch and Smaller Branch: Sockolet in conformance with Fittings above and meeting the requirements of MSS SP-97. |

| SECTION 40 27 00.09<br>STAINLESS STEEL PIPE AND FITTINGS | | |
|---|---|---|
| **Item** | **Size** | **Description** |
| | 2-1/2” & larger | Butt-Welded Tee or Reducing Tee: In accordance with Fittings above. Weldolet per MSS SP-97 where branch size is less than 1/2 the header size. Weldolet material A182/A182M, Grade F316/316L, schedule to match pipes. |
| Flanges | 1-1/2” & smaller | Forged: ASTM A182/A182M Grade F316/316L, ASME B16.5 Class 150, socket weld, 1/16-inch raised face. |
| | 2” & larger | Forged: ASTM A182/A182M Grade F316/316L, ASME B16.5 Class 150, slip-on or welding neck, 1/16-inch raised face. Weld neck bore to match pipe internal diameter. Use weld neck flanges when abutting butt-weld fittings. Weld slip-on flanges inside and outside. |
| Unions | 1-1/2” & smaller | Socket Weld Forged: ASTM A182/A182M Grade F316/316L, Class 3000, integral ground seats, AAR design meeting requirements of MSS SP-83. |
| Bolting | All | General Conditions: Type 316 stainless steel, ASTM A193/A193M, Grade B8M heavy hex head or stud bolts, ASTM A194/A194M Grade 8M heavy hex head nuts. Torque bolts per gasket manufacturer recommendations.<br><br>When mating flange on valve or equipment is cast iron and gasket is flat ring, provide ASTM A307 Grade B heavy hex head or stud bolts, ASTM A563 Grade A heavy hex nuts and ASTM F436/F436M hardened steel washers at nuts and bolt heads. Torque bolts per gasket manufacturer recommendations. |

| SECTION 40 27 00.09<br>STAINLESS STEEL PIPE AND FITTINGS | | |
|---|---|---|
| **Item** | **Size** | **Description** |
| Gaskets | All Flanges | Landfill Gas Service: 1/8-inch-thick, homogeneous black rubber (EPDM), Hardness 60 (Shore A), rated to 250 degrees F, continuous and conforming to ASME B16.21 and ASTM D1330, Steam Grade.<br>Ozone Service: 1/8-inch-thick virgin Teflon or inorganic filled Teflon flat ring type for raised face flanges and full face type for flat face flanges; Garlock or Durlon. |
| Thread Lubricant | 1-1/2” & smaller | General Service: 100 percent virgin PTFE Teflon tape.<br>Oxygen and Ozone Services: Green Teflon tape designed for oxygen service,<br>Air Force A-A-58092, AA Thread Seal Tape, Inc. |

**END OF SECTION**

| SECTION 40 27 00.10<br>POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS | | |
|---|---|---|
| **Item** | **Size** | **Description** |
| General | All | Materials in contact with potable water shall conform to NSF 61 acceptance. |
| Pipe | All | Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with titanium dioxide for ultraviolet protection.<br>Threaded Nipples: Schedule 80 PVC. |
| Fittings | All | Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with titanium dioxide for ultraviolet protection. |
| Joints | All | Solvent socket weld except where connection to threaded valves and equipment may require future disassembly, or where double wall containment piping is used. |
| Flanges | All | One-piece, molded hub type PVC flat face flange in accordance with Fittings above, ASME B16.1, Class 125 drilling. |
| Bolting | All | Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts, ASTM A194/A194M Grade 8M hex head nuts, and Type 316 stainless steel washers at nuts and bolt heads. Torque to gasket manufacturers recommendations.<br>With Raised Face Mating Flange: Carbon steel ASTM A307 Grade B square head bolts, ASTM A563 Grade A heavy hex head nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Torque to gasket manufacturers recommendations. |

| SECTION 40 27 00.10<br>POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS | | |
|---|---|---|
| **Item** | **Size** | **Description** |
| Gaskets | All | Flat Face Mating Flange: Full faced 1/8-inch-thick ethylene propylene (EPR) rubber.<br>Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment. |
| Solvent Cement | All | Socket type joints shall be made employing solvent cement that meets or exceeds the requirements of ASTM D2564 and primer that meets or exceeds requirements of ASTM F656, chemically resistant to the fluid service, and as recommended by pipe and fitting manufacturer, except solvent weld cement for PVC pipe joints in sodium hypochlorite service shall be free of silica filler and shall be certified by the manufacturer to be suitable for that service, IPS Weld-On 724, or approved equal. Certification shall be submitted. Solvent cement and primer shall be listed by NSF 61 for contact with potable water. |
| Thread Lubricant | All | Teflon Tape. |

**END OF SECTION**

| SECTION 40 27 00.13<br>COPPER AND COPPER ALLOY PIPE, TUBING, AND FITTINGS | |
|---|---|
| **Item** | **Description** |
| General | Materials in contact with potable water shall conform to NSF 61 acceptance. |
| Tubing | Seamless, conforming to ASTM B88 as follows:<br>Water (buried)……..Type K, soft or hard temper<br>Compressed air service…….Type L, hard drawn |
| Fittings | ASTM B75 commercially pure wrought copper, socket joint, dimensions conforming to ASME B16.22. |
| Flanges | Class 150, ASTM B75 commercially pure wrought copper, socket joint, ASME B16.24 standard. |
| Bolting | ASTM A307, carbon steel, Grade B hex head bolts, ASTM A563 Grade A hex head nuts and ASTM F436/F436M hardened steel washers at nuts and bolt heads. Torque to gasket manufacturers recommendations. |
| Gaskets | 1/16-inch-thick nonasbestos compression type, full face, Cranite, John Manville. |
| Solder | Joints 2-1/2 Inch and Smaller: Wire solder (95 percent tin), conforming to ASTM B32 Alloy Grade Sn95. Do not use cored solder. |

**END OF SECTION**

| SECTION 40 27 00.15<br>DOUBLE WALL CONTAINMENT PIPING | |
|---|---|
| **Item** | **Description** |
| Carrier Pipe | Black carbon steel, ASTM A106/A106M, Grade B seamless or ASTM A53/A53M, Grade B seamless or ERW. Threaded, butt-welded, grooved end, and flanged joints. |
| Containment Pipe | Polyvinyl Chloride (PVC): Schedule 40, in accordance with ASTM D1784. Joints shall be solvent welded socket type, or flanged per Section 40 27 00.10, Polyvinyl Chloride (PVC) Pipe and Fittings Data Sheet. Clamshell type piping and joints to be used where appropriate to accommodate welded carrier pipe. |

**END OF SECTION**

| SECTION 40 27 00.19<br>POLYETHYLENE (PE) PIPE AND FITTINGS—<br>NATURAL GAS SERVICE | | |
|---|---|---|
| **Item** | **Size** | **Description** |
| General | All | Pipe lengths, fittings, and flanged connections to be joined by thermal butt-fusion; shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.<br>Pipe tubing and fittings manufactured in accordance with ASTM D2513. |
| Pipe | 1/2” to 12” | ASTM D2513 medium-density polyethylene, maximum allowable hoop stress 1,250 psi at 73.4 degrees F.<br>Polyethylene Resins: Conform to Type PE 2406/2708 or better.<br>Pipe wall thickness shall reflect the required SDR* and diameter, as shown in Table 8, ASTM F714.<br>Design Stress Rating: ASTM F1924, 1,250 psi hydrostatic design basis (HDB).<br>Pressure Rating (psi) at 100 degrees F / SDR*<br>100 / 7.0<br>100 / 7.3<br>100 / 9.0<br>97 / 9.3<br>80 / 11.0<br>64 / 13.5<br>Note: Installed outdoors and underground only. Operating pressure for natural gas piping shall be limited to 100 psig or less per 2009 IFGC.<br>Identification: Pipe and fittings shall be yellow in color and shall be marked “ASTM D2513”.<br>*SDR: standard dimension ratio = OD/thickness |

| SECTION 40 27 00.19<br>POLYETHYLENE (PE) PIPE AND FITTINGS—<br>NATURAL GAS SERVICE | | |
|---|---|---|
| **Item** | **Size** | **Description** |
| Fittings | 4" & smaller | Molded Fittings: Conform to PE 2406/2708.<br>Socket Fusion Fittings: Meet requirements of ASTM D2683.<br>Butt Fusion Fittings: Meet requirements of ASTM D3261. |
| Flanges | All | Flanges not permitted underground. Aboveground, flanges and bolting shall be part of approved, listed transition fitting. |
| Risers and Transitions | | Conform to ASTM F1973. |
| Manufacturer | | Pipe: JM Eagle UAC 2000 MDPE yellow gas pipe; Driscoplex 6500 series.<br>Risers and Transitions: George Fisher Central Plastics.<br>Or approved equal. |

**END OF SECTION**

# SECTION 40 27 01
# PROCESS PIPING SPECIALTIES

## PART 1 GENERAL

### 1.01 SUBMITTALS

A. Action Submittals: Manufacturer's data on materials, construction, end connections, ratings, overall lengths, and live lengths (as applicable).

B. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

## PART 2 PRODUCTS

### 2.01 GENERAL

A. Provide required piping specialty items, whether shown or not shown on Drawings, as required by applicable codes and standard industry practice.

B. Mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints are considered flexible joints; welded, screwed, and flanged pipe joints are not considered flexible.

C. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

### 2.02 CONNECTORS

A. Elastomer Bellows Connector:

1. Type: Fabricated spool, with single filled arch.
2. Materials: Nitrile tube and wrap-applied neoprene cover.
3. End Connections: Flanged, drilled 125-pound ASME B16.1 standard, with full elastomer face and steel retaining rings.
4. Working Pressure Rating: 140 psig, minimum, at 180 degrees F for sizes 12 inches and smaller.

5. Thrust Restraint: Control rods to limit travel of elongation and compression.
6. Manufacturers and Products:
    a. Goodall Rubber Co.; Specification E-1462.
    b. Garlock; Style 204.
    c. Unisource Manufacturing, Inc.; Style 1501.
    d. Proco Products, Inc.; Series 220.
    e. Or approved equal.

B. Flexible Metal Hose Connector:

1. Type: Close pitch, annular corrugated with single braided jacket.
2. Material: Bronze.
3. End Connections: Female copper solder joint.
4. Minimum Burst Pressure: 500 psig at 70 degrees F.
5. Length: Minimum manufacturer recommendation for vibration isolation.
6. Manufacturers:
    a. U.S. Hose Corp.; Series 300.
    b. Anamet Industrial, Inc.
    c. Unisource Manufacturing, Inc.
    d. Proco Products, Inc.
    e. Or approved equal.

C. Quick Connect Couplings:

1. Type: Twin cam arm actuated, male and female, locking, for chemical loading and transfer.
2. Materials: Glass-filled polypropylene or PVDF with EPDM, Viton-A or Teflon gaskets as recommended for the service by manufacturer.
3. End Connections: NPT threaded or flanged to match piping connections. Hose shank for chemical installations.
4. Plugs and Caps: Female dust cap for each male end; male dust plug for each female end.
5. Pressure Rating: 125 psi, minimum, at 70 degrees F.
6. Manufacturers and Products:
    a. OPW; Kamlock.
    b. Ryan Herco; 1300 Series.
    c. Or approved equal.

## 2.03 COUPLINGS

A. General:

1. Coupling linings for use in potable water systems shall be in conformance with NSF/ANSI 61.
2. Couplings shall be rated for working pressure not less than indicated in Piping Schedule for the service and not less than 150 psi.
3. Couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213.
4. Unless thrust restraint is provided by other means, couplings shall be harnessed in accordance with requirements of AWWA Manual M11 or as shown on Drawings.
5. Sleeve type couplings shall conform to AWWA C219 and shall be hydraulically expanded beyond minimum yield for accurate sizing and proofing of tensile strength.

B. Flexible Sleeve Type Coupling:

1. Manufacturers and Products:
   a. Steel Pipe:
      1) Dresser Piping Specialties; Style 38.
      2) Smith-Blair, Inc.; Style 411.
      3) Or approved equal.
   b. Ductile Iron Pipe:
      1) Dresser Piping Specialties; Style 253.
      2) Smith-Blair, Inc.; Style 441.
      3) Or approved equal.
   c. PVC Pipe:
      1) Romac; Style 501.
      2) Or approved equal.

C. Transition Coupling for Steel Pipe:

1. Manufacturers and Products:
   a. Dresser Piping Specialties; Style 162.
   b. Smith-Blair, Inc.; Style 413.
   c. Or approved equal.

D. Flanged Coupling Adapter:

1. Anchor studs where required for thrust restraint.

2. Manufacturers and Products:
   a. Steel Pipe:
      1) Dresser Piping Specialties; Style 128.
      2) Smith-Blair, Inc.; Style 913.
      3) Or approved equal.
   b. Ductile Iron Pipe:
      1) Dresser Piping Specialties; Style 128.
      2) Smith-Blair, Inc.; Style 912.
      3) Or approved equal.

E. Restrained Flange Adapter:

1. Pressure Rating:
   a. Minimum Working Pressure Rating: Not less than 150 psi.
   b. Safety Factor: Not less than two times working pressure and shall be supported by manufacturer's proof testing.
2. Thrust Restraint:
   a. Provide hardened steel wedges that bear against and engage outer pipe surface, and allow articulation of pipe joint after assembly while wedges remain in their original setting position on pipe surface.
   b. Products employing set screws that bear directly on pipe will not be acceptable.
3. Manufacturer and Product:
   a. EBAA Iron Sales Co.; Mega-Flange.
   b. Or approved equal.

F. Restrained Dismantling Joints:

1. Pressure Rating:
   a. Minimum working pressure rating shall not be less than rating of the connecting flange.
   b. Proof testing shall conform to requirements of AWWA C219 for bolted couplings.
2. Manufacturers and Products:
   a. Dresser Piping Specialties; Style 131.
   b. Smith Blair, Inc.; Model 975.
   c. Or approved equal.

G. Exposed Metallic Piping Plain End Couplings:

1. Plain end pipe couplings shall be self-restrained against hydrostatic thrust forces equal to not less than two times the working pressure rating of the coupling. Couplings shall accommodate 4 degrees angular deflection at the time of installation and subsequent to pressurization.

2. Casing, bolts, and nuts shall be Type 304 or Type 316 stainless steel. The sealing sleeve shall be EPDM or NBR elastomer as best suited for the fluid service.
3. Couplings manufacturer and products shall be:
   a. Straub Couplings, Grip-L or Metal Grip.
   b. Or approved equal.

H. Flexible Grooved Joint Couplings:

1. For use in locations where vibration attenuation and stress relief are required.
2. Three flexible couplings may be used in lieu of a flexible connector.
3. The couplings shall be placed in close proximity to the source of the vibration.
4. Coating: As specified in Section 09 90 00, Painting and Coating.
5. Model numbers from one manufacturer are shown to indicate type only. Equivalent products of other manufacturers may be submitted for approval.
   a. Manufacturer:
      1) Victaulic Style 77.
      2) Or approved equal.

## 2.04 EXPANSION JOINTS

A. Elastomer Bellows:

1. Type: Reinforced molded wide arch.
2. End Connections: Flanged, drilled 125-pound ASME B16.1 standard, with split galvanized steel retaining rings.
3. Washers: Over retaining rings to help provide leak-proof joint under test pressure.
4. Thrust Protection: Control rods to protect the bellows from overextension.
5. Bellows Arch Lining: Buna-N, nitrile, or butyl.
6. Rated Temperature: 250 degrees F.
7. Rated Deflection and Pressure:
   a. Lateral Deflection: 3/4 inch, minimum.
   b. Burst Pressure: Four times the working pressure.
   c. Compression deflection and minimum working pressure as follows:

| Size (inch) | Deflection (inch) | Pressure (psig) |
|---|---|---|
| 2-1/2 to 12 | 1.06 | 150 |

| Size (inch) | Deflection (inch) | Pressure (psig) |
|---|---|---|
| 14 | 1.65 | 130 |
| 16 to 20 | 1.65 | 110 |

8. Manufacturers and Products:
   a. General Rubber Corp.; Style 1015 Maxijoint.
   b. Mercer; Flexmore Style 450.
   c. Goodall Rubber Co.; Specification E-711.
   d. Unisource Manufacturing, Inc.; Series 1500.
   e. Proco Products, Inc.; Series 251.
   f. Or approved equal.

B. Flexible Metal Hose:

1. Type: Close pitch, annular corrugated with single braided jacket.
2. Material: Stainless steel, ASTM A276, Type 321.
3. End Connections:
   a. 3 Inches and Larger: Shop fabricated flanged ends to match mating flanges.
   b. 2-1/2 Inches and Smaller: Screwed ends with one union end.
4. Minimum Burst Pressure: 600 psig at 70 degrees F for 12 inches and smaller.
5. Length: Provide hose live-length equal to lengths shown on Drawings.
6. Manufacturers and Products:
   a. U.S. Hose Corp.; Series 401M.
   b. Anamet Industrial, Inc.; BWC21-1.
   c. Or approved equal.

## 2.05 SEAL WATER HOSE

A. Product as specified for water hose, except 3/8 inch with male NPT ends, in 2-foot lengths.

## 2.06 SERVICE SADDLES

A. Double-Strap Iron:

1. Pressure Rating: Capable of withstanding 150 psi internal pressure without leakage or over stressing.
2. Run Diameter: Compatible with outside diameter of pipe on which saddle is installed.
3. Taps: Iron pipe threads.

4. Materials:
   a. Body: Malleable or ductile iron.
   b. Straps: Galvanized steel.
   c. Hex Nuts and Washers: Steel.
   d. Seal: Rubber.
5. Manufacturers and Products:
   a. Smith-Blair; Series 313 or 366.
   b. Dresser; Style 91.
   c. Or approved equal.

## 2.07 OUTLET/TAPPING SADDLES

A. Materials:

1. Straps: Alloy steel with 3/4-inch threaded ends.
2. Seal: O-Ring SBR rubber gasket.
3. Compatible with ductile iron pipe.

B. Connection: AWWA C110/A21.10 flange or mechanical joint outlet as shown.

C. Pressure Rating: Capable of withstanding 250 psi internal pressure without leakage over stressing.

D. Manufacturer and Product:

1. American Ductile Iron; Outlet/Tapping Saddle.
2. Or approved equal.

## 2.08 PIPE SLEEVES

A. Steel Pipe Sleeve:

1. Minimum Thickness: 3/16 inch.
2. Seep Ring:
   a. Center steel flange for water stoppage on sleeves in exterior or water-bearing walls, 3/16-inch minimum thickness.
   b. Outside Diameter: Unless otherwise shown, 3 inches greater than pipe sleeve outside diameter.
   c. Continuously fillet weld on each side all around.
3. Factory Finish:
   a. Galvanizing:
      1) Hot-dip applied, meeting requirements of ASTM A153/A153M.
      2) Electroplated zinc or cadmium plating is unacceptable.

b. Shop Lining and Coating: Factory prepare, prime, and finish coat in accordance with Section 09 90 00, Painting and Coating.

B. Modular Mechanical Seal:

1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
2. Fabrication:
   a. Assemble interconnected rubber links with ASTM A276, Type 316 stainless steel bolts and nuts.
   b. Pressure plates shall be reinforced nylon polymer.
3. Size: According to manufacturer's instructions for size of pipes shown to provide a watertight seal between pipe and wall sleeve opening and to withstand a hydrostatic head of 40 feet of water.
4. Manufacturer:
   a. Thunderline Corp., Link-Seal Division.
   b. Or approved equal.

## 2.09 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Ductile Iron Wall Pipe:

1. Diameter, Lining, and Ends: Same as connecting ductile iron pipe.
2. Thickness: Equal to or greater than remainder of pipe in line.
3. Fittings: In accordance with applicable Pipe Data Sheet.
4. Thrust Collars:
   a. Rated for thrust load developed at 250 psi.
   b. Safety Factor: Two, minimum.
   c. Material and Construction: Ductile iron or cast iron, cast integral with wall pipe wherever possible, or thrust rated, welded attachment to wall pipe.
5. Manufacturers:
   a. American Cast Iron Pipe Co.
   b. U.S. Pipe and Foundry Co.
   c. Or approved equal.

B. Steel or Stainless Steel Wall Pipe:

1. Same material and thickness as connecting pipe, except 1/4-inch minimum thickness.
2. Lining: Same as connecting pipe.
3. Thrust Collar:
   a. Outside Diameter: Unless otherwise shown, 3 inches greater than outside diameter of wall pipe.
   b. Continuously fillet welded on each side all around.

## 2.10 MISCELLANEOUS SPECIALTIES

A. Strainers, Water Service, 2 Inches and Smaller:

1. Type: Bronze body, Y-pattern, 200 psi nonshock rated, with screwed gasketed bronze cap.
2. Screen: Heavy-gauge Type 304 stainless steel or monel, 20-mesh.
3. Manufacturers and Products:
   a. Armstrong International, Inc.; Model F.
   b. Mueller Steam Specialty; Model 351M.
   c. Or approved equal.

B. Strainers, Water Service, 2-1/2 Inches and Larger:

1. Type: Cast iron or ductile iron body, Y-pattern, 175 psi nonshock rated, with flanged gasketed iron cap.
2. Screen: Heavy-gauge Type 316 stainless steel, 0.045-inch perforations.
3. Manufacturer and Product:
   a. Armstrong International, Inc.; Model A7FL 125.
   b. Or approved equal.

C. Strainers, Plastic Piping Systems, 4 Inches and Smaller:

1. Type: Y-pattern PVC body, 150 psi nonshock rated, with screwed PVC cap and Viton seals.
2. End Connections: Screwed or solvent weld, 2 inches and smaller. Class 150 ANSI flanged, 2-1/2 inches and larger.
3. Screen: Heavy-gauge PVC, 1/32-inch mesh, minimum 2 to 1 screen area to pipe size ratio.
4. Manufacturer:
   a. Hayward.
   b. Or approved equal.

D. Water Hose:

1. Furnish 50-foot lengths of 1-inch and 50-foot lengths of 1-1/2-inch rubber hose. EPDM black cover and EPDM tube, reinforced with two textile braids. Provide each length with brass male and female NST hose thread couplings to fit hose nozzle and hose valve.
2. Rated minimum working pressure of 200 psi.
3. Manufacturers:
   a. Goodyear.
   b. Boston.
   c. Or approved equal.

E. Hose Nozzles:

1. Furnish 1-inch and 1-1/2-inch cast brass, satin finish, nozzles with adjustable fog, straight-stream, and shut-off feature and rubber bumper. Provide nozzles with female NST hose thread.
2. Manufacturers:
   a. Croker.
   b. Elkhart.
   c. Or approved equal.

F. Instrument Tees:

1. Manufacturers:
   a. For 12-Inch and Smaller:
      1) CRANE ChemPharma, Resistoflex®.
      2) Allied Fluid Products, JCS Lined Piping Products.
      3) Or approved equal.
   b. For Greater than 12-Inch:
      1) Andronaco Industries, Ethylene™.
      2) Allied Fluid Products, JCS Lined Piping Products.
      3) Or approved equal.
2. Design:
   a. Housing Materials: Fabricated steel.
   b. Lining: PTFE.
   c. Process Connection Type: Flange.
   d. Materials: Carbon steel ASTM A105.
   e. Rating: 300 pounds if 8 inches or less, 150 pounds if greater than 8 inches.
   f. Full vacuum rated.
3. Branch Size:
   a. For instruments, refer to specifications.
   b. Otherwise as indicated on Drawings.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Provide accessibility to piping specialties for control and maintenance.

### 3.02 PIPING FLEXIBILITY PROVISIONS

A. General:

1. Thrust restraint shall be provided as specified in Section 40 27 00, Process Piping—General.

2. Install flexible couplings to facilitate piping installation, in accordance with approved Shop Drawings.

B. Flexible Joints at Concrete Backfill or Encasement: Install within 18 inches or one-half pipe diameter, whichever is less, from the termination of any concrete backfill or concrete encasement.

C. Buried Flexible Joints at Concrete Structures – Ductile Iron Pipe:

1. Install 18 inches or less from face of structures; joint may be flush with face.
2. Install a second flexible joint, whether or not shown.
   a. Pipe Diameter 18 Inches and Smaller: Within 18 inches of first joint.
   b. Pipe Diameter Larger than 18 Inches: Within two to three pipe diameter of first joint.

D. Buried Flexible Joints at Concrete Structures – All Others: Install as shown on Drawings.

E. Flexible expansion joints shall be provided to compensate for earth settlement at buried piping connections to structure wall pipes. Wrap complete joint assembly in a double layer of polyethylene encasement, as specified in Section 40 27 00, Process Piping—General, or as shown on Drawings.

3.03 PIPING TRANSITION

A. Applications:

1. Provide complete closure assembly where pipes meet other pipes or structures.
2. Pressure Pipeline Closures: Plain end pieces with double flexible couplings, unless otherwise shown.
3. Restrained Joint Pipe Closures: Install with thrust tie-rod assemblies as shown or in accordance with NFPA 24.
4. Gravity Pipe Closures: As specified for pressure pipelines, or concrete closures.
5. Concrete Closures: Use to make connections between dissimilar pipe where standard rubber gasketed joints or flexible couplings are impractical, as approved.
6. Elastomer sleeves bonded to pipe ends are not acceptable.

B. Installation:

1. Flexible Transition Couplings: Install in accordance with coupling manufacturer's instructions to connect dissimilar pipe and pipes with a small difference in outside diameter.
2. Concrete Closures:
   a. Locate away from structures so there are at least two flexible joints between closure and pipe entering structure.
   b. Clean pipe surface before placing closure collars.
   c. Wet nonmetallic pipe thoroughly prior to pouring collars.
   d. Prevent concrete from entering pipe.
   e. Extend collar a minimum of 12 inches on each side of joint with minimum thickness of 6 inches around outside diameter of pipe.
   f. Make entire collar in one placement.
   g. After concrete has reached initial set, cure by covering with well-moistened earth.

## 3.04 PIPING EXPANSION

A. Piping Installation: Allow for thermal expansion due to differences between installation and operating temperatures.

B. Expansion Joints:

1. Grooved Joint and Flanged Piping Systems: Elastomer bellows expansion joint.
2. Nonmetallic Pipe: Teflon bellows expansion joint.
3. Screwed and Soldered Piping Systems: Copper or galvanized and black steel pipe expansion compensator, as applicable.
4. Air and Water Service above 120 Degrees F: Metal bellows expansion joint.
5. Pipe Run Offset: Flexible metal hose.

C. Anchors and Anchor Walls: Install as specified in Section 40 05 15, Piping Support Systems, to withstand expansion joint thrust loads and to direct and control thermal expansion.

## 3.05 SERVICE SADDLES

A. Ferrous Metal Piping (except stainless steel): Double-strap iron.

B. Plastic Piping: Nylon-coated iron.

## 3.06 OUTLET/TAPPING SADDLE

A. Install in accordance with manufacturer's written instructions.

## 3.07 COUPLINGS

A. General:

1. Install in accordance with manufacturer's written instructions.
2. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
3. Do not remove pipe coating. If damaged, repair before joint is made.
4. Application:
   a. Metallic Piping Systems: Flexible couplings, transition couplings, and flanged coupling adapters.
   b. Concrete Encased Couplings: Flexible coupling.

## 3.08 FLEXIBLE PIPE CONNECTIONS TO EQUIPMENT

A. Install to prevent piping from being supported by equipment, for vibration isolation, and where shown.

B. Product Applications Unless Shown Otherwise:

1. Nonmetallic Piping: Teflon bellows connector.
2. Copper Piping: Flexible metal hose connector.
3. Compressor and Blower Discharge: Metal bellows connector.
4. All Other Piping: Elastomer bellows connector.

C. Limit Bolts and Control Rods: Tighten snug prior to applying pressure to system.

## 3.09 PIPE SLEEVES

A. Application:

1. As specified in Section 40 27 00, Process Piping—General.
2. Abovegrade in Nonsubmerged Areas: Hot-dip galvanized after fabrication.
3. Belowgrade or in Submerged or Damp Environments: Shop-lined and coated.
4. Alternatively, molded polyethylene pipe sleeve as specified may be applied.

B. Installation:

1. Support noninsulating type securely in formwork to prevent contact with reinforcing steel and tie-wires.
2. Caulk joint with specified sealant in nonsubmerged applications and seal below grade and submerged applications with wall penetration seal.

## 3.10 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Applications:

1. Watertight and Belowground Penetrations:
   a. Wall pipes with thrust collars.
   b. Provide taps for stud bolts in flanges to be set flush with wall face.
2. Nonwatertight Penetrations: Pipe sleeves with seep ring.
3. Existing Walls: Rotary drilled holes.
4. Fire-Rated or Smoke-Rated Walls, Floors or Ceilings: Insulated and encased pipe sleeves.

B. Wall Pipe Installation:

1. Isolate embedded metallic piping from concrete reinforcement using coated pipe penetrations as specified in Section 09 90 00, Painting and Coating.
2. Support wall pipes securely by formwork to prevent contact with reinforcing steel and tie-wires.

**END OF SECTION**

# SECTION 40 27 02
# PROCESS VALVES AND OPERATORS

## PART 1 GENERAL

### 1.01 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.
   b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
   c. Certification for compliance to NSF/ANSI 61 for valves used for drinking water service.
   d. Power and control wiring diagrams, including terminals and numbers.
   e. For each power actuator provided, manufacturer's standard data sheet, with application specific features and options clearly identified.
   f. Sizing calculations for open-close/throttle and modulating valves.
   g. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for:
   a. Electric actuators; full compliance with AWWA C542.
   b. Butterfly valves; full compliance with AWWA C504.
3. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
4. Tests and inspection data.
5. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
6. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

## PART 2 PRODUCTS

### 2.01 GENERAL

A. Valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, operating nut, chain, wrench, and accessories to allow a complete operation from the intended operating level.

B. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

C. Valve same size as adjoining pipe, unless otherwise called out on Drawings or in Supplements.

D. Valve ends to suit adjacent piping.

E. Resilient seated valves shall have no leakage (drip-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this section or in stated valve standard.

F. Size operators and actuators to operate valve for full range of pressures and velocities.

G. Valve to open by turning counterclockwise, unless otherwise specified.

H. Factory mount operator, actuator, and accessories.

I. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

### 2.02 MATERIALS

A. Bronze and brass valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.

1. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100),

B139/B139M (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
2. Stainless steel Alloy 18-8 may be substituted for bronze.

B. Valve materials in contact with or intended for drinking water service to meet the following requirements:

1. Materials to comply with requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements.
2. Coatings materials to be formulated from materials deemed acceptable to NSF/ANSI 61.
3. Supply certification product is certified as suitable for contact with drinking water by an accredited certification organization in accordance with NSF/ANSI 61. Provide certification for each valve type used for drinking water service.

## 2.03 FACTORY FINISHING

A. General:

1. Interior coatings for valves and hydrants shall be in accordance with AWWA C550, unless otherwise specified.
2. Exterior coating for valves and hydrants shall be in accordance with Section 09 90 00, Painting and Coating.
3. Material in contact with potable water shall conform to NSF/ANSI 61.
4. Exposed safety isolation valves and lockout valves with handles, handwheels, or chain wheels shall be “safety yellow.”

B. Where epoxy lining and coating are specified, factory finishing shall be as follows:

1. In accordance with AWWA C550.
2. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as “fusion” or “fusion bonded” epoxy.
3. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

## 2.04 VALVES

A. Ball Valves:

1. Type V301 Ball Valve 2 Inches and Smaller for General Water and Air Service:
   a. Two-piece, full port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats

and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.

b. Manufacturers and Products:
   1) Threaded:
      a) Conbraco Apollo; 77-100.
      b) Nibco; T-585-70.
      c) Or approved equal.
   2) Soldered:
      a) Conbraco Apollo; 77-200.
      b) Nibco; S-585-70.
      c) Or approved equal.

2. Type V306 Stainless Steel Ball Valve 2 Inches and Smaller:
   a. Two-piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece, NPT threaded ends, ASTM A276 Type 316 stainless steel ball, reinforced PTFE seats, seals, and packing, adjustable packing gland, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 1,000 psig CWP, complies with MSS SP-110.
   b. Manufacturers and Products:
      1) Conbraco Apollo; 76F-100 Series.
      2) Nibco; T-585-S6-R-66-LL.
      3) Or approved equal.
3. Type V330 PVC Ball Valve 2 Inches and Smaller:
   a. Rated 150 psi at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Viton or Teflon O-ring stem seals, to block flow in both directions. Provide pressure relief hole drilled on low pressure side of ball for sodium hypochlorite service.
   b. Manufacturers and Products:
      1) Nibco; Chemtrol Tru-Bloc.
      2) ASAHI/America; Type 21.
      3) Spears; True Union.
      4) Or approved equal.

B. Plug Valves:

1. Type V464 Corporation Stop 1/2 Inch to 2 Inches:
   a. AWWA C800 type, tapered threaded inlet, except when connecting to tapped fittings which require IPS tapered threads, outlet compression connection or IPS threads to suit connecting pipe, stops 1 inch and smaller rated 100 psi, larger stops rated 80 psi.

b. Manufacturers:
   1) Ford Meter Box Co.
   2) Mueller Co.
   3) Or approved equal.

2. Type V466 Buried Service Natural Gas Plug Valve 2 Inches and Smaller:
   a. UL listed, iron body type, rated 125 psi, screwed ends, drilled key head for permanent pinned operating rod.
   b. Manufacturers and Products:
      1) DeZurik; Figure 425.
      2) Mueller; (Gas) Curb Stop H-11104.
      3) Or approved equal.

C. Butterfly Valves:

1. General:
   a. In full compliance with AWWA C504 and following requirements:
      1) Suitable for throttling operations and infrequent operation after periods of inactivity.
      2) Elastomer seats which are bonded or vulcanized to the body shall have adhesive integrity of bond between seat and body assured by testing, with minimum 75-pound pull in accordance with ASTM D429, Method B.
      3) Bubble-tight with rated pressure applied from either side. Test valves with pressure applied in both directions.
      4) No travel stops for disc on interior of body.
      5) Self-adjusting V-type or O-ring shaft seals.
      6) Isolate metal-to-metal thrust bearing surfaces from flowstream.
      7) Provide traveling nut or worm gear actuator with handwheel. Valve actuators to meet the requirements of AWWA C504.
      8) Buried service operators shall withstand 450-foot-pounds of input torque at fully open and fully closed positions.
      9) Provide linings and coatings per AWWA, unless otherwise indicated on Drawings or specified herein.
      10) Valves to be in full compliance with NSF/ANSI 61.
   b. Non-AWWA butterfly valves to meet the following actuator requirements:
      1) For aboveground installations, provide handle and notch plate for valves 6 inches and smaller and heavy-duty, totally enclosed gearbox type operators with handwheel, position indicator and travel stops for valves 8 inches and larger, unless otherwise indicated on Drawings or specified herein.

2. Type V500 Butterfly Valve Water Works Service 3 Inches to 72 Inches:
   a. AWWA C504, Class 150B.
   b. Short body type, flanged ends.
   c. Cast-iron body, cast or ductile iron disc, Type 304 stainless steel shafts, Buna-N rubber seat bonded or molded in body only, and stainless steel seating surface.
   d. Provide epoxy lining and coating in compliance with AWWA C550.
   e. Manufacturers and Products:
      1) Pratt; Model 2FII or Triton XR-70.
      2) DeZurik; AWWA Valve.
      3) Or approved equal.
3. Type V520 Solid Polyvinyl Chloride Butterfly Valve 1-1/2 Inches to 8 Inches:
   a. Wafer body type, pressure rated 150 psi at 70 degrees F CWP, solid ASTM D1784, Type I, Grade 1, PVC body and contoured PVC or polypropylene valve disc, stainless steel valve stem, Viton seat, lever operator.
   b. Manufacturers and Products:
      1) ASAHI/America; Type 57.
      2) Spears.
      3) Or approved equal.

D. Check and Flap Valves:

1. Type V600 Check Valve 2 Inches and Smaller:
   a. All bronze, threaded cap, threaded or soldered ends, swing type replaceable bronze disc, rated 125-pound SWP, 200-pound WOG.
   b. Manufacturers and Products:
      1) Stockham; Figure B-319, threaded ends.
      2) Milwaukee; Figure 509, threaded ends.
      3) Stockham; Figure B-309, soldered ends.
      4) Milwaukee; Figure 1509, soldered ends.
      5) Or approved equal.
2. Type V608 Swing Check Valve 2 Inches to 24 Inches:
   a. AWWA C508, 125-pound flanged ends, cast-iron body, bronze body seat, bronze mounted cast-iron clapper with rubber facing, stainless steel hinge shaft.
   b. Valves, 2 inches through 12 inches rated 175-pound WWP and 14 inches through 24 inches rated 150-pound WWP. Valves to be fitted with adjustable outside lever and weight 12 inches and smaller, fitted with adjustable outside lever and spring for 14 inches and larger. Increasing-pattern body valve may be used where increased outlet piping size is shown.

c. Manufacturers and Products:
   1) M&H Valve; Style 59, 159, or 259.
   2) Mueller Co.; No. A-2600 Series.
   3) Or approved equal.

3. Type V630 PVC Ball Check Valve 4 Inches and Smaller:
   a. ASTM D1784, Type I, Grade 1 polyvinyl chloride body, dual union socket weld ends, rated 150 psi at 73 degrees F, and Viton seat and seal.
   b. Manufacturers and Products:
      1) Nibco; Chemtrol Tru Union.
      2) ASAHI/America.
      3) Spears; True Union.
      4) Or approved equal.
4. Type V640 Double Check Valve Backflow Prevention Assembly 3/4 Inch to 10 Inches:
   a. Two resilient seated check valves, two outside screw and yoke resilient-seated isolation valves, test cocks, in accordance with AWWA C510, rated 175 psi maximum working pressure, meets requirements of USC Foundation For Cross-Connection Control and Hydraulic Research.
   b. Manufacturers and Products:
      1) FEBCO; Model 850.
      2) Danfoss Flomatic; Model DCVE/DCV.
      3) Watts; Series 007/709.
      4) Or approved equal.
5. Type V642 Reduced-Pressure Principle Backflow Prevention Assembly 3/4 Inch to 10 Inches:
   a. Two resilient seated check valves with an independent relief valve between the valves, two outside screw and yoke resilient-seated isolation valves, test cocks, in accordance with AWWA C511, rated 175 psi maximum working pressure, meets requirements of USC Foundation for Cross-Connection Control and Hydraulic Research.
   b. Manufacturers and Products:
      1) FEBCO; Model 860.
      2) Danfoss Flomatic; Model RPZE/RPZ.
      3) Watts; Series 009/909.
      4) Or approved equal.

E. Self-Regulated Automatic Valves:

1. Type V710 Pressure-Reducing Valve 2-1/2 Inches and Smaller:
   a. Direct diaphragm operated, spring controlled, bronze body, NPT threaded ends, 200 psig rated minimum.
   b. As shown in Valve Schedule.

c. Manufacturers and Products:
   1) Fisher; Type 75A.
   2) Watts; Series 223.
   3) Or approved equal.

2. Type V720 PVC Pressure Relief, By-Pass Relief, Back-Pressure Regulator, Back-Pressure, Anti-Siphon Valve 1/2 Inch to 2 Inches:
   a. Direct acting diaphragm, spring controlled, in-line pattern, NPT threaded inlet and outlet, 150 psi design pressure.
   b. PVC body, Teflon or Viton diaphragm, PVC or Teflon piston, high-density polyethylene or stainless steel adjusting bolt and locknut, stainless steel or coated steel spring, stainless steel fasteners.
   c. Designed to open when upstream pressure reaches set point; set pressure adjustable from 10 psi to 100 psi, minimum. Pressure set point included in Piping Schedule as shown on Drawings.
   d. Manufacturers and Products:
      1) Plast-O-Matic; Series RVDT.
      2) Griffco; Series BPV.
      3) Primary Fluid Systems; TOP Valve.
      4) Or approved equal.
3. Type V740 Air and Vacuum Valve 1/2 Inch to 16 Inches:
   a. 1/2-inch through 3-inch NPT inlets and outlets, 4-inch and larger ASME B16.1 Class 125 flanged inlet with plain outlet and protective hood.
   b. Rated 150 psi working pressure, cast-iron or ductile iron body and cover, stainless steel float and trim, built and tested to AWWA C512. Operating pressure as shown on Valve Schedule as shown on Drawings.
   c. Manufacturers and Products:
      1) APCO Valve and Primer Corp.; Series 140 or Series 150.
      2) Val-Matic Valve; Series 100.
      3) Or approved equal.
4. Type V744 Air Release Valve 1/2 Inch to 2 Inches:
   a. Suitable for water service, automatically exhaust small amounts of entrained air that accumulates in a system. In CLOSED position, seat against resilient seat to prevent water leakage.
   b. Rated 150 psi working pressure, cast iron or ductile iron body and cover, stainless steel float and trim, NPT threaded inlet and outlet, built and tested to AWWA C512.
   c. Manufacturers and Products:
      1) APCO Valve and Primer Corp.; Series 50, 200, and 200A.
      2) Val-Matic Valve; Series 15A to 45.6.
      3) Or approved equal.

5. Type V746 Combination Air Release Valve 1 Inch to 16 Inches:
   a. Suitable for water service, combines operating features of air and vacuum valve and air release valve. Air and vacuum portion to automatically exhaust air during filling of system and allow air to re-enter during draining or when vacuum occurs. Air release portion to automatically exhaust entrained air that accumulates in system.
   b. Valve single body or dual body, air release valve mounted on air and vacuum valve, isolation valve mounted between the dual valves. 1-inch through 3-inch valves with NPT threaded inlet and outlet, 4-inch and larger valves with ASME B16.1 Class 125 flanged inlet and cover outlet.
   c. Rated 150 psi working pressure, cast-iron or ductile iron body and cover, stainless steel float and trim, built and tested to AWWA C512.
   d. Manufacturers and Products:
      1) APCO Valve and Primer Corp.; Series 143C to 147C or 1804 to 1816.
      2) Val-Matic Valve; Series 201C to 203C or 104/22 to 116/38.
      3) ARI Valves; D-040 or D-040-C.
      4) Or approved equal.

## 2.05 OPERATORS AND ACTUATORS

A. Manual Operators:

1. General:
   a. For AWWA valves, operator force not to exceed requirements of applicable valve standard. Provide gear reduction operator when force exceeds requirements.
   b. For non-AWWA valves, operator force not to exceed applicable industry standard or 80 pounds, whichever is less, under operating condition, including initial breakaway. Provide gear reduction operator when force exceeds requirements.
   c. Operator self-locking type or equipped with self-locking device.
   d. Position indicator on quarter-turn valves.
   e. Worm and gear operators one-piece design, worm-gears of gear bronze material. Worm of hardened alloy steel with thread ground and polished. Traveling nut type operator’s threaded steel reach rod with internally threaded bronze or ductile iron nut.
2. Exposed Operator:
   a. Galvanized and painted handwheel.
   b. Cranks on gear type operator.

c. Chain wheel operator with tieback, extension stem, floor stand, and other accessories to permit operation from normal operation level.
d. Valve handles to take a padlock, and wheels a chain and padlock.

3. Buried Operator:
   a. Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
   b. Buried service operators to be grease packed and gasketed to withstand submersion in water to 20 feet minimum.
   c. Buried valves shall have extension stems, bonnets, and valve boxes.

B. Electric Operators, 120 Volts:

1. General:
   a. Unit shall be low profile to reduce amount of required space and weigh 15 pounds or less.
   b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of the valve.
   c. Provide operator mounting bracket to mount operator to valve providing minimal torque to piping system when operating.
2. Operator Operation, General:
   a. Suitable for full 90-degree rotation of quarter-turn valves.
   b. Manually override handwheel.
   c. Mechanical valve position indication.
3. Electronic Control:
   a. Torque Limiting Switches: Two single-pole, double-throw mechanical switches. Switches operate at any point in valve travel.
   b. Jammed-valve detection and protection.
   c. Motor over-temperature detection and protection.
   d. Travel limit switches, single-pole double-throw.
4. Open-Close (O/C) Service:
   a. Duty cycle for intermittent ON-OFF operation shall be 25 percent.
   b. Operator shall power to OPEN and power to CLOSE.
   c. Local Indication and Control:
      1) Integral mechanical valve POSITION indication, 0 percent to 100 percent OPENED.
      2) Integral OPENED and CLOSED indication lights.
      3) Integral LOCAL-OFF-REMOTE (L-O-R).

4) Integral OPEN maintained switch which causes the valve to stroke full OPENED, even if OPEN switch is released, while L-O-R switch is in LOCAL.
5) Integral CLOSE maintained switch which causes valve to stroke full CLOSED, even if CLOSED switch is released, while L-O-R switch is in LOCAL.

d. Remote Indication and Control:
1) Relay contact that closes when valve is capable of being controlled remotely (L-O-R switch in REMOTE) for connection to and monitoring by plant control system.
2) Limit switch that closes when valve is fully OPENED for connection to and monitoring by plant control system.
3) Limit switch that closes when valve is fully CLOSED for connection to and monitoring by plant control system.

e. Local Indication and Control:
1) Integral mechanical valve POSITION indication, 0 percent to 100 percent OPENED.
2) Integral OPENED and CLOSED indication lights.
3) Integral LOCAL-OFF-REMOTE (L-O-R).
4) Integral OPEN momentary switch which causes valve to stroke towards OPENED, as long as OPEN switch is held, while L-O-R switch is in LOCAL.
5) Integral CLOSE momentary switch which causes valve to stroke towards CLOSED, as long as CLOSED switch is held, while L-O-R switch is in LOCAL.
6) Position valve proportionally 0 percent to 100 percent OPEN with external 4 mA to 20 mA dc signal while in REMOTE.

f. Remote Indication and Control:
1) Relay contact that closes when valve is capable of being controlled remotely (L-O-R switch in REMOTE) for connection to and monitoring by plant control system.
2) Limit switch that closes when valve is fully OPENED for connection to and monitoring by plant control system.
3) Limit switch that closes when valve is fully CLOSED for connection to and monitoring by plant control system.
4) Current Position Transmitter, 4 mA to 20 mA dc signal in proportion to 0 percent to 100 percent OPENED, with 0.5 percent accuracy and 0.5 percent repeatability, capable of driving a 750-ohm load, for connection to and monitoring by Plant Control System.

5. Control Features: Electric motor actuators with features as noted above, and as modified/supplemented in Electric Actuated Valve Schedule.

C. Manufacturers and Products:

1. Rotork Controls Inc.; IQT.
2. Limitorque Corp.; Accutronix QX.
3. Or approved equal.

2.06 ACCESSORIES

A. Cast-Iron Valve Box: Designed for traffic loads, sliding type, with minimum of 5-1/4-inch ID shaft.

1. Box: Cast iron with minimum depth of 9 inches.
2. Lid: Cast iron, minimum depth 3 inches, locking type, marked with appropriate service.
3. Extensions: Cast iron.
4. Two-piece box and lid for valves 4 inches through 12 inches, three-piece box and lid for valves larger than 12 inches with base sized for valve.
5. Valve extension stem for valves with operating nuts 3 feet or greater below finish grade.
6. Manufacturers and Products:
   a. East Jordan Iron Works; Cast-Iron Valve Boxes.
   b. Bingham & Taylor; Cast-Iron Valve Boxes.
   c. Or approved equal.

B. Concrete Valve Box: Designed for traffic loads, sliding type, with minimum of 10-inch ID shaft.

1. Box: High-density, reinforced concrete, minimum depth 12 inches, cast iron ring seat.
2. Lid: Cast iron, minimum depth 3 inches, marked with appropriate service.
3. Extensions: Concrete.
4. Manufacturers and Products:
   a. Christy Concrete Products; G Series.
   b. BES Concrete Products; G Series.
   c. Or approved equal.

C. Indicator Post Assembly:

1. Cast or ductile iron post head, bell, and wrench with cast or ductile iron or steel barrel.
2. Plexiglas, or approved equal, protected window to indicate OPEN and CLOSED position.
3. Padlockable eye bolt for wrench.
4. Adjustable bury depth. Bury depth as required for valve installation.

5. UL listed and FM approved.
6. Manufacturers and Products:
    a. Clow; Style 2945.
    b. Mueller; A-20806.
    c. Or approved equal.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Flange Ends:

1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:

1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

C. PVC Valves: Install using solvents approved for valve service conditions.

D. Valve Installation and Orientation:

1. General:
    a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
    b. Install valves in location for easy access for routine operation and maintenance.
    c. Install valves per manufacturer’s recommendations.
2. Gate, Globe, and Ball Valves:
    a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
    b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.
3. Butterfly Valves:
    a. Unless otherwise restricted or shown on Drawings, install valve a minimum of 8 diameters downstream of a horizontal elbow or branch tee with shaft in horizontal position.
    b. For vertical elbow or branch tee immediately upstream of valve, install valve with shaft in vertical position.
    c. For horizontal elbow or branch tee immediately upstream of valve, install valve with shaft in horizontal position.

d. When installed immediately downstream of swing check, install valve with shaft perpendicular to swing check shaft.
e. For free inlet or discharge into basins and tanks, install valve with shaft in vertical position.

4. Check Valves:
   a. Install valve in accordance with manufacturer's instructions and provide required distance from immediate upstream fitting.
   b. Install valve in vertical flow (up) piping only for gas services.
   c. Install swing check valve with shaft in horizontal position.
   d. Install double disc swing check valve to be perpendicular to flow pattern when discs are open.

E. Install line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

F. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

G. Extension Stem for Operator: Where depth of valve operating nut is 3 feet or greater below finish grade, furnish operating extension stem with 2-inch operating nut to bring operating nut to a point within 6 inches of finish grade.

H. Floor Box and Stem: Steel extension stem length shall locate operating nut in floor box.

I. Chain Wheel and Guide: Install chain wheel and guide assemblies or chain lever assemblies on manually operated valves over 6 feet 9 inches above finish floor. Install chain to within 3 feet of finish floor. Where chains hang in normally traveled areas, use appropriate "L" type tie-back anchors. Install chains to within operator horizontal reach of 2 feet 6 inches maximum, measured from normal operator standing location or station.

## 3.02 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.

C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.

D. Count and record number of turns to open and close valve; account for discrepancies with manufacturer's data.

E. Set, verify, and record set pressures for relief and regulating valves.

3.03 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification:

1. Electric Actuated Valve Schedule.

**END OF SECTION**

**ELECTRIC ACTUATED VALVE SCHEDULE**

| Tag Number | Valve Type | Actuator Power Supply | Valve Size (inches) | Process Fluid | Maximum Operating Flow (gpm) | Maximum ΔP (psi) | Service | Travel Time (Seconds) | Control Feature Modifications/ Supplements |
|---|---|---|---|---|---|---|---|---|---|
| V-04105 | Butterfly | 120-volt, single-phase | 8 | Ozone Contactor Influent | 1,100 | 40 | O/C | 60 | C, D, E |
| V-04130 | Butterfly | 120 volt, single-phase | 8 | Ozone Contactor Influent | 1,100 | 40 | O/C | 60 | C, D, E |
| V-04205 | Butterfly | 120 volt, single-phase | 6 | Ozone Contactor Influent | 1,100 | 40 | O/C | 60 | C, D, E |
| V-04230 | Butterfly | 120 volt, single-phase | 6 | Ozone Contactor Influent | 1,100 | 40 | O/C | 60 | C, D, E |

Service: O/C = Open-Close, T = Throttling, M = Modulating

Control Feature Modifications/Supplements:

A = Actuator shall open valve upon loss of signal.

B = Actuator shall close valve upon loss of signal.

C = Actuator shall remain in last position upon loss of signal.

D = Local OPEN-CLOSE momentary pushbuttons that must be continuously depressed to initiate/maintain valve travel; travel stops when pushbutton is released or when end of travel limit is reached.

E = Remote OPEN-CLOSE maintained dry contacts; travel stops when remote contact opens, or when end of travel limit is reached.

F = Three 24-volt dc interposing relays for remote OPEN-STOP-CLOSE control. Relays powered externally, thereby permitting valve control from greater distances.

G = Motor and control enclosure(s) NEMA 250, Type 4 with 120-volt space heaters.

H = Motor and control enclosure(s) NEMA 250, Type 6 (IP 68) with 120-volt space heaters.

I = Motor and control enclosure(s) NEMA 250, Type 7 with 120-volt space heaters.

J = Valve position output converter that generates isolated 4 mA to 20 mA dc signal in proportion to valve position, and is capable of driving into loads of up to 500 ohms at 24 volts dc.

K = 120-volt secondary control power transformer.

L = Externally operable power disconnect switch.

# SECTION 40 42 13
# PROCESS PIPING INSULATION

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
2. ASTM International (ASTM):
   a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   b. C165, Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
   c. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   d. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   e. C534/C534M, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
   f. C547, Standard Specification for Mineral Fiber Pipe Insulation.
   g. C552, Standard Specification for Cellular Glass Thermal Insulation.
   h. C585, Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
   i. C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
   j. C1729, Standard Specification for Aluminum Jacketing for Insulation.
   k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   l. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
3. International Code Council (ICC): International Energy Conservation Code (IECC).
4. UL.

1.02 SUBMITTALS

A. Action Submittals: Manufacturer's descriptive literature.

B. Informational Submittals: Maintenance information.

**PART 2 PRODUCTS**

2.01 PIPE AND FITTING INSULATION

A. Type 1—Elastomeric:

1. Material: Flexible elastomeric pipe insulation, closed-cell structure in accordance with ASTM C534/C534M.
2. Temperature Rating: Minus 297 degrees F to 220 degrees F.
3. Nominal Density: 3 pcf to 6 pcf.
4. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.25 Btu-in./hr-square foot degrees F at 75 degrees F per ASTM C177 or ASTM C518.
5. Maximum water vapor transmission of 0.06 perm-inch per ASTM E96/E96M, Procedure A.
6. Joints: Manufacturer's adhesive.
7. Flame Spread Rating: Less than 25 per ASTM E84.
8. Smoke Developed Index: Less than 50 per ASTM E84.
9. Manufacturers and Products:
   a. Nomaco; K-Flex.
   b. Armacell; AP Armaflex.
   c. Or approved equal.

B. Type 2—Fiberglass:

1. Material: UL rated, preformed, sectional bonded fiberglass per ASTM C585 with factory applied, Kraft paper with aluminum foil vapor barrier jacket with pressure-sensitive, self-sealing lap.
2. Insulation Temperature Rating: 0 degrees F to 850 degrees F.
3. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.23 Btu-in./hr-square foot degrees F at 75 degrees F.
4. Jacketing per ASTM C1136 with minimum water vapor transmission for jacket of 0.02 perm-inch per ASTM E96/E96M. Furnish with no jacket if field finish system specified.
5. Joints: Matching pressure-sensitive butt strips for sealing circumferential joints.
6. Flame Spread Rating: Less than 25 per ASTM E84.
7. Smoke Developed Index: Less than 50 per ASTM E84.

8. Manufacturers and Products:
   a. Owens Corning Fiberglass; ASJ/SSL-11.
   b. John Manville; Micro-Lok with Jacket.
   c. Or approved equal.

C. Type 3—Foamglass:

1. Material: Cellular glass per ASTM C552.
2. Nominal Density: 7.5 pcf.
3. Compressive Strength: 90 psi per ASTM C165.
4. Temperature Rating: Minus 290 degrees F to 900 degrees F.
5. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.29 Btu-in./hr-square foot degrees F.
6. Minimum water vapor transmission for insulation of 0.00 perm-inch per ASTM E96/E96M.
7. Joints: Matching pressure-sensitive butt strips for sealing circumferential joints.
8. Flame Spread Rating: 0 per ASTM E84.
9. Smoke Developed Index: 0 per ASTM E84.
10. Follow manufacturer's recommendation, based upon temperature of piping to be insulated.
11. Manufacturer and Product:
    a. Pittsburgh Corning; Foamglass One.
    b. Or approved equal.

## 2.02 ROOF DRAIN AND OVERFLOW DRAIN SUMP INSULATION

A. Type 1: 1-inch-thick.

## 2.03 INSULATION AT PIPE HANGERS AND SUPPORTS

A. Refer to Section 40 05 15, Piping Support Systems.

B. Copper, Ductile Iron, and Nonmetallic Pipe: High-density insert, thickness equal to adjoining insulation of Type 3 or other rigid insulation or manufactured preinsulated pipe hanger and insulation shield. Extend insert beyond shield.

C. Steel Pipe: Insulation saddle or high-density insert, thickness equal to adjoining insulation of Type 3 or other rigid insulation or manufactured preinsulated pipe hanger and insulation shield at support location. Extend insert beyond shield.

## 2.04 INSULATION FINISH SYSTEMS

A. Type F1—PVC:

1. Polyvinyl chloride (PVC) jacketing, minimum 20 mils indoors and 30 mils outdoors, for straight run piping and fitting locations, temperatures to 140 degrees F.
2. Color: PVC jacketing shall be color coded to match colors listed in pipe schedule where suitable matching colors are available. If no suitable colors are available jacketing shall be white.
3. Flame Spread Rating: 25 per ASTM E84.
4. Smoke Developed Index: 50 per ASTM E84.
5. Manufacturers and Products:
    a. Knauf Insulation; Proto 1000.
    b. Johns Manville; Zeston 2000 or 300.
    c. Speedline; 25/50 Smoke-Safe.
    d. Or approved equal.

B. Type F2—Paint:

1. Type 1 Insulation: Acrylic latex paint, white, and suitable for outdoor use.
    a. Manufacturer and Product:
        1) Armacell; WB Armaflex finish.
        2) Or approved equal.
2. Type 2 Insulation: In accordance with Section 09 90 00, Painting and Coating.

C. Type F3—Aluminum:

1. Aluminum Roll Jacketing: For straight run piping, wrought aluminum Alloy 3003, 5005, 1100, or 3105 to ASTM B209 with H-14 temper, in accordance with ASTM C1729, minimum 0.016-inch thickness, with smooth mill finish.
2. Vapor Barrier: Provide factory applied vapor barrier, heat and pressure bonded to inner surface of aluminum jacketing.
3. Fitting Covers: Material as for aluminum roll jacketing, premolded, one or two piece covers, which includes elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings.
4. Manufacturers:
    a. RPR Products; Insul-Mate.
    b. ITW, Pabco-Childers.
    c. Or approved equal.

D. Type F4—Foamglass Jacketing:

1. Type 3 Insulation—Buried and Up to 1 Foot Abovegrade: 70-mil bituminous resin with woven, glass fabric, aluminum foil layer, and plastic film coating, self-sealing manual pressure seals.
   a. Manufacturer and Product:
      1) Pittsburgh Corning; Pittwrap SS.
      2) Or approved equal.
2. Type 3 Insulation—Greater that 1 Foot Abovegrade: 30-mil modified bituminous membrane with self-sealing manual pressure seals.
   a. Manufacturer and Product:
      1) Pittsburgh Corning; Pittwrap CW30.
      2) Or approved equal.

## PART 3 EXECUTION

### 3.01 APPLICATION

A. General:

1. Insulate valve bodies, flanges, and pipe couplings.
2. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
3. Do not insulate flexible pipe couplings and expansion joints.
4. Service and Insulation Thickness: Refer to Supplement Service and Insulation Thickness table following “End of Section” and to Piping Schedule in Section 40 27 00, Process Piping—General.

### 3.02 INSTALLATION

A. General:

1. Install in accordance with manufacturer’s instructions and as specified herein.
2. Install after piping system has been pressure tested and leaks corrected.
3. Install over clean dry surfaces.
4. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
5. Do not allow insulation to cover nameplates or code inspection stamps.
6. Run insulation or insulation inserts continuously through pipe hangers and supports, wall openings, ceiling openings, and pipe sleeves, unless otherwise shown.
7. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.

8. Personnel Protection: Install on pipes from floor to 8 feet high. Install on pipes within 4 feet of platforms and to 8 feet high above platforms.

B. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.

C. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.

D. Placement:

1. Insulate valves and fittings with sleeved or cut pieces of same material.
2. Seal and tape joints.

E. Aluminum Jacket:

1. Use continuous friction type joint to hold jacket in place, providing positive weatherproof seal over entire length of jacket.
2. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
3. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
4. Do not use screws or rivets to fasten fitting covers.
5. Install removable prefabricated aluminum covers on exterior flanges and unions.
6. Caulk and seal exterior joints to make watertight.

## 3.03 FIELD FINISHING

A. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

B. Where pipe labels or banding are specified, apply to finished insulation, not to pipe.

C. Painting Piping Insulation (Exposed to View):

1. Aluminum or color coded PVC jacketing does not require painting.
2. If insulated piping system is indicated to be painted in Section 40 27 00, Process Piping—General, piping shall receive the following:
   a. Prime coat in accordance with Section 09 90 00, Painting and Coating.
   b. Finished insulation (and not pipe) shall be painted in accordance with Section 09 90 00, Painting and Coating.

3.04 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification:

1. Service and Insulation Thickness Table.

**END OF SECTION**

| SERVICE AND INSULATION THICKNESS | | | | | | |
|---|---|---|---|---|---|---|
| | | | Finish Systems | | | |
| **Service Type** | **Thickness** | **Insulation** | **Concealed from View** | **Indoors Exposed** | **Outdoors** | **Buried** |
| OZG – Sodium bisulfite for ozone quench | Pipe Size: Insulation Thickness Inches:*<br>1/4-3: 1<br>3.5-10: 1.5<br>12-16: 2<br>18-24: 2.5 | Type 2 | None | None | F3 | None |
| CLW – Cooling water for generator engine | Pipe Size: Insulation Thickness Inches:*<br>1/4-3: 1<br>3.5-10: 1.5<br>12-16: 2<br>18-24: 2.5 | Type 2 | None | None | F3 | None |
| Inches*: Based upon insulation with glass fiber per ASTM C547, outdoors with 20 mph wind with 10 percent safety and no value assigned to cladding or air space at cladding. | | | | | | |

# SECTION 40 80 01
# PROCESS PIPING LEAKAGE TESTING

## PART 1 GENERAL

### 1.01 SUBMITTALS

A. Informational Submittals:

1. Testing Plan:
   a. Submit prior to testing and include at least the information that follows.
      1) Testing dates.
      2) Piping systems and section(s) to be tested.
      3) Test type.
      4) Method of isolation from existing piping and equipment.
      5) Method of isolation from instrumentation and other items not to be tested.
      6) Method to remove all air from piping prior to testing.
      7) Method of filling and removing water.
      8) Calculation of maximum allowable leakage for piping section(s) to be tested.
2. Certifications of Calibration: Testing equipment.
3. Certified Test Report.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Notify Construction Manager in writing 5 work days in advance of testing. Perform testing in presence of Construction Manager.

B. Pressure Piping:

1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
2. Wait 5 days minimum after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 2 days.
3. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.

4. New Piping Connected to Existing Piping:
   a. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Construction Manager.
   b. Test joint between new piping and existing piping by methods that do not place entire existing system under test load, as approved by Construction Manager.
5. Items that do not require testing to be coordinated with Construction Manager.
6. Test Pressure: As indicated in Piping Schedule as shown on Drawings.

C. Test section may be filled with water and allowed to stand under low pressure prior to testing.

D. Gravity Piping:

1. Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.
2. Determine groundwater level at time of testing by exploratory holes or other method acceptable to Construction Manager.
3. Pipe 42 Inches Diameter and Larger: Joint testing device may be used to isolate and test individual joints.

## 3.02 HYDROSTATIC TEST FOR PRESSURE PIPING

A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.

B. Exposed Piping:

1. Perform testing on installed piping prior to application of insulation.
2. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.
3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
4. Maintain hydrostatic test pressure continuously for 60 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
5. Examine joints and connections for leakage.
6. Correct visible leakage and retest as specified.
7. Leave pipe full of water after repair of leaks or empty pipe of water prior to final cleaning or disinfection per direction of Construction Manager.

C. Buried Piping:

1. Test after backfilling has been completed.
2. Expel air from piping system during filling.
3. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
4. Maintain hydrostatic test pressure continuously for 2 hours minimum, reopening isolation valve only as necessary to restore test pressure.
5. Maximum Allowable Leakage: Zero.
6. Correct leakage greater than allowable, and retest as specified.

## 3.03 PNEUMATIC TEST FOR PRESSURE PIPING

A. Perform only on:

1. Landfill gas and gas chromatograph stainless steel piping.
2. Filter air scour stainless steel piping.
3. Ozone generator compressed air copper piping.

B. Fluid: Oil-free, dry air.

C. Procedure:

1. Apply preliminary pneumatic test pressure of 5 psig to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections; examine for leakage.
2. Correct visible leaks and repeat preliminary test until visible leaks are corrected.
3. Maintain pneumatic test pressure continuously for minimum of 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.
4. Correct visible leakage and retest as specified.

D. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.

E. After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to assure no explosive mixtures will be present in system during filling process.

## 3.04 HYDROSTATIC TEST FOR GRAVITY PIPING

A. Testing Equipment Accuracy: Plus or minus 1/2-gallon water leakage under specified conditions.

B. Maximum Allowable Leakage: 0.16 gallon per hour per inch diameter per 100 feet. Include service connection footage in test section, subjected to minimum head specified.

C. Storm Drain Piping: Test with 15 feet of water to include highest horizontal vent in filled piping. Where vertical drain and vent systems exceed 15 feet in height, test systems in 15-foot vertical sections as piping is installed.

D. Exfiltration Test:

1. Hydrostatic Head:
   a. At least 6 feet above maximum estimated groundwater level in section being tested.
   b. No less than 6 feet above inside top of highest section of pipe in test section, including service connections.
2. Length of Pipe Tested: Limit length such that pressure on invert of lower end of section does not exceed 30 feet of water column.

E. Infiltration Test:

1. Groundwater Level: At least 6 feet above inside top of highest section of pipe in test section, including service connections.

F. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.

G. Defective Piping Sections: Replace and retest as specified.

3.05 FIELD QUALITY CONTROL

A. Test Report Documentation:

1. Test date.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, including:
   a. Leaks (type, location).
   b. Repair/replacement performed to remedy excessive leakage.
6. Signed by Contractor and Construction Manager to represent that test has been satisfactorily completed.

**END OF SECTION**

# SECTION 40 90 00
# INSTRUMENTATION AND CONTROL

## PART 1 GENERAL

### 1.01 WORK OF THIS SECTION

A. The Work of the following Divisions and Sections applies to the Work of this section. Other sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Section 01 33 00, Submittal Procedures.
2. Division 26, Electrical.
3. Division 40, Process Interconnections.

B. The Work of this section includes the general specification and requirements for the Instrumentation and Control (I&C) Work under this, and other applicable specifications, including providing instrumentation and all related wiring as shown in these Contract Documents and Drawings. Detailed scope and quantities are shown in Section 40 90 06, Bill of Materials and Quantities.

C. The Contractor shall be responsible for the design, procurement, installation, testing, training, and documentation for I&C systems provided under this Contract in accordance with this section and Section 40 90 06, Bill of Materials and Quantities.

D. Where shown, the Contractor shall be responsible for terminating and integrating all I&C equipment with the existing Emerson Process Management (EPM) DCS systems or with existing vendor package systems.

### 1.02 SCOPE

A. The intent of this section is that the Contractor will provide a complete and operational, turn-key, integrated I&C system, including all instrumentation and equipment as shown on Drawings and as specified herein.

B. The Contractor shall furnish all materials, tools, equipment, consumables and supplies and shall perform all labor required to complete the work in this Specification.

1.03 REFERENCES

A. The following is a list of standards which may be referenced in the Section:

1. American Petroleum Institute (API): API RP-550, Manual on Installation of Refinery Instruments and Control Systems, Part 1 - Process Instrumentation and Control Sections 1 Through 13.
2. American National Standards Institute (ANSI):
   a. ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
   b. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
   c. ANSI/AWWA, Ductile-Iron and Gray-Iron Fittings, 3-In Through C110/A21.10 48-In for Water and Other Liquids.
   d. ANSI/AWWA C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 In Through 144 In.
   e. ANSI/AWWA C701, Cold-Water Meters - Turbine Type for Customer Service.
   f. ANSI/AWWA C702, Cold-Water Meters - Compound Type.
3. American Society of Mechanical Engineers (ASME): ASME Report Fluid Meters, Sixth Edition, 1971.
4. American Water Works Association (AWWA): AWWA C704, Cold-Water Meters - Propeller Type for Main Line Applications.
5. ASTM International (ASTM):
   a. ASTM A105, Specification for Forgings, Carbon Steel for Piping Components.
   b. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
   c. ASTM A193, Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service.
   d. ASTM A194, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.
   e. ASTM A283, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars.
   f. ASTM A312, Stainless Steel Piping.
   g. ASTM B61, Specification for Steam or Valve Bronze Castings.
6. International Society of Automation (ISA):
   a. ISA-RP60.6, Nameplates, Labels, and Tags for Control Centers.
   b. ISA-RP7.1, Pneumatic Control Circuit Pressure Test.
   c. ISA-RP12.6, Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations.
   d. ISA-S5.1, Instrument Symbols and Identification.
   e. ISA-S5.4, Instrument Loop Diagrams.

f. ISA-S12.4, Instrument Purging for Reduction of Hazardous Area Classification.
g. ISA-S20, Specification Forms for Process Measurement and Control Instrumentation; Primary Elements and Control Valves.

B. Work of this section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. National Electrical Code.
2. National Fire Protection Association: NFPA 70.
3. Uniform Fire Code.

C. UL: All I&C and instrument equipment furnished in this section shall be listed by and shall bear the label of UL or of an independent testing laboratory acceptable to the City of San Diego (City).

1.04 SUBMITTALS

A. General:

1. All submittals shall be provided in accordance with Section 01 33 00, Submittal Procedures, as a minimum, and in accordance with specialty submittal requirements below.
2. All submittals of this section shall be provided with six hard copies and one soft copy (CD).
3. Submittals of this section shall be in Adobe Acrobat PDF format, unless otherwise specified. Vendor and Contractor shop drawings developed under this section shall be in Bentley MicroStation (.dgn) format, utilizing monochrome.
   a. Documents not available in electronic format shall be scanned at 600 dpi, black and white) for documents without graphics, or color for documents with graphics and converted to Adobe Acrobat (PDF).
4. Submittal Special Requirements of this Section:
   a. Preliminary Submittal: Where required by Specification, four copies of the preliminary submittals shall be provided, in PDF format, to the City's Representative for review.
   b. Final Submittal: All Submittal documents in this section, including design and O&M documents, shall be provided in accordance with requirements of this section on two CDs; one CD shall provide documents in native format (e.g., MicroStation, MS Word, MS Excel, etc.), and the other CD shall provide documents in PDF format. Both CDs shall use the same file naming convention, except that the suffixes shall be different (e.g., PDF, XLS, etc.).

c. Each document shall be indexed, and a database table in Excel shall be provided, which includes the following data for each document:
   1) Document file name.
   2) Document description.
   3) Hard Copy Catalog No. (used by facility document coordinator).
   4) Document Type:
      a) Shop Drawings:
         (1) P&IDs.
         (2) Loop Drawings.
         (3) Instrument Data Sheets.
         (4) Other.
      b) Manufacturer's data.
      c) Maintenance instructions.
      d) Training.
   5) Facility Name.
   6) Specification Number.
   7) Process Name.
   8) Unit Process Number.

B. Presubmittal Conference:

1. The Contractor shall arrange and conduct a Presubmittal Conference within 45 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 Drawings submittal on the Work to be provided under this section. The Contractor and the City Representative shall attend. Both the Contractor and the City Representative may invite additional parties at their discretion.
2. The Contractor shall allot a minimum of 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 and I&C systems, including proposed manufacturer names and model numbers.
   b. List of proposed clarifications to the indicated requirements plus a brief written explanation of each exception. Review and acceptance of proposed clarifications will be according to Section 01 33 00, Submittal Procedures.
   c. One complete example of each type of submittal proposed.

d. A flow chart showing the steps the Contractor will take in preparing and coordinating each submittal to the City's Representative.
e. A Gantt-Chart type schedule for the Work provided under this section, covering the time period beginning with the conference and ending after startup and acceptance. Dates for the beginning and ending of submittal preparation, submittal review periods, design, fabrication, programming, factory testing, delivery to the site, installation, field testing, and training shall be scheduled. The schedule shall be subdivided into major items or groups of items which are on the same schedule.

4. The Contractor shall take formal minutes of the Presubmittal Conference, including all events, questions, and resolutions. Minutes shall be distributed to the City's Representative within 48 hours after the meeting.
5. The Contractor shall prepare a formal sign-in sheet for the presubmittal meeting that captures the name, telephone number, affiliation/title and email address for each participant. Contractor shall deliver a copy of the sign-in sheet with the 'Minutes' as required above.

C. Informational Submittals:

1. Submittal List: The Contractor shall develop and deliver a detailed list of all submittals required by the specification, as well as all additional submittals he/she envisions. This should be inclusive of instruments and I&C hardware, software, reports, plans, status of schedules, testing documents and relevant maintenance documentation and forms.
2. I&C Schedule: Within 60 days of Contract NTP, the Contractor shall develop and deliver a detailed baseline schedule for the Instrumentation and I&C disciplines of the Project. The baseline schedule shall reference each submittal shown on the 'Submittal List', as well as all design, engineering, fabrication, delivery, installation, testing and acceptance elements related to Instrumentation and I&C Work.
   a. The baseline schedule shall be prepared utilizing Primavera P6, or other project controls software standards that the city may direct.
   b. The baseline schedule shall ensure that each activity is tied to all appropriate predecessor(s) and successor(s) activities.
   c. 'Float' contained within the schedule shall be 'owned' by the City. Contractor utilization of schedule float is at the discretion of the City and the City may, at its sole discretion, require 'schedule recovery' efforts to regain float, to maintain Project delivery, if the City deems Contractor use of the float as deleterious to the Project.
   d. Contractor shall allocate a minimum of 1 day to present and explain the baseline schedule to the City's Representative.

e. The City will review, and approve, the Contractor's baseline schedule, and Contractor shall not proceed with any of the Work of this section until he as obtained Instrumentation and I&C schedule approval.
f. The 'approved' baseline schedule shall be 'statused' and submitted to the City, no later than the fifth of each month, following the Work status period.

3. Shop Drawings: The Contractor shall submit a sample of each 'type' of Shop Drawing that he/she anticipates making.
4. Loop Drawings: The Contractor shall submit a sample for each 'type', Analog, Discrete and Foreign Device Interface (Data link), Loop Drawings.
   a. The Sample Loop Drawings will utilize a City Standard format which will be provided to the Contractor after Contract NTP. The purpose of this is to prove that the Contractor understands the various steps necessary to deliver a final, as constructed, set of Loop Drawings to the City.
5. Training Submittal: The Contractor shall submit a sample of a training syllabus, and his/her training plan for each piece of Instrumentation and I&C and control system components and software.

D. Action Submittals:

1. General: The Contractor shall be responsible for providing instrument and I&C Submittals to be used in the generation of control-panel wiring diagrams and Loop Drawings which depict the interconnection between instruments, panels, valve actuators, MCCs, PLC control systems, and the DCS (where shown).
2. Shop Drawings:
   a. Preparation of Shop Drawings shall not commence until completion of the Presubmittal Conference.
   b. Preliminary Shop Drawings shall be submitted as a single package at one time within not later than 90 days after NTP.
   c. All systems, meters, instruments, and other elements shall be represented by symbology derived from the latest version of ANSI/ISA S5.1 and in accordance with Contract Documents and Drawings. The ISA nomenclature and numbers indicated herein shall be used exclusively on all Shop Drawings. No manufacturer's standard symbology or nomenclature shall replace those indicated in the Contract Documents.

d. During Shop Drawing development, the Contractor shall maintain a direct, informal liaison with the City's Representative for exchange of technical information. As a result, certain minor refinements and revisions to the indicated systems may be authorized informally by the City's Representative. However, these shall not alter the Work of this section and shall not cause increase or decrease in the Contract Price. No statement or direction by the City's Representative shall be construed as approval of any component or method, or exception to, or deviation from these Contract Documents.

e. After review of preliminary Shop Drawings by City's Representative and, receipt of review comments, Contractor shall provide final shop drawing Submittals within 30 calendar days.

f. All Shop Drawings shall include the letterhead or title block of the Contractor. The title block shall include, as a minimum, the Contractor registered business name and address, project name, drawing name, revision level, and personnel responsible for drawing development and the name of the QA/QC reviewer.
   1) Shop drawing copies shall be submitted as standard size three-ring, loose-leaf, vinyl plastic binders suitable for bookshelf storage. Maximum binder size shall be 2 inches.
   2) A complete index shall be placed at the front of each binder.
   3) Specification deviation requests shall be itemized at the front of the submittal in its own section.
   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.

3. Loop Drawings:
   a. Contractor is responsible for the overall development, coordination efforts and final delivery of Loop Drawings. Special requirements are outlined below.
   b. Loop Diagrams: Loop diagrams shall be submitted in accordance with Section 01 33 00, Submittal Procedures, and the special requirements of this section. All Loop Drawings will conform to ISA 5.4 to verify DCS and PLC control system interface with all instrumentation and devices provided or installed under the Project. The loop diagrams shall also define all interfaces with equipment provided by skid-mounted for Foreign Device interfaces.

c. Loop Drawings shall be developed utilizing a three-sheet format. Examples of the City's Standard three-sheet format types will be provided to the Contractor after NTP. The following three-sheet format is required:

1) Sheet 1:
   a) Provide a device schedule developed from an electronic spreadsheet or database file, which will be submitted with the loop diagrams. The table will show the following:
      (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) Specification 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.
2) Sheet 2: Loop Drawing meeting the Requirements of ANSI/ISA S5.4, except that intermediate terminal junction boxes may be omitted, and shall be shown on Page 3 for clarity. Butt splices and wire nuts shall be shown on as-builts, with the corresponding termination housing (JB, LB, etc.) shown on Sheet 3.
3) Sheet 3: (Expansion sheet - required if the number of intermediate devices or terminal junction boxes exceeds what can be legibly shown on Sheet 2). Abbreviated diagram showing instrument, wire and cable numbers, intermediate terminal junction boxes, and PCM or PLC terminations. Wire identification numbers will reflect the

field instrument tag number, and not the DCS or PLC I/O number.

4) DCS or PLC 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 |
| YA | Device Fail |
| HS | Equipment Start/Stop |
| JI | Kilowatts |
| JQI | Kilowatt hours |
| JXI | KVARs |
| JFI | Power Factor |

d. The Contractor in concert with his/her I&C subcontractor shall be responsible for the preliminary development of all Loop Drawings, in the format specified. The Contractor will develop a 'draft' of each loop drawing.

e. The Contractor will then coordinate with the City, delivering draft loop drawings to the City, who shall be responsible to filling out all the DCS-related addressing, software-level information, DCS termination numbering, etc., where required.

f. The Contractor will then receive the draft loop drawings from the City, and the Contractor shall finalize all Loop Drawings in AutoCAD. Contractor shall ensure that all 'as-constructed' information (such as I/O wiring being re-addressed at the DCS) has been incorporated onto the finalized Loop Drawings.

g. The Contractor shall deliver the finalized Loop Drawings to the project Design Engineer. The Design Engineer is responsible for Quality Assurance/Quality Control of the final Loop Drawings, and shall check all Loop Drawings against design P&IDs, electrical design, and Contractor's field as-constructed drawings. Contractor is responsible for all coordination with the Design Engineers and shall incorporate all changes and corrections require by the Design Engineer.

h. Contractor shall prepare and deliver all Loop Drawing packages in accordance with these Specifications. Note: All Loop Drawings shall be submitted to the City's Representative, prior to the start of any DCS or PLC cutover.

i. The City's Representative will review and approve the Loop Drawing Submittal in accordance with Section 01 33 00, Submittal Procedures. The Contractor is responsible for making all changes and annotation to the final Loop Drawings, as may be dictated during the various testing procedures. Red-line mark-up of all annotated loop drawings shall be delivered to the City's Representative at the conclusion of DCS or PLC testing activities.

4. Instruments and I&C Devices: For all Instruments and I&C devices provided under this section, Contractor shall submit technical brochures, bulletins and data sheets containing:
   a. Fully completed ISA S20 data sheets.
   b. Component functional descriptions.
   c. Locations or assembly at which component is to be installed.
   d. Materials of a component's parts which will be in contact with process fluids or gases.
   e. Instrument Factory Calibration Sheets: Where an instrument is of necessity, precalibrated at the factory, the Contractor shall submit all Factory Calibration Sheets to the City's Representative immediately upon arrival.
   f. Instrument Bench Calibration Sheets: Contractor shall submit a calibration plan for bench calibration of each type of instruments. Upon approval of the Bench Calibration Plant by the City, Contractor shall coordinate and commence Bench Calibration of all instruments, other than those containing Factory Calibration. Bench Calibration of Instruments will be witnessed by the City's Representative, who may at the representative's sole discretion, provide Contractor a waiver of witnessing. Upon completion of bench calibration, Contractor shall submit Calibration Sheet documentation and shall affix calibration stickers to each instrument, indicating date of calibration and initials of person performing calibration.
   g. Panels, Local Control Panels. Contractor shall supply:
      1) Schematic and wiring diagrams for control circuits shall be submitted in two stages. Initially, schematic control diagrams shall show complete details on the circuit interrelationships of all devices within and outside each Control Panel. Subsequent to acceptance of all schematic control diagrams, by the City's Representative, piping and wiring diagrams shall be submitted. The diagrams shall consist of component layout drawings to scale, showing

numbered terminals on components together with the unique number of the wire to be connected to each terminal.

2) 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.
3) Assembly and Construction Drawings for each Panel and Local Control Panel type. These Drawings shall include dimensions, identification of all components, surface preparation and finish data, and nameplates. These Drawings also shall include enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly; a finish treatment sample shall be included.
4) Installation, mounting, and anchoring details for all components and assemblies to be field-mounted, including conduit connection or entry details. Where applicable and required by Code, Contractor shall include seismic calculations for the panel assembly and mounting, which shall be stamped by a California registered structural engineer.
5) Complete control panel layouts, all drawn to a 1-1/2 inch equals 1 foot scale showing.
6) 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.
7) All cutout locations fully dimensioned. All outside panel dimensions shall be shown.
8) Locations of back-of-panel stiffeners.
9) 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.
10) Contractor shall submit a complete nameplate engraving list, annotating the size of each engraved plate, the material, font size, color and attaching methodology. Note: Adhesive-backed mount is to be avoided, except in those cases where screw mounting is not possible.

11) 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.

1.05 OWNER'S MANUAL

A. The Owner's Manual shall be submitted in both paper and electronic format. Electronic format shall conform to the Electronic Document Submittal Requirements for Shop Drawings.

B. Information included in the Owner's Manual shall comply with the requirements of Section 01 33 00, Submittal Procedures, with the following exceptions:

1. Two copies of the Owner's Manual shall be submitted after acceptance of all submittals as specified below. One set will be returned to the Contractor with comments.
2. Final copies of the Owner's Manual, after revision, shall be submitted to the City's Representative 15 days prior to startup.

C. The following shall be included in the Owner's Manual in accordance with Section 01 33 00, Submittal Procedures:

1. Installation, connection, operating, troubleshooting, maintenance, and overhaul instructions from the manufacturer.
2. Exploded or details views of all instruments, assemblies, and accessory components.
3. Parts lists and ordering instructions.
4. Wiring diagrams.
5. A list of spare parts for 1 year operation recommended by the manufacturers of all analog equipment.

1.06 AS-BUILT DRAWINGS

A. As-built drawings shall be prepared in accordance with Section 01 33 00, Submittal Procedures, with the following exceptions and changes:

1. The Contractor shall keep current an approved set of complete loop diagrams and schematic diagrams which shall include all field and panel wiring, all piping and tubing runs, all routing, all mounting details, all point-to-point diagrams with cable, wire, tube and termination numbers. These drawings shall include all instruments and all instrument elements

for the complete instrument loop as provided under Division 40, Process Interconnections, 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 City's Representative after completion of field checkout but before placing the systems in service for the Owner's use.
3. Drawings shall also be submitted in electronic format (MicroStation).

1.07 SERVICES OF MANUFACTURER

A. Calibration, Testing and Startup: A technical service representative of the manufacturer shall visit the site and perform the following on all flow meters and analyzers.

1. Inspection, checking and calibrating the equipment.
2. Startup and field testing for proper operation.
3. Performing field adjustments to ensure that installation and operation comply with the Specifications.

B. Instruction of Owner's Personnel: The manufacturer's technical service representative shall instruct the Owner's personnel as indicated in Article Installation, Calibration, Testing, Precommissioning, Startup and Instruction.

1.08 SPECIAL GUARANTEE

A. The Contractor shall guarantee the Work of this Section for 2 years following final acceptance of the Work. In making any warranty repairs, the Contractor shall utilize technical service personnel designated by the manufacturer of the failed device. Repairs shall be completed within 5 days after written notification by the Owner.

1.09 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Products delivered to the site for incorporation into the Work of this section shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

## 1.10 ENVIRONMENTAL CONDITIONS

A. General: All instrumentation and control system components and associated wiring shall be suitable for use in a treatment facility environment where there may be high energy ac fields, dc control pulses, and varying ground potentials between transducers and system components. The system design shall be adequate to provide proper protection against interferences from all such possible situations.

B. Field Situated Equipment: The instrumentation and control system shall be installed on a wastewater treatment plant site. All devices shall be designed to exist in environments rated (G2)(G3)(GX) per ISA S71.04. The system design shall be adequate to provide proper protection the environment typically associated with these facilities. As a minimum, the instrumentation and control systems shall be designed and constructed for satisfactory operation and low maintenance requirements under the following environmental conditions:

1. Temperature Range: 0 degree F through 50 degrees C (32 degrees F through 122 degrees F).
2. Thermal Shock: 0.55 degrees C per minute (1.0 degrees F per minute).
3. Relative Humidity: 20 percent through 95 percent (noncondensing).

C. Control Room Situated Equipment: Control rooms shall be air conditioned to achieve the environmental noted in Paragraph Field Situated Equipment. (No positive control of relative humidity is provided). In the event of a failure of the air conditioning system, all components of the instrumentation and control system shall be rated to operate in an environment where the ambient temperature is 15 degrees C through 35 degrees C (59 degrees F through 95 degrees F) and the relative humidity is 20 percent to 95 percent (noncondensing).

D. Noise Tolerance: The instrumentation and control system components shall not exceed a dB level of 55 when monitored 3 feet away from the devices. If upon testing it is found that this limit is exceeded at the option of the City's Representative and at no additional cost to the Owner, devices shall be replaced in order to achieve a maximum level of 55 dB or sound absorption materials shall be added.

## 1.11 CABLE NUMBERING

A. The first two characters denote the facility or area number.

B. The second group of characters identifies the device being served (field device).

C. The third section uses one of the four suffixes in the table below. Where multiple circuits of the same type are routed to the same endpoint, the suffix will be P1, P2, as required.

D. At each device or termination point, the circuit identification number is appended with the individual wire number. For direct current (DC) circuits only, wire polarity is shown in parentheses as (+) or (-).

E. Spaces are not allowed, and letters are not case-sensitive, and written in upper case.

| Suffix | Circuit Type | Example |
|---|---|---|
| (A) | 24V dc analog (4 mA to 20 mA) | 01FIT022(A)-1(+) |
| (C) | 120V ac control | 05P320(C)-2 |
| (D) | 24V dc digital status or control | 55LSH201(D)-1(+) |
| (P) | Power (120-volt, 480V, 5 kV, 15 kV, etc.) | 01MCC6101(P)-2 |

## PART 2 PRODUCTS

2.01 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 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. Sunshields shall be provided for all outdoor instrumentation.

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 mA dc to 20 mA dc except as noted. Signals within enclosures shall be 1V dc to 5V 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 plus or minus 0.5 percent of full scale and a minimum repeatability of plus or minus 0.25 percent of full scale unless otherwise indicated. Instruments which do not conform to or improve upon these criteria are not acceptable.

H. Control panels shall be provided with redundant power supplies which are configured in a fault-tolerant manner to prevent interruption of service upon failure and interruption of service necessitated by the replacement of a power supply. All power supplies shall have an excess rated capacity of 40 percent. The failure of a power supply shall be annunciated locally and shall generate an alarm to the DCS or PLC.

I. Each control loop shall be individually fused.

2.02 CONTROL PANELS

A. General: Control Panels shall minimize the use of PLCs as it is the intent of the City to maximize the use of the DCS as the primary control system. PLCs may be used where ‘package system’ vendors require PLC use to provide warranty and support of their system. Where PLCs are utilized they shall conform to the Allen Bradley ControlLogix or CompactLogix standards of the City.

1. When PLCs are utilized, the Contractor shall interface the ‘Package system’ PLC to the DCS utilizing TCP/IP network interface, or Mod-Bus interface only.

B. Control panels, including those furnished by equipment manufacturers, and shall be provided according to the following requirements.

1. Where indicated, control panels shall be provided with all required taps, fittings, rotameters, regulation and alarm interlocks to enable the implementation of a purge system which is in conformance with ISA-S12.4 Type Z requirements. Dimensions shall be in accordance

with manufacturer's requirements. Elevations and horizontal spacing shall be subject to City's Representative approval.

2. All control panels which require NEMA 3 or NEMA 4 ratings will be provided with window kits to preserve the panel's integrity and enable operations ready access to information.
3. Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.
4. See P&IDs for control panels to be provided under this Contract.

C. Materials:

1. Panel section faces shall be No. 10-gauge minimum thickness steel for free standing panels and No. 14-gauge minimum thickness steel for smaller panels. All materials shall be selected for levelness and smoothness.
2. Relay rack high density type panels shall utilize standard relay racks with No. 14-gauge steel frame and supports.
3. Structural Shapes and Strap Steel: ASTM A283.
4. Bolting Material: Commercial quality carbon steel bolts, nuts and washers, all 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex head machine bolts. All nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. All other bolted joints shall have S.A.E. standard lock washers.

D. Fabrication:

1. End plates, top plates and top closure panels shall be furnished when required. End plates, top plates, and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be furnished in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4 feet 6 inches wide or five 2 feet 0 inches wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.
2. End closure or rear closure doors shall be provided. Such doors shall be flush fitting and gasketed and be of the hinged lift-off type with lockable door handles. A common key shall be provided for all doors on one panel assembly. Where removable access panels are indicated, they shall be furnished with dished handle fasteners. Screw driver 1/4 turn type fasteners are not acceptable.
    a. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.
    b. The face of the panel shall be true and level after flanging.

c. All panel cut-outs and holes may be cut or drilled by any standard method that will not cause deformation. Burrs shall be ground smooth.
d. Adjacent panels shall be assembled with faces flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.
e. Stiffeners shall be welded to the back of panels, as required to prevent panel deformation due to the weight of front of panel mounted instruments.
f. Panels shall be self-supporting as defined below.

E. Framework and Supports:

1. The rear of each panel section shall have a steel framework for supporting conduit, tubing, wireways, switches, air piping and all instrument accessory items such as relay or terminal enclosures, transducers, pressure switches, valves and air relays. The main frame work shall be constructed of standard structural shapes. Special shapes such as “Unistrut” may be used for secondary supports. Framework must not interfere with instrument connections or access needed for maintenance or adjustments.
2. Steel framework shall extend 2 feet 8 inches back of the panel face unless otherwise required. Where indicated, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel shall be self-supporting.

F. Finish:

1. Preparation:
   a. The front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all openings shall be prepared as follows:
      1) All high spots, burrs, and rough spots shall be ground smooth.
      2) The surfaces shall be sanded or sandblasted to a smooth, clean bright finish.
      3) All traces of oil shall be removed with a solvent.
2. Finishing:
   a. A 3-mil dry coat of Amercoat 185, or approved equal, primer shall be applied over the entire panel surface immediately after solvent cleaning.
   b. Wet sand, dry, then quick glaze spot putty on the front of the panel only. Dry, then wet sand again and dry.
   c. Apply a second 3-mil dry coat of alkyd enamel primer to the front of the panel.

d. Wet sand to smooth clear finish, then dry.
e. At least two 3-mil dry coats of air-dry, satin finish, alkyd enamel shall be applied over the entire surface. Color to be as selected by City's Representative.
f. The Contractor shall furnish two 1 pint containers of the enamel to the City's Representative.

3. Instrument Finishing: The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black japan or "crinkle" finishes on instrument cases are not acceptable.

G. Mounting of Instruments:

1. The Contractor shall provide cut-outs, and shall mount all instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other manufacturers.
2. The Contractor shall also mount, behind the panels, other instrument accessory items as indicated.
3. Rear of panel mounted equipment shall be installed with due regard to commissioning adjustments, servicing requirements, and cover removal.
4. Wiring shall be kept clear of spare space to give maximum space for future additions.

H. Piping Requirements for Control Panels:

1. General:
   a. The Contractor shall provide terminal connections near the top, rear of the panel for all tubing and piping which connect to instruments, valves, air supply, and other pressure leads external to the panel. Terminal connections for tubing shall be bulkhead tube unions. Those for pipe shall be threaded couplings, plugged for shipping purposes.
   b. Each terminal connection shall have an engraved metal or plastic plate with a terminal and instrument tag number affixed nearby.
   c. The Contractor shall provide the air supply pressure reducing station, all instrument and supply piping and all pneumatic tubing or piping to terminal connections and between instruments located within the confines of the panel and supporting framework.
2. Air Supply Piping:
   a. The Contractor shall provide air supply piping from a point near the top of the panel framework to the inlet side of the pressure reducing station, or alternately to the inlet side of individual filter regulators.

b. Piping, fittings and valves downstream of the filters at the air supply reducing station shall be brass or copper. Headers may be extruded aluminum if the tube wall section is thick enough to accept threaded connections.
c. The low pressure instrument air supply header shall extend from the downstream side of the main pressure reducing valves across the length of panel which includes air users. Where the header must be broken for shipping purposes, brass unions shall be provided at the panel section junctions.
d. A separate air supply take-off consisting of a 1/4-inch brass connection braced into the air header (if brass or copper) shall be furnished for each instrument requiring an air supply. An additional 10 percent of the take-offs shall also be provided. Take-offs for 3/4-inch size headers may be made by using 3/4-inch by 3/4-inch by 1/4-inch reducing tees.
e. Each take-off shall be fitted with a 1/4-inch brass diaphragm of needle type shut-off valve. Provide circular type handle with tag number shown thereon.
f. The dead end of the air header opposite the supply end shall be fitted with a plugged 1/2-inch brass gate valve.
g. The connection from the shut-off valves air head to the instruments shall be by means of 1/4-inch or 3/8-inch O.D. tubing as required.

I. Electrical Requirements for Control Panels:

1. The Contractor shall provide all wiring, conduit, wireways, and switches required to make instruments and other panel electrical devices operational.
2. Conduit, wireways, junction boxes, and fittings shall be installed for all signal wire, all thermocouple and resistance thermometer lead wire including those between temperature sensors and temperature indicators.
3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. All wiring shall be identified with stamped tubular wire markers.
4. Freestanding panels shall be provided with switched 100-watt incandescent back-of-panel lights which are powered from a source independent from that which powers the panel devices. One light shall be provided for every 4 feet of panel width and shall be mounted inside in the top of the back-of-panel area.
5. Freestanding panels shall be provided with a 15-amp, 120-volt service outlet circuit within the back-of-panel area which are powered from a source independent from that which powers the panel devices. The circuit shall be provided with one three-wire, 120-volt, 15-ampere,

duplex receptacle for every 4 feet of panel width spaced evenly along the back-of-panel area. As a minimum, two duplex outlets shall be provided for each panel.

6. Smaller panels shall be sized to adequately dissipate heat generated by equipment mounted in or on the panel.
7. Where smaller panels are mounted outside or in unshaded areas, they shall be provided with thermostatically controlled heaters capable of maintaining inside temperatures above 40 degrees F.
8. Smaller panels shall be provided with a hand-switch controlled 100-watt incandescent light and a breaker protected 120-volt, 15-amp duplex receptacle.
9. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose unless otherwise indicated. Opening wiring in close cabinet type panels is allowed when indicated.
10. Construction:
    a. Wire for 115-volt circuits shall be No. 14 AWG stranded with Type THWN or THHN insulation. All terminals for external wiring connections shall be suitable for No. 12 AWG wire.
    b. Flexible conduit is not acceptable.
    c. Conduit fittings shall be cast fittings.
    d. Soldered or pressure crimped wire splicing in conduits shall be acceptable.
    e. For case grounding, panels shall be provided with a 1/4-inch by 1-inch copper ground buss completed with solderless connector for one No. 4 AWG bare stranded copper cable. The Contractor shall connect the copper cable to a system ground loop.
    f. Single case annunciator units with no remote logic which are installed at the top of a panel may be considered as being a terminal box when top of panel wire entry is indicated. If bottom of panel entry is indicated, terminal box shall be provided at the bottom of the panel and wired to the annunciator. Terminals shall be identified with plastic marker strips.
    g. Terminal boxes for incoming and outgoing signal leads shall be located at the top or bottom of the panel as indicated or as otherwise required.
11. Power Supply Wiring:
    a. Unless otherwise indicated, all instruments, all alarm systems, and all motor controls shall operate on 24V dc circuits.
    b. The Contractor shall furnish terminal box connections for the main power supply entry as indicated.
    c. Power supply switches for alarm units shall be three-pole type, arranged to open both the power and alarm circuits. Each annunciator shall be equipped with a separate switch.

d. Instruments located on a single panel section which serve one process unit may be connected to a common branch power circuit. The number of branch circuits shall be such that no circuit load exceeds 10 amps. Different panel sections and instruments serving different process units shall not use common branch circuits. A 15-amp, two-pole circuit breaker shall be provided in each branch circuit. When instruments do not come equipped with integral fuses, the panel fabricator shall furnish and install fuses as required for the protection of individual instrument against fault currents. Fuses shall be mounted on the back of the panel, in a 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.

12. Alarm Wiring: The Contractor shall provide all alarms including light cabinets, audible signal units, test and acknowledge switches and remote logic units as indicated. Interconnecting wiring to panel mounted initiating devices shall also be provided. Wiring from external initiating devices shall be provided by the Contractor. Where plug and cord sets are provided for component interconnection, the Contractor shall harness and support the cables in a neat and orderly fashion. Where separate wire is required, the Contractor shall install 16 AWG with THWN or THHN insulation between all components.

13. Signal Wiring:
    a. Computer and Noncomputer Use:
        1) 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:
            a) Positive: Black (+).
            b) Signal Ground Negative: White (-).
            c) Equipment Ground: Green.
            d) Ungrounded: Red.
            e) Energized by Voltage Sound External to Panel: Yellow.
            f) DC Circuit: Blue.

b. Multiconductor cables where indicated shall consist of No. 16 AWG copper signal wires twisted in pairs, with 600-volt fault insulation. A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.

c. Multi-conductor cables, wireways, and conduit shall provide for 10 percent allocation of spare, unused signal wires in addition to the indicated requirements.

14. Thermocouple Wiring:

a. The Contractor shall provide metal wire troughs, pullboxes, and thin walled conduit for duplex thermocouple lead wire in a manner which will facilitate field installation of lead wire without splices or terminal connections. The Contractor shall also provide the lead wire connections between multipoint temperature sensors and temperature indicators when indicated. When a thermocouple junction box is indicated, it shall be located with the approval of the City's Representative. The panel manufacturer shall install conduit and troughs and lead wires between the junction box and the instruments. Terminal material shall be compatible with extension wire used.

b. Thermocouple lead wire shall be No. 16 AWG with high temperature PVC insulation on each wire and PVC jacket overall, and shall conform to the latest ISA Specification for standard grade.

c. Conduit for thermocouple lead wire shall be in accordance with the following:

| CONDUIT SIZE | 1/2" | 3/4" | 1" | 1½" | 2" |
|---|---|---|---|---|---|
| NO. OF DUPLEX | 1 | 4 | 6 | 16 | 26 |

d. Where the number of duplex lead wires exceeds 26, the wires shall be installed in rectangular ducts filled to not more than 40 percent capacity.

e. All thermocouple wireways and main conduits shall be sized to allow for 10 percent spare thermocouple leads.

f. Each signal, control, alarm, and indicating circuit conductor shall be designated by a single unique number which shall be shown on Shop Drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be plastic-coated cloth, or shall be permanently marked heat-shrink plastic.

15. Terminal Blocks: Terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 15 amperes at 600 volts. White marking strips, fastened securely to the molded sections, shall be provided and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid.

J. Color Conventions:

1. Lens covers for indicating (status or alarm) lights on all panels will be colored as follows:
   a. Red-ON when:
      1) Motor not running (STOPPED).
      2) Valve CLOSED (not fully opened).
      3) Device not energized.
      4) Circuit breaker OPENED.
   b. Green-ON when:
      1) Motor running in forward direction (fast speed for multi-speed motors).
      2) Valve OPEN (not fully closed).
      3) Device energized.
      4) Circuit breaker CLOSED.
   c. White-ON when:
      1) Power available.
      2) System in AUTOMATIC mode.
      3) Monitoring taking place.
   d. Amber-ON when:
      1) Malfunction trip.
      2) Equipment locked out.
      3) Alarm condition.

K. 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.

L. Factory Inspection:

1. Panels shall be inspected for compliance with requirements at the factory before shipment to the Site. The Contractor shall notify the City's Representative 2 weeks in advance of the testing date. A representative of the City's Representative will visit the factory to make the inspection.
2. Contractor shall perform the following tests prior to arrival of the City's Representative:
   a. All air lines adequately tested for leaks.
   b. All alarm circuits rung out to determine their operability.
   c. Electrical circuits checked for continuity and where applicable, operability.
   d. Nameplates checked for correct spelling and correct size of letters.
   e. Other test required to place the panel in an operating condition.
3. It shall be the responsibility of the Contractor to furnish all necessary testing devices and sufficient manpower to perform the tests required by the City's Representative to determine conformance to the requirement of the Contract Documents.
4. If the above tests have not been performed prior to the arrival of the City's Representative, the Contractor shall reimburse the Owner for the cost of the extra time required for the inspector's services and travel expenses.

M. 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.

## 2.03 GENERAL INSTRUMENTATION ENCLOSURE COMPONENTS

A. Signal Isolators, Converters, and Power Supplies: Signal isolators shall be provided in each measurement and control loop, wherever required, to match adjacent component impedances, or where feedback paths may be generated or to maintain loop integrity when the removal of a component of a loop is required. Signal converters shall be provided where required to resolve any signal incompatibilities. Signal power supplies shall be provided to supply sufficient power to each loop component.

B. General Purpose Relays: General purpose relays in the Control Panels shall be plug-in type with contacts rated 10 amperes at 120V ac; quantity and type of contacts shall be as indicated. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover. Sockets for relays shall have screw type terminals.

C. Time Delay Relays: Time delay relays shall be electronic on-delay or off-delay type with contacts rated 10 amperes at 120V ac. Units shall include adjustable dials with graduated scales covering the indicated time range.

D. Slave Relays: Slave relays shall be provided when the number or type of contacts indicated exceed the contact capacity of the indicated relays and timers.

E. Circuit Breakers: Circuit breakers shall be single pole, 120-volt, 15-ampere rating or as required to protect wiring and equipment. Circuit breakers shall be mounted inside the panels as shown.

## 2.04 FLOW MEASURING SYSTEMS

A. Magnetic Flow Measuring Systems: Magnetic flowmeter systems shall be of the low frequency electromagnetic induction type and produce a 4 mA to 20 mA dc signal directly proportional to and linear with the liquid flowrate. 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 (where shown).

1. The metering tube shall have the following attributes:
    a. Constructed of Type 304 or Type 316 stainless steel with flanged connections.
    b. Utilize a minimum of two bullet-nosed, self-cleaning electrodes.
    c. Liner in conformance with the manufacturer’s recommendation for the meters intended service.
    d. Electrodes constructed of materials which are in conformance with the manufacturer’s recommendation for the meters intended service.
    e. Meter housing rated for NEMA 6 submergence conditions.
    f. Meter coating consisting of epoxy painted finish.
    g. Two grounding rings which are in conformance with the manufacturer’s bore and material recommendation for the meters intended service. Grounding rings shall be designed to protect and shield from process abrasion the liners edge interface at the meters end.

2. The microprocessor-based signal converter/transmitter shall have the following attributes:
   a. Utilize dc pulse technique to drive flux-producing coils.
   b. Convert dc pulse signal from the tube to a standardized 4 mA to 20 mA signal into a minimum of 700 ohms.
   c. Six-digit LCD display for flow rate, percent of span, and totalizer.
   d. An operator interface consisting of keypads which respond to English text entry.
   e. Integral zero return to provide a consistent zero output signal in response to an external dry contact closure.
   f. Integral low flow cutoff and zero return.
   g. Automatic range change.
   h. Capable of measuring flow in both directions.
   i. Programmable parameters including meter size, full scale Q, magnetic field frequency, primarily constant, time constant.
   j. Data retention for a minimum of 5 years without auxiliary power (main or battery).
   k. Self-diagnostics and automatic data checking.
   l. Protected terminals and fuses in a separate compartment which isolates field connection from electronics.
   m. Utilize “Smart” technology which employs a hand-held configuration terminal and outputs a digital flow signal superimposed on 4 mA to 20 mA signal and complies to protocol which is ungradable to SP 50.
   n. Produces a scalable frequency output, 0-Hz to 100-Hz, transistor switch closure up to 5.75W externally powered, 5V dc to 24V dc.
   o. Can tolerate ambient temperature operating limits of minus 20 degrees F to 140 degrees F (minus 29 degrees C to 60 degrees C).
3. Each flow metering system shall be hydraulically calibrated at a facility which is traceable to the National Institute of Standards and Technology. The calibrations 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 30 days prior to shipment of the meters to the Project Site. The flow metering system shall conform to the following technical specifications:
   a. Time constant equals 0.5 second to 1,000 seconds.
   b. Galvanic or Optic Isolation:
      1) Accuracy: 0.25 of flow rate from 10 percent to 100 percent full scale for velocities over 3 fps.
      2) Repeatability: 0.25 percent full scale.
      3) Power Consumption: 30 watts or less.

4) Power Requirements: 120V ac, plus or minus 10 percent (24V dc).

4. See Section 40 90 06, Bill of Materials and Quantities, for instrument data sheet of required devices for this Contract. Manufacturers called out on the Data Sheet.

2.05 FLOW DETECTION SWITCHES

A. Vane Flow Switches:

1. Vane flow switch shall utilize the motion of the vane to attract a magnet which actuates a micro switch. Switch shall be SPDT snap-action with contacts rated at 10 amps, 110V ac. The switch actuating magnet shall reside in a sealed body. Proof-pressure rating of the entire switch shall be 1,000 psi. Vane flow switches shall be WE Anderson Series V6, or approved equal.
2. See Section 40 90 06, Bill of Materials and Quantities, for instrument data sheet of required devices for this Contract. Manufacturers called out on the data sheet.

B. Thermal Flow Switches:

1. Flow switches shall be thermally activated based on heat transfer between probes in the pipe flow stream. The probes, electronic circuits and relay shall all be part of an integral unit with a nonferrous cast housing. Process wetted parts shall be Type 316 stainless steel. In horizontal pipe runs the unit shall be side mounted. All switches shall be equipped to function in an environment where the probes are not always immersed. Output relay shall be configurable to energize on increasing decreasing flow and have SPDT contacts rated 2 amps at 120V ac minimum. Contact transfer point shall be field adjustable from 0.015 feet to 5 feet per second in water. Response time shall be adjustable from 1 second to 150 seconds. The trip flow point shall not be affected by process fluid changes in the range of 32 degrees F to 140 degrees F and shall have a repeatability of plus or minus 5 percent. The contract unit shall operate with the specified repeatability in an ambient temperature range of 25 degrees F to 120 degrees F. The power supply shall be 120V ac. Thermal flow switches shall be FCI, or approved equal.
2. See Section 40 90 06, Bill of Materials and Quantities, for instrument data sheet of required devices for this Contract. Manufacturers called out on the data sheet.

## 2.06 LEVEL MEASURING SYSTEMS

A. Radar PTOF Level Measuring Systems:

1. The level measurement system shall consist of a sensing element, a two-wire electronic transmitter, a three terminal interconnecting cable, and radio frequency filters. The transmitter shall be a solid state unit with 4 mA to 20 mA output into 500 ohms (minimum), linear to level. The transmitter shall have noninteracting zero and span controls, a local indicator scalable in the desired process variable. The sensing element shall be flange mounted. The flange shall be chemically resistant to the process. The interconnecting cable shall be a temperature stabilized coaxial cable with molded ground. The cable shall be capable of field shortening without affecting the system calibration, and shall be intrinsically safe. RFI filters shall be supplied by the system manufacturer and shall be field mounted on the sensing element input and transmitter output.
2. See Section 40 90 06, Bill of Materials and Quantities, for instrument data sheet of required devices for this Contract. Manufacturers called out on the data sheet.

## 2.07 LEVEL DETECTION SWITCHES

A. Four-Point Conductance Level Switch:

1. Switch shall be of the conductance type with PVC sheath and 0.25-inch stainless steel rod electrodes for lengths up through 6 feet. For lengths greater than 6 feet, wire suspension type with stainless steel shield electrodes shall be provided. Electrode fitting enclosure shall be an epoxy coated and gasketed cast aluminum housing of suitable configuration for the application. Induction relays shall be two winding type. Primary power supply shall be 120 volts, 60-Hz. Secondary potential shall not exceed 300V ac and short circuit current shall not exceed 25 milliamperes.
2. See Section 40 90 06, Bill of Materials and Quantities, for Instrument Data Sheet of required devices for this Contract. Manufacturers called out on the data sheet.

## 2.08 PRESSURE MEASURING SYSTEMS

A. Local Pressure Measuring Systems:

1. 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. 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 plus or minus 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. Gauges attached to systems containing chemical solutions, corrosive fluids, sludge, sewage, or other liquids containing solids, shall be equipped with diaphragm seals, or approved equal, protective pressure or vacuum sensing devices, and comply with the following:

a. 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 NTP capable of disassembly without loss of filler fluid.

2. See Section 40 90 06, Bill of Materials and Quantities, for instrument data sheet of required devices for this Contract. Manufacturers called out on the data sheet.

## 2.09 PRESSURE DETECTION SWITCHES

A. Diaphragm Piston Pressure Switches:

1. 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 percent 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 nonadjustable deadband type. Diaphragm piston pressure switches shall be SOR, or approved equal.
2. See Section 40 90 06, Bill of Materials and Quantities, for instrument data sheet of required devices for this Contract. Manufacturers called out on the data sheet.

## 2.10 CONTROL PANEL INSTRUMENTATION

A. Digital Indicators:

1. Digital indicators shall be self-contained instruments that display process signals directly in engineering units. The unit shall be suitable for panel mounting and shall utilize an LED display where numerals are no less than 0.5-inch height.
2. The input signal to the digital process indicator shall be 4 mA to 20 mA dc or 1V dc to 5V dc. The input sample rate of the unit shall be a minimum of 2 per second. The unit shall have an auto-zeroing feature and shall have provisions for field adjustable scaling and offset. Accuracy shall be plus or minus 1 least significant digit. Input power to the digital indicator shall be 120V ac, 60-Hz.

B. Current Alarm Trip Switches: Current alarm trips shall be single or dual type as indicated. Units shall accept voltage or current input signals. Dead bands shall be factory set at 1.0 percent of full span for dual trips and adjustable over 100 percent of span for single trips. Alarm trips shall be equipped with 10A DPDT contacts. Alarm trips shall include setpoint dials calibrated 0 percent to 100 percent for each trip point. Single alarm trips shall include a dead band adjustment dial calibrated 0 percent to 100 percent.

C. Selector and Pushbutton Switches: Selector and pushbutton switches shall be rated 10A at 600 volts, shall be heavy-duty, oil-tight, and shall have the number of positions and poles indicated. Operators shall be corrosion resistant.

D. Indicating Lights: Indication lights shall be incandescent push-to-test type and shall be heavy-duty, oil-tight. Each light shall have a screwed-on glass prismatic lens approximately 1-inch in diameter. Each light shall have a factory-engraved legend plate as indicated. Indicating lights shall be 120V ac type with transformers for use with 6.3-volt lamps.

## 2.11 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. Where required, the Contractor shall furnish, install, program/reprogram, test, calibrate, fully configure, expand, and place into operation new and/or existing Programmable Logic Controllers (PLCs) and their ancillary devices as specified herein. These requirements also pertain to all PLCs provided under Division 40, Process Interconnections.

B. General: The Contractor shall furnish all necessary interconnecting cables, all accessories, and all appurtenances as indicated herein or as required for proper operation of the system. All major PLC components of the system shall be of the same manufacturer and PLC family product line. All equipment shall be

housed in an enclosure or control panel suitable for the intended operation and location. The PLC system shall be capable of tolerating and capable of riding through a power interruption of 8 milliseconds or less without interruption of normal operation. The PLC system shall be Allen-Bradley to match existing.

C. Construction: The PLC central processing unit (CPU) shall be of solid-state design. The PLC system shall be provided with a housing or chassis with enough slots to handle all power supplies, CPUs, I/O cards, and communication modules. All CPU operating logic shall be contained on plug-in modules for quick replacement. Chassis wired logic is not acceptable. The controller shall be capable of operating in a hostile industrial environment (i.e., heat, electrical transients, RFI, vibration, etc.) without fans, air conditioning, or electrical filtering (up to 60 degrees C and 95 percent humidity).

D. Design: The PLC shall be furnished with I/O (input/output) modules suitable for interfacing with new and existing field devices. The PLC I/O modules shall be 4 mA to 20 mA signals for analog inputs and analog outputs and shall be 24V dc and/or 120V ac signals for discrete inputs and discrete outputs. Expansion of existing I/O systems (local or remote) shall match existing I/O cards. The PLC shall provide internal fault analysis with a fail-safe mode and a dry contact output for remote location alarming, and a local indicator on the PLC frame in the event of a fault in the PLC.

E. Central Processor: The central processor shall contain all the relays, timers, counters, number storage registers, shift registers, sequencers, arithmetic capability, and comparators necessary to perform the specified control strategy functions. It shall be capable of interfacing sufficient discrete inputs, analog inputs, discrete outputs, and analog outputs to meet the specified requirements plus an additional 25 percent excess capacity. The power supply shall contain capacitors to provide orderly shutdown in the event incoming power does not meet specifications. If this occurs, the processor shall cease operation, forcing all outputs off. The processor shall have a key type memory protect switch to prevent unauthorized program changes. The central processor shall be 32-bit, minimum.

F. Memory:

1. The programmable controller memory shall be Complementary Metal Oxide Semi-conductor (CMOS) based memory with battery backup or Erasable Programmable Read-Only Memory (EPROM) based memory. The CMOS memory shall be a minimum of 21K with sufficient battery backup to retain the program during power interruptions of up to 1 year. An indicator shall show the status of the batteries. A reference shall be

available through the discrete outputs to alarm the operator that the batteries should be changed.

2. The PLC shall be supplied with sufficient memory to implement the specified control strategy functions plus a reserve capacity of 25 percent of the total provided. This reserve capacity shall be totally free from any system use. The memory shall be programmed in a multi-node configuration with multiple series or parallel contacts, counters, timers, and arithmetic functions.

G. Controller: The controller shall have its control strategies programmed in a "ladder logic" language. It shall be easily reprogrammed with a laptop computer as specified below. The PLC system shall be programmed by the Contractor to perform the specified control strategies and monitoring functions. Two documented copies, in hardcopy and electronic format, of the operating PLC program(s) shall be furnished to the Owner which shall allow direct, step-by-step, reloading of the PLC system program(s). The ladder logic shall reflect equipment name designations used in the PLC as well as the Contract Drawing equipment name designations (i.e., timer "Q" in the Contract Drawing may become timer OL in PLC program).

H. Power Supply:

1. The PLC shall be provided with all requisite power supplies and shall operate at the following:
   a. 120V ac RMS plus or minus 15 percent continuously.
   b. 120V ac RMS plus or minus 30 percent maximum 30 seconds.
   c. 120V ac RMS plus or minus 100 percent maximum milliseconds.
   d. Line spikes at 1,000V ac (5,000 micro-seconds duration; 0.05 percent maximum duty cycle).

I. Input/Output Modules: All I/O housings and I/O modules shall be of rugged construction with modules in place. Sufficient input and sufficient output modules shall be provided with the PLC to implement the specified control functions plus a reserve capacity of 25 percent of the total provided. All PLC I/O shall be arranged in a distributed I/O configuration such that the failure of any I/O card will not affect multiple items of the same equipment. New I/O cards shall match existing.

1. Discrete Input Modules: Defined as contact closure inputs from devices external to the programmable logic controller module. Input modules shall be shielded from short time constant noise and 60-Hz pickup. Individual inputs shall be optically isolated for low energy common mode transients to 1,500 volts peak from user's wiring or other I/O Modules. The modules shall have LED lights to indicate a discrete input.

2. Discrete Output Modules: Defined as contact closure outputs for ON/OFF operation of devices external to the programmable logic controller module. The output modules shall be fused (typically 5-amp at 115V ac) with blown fuse indicator lights. The output modules shall be optically isolated from inductively generated, normal mode and low energy, common mode transients to 1,500-volt peak. All output modules shall have LED lights to indicate output has been cycled ON by the controller.
3. Analog Input Modules: Defined as analog inputs for 1V dc to 5V dc or 4 mA to 20 mA dc signals, where an analog to digital conversion is performed and the digital result is entered into the processor. New inputs shall be provided for every scan.
4. Analog Output Modules: Defined as analog output for 1V dc to 5V dc or 4 mA to 20 mA dc signals, where a digital to analog conversion is performed and the analog result is produced as an output. New outputs shall be produced on every scan.

J. Operator Interface Terminal (OIT): Where required, an OIT with LCD display and keypad shall be provided to allow the operator to monitor and make changes in internal registers for set points, timers, and counters in the PLC. Program logic or sequence changes shall not be made from this panel unless a security code or key lock is used to prevent unauthorized changes. Interconnecting cables between the OIT and the PLC shall be provided.

K. Communications: If the vendor PLC is required to interface with the DCS via a datalink, is shall be done so by an RS422 or RS232 serial link or by TCP/IP. The serial link type used shall be determined by distances. The PLC system shall be provided with all appurtenances to support this requirement. The serial communications protocol (if used) shall be MODBUS with the PLC configured in a slave mode. The DCS will operate in the master mode.

L. Programming Laptop: All programming shall be accomplished with a laptop computer. The laptop shall be capable of being directly plugged into the PLC system without the requirements of additional hardware. All programming, all monitoring, all searching, and all editing shall be accomplished with the laptop. These functions shall be capable of being done both “on line” while the PLC processor is scanning or “off line” while the PLC processor is not scanning. The laptop shall display multiple series and parallel contacts, coils, timers, counters, and calculation functions. The laptop shall also be able to monitor the status of all inputs, all outputs, all timers, all counters, and all coils. It shall have the capability to disable/force all inputs, all outputs, and all coils to simulate system operation. It shall also indicate “power flow” through all elements and include a search function to locate any element and its program location. The PLC processor status information, such as error indication and amount of memory remaining, shall be shown on the laptop

screen. The Contractor shall provide one new laptop complete with manuals to the Owner to enable future system support. The laptop shall be turned over to the Owner at startup.

M. PLC Control System Software: This section covers the furnishing of standard and customized software, fully installed and fully configured in the control systems specified herein. It is the intent of this Specification to have the PLC System Supplier furnish his/her latest generation, standard, field proven, fully debugged and supported software package for this application with a minimum of additions or changes. Customized or specially written software shall be furnished if required to meet all of the functional requirements specified herein. Any custom applications software required shall be fully integrated into the basic software and shall not require unique command structures. Software specified herein is described in broad, functional categories. The System Supplier shall furnish a complete software package including the functional requirements specified herein along with whatever additional software is required by the supplier for proper and efficient operation of the PLC Control System. No attempt has been made to list all software or list all characteristics of software required by the System Supplier to meet the functional requirements specified herein.

1. General: The software package shall provide a system capable of controlling system level activities and a higher-level process control language allowing the operator to monitor and control the process through an interactive human interface. The software environment shall support a multi-programming atmosphere allowing concurrent execution of more than one program in a background/foreground mode or multi-tasking mode.
2. Throughout the execution of all software modules, the operator shall be presented with all of the command or operation choices available at that point in the program using sufficient verbiage or symbols to make the choices self-explanatory and unambiguous. Question and answer or fill-in-the-blank requests shall only be permitted where file names, tag names, or other unique text or numerical information is required.
3. System-level software shall include a real-time operating system, a calendar/time program, a file management program and a system of diagnostic routines in addition to any compilers, editors, loaders, or assemblers required to support the process control software language.
4. All programs shall be self-configuring, such that they obtain the size and configuration of the system from parameters contained in the various files created during system generation. No parameters related to the hardware configuration shall be hard coded into any of the software.
5. System Level Software: System level software shall include a complete and unmodified operating system furnished by the System Supplier that provides system-level functions as specified herein. Operating system

software shall function automatically without operator intervention, except as required to establish file names and similar information.

6. Operating System Software:
   a. The real-time operating system software shall be the standard uncorrupted product of the host computer and shall provide the following minimum functions:
      1) Respond to demands from a program request or to demands from an operator.
      2) Dynamic allocation of the resources available in the system. These resources shall include main memory usage, computation time, peripheral usage, and I/O channel usage.
      3) Allotment of system resources on the basis of task priority levels such that a logical allocation of resources and suitable response times are assured.
      4) Queuing of requests in order of priority if one or more requested resources are unavailable.
      5) Resolution of contending requests for the same resource in accordance with priority.
      6) Service requests for execution of one program by another.
      7) Transfer data between programs as requested.
      8) Management of all information transfers to and from peripheral devices.
      9) Control and recovery from all program fault conditions.
      10) Diagnose and report real-time hardware device errors.
7. Program execution shall be scheduled on a priority basis. A multilevel priority interrupt structure is required. A program interrupted by a higher priority program shall be entered into a list of pending programs. Its execution shall be resumed once it becomes the currently highest priority program. Initiation of programs shall, as a minimum, be activated in the following ways:
   a. In response to external interrupts.
   b. At a scheduled time of the day.
   c. On an elapsed-time interval basis.
   d. On request by another program.
   e. On request from the data access panel.
8. The system shall allow periodic programs to be scheduled. The allocation of resources to a time scheduled program shall be based on its relative priority and the availability of computer system resources.
9. Start-up and Restart:
   a. Software shall be provided which initializes and brings a computer or any microprocessor based hardware unit from an inactive condition to a state of operational readiness.
   b. Initialization shall include determination of computer system status prior to startup of initializing operating system software and initializing application software. Initialization shall also include

the loading of all memory resident software, initialization of timers, counters, and queues, and initialization of all dynamic database values.

10. Shutdown: The software shall provide an orderly shutdown capability for shutdowns resulting from equipment failure, including computer processor failure, primary power failure, or a manually entered shutdown command. When the loss of primary power is sensed, a high-priority hardware interrupt shall initiate software for an immediate, orderly shutdown. When a shutdown occurs in response to a command or malfunction, the software shall control the affected hardware quickly and automatically to a secure state.
11. Diagnostics:
    a. Diagnostic programs shall be furnished with the software package to detect and isolate hardware problems and assist maintenance personnel in discovering the causes for system failures. The system manufacturer's standard diagnostic routines shall be used as much as possible. Diagnostic software and test programs shall be furnished for each significant component in the system.
    b. Diagnostic routines shall test for power supply, central processing unit, memory, and I/O bus failures as a minimum.
12. Calendar/Time Program: The calendar/time program shall update the second, minute, hour, day, month, and year in the operating system and transfer accurate time and date information to all system level and application software. Variations in the number of days in each month and in leap years shall be handled automatically by the program. The operator shall be able to set or correct the time and date from the data access panel, only at the highest security level.

N. Operator Interface:

1. System-level software shall provide for creation and modification of alphanumeric displays, compression of display information for storage, and linking of dynamic files to database variables. Each display screen shall be able to be made up of static and dynamic alphanumeric information. The system shall be furnished with standard displays as specified herein. The system shall be capable of storing and utilizing all standard display formats.
2. Additionally, all display screens shall include a dedicated area that shall display the current time and date, and at least one line for system-level messages.

O. Standard Displays: The operator interface systems shall include at least the following standard, nonconfigurable displays.

1. Current Alarm Summary: As specified in the alarm processing section of this Document.
2. System Overview: Displaying the current status of major systems hardware components including the input/output hardware.
3. Menu Displays: Indicating the various displays and application level choice available to the operator.
4. Point Displays: Detailed displays in a standard format for all types of points in the system. Any point in the system shall be able to be displayed indicating all parameters associated with the point. Each entry in the display shall be labeled in engineering units.

P. Algorithms:

1. System software shall support the implementation of algorithms for the determinations of control actions and special calculations involving analog and discrete inputs. These algorithms shall be capable of outputting positional or incremental control outputs or providing the product of calculations. The algorithms shall include alarm checks where appropriate. As a minimum, the following types of algorithms shall be provided:
   a. A calculator algorithm which performs functions such as summing several variables, raising to a power, roots, dividing, multiplying, and subtracting.
   b. A switch algorithm which reads the current value from its input address and stored it as the value of its output address. Two types of switches shall be accommodated, two outputs with one input and one output with two inputs.
   c. A three-mode Proportional-integral-Derivative (PID) controller algorithm, with each of the three modes independently adjustable. The algorithm shall support both direct and reverse acting modes.
   d. Algorithms for lead, lag, dead time, and ration compensators.
   e. Algorithms to perform integration and totalization of analog process variables.
   f. Algorithms that drive the set point of a controller shall include provisions for bumpless transfer, which shall be implemented by use of a bias value.
   g. Algorithms shall be implemented and modified in the system at any time through the use of interactive software modules in a manner consistent with other interactive modules and shall not require any direct source of code changes.

Q. Alarm Processing:

1. Alarm processing software shall be provided to recognize and report alarm events and conditions to the Local Control Panel in an organized, unambiguous, clear, and convenient manner. Alarms shall be classified into at least two priority levels and at least two independent classes.
2. Alarm processing software shall generate alarms for the following conditions:
   a. Discrete input or output change of state is defined as an alarm in the control software.
   b. Analog value exceeding alarm limits defined in the control software.
   c. Analog rate of change exceeding limits defined in the control software.
   d. Failure of the PLC processor, mass memory device, process input/output hardware, or other major hardware component.
   e. Alarms shall be generated in each case above at the time of occurrence and at the time the condition returns to normal.

R. Testing: The City's Representative shall witness testing of the PLC system. Solid-state logic systems shall be tested as complete assemblies. Testing of individual components or modules shall not be acceptable.

S. Training: A manufacturer's representative shall supply two 8-hour days of onsite training for the Owner's personnel. The training shall include but not be restricted to, operation of programming unit, trouble shooting of system hardware and software, and program development.

T. 7-Day Acceptance Test:

1. After startup has been completed, the system shall undergo a 7-day acceptance test. The system must run continuously for 7 consecutive days. During this period, all system functions shall be exercised. Any System interruption and accompanying component, subsystem, or program failure shall be logged for cause of failure, as well as time of occurrence and duration of each failure. A failure shall cause termination of the 7-day acceptance test. When the cause of a failure has been corrected, a new 7-day acceptance test shall be started.
2. Each time the Contractor's technician is required to respond to a system malfunction, he must complete a report which shall include details concerning the nature of the complaint or malfunction and the resulting repair action required and taken.

U. Operations and Maintenance Manuals:

1. The Contractor shall furnish to the Owner five complete sets of operation and maintenance manuals. The manuals shall include date, information drawings, etc., for the system, subsystem, and all components, and shall include names, addresses and telephone numbers of equipment suppliers, representatives and repair facilities.
2. This shall include a complete description of the recommended operating procedures, maintenance procedures, and spare/replacement parts list for equipment items with catalog data, diagrams, and drawings or cuts describing the equipment. Each set shall include full size assembly and wiring diagrams; drawings showing "as-build" conditions shall be furnished to the Owner.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. The Contractor shall employ installers who are skilled and experienced in the installation and connection of all elements, all instruments, all accessories, and all assemblies provided under this Contract.

B. The Contractor shall install all instruments according to the manufacturer's installation instructions and the following:

1. Perform field engineering as required for mounting and supporting all field mounted components.
2. Prepare any additional schematic and interconnection diagrams required for installation.
3. Assemble and interconnect instrument components disconnected for shipping purposes.
4. Remove all temporary supports, bracing, and padding inserted in instrument control panels and other equipment to prevent damage during shipping, storage, or installation.
5. All piping shall be field measured prior to fabrication and erection. Any significant discrepancies between drawings and field conditions shall be reported to the City's Representative. The Owner will not be responsible for any costs to the Contractor for rework because of Contractor failure to take measurements prior to fabrication.
6. Adequately support and protect capillary tubing. All extra tubing shall be carefully coiled, tied, and protected at the instrument location.

C. The Contractor shall install pneumatic instrument air systems according to the manufacturer's installation instructions and the following:

1. Install all pneumatic tubing and make all connections at control panels, instruments, and control valves.
2. Perform field engineering as required for instrument air supply headers and individual air supply taps and lines.
3. Check all air supply branch headers by blowing with clean air and checking for tightness.
4. Clean all transmission and control tubing by blowing with dried and filtered air prior to connecting to instrument components.
5. Leak test all pneumatic control circuits in accordance with ISA Recommended Practice RP-7.1.
6. Set all instrument air regulators at manufacturer's recommended supply pressures.

D. It is the intent of the Contract Documents that all wiring external to Control Panels be provided under the requirements of Division 26, Electrical. Further, it is the general intent that all 4 mA to 20 mA signal circuits, process equipment control wiring, signal wiring to field instruments, and Control Panel input and output wiring, be provided under Division 26, Electrical, and be terminated and identified under Division 40, Process Interconnections.

E. 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.

F. Monitoring and control system configurations are diagrammatic only. Locations of equipment are approximate unless dimensioned on Drawings. Exact locations and routing of wiring and cables shall be governed by structural conditions, physical interferences, and locations of electrical terminations on equipment.

G. Where job conditions require minor changes in approximated locations and arrangements, the Contractor shall make such changes without additional cost to the Owner.

H. 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.

I. 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.

3.02 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.

3.03 INSTRUMENT CABLE TESTS

A. General: The following tests shall be performed on each instrumentation and control system cable. All tests shall be end-to-end tests of installed cables with the ends supported in free air, not adjacent to any grounded object. All test data shall be recorded on forms which are available from the City's Representative. Complete records of all tests shall be made and delivered to the City's Representative. Each form shall be signed by the City's Representative's designed representative who witnessed the testing.

B. Continuity tests shall be performed by measuring wire/shield loop resistance of each signal cable as the wires, taken one at a time, are shorted to the channel shield. No loop resistance measurement shall vary by more than plus or minus 2 ohms from the calculated average loop resistance value.

C. Insulation resistance tests shall be performed by using a 500-volt megometer to measure the insulation resistance between each channel wire, between each channel wire and the channel shield, between individual channel shields in a

multichannel cable, between each individual channel shield and the overall cable shield in a multi-channel cable, between each wire and ground, and between each shield and ground. Values of resistance less than 1 megohms shall be unacceptable.

## 3.04 INSTALLATION, CALIBRATION, TESTING, PRECOMMISSIONING, STARTUP AND INSTRUCTION

A. Installation and Connection:

1. The Contractor shall install and connect all field-mounted components and assemblies under the following criteria:
   a. Process sensing lines and air signal tubing shall be installed to the installation of conduit indicated under Section 26 05 33, Raceway and Boxes. Individual tubes shall be run parallel and near the surfaces from which they are supported. Supports shall be used at intervals not longer than 3 feet of tubing.
   b. 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.
   c. 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.
   d. Thermocouple lead wire shall be provided in dedicated conduit or wireway from the thermocouple to the control panel. Conduit or wireway shall be sized in accordance with the capacity of the instrument.
   e. All power and all signal wires shall be terminated with spade type lugs.
   f. All connectors shall be, as a minimum, watertight.
   g. 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.
   h. All wire and all cable shall be connected from terminal to terminal without splices, arranged in a neat manner and securely supported in cable groups. All wiring shall be protected from sharp edges and corners.

B. Calibration: All analog instrumentation and all control system equipment shall be calibrated and tested after installation to verify that requirements are satisfied. The Contractor shall provide all necessary labor, tools, and equipment to calibrate and test each instrument in accordance with the manufacturer's instructions. Each instrument shall be calibrated at a minimum of three points using test equipment to simulate inputs and read outputs. All test equipment and all instruments used to simulate inputs and read outputs shall be suitable for the purpose intended and shall have an accuracy better than the required accuracy of the instrument being calibrated. Test equipment shall have accuracies traceable to the NIST as applicable. All analog instruments shall be calibrated and tested in place without removal. Test data, applicable accuracy requirements, all instrument manufacturer published performance specifications and all permissible tolerances at each point of calibration shall be entered on test forms available from the City's Representative. These test forms shall verify compliance with all. A report shall be delivered to the City's Representative for each instrument, certifying that the instrument has been calibrated in the presence of the City's Representative'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 City's Representative at no additional cost to the Owner.

1. At least 15 days before installation testing begins, the Contractor shall submit to the City's Representative a detailed description, in duplicate, of the installation tests to be conducted to demonstrate correct installation of the instrumentation and control system and the anticipated dates the testing will occur.
2. Controllers and electronic function modules, shall be tested and exercised by the Contractor to demonstrate correct operation, first individually and then collectively as functional analog networks. Each hardwired analog control network shall be tested to verify proper

performance within indicated accuracy tolerances. Accuracy tolerances for each analog network are defined as the root-mean-square-summation of individual component accuracy tolerances. Individual component accuracy tolerances shall be as indicated by contract requirements, or by published manufacturer accuracy specifications, whenever contract accuracy tolerances are not indicated.

3. Each analog network shall be tested by applying simulated inputs to the first element(s). Simulated sensor inputs corresponding to 10 percent, 50 percent, and 90 percent of span shall be applied, and the resulting outputs read to verify compliance to network accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation of discrete devices. Temporary settings shall be made on controllers, alarms, etc., during analog loop tests. All analog loop test data shall be recorded on test forms, which include calculated root-mean-square-summation system accuracy tolerance requirements for each output.
4. Air systems shall be tested for leaks in compliance with ISA RP7.1.
5. When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of all test forms signed by the City's Representative's representative as a witness, with test data entered, shall be submitted together with a clear and unequivocal statement that all instrumentation has been success fully calibrated, fully inspected, and fully tested.

D. System Precommissioning: The Contractor shall responsible for demonstrating the operability of all systems provided under this Specification. The City will assist and coordinate the operability assessment with the Contractor. Precommissioning shall commence after acceptance of all wire, all calibrating and loop tests, and all inspections have been conducted. Precommissioning shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under actual operating conditions.

1. The Contractor shall develop and submit to the City's Representative for approval a Precommissioning 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 precommissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. All hardwired and software control circuit

interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady-state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers, as required, to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any) and making necessary controller adjustments, as required, to eliminate excessive oscillatory amplitudes and decay rates.

3. All 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 set point settings shall be compared to measured final control element position/speed values at 10 percent, 50 percent, and 90 percent of span and the results checked against indicated accuracy tolerances. Accuracy tolerances are defined as the root-mean-square summation of individual component accuracy tolerances.
4. Individual component accuracy tolerances shall be as indicated in the Contract Documents or as specified by published manufacturer accuracy specifications whenever not indicated.
5. The Contractor shall submit an instrumentation and control system precommissioning 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 precommissioning testing. The City's Representative must accept the instrumentation and control system precommissioning testing before the 7-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 required in Section 01 91 14, Testing, Integration, and Startup, to produce a fully operational system.

F. Instruction: The Contractor shall train the Owner's maintenance personnel in the maintenance, calibration, and repair of all instruments provided under this Contract.

1. The training shall be scheduled a minimum of 3 weeks in advance of the first session. The training shall be performed concurrent with the precommissioning in Article Installation, Calibration, Testing, Precommissioning, Startup and Instruction, Paragraph D, above.
2. The training shall be performed by qualified representatives of the instrument manufacturers and shall be specific to each instrument model provided. Instructors shall have training experience.
3. Each training class shall be a minimum of 4 hours in duration and shall cover Operational Theory, Maintenance, Trouble Shooting/Repair, and Calibration of the instrument.
4. Proposed training material, including resumes for the proposed instructors and a detailed outline of each lesson shall be submitted to the City's Representative at least 30 days in advance of when the lesson is to be given. The City's Representative shall review the submitted data for suitability and provide comments which shall be incorporated into the course.
5. Within 10 days after the completion of each lesson the Contractor shall present to the City's Representative the following:
   a. A list of all Owner personnel that attended the lesson.
   b. An evaluation of Owner personnel knowledge through written testing, or equivalent.
   c. A copy of text utilized during the lesson with all notes, diagrams, and comments.

## 3.05 PROCESS CONTROL STRATEGIES

A. The general control strategies, shown in Appendix A, complement of the Process and Instrumentation Diagrams (P&IDs). All materials and components shall be furnished, whether explicitly indicated or not, to affect the functional requirements defined on the P&IDs and in the general and specific process control strategy descriptions. The Contractor shall utilize the control strategies as a resource in generating control narratives to be included in the analog hardware submittal. All automation control updates will be modifications to the existing vendor PLCs as identified in the specific control strategies. The DCS will be performing monitoring only.

B. Common functions that are generally applicable to all strategies or to similar strategies are described under the heading "General Functions". These functions are not repeated in the descriptions for each strategy.

C. Each strategy is described as follows:

1. Overview: A brief description of the mission of the related strategy including the roles of logic, monitoring, and control stations located/associated with MCCs, field situated, and DCS or PLC-based.
2. Detailed Strategy Functions: A detailed description of each and every monitoring and control function associated with the associated strategy. This description addresses the strategies reaction to sensor failures, process equipment failures, control device failures, DCS or PLC malfunctions, and power interruptions. All control modes (MCC, local hand station, local control panel, DCS keyboard) are fully described. These descriptions are augmented by a listing of all instruments, valves, control devices, process equipment, and DCS or PLC equipment associated with the noted strategy. All control sequences associated with equipment activation, deactivation, process startup and process shutdown are defined along with all required time delays.
3. Preface to Control Strategy Section:
    a. Tag numbering system definitions and terms.
    b. Controls and control functions provided for all equipment, unless otherwise noted Local control station at equipment.
    c. Local/DCS or Local/Remote switch.
    d. Alarms Logic: Open contact for alarms (fail-safe).
4. Format for Each Strategy:
    a. General Description:
        1) An overall description of the process.
        2) Major control components (PCM, PLC, annunciator, panels).
        3) General function of each major control component.
        4) P&ID references for this strategy.
        5) Reference to I/O listing.
    b. Related equipment.
    c. Overview of strategy.
    d. Non-DCS Control:
        1) Local Manual Control: Description of monitoring and control from each equipment item. If this is covered by the general statement in the Preface, describe any deviations. Example: “Because of inaccessibility location of this valve in the sump, a local control station is not provided.”
        2) Remote Manual Control: Description of control from any local or area control panels. Other Control: Package system, PLC, etc.

e. DCS or PLC Alarm, Monitoring and Control Functions:
   1) DCS or PLC Manual Control.
   2) DCS or PLC Automatic Control.
   3) Alarms: Define alarms and alarm priorities. Define level (1, 2, 3, or 4) for each alarm.
f. Failure modes.
g. Communications interfaces.
h. In-Service/Out of Service Algorithm: Description of devices which determine in/out of service status for each piece of equipment. (In-service (I/S)/out of service (OOS) algorithms mask or block out all or selected alarms associated with the OOS device (i.e., if a wet well is declared OSS, low level alarms shall be inhibited). Additionally, if a device has been designated OOS, all control routines shall declare the equipment as being unavailable for service.
i. See Appendix A for general and specific descriptions of the process control strategies.

3.06 SUPPLEMENT

A. The supplement listed below, following "End of Section," is part of this Specification:

1. Appendix A – Control Strategies.

**END OF SECTION**

# APPENDIX A - CONTROL STRATEGIES

## LEGEND

A. PCM: Process Control Module (transmits process data to and from the field and provides plant automation).

B. DCS: Distributed Control System (Plant Computer Control System).

C. UPS: Uninterruptable Power System (provides battery back-up power to the PCM).

D. DH: Data Highway (Plant process network where PCM, workstation, and historian communications take place).

E. DIN: District Information Network (Fiber Optic Transmission to COMC).

F. LCP: Local Control Panels.

G. PID: Proportional-Integral-Derivative.

H. PLC: Programmable Logic Controller.

## PROJECT OVERALL CONTROL SYSTEM STRATEGY OVERVIEW

A. Provide a brief overall project control strategy overview.

## GENERAL CONTROL AND MONITORING

A. These control strategies are not intended to be all-inclusive operational procedures for the operation of the complete facility. In general, control and monitoring functionality is as follows:

1. Alarm monitoring and generation, process sequencing, automatic control of auxiliary systems, and equipment interlocking control strategies are resident within the DCS or PLC.
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**

A. Common functions and terms for basic monitoring and control operations are provided as a standard of implementation for the control system. These terms and functions address items that are typical for process control loops and most operator initiated actions. These functions are not necessarily repeated in each individual control strategy. Unless otherwise stated they are considered a part of each implemented control strategy.

B. Provision shall be made to include certain control functions that apply to all analog inputs, virtual variables, analog controllers and discrete control whether or not shown on the P&IDs, even though one or more of the functions may be disabled by the user for a given data base point:

1. Verification of Digital Outputs: In SEMI-AUTO and AUTO mode each command will be monitored for the desired results before proceeding to the next step and if the sired results are not achieved in a certain predetermined time an alarm will be generated. The operator will have the ability to override and move to the next stage.
2. Analog Data Scaling: This control function shall scale all analog inputs to a common span and shall normalize the digital representation of each analog input to a percent of the operating span. The processed value shall be expressed as a binary number that specifies the analog input's position on a straight line lying between zero and full scale as defined for a given input by the zero span values in the data base.
3. Amplitude Limit Check: This control function shall perform dual level, high/low amplitude limit checking and shall identify a limit violation every time a measured or virtual variable goes out-of-limits and returns back into limits. The control function shall determine the time at which each limit excursion occurred. A dead-band shall be provided on each limit and shall be expressed as a percentage of span or in engineering units.

4. Engineering Unit Conversion:
   a. This control function shall convert scaled analog data to engineering units by means of the following equation:

      $$Y = (H - L) (D/DH) + L$$

      where:

      Y = value in engineering units

      H = high value of span, expressed in engineering units

      L = low value of span, expressed in engineering units

      D = digitized scale input value in counts

5. Discrete Event Monitor: This control function shall monitor an alarm (where appropriate) all discrete status changes.
6. Manual Control: It shall be possible for the operator or plant engineer to interrupt any sequence, loop, or automatic operation and operate the same manually from remote.

C. The following terms are used in the descriptions of DCS/PLC functions:

1. Operator Settings (Set Points): Operator set or entered values that are adjustable or set from operator displays. Examples of operator set or entered values are controller set points, batch set points, timers, counters, mode selection, etc. Specific values that are required to be operator settable are noted (bracketed [ ]) in the process control strategy descriptions. Unless otherwise stated to be tunable or fixed, a set point value is operator settable.
2. Tunable Values: Tunable values are set points that are adjustable at password protected engineer level displays without requiring any PLC or DCS software reconfiguration. Examples of tunable values are tunable time settings, tunable alarm set points, PID tuning constants, etc. These values are not adjustable from operator level displays. Tunable values are also identified and their preliminary values are shown in brackets [xxx].
3. Fixed Values: Fixed values are constants that are contained within the PLC or DCS control logic normally inaccessible by the DCS system. Modification of fixed values requires a modification to the control logic via the PLC 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.
    a. Hardware interlocks may also be derived by local control panels or switches wired directly to the PLC or DCS to provide direct hardwired alarm status to the PLC or DCS for processing.
6. Software Interlocks: Software interlocks refer to interlocks that are generated by the PLC or DCS logic or otherwise pass through the PLC or DCS. Software interlocks are not operable when the PLC is not operable or if for some reason equipment is operated while by-passing the PLC logic.
7. Hardware Generated Alarms: Hardware generated alarms are alarms that are generated external to the PLC by equipment such as local control panels, analytical devices and process switches.
    a. Direct wired alarms that do not depend on the PLC or DCS to be operable. An example would be a HIGH H2S level signal from the H2S monitor and wired directly to an alarm light or horn.
    b. Direct PLC 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 or PLC Automatic Control Mode: In DCS/PLC 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 or PLC Manual Control Mode: DCS/PLC manual control refers to the remote manual control of equipment from the DCS workstation. In this mode, the operators override the DCS or PLC 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**

A. 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.

B. DCS is configured as the primary control system for all alarm monitoring, start/stop sequencing, shutdown and interlock and basic process control functions.

C. When delineated within individual control strategies as DCS controlled or DCS logic, the control program is resident within the DCS system. Complex control algorithms and historical data calculations are normally performed by the DCS system.

D. 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:
    a. Level 1: Life Threatening or Danger Conditions.
    b. Level 2: Critical process alarms that shall create a plant shutdown condition, cause a critical process failure or severely hinder plant operation.
    c. Level 3: Minor process alarms associated with warning conditions and minor equipment failures.
    d. Level 4: Informational alarms shall not hinder operation or cause equipment failure.
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.
c. For equipment that the DCS/PLC is allowed to control, the DCS/PLC shall provide a FAIL-TO-OPERATE alarm if the equipment fails to comply with a DCS/PLC command signal. The (START, STOP, OPEN, CLOSE) shall has been present for more than a tunable time period. In this event, the command shall be removed subsequent to the expiration of the tunable time period.
d. 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.
e. 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:
    1) 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.
    2) 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.
    3) Set point, process variable, and controller output shall be displayed. Provisions shall be included to prevent reset windup.
    4) 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.
    5) 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.
    6) 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.

10. 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.

E. Specific Control Strategies are shown in the following Appendix. Required modifications for this Project are incorporated into the existing control strategies. These modifications are to be programmed by the original vendor into the existing vendor's PLC. The existing Emerson Ovation DCS shall be reprogrammed to monitor all statuses and alarms and archive all new analog and digital inputs and outputs being provided under this contract. The Contractor shall facilitate exchange of register mapping being transmitted over the communications link.

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# Abbreviations and Acronyms

| | |
|---|---|
| AP | Aria Pall |
| A/S | Antiscalant Agent |
| AWT | Advanced Water Treatment |
| BAC | Biological Activated Carbon |
| BPL | Ballast Power Level |
| BW | Backwash |
| CCB | Communication Control Board |
| CIP | Clean-In-Place |
| CHN | Chemical, Hot Water, Neutralization |
| CV | Control Value |
| DCS | Distributed Control System |
| DICON | Digital Converter |
| $DO_3$ | Dissolved Ozone |
| dP | Differential Pressure |
| DPWF | Demonstration Pure Water Facility |
| E-stop | Emergency Stop Pushbutton |
| EFM | Enhanced Flux Maintenance |
| EPDM | Ethylene Propylene Diene Monomer |
| EQ | Equalization |
| FM | Flux Maintenance |
| gpm | Gallons Per Minute |
| $H_2O_2$ | Hydrogen Peroxide |
| $H_2SO_4$ | Sulfuric Acid |
| HDPE | High Density Polyethylene |
| HMI | Human Machine Interface |
| HV | High Voltage |
| IT | Integrity Test |
| LRV | Log Removal Value |
| MF | Microfiltration |
| mgd | Million Gallons Per Day |
| NaOCl | Sodium Hypochlorite, also known as bleach |
| $NH_4OH$ | Ammonium Hydroxide |
| $O_3$ | Ozone |
| OIT | Operator Interface Terminal |
| P&ID | Piping & Instrumentation Diagram |
| PDC | Power Distribution Center |
| PDT | Pressure Decay Test |
| PID | Proportional-Integral-Derivative |
| PLC | Programmable Logic Controller |
| PPD | Pounds Per Day |
| PSA | Pressure Swing Adsorption |
| PSU | Power Supply Unit |
| PTFE | Polytetrafluoroethylene |

| | |
|---|---|
| RO | Reverse Osmosis |
| scfm | Standard Cubic Feet Per Minute |
| SP | Setpoint |
| TMP | Transmembrane Pressure |
| TOC | Total Organic Carbon |
| UF | Ultrafiltration |
| UV | Ultraviolet |
| UV/AOP | Ultraviolet Advanced Oxidation Process |
| UVT | Ultraviolet Transmission |
| VAC | Volt(s) Alternating Current |
| VDC | Volt(s) Direct Current |
| VFD | Variable Frequency Drive |

# Appendix A. INTRODUCTION

The following report provides a summary of the control philosophy for five unit processes at the 1 million gallons per day (mgd) Potable Reuse Demonstration Pure Water Facility (DPWF; formerly Advanced Water Purification Facility, or AWPF) in 2016. This report is organized to first provide descriptions of the unit processes and components, modes of operation, and alarms. Each unit process is covered as a separate chapter. Each chapter provides the control strategy of the individual unit process. Following the individual unit processes and controls chapters, this report provides details on the global plant control philosophy, identifying communications and messages between programmable logic controllers, plant wide alarms, and controls. The final section of the report provides a list of recommended process variables for monitoring and data logging of the Demonstration Plant events by the Distributed Control System.

## DOCUMENT OBJECTIVES

The objective of this technical memorandum is to describe the current control strategy of the City of San Diego DPWF.

## HOW TO USE THIS DOCUMENT

This Technical Memorandum can be utilized as a manual to gain an understanding of all the unit processes at the DPWF. Full details for each system as well as the integration of the system controls are provided. Chapters are arranged to first provide a general overview of each unit process and subsequent sections elaborate and build upon the information of the previous sections. Unit processes are described first in individual chapters, and are followed by a chapter describing the global communication and controls for operating the treatment train.

Chapters covering unit processes are arranged and described in the following order. Each system is first described with a general theory of operation and intended treatment/usage. Building on the theory or operation, major components critical for system operation are described. Following the description of physical components of the system, the chapter progresses with operations of the system. Sections describing operations cover operation modes and available processes. Interface between operators and control of the systems are described in the human machine interface (HMI) screens section. Piping and instrumentation diagrams (P&IDs) provide full detail on physical components and inputs and outputs between the system's programmable logic controller (PLC) and the main PLC governing global controls. References to the record drawings are provided in the document and the original drawings are included as reference documents. The next section covers local alarms and response of the unit process to these alarms. The control philosophy is presented in the last section. Unit process chapters describe how each unit operates and regulates itself when called by the main PLC.

Following description of the unit processes, the control and communication of the overall treatment train is presented in the final chapter. Overall descriptions of modes of operations and detailed descriptions of network nodes and pathways for transmitting information, data, and signals are included in this chapter.

The intention of this document is to provide summarized descriptions of treatment processes and operations and describe control philosophy for the Demonstration Plant. Additional information on the individual unit processes can be obtained from manufacturer's final submittals, design drawings, and standard operating procedures.

## PLANT OVERVIEW

The San Diego region is located at the terminus of the two major water conveyance systems of California: the State Water Project and the Colorado River Project. Rising costs and questions of reliability have pushed the region to seek more robust local solutions to their water resources issues. The City of San Diego has long been a leader in investigating the feasibility of potable reuse to supplement its drinking water supplies. The Pure Water San Diego Program currently underway is a long-term effort to develop potable reuse supplies that will provide up to one-third of the City's future drinking water needs.

The DPWF is one component of the Pure Water San Diego Program, and is located at the North City Water Reclamation Plant (NCWRP). NCWRP is a 30-mgd capacity facility consisting of primary, secondary, and tertiary treatment. Primary treatment consists of bar screens, grit removal, and conventional primary sedimentation. Following that, flow undergoes biological nitrification and partial denitrification in a Modified Ludzack-Ettinger secondary process. Tertiary treatment for reclaimed water includes filtration with anthracite media, demineralization with electrodialysis reversal, and chlorine disinfection. An aerial layout and process flow diagram for the NCWRP treatment processes are shown in Figure 1 and Figure 2.

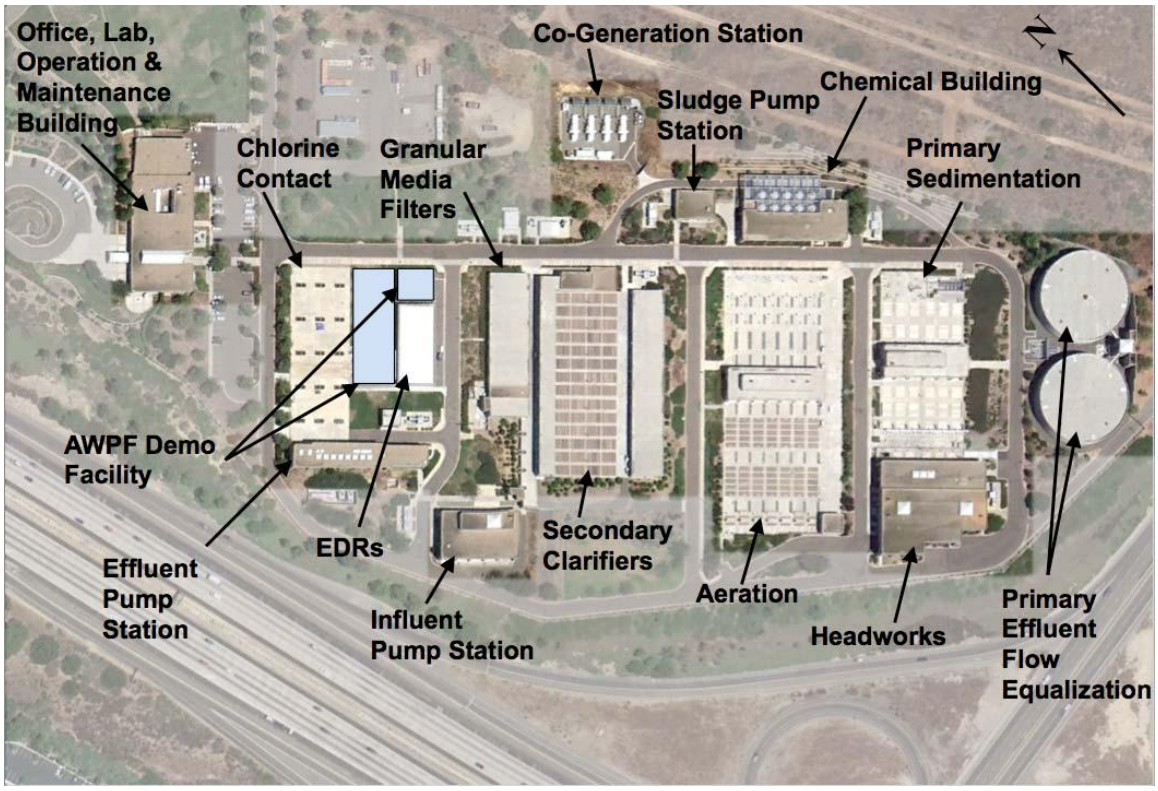


**Figure 1. Aerial view of North City Water Reclamation Plant**

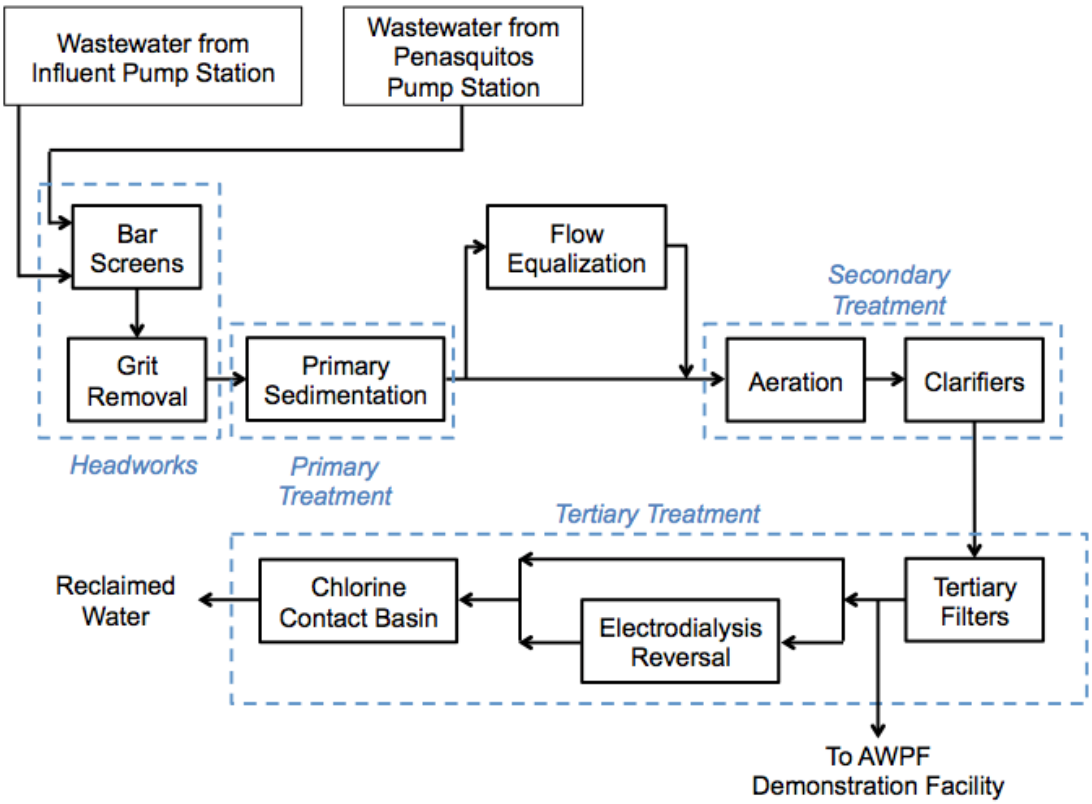


**Figure 2. North City Water Reclamation Plant process flow diagram**

The Advanced Water Purification Facility (AWPF) was built in 2011 as part of the water purification demonstration project, which assessed the feasibility of supplementing San Diego's water supply via the San Vicente Reservoir. The AWPF consists of parallel trains of microfiltration (MF) and ultrafiltration (UF), parallel trains of reverse osmosis (RO), and ultraviolet light (UV) with an advanced oxidation process (AOP).

In early 2014, ozone and biological activated carbon (BAC) filters were added as pretreatment to the MF/UF-RO-UV/AOP treatment train. The official name of the entire demonstration plant including ozone and BAC is now Demonstration Pure Water Facility (DPWF). Figure 3 shows a process flow diagram of the DPWF.

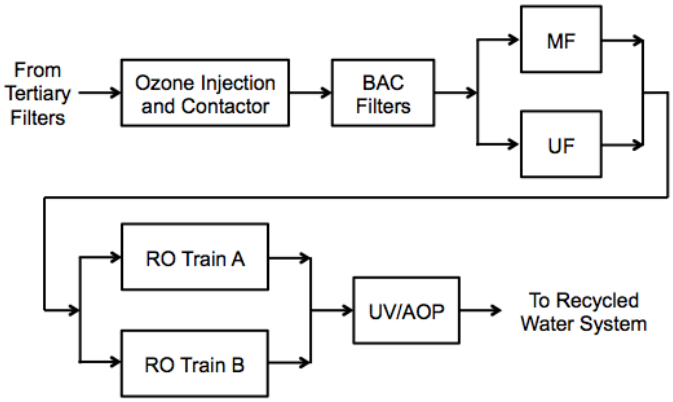


**Figure 3. Demonstration Pure Water Facility process flow diagram**

# Appendix B. OZONE SYSTEM

## OZONE SYSTEM OVERVIEW

Ozone provides disinfection and can also be used for removal of taste and odor compounds, color, and compounds of emerging concern such as pharmaceuticals, endocrine disrupting compounds, hormones and personal care products. The ozone system consists of ozone generation and injection, as well as an ozone contactor. The ozone generation system is containerized and consists of an oxygen generator, ozone generator, two ozone dissolution systems (1,100 and 550 gallons per minute, or gpm), ozone destruct system, alarms, generator cooling water system, exhaust fan and respective instrumentation and controls. The ozone generator has a capacity of 190 lbs/day (PPD) at 10% ozone by weight. After ozone is injected into the flow, it enters the contactor, which is a 24-inch diameter pipeline 360 feet in length. At 1,100 gpm, the contact time provided is approximately 8 minutes. Flow straighteners are used at each turn to maintain plug flow hydraulics by redistributing the flow and minimizing short-circuiting. The following parameters and operating ranges in Table 1 are relevant to process performance and design criteria are summarized in Table 2.

**Table 1. Ozone system parameter ranges**

| Parameter | Operating Range |
|---|---|
| Feed Water Flow | 1040-1080 gpm |
| Ozone Production | 60-145 PPD |
| Dissolved Ozone Residual at OSP 4 | 0.75-1.5 mg/L |
| Dissolved Ozone Residual at OSP 7 | 0.25-0.70 mg/L |
| Dissolved Ozone Residual at OSP 10 | 0.10-0.30 mg/L |
| Water Temperature | 20-30 °C |

**Table 2. Ozone system design criteria**

| **Ozone Generation and Injection System** | |
|---|---|
| Design Flow | 1.6 mgd (1100 gpm) |
| Generator Capacity | 190 PPD at 10% |
| Maximum Applied Dose | 14.3 mg/L (1100 gpm at 10%) |
| Manufacturer | Wedeco |
| **Ozone Contactor (Pipeline)** | |
| Pipeline Diameter | 24 in |
| Pipeline Length | 6 x 60 foot segments |
| Total Volume | 7,800 gal |
| Contact Time | 7.5 min at 1.5 mgd |
| Contact Time at Design Flow | 7.02 min at 1.6 mgd |
| Design CT | 14 mg/L-min |
| Baffling Efficiency | 95% $T_{10}/T_{HRT}^{*}$ |
| $T_{10}$ | 6.85 min at 1100 gpm |

## OZONE SYSTEM MAJOR COMPONENTS

All equipment interfaces are connected through the Ozone Generator Main programmable logic controller (PLC). The Ozone/Filtration System is shown below in Figure 4. As shown in Figure 4, the Ozone Generation System is a once through system using oxygen as the feed gas. Oxygen gas is produced by the pressure swing adsorption (PSA) Oxygen Generation System that is fed by an air compressor. Produced oxygen gas is stored in a product tank that provides the feed to the ozone generator. The ozone generator produces ozone gas from oxygen gas. Once ozone is generated, ozone is introduced into the process water through the injection system. The injection can accommodate operation at full flow (1100 gpm) and operation at half flow (550 gpm). This injection system can inject either ozone gas when ozone generator is on, or oxygen gas if operating in purge position. Gas flow must be greater than 10 standard cubic feet per minute (scfm) to prevent surging in the gas line. The closed loop chiller system dissipates the heat generated in the ozone generation process by passing cooling water through the water jacket of the ozone generator shell. The offgas treatment consists of the destruct unit. The unit is comprised of an air blower that pulls gas from the top of the Biological Activated Carbon (BAC) Influent Tank and the ozone contactor. Gas flows through the destruct catalyst that has heated material (CARULITE 200) that decomposes ozone gas to oxygen gas.

### Air Compressor

A rotary screw air compressor creates an air source for the PSA oxygen generator. The air created consists of 78% nitrogen, 21% oxygen and other gases. The air is treated by multiple levels of filtration and dried by an integral refrigerated dryer. The air compressor component is critical for operation of the ozone system. The ozone system will not start or operate if the air compressor is not available.

### Pressure Swing Adsorption Oxygen Generator

The pressure swing adsorption (PSA) Oxygen unit concentrates oxygen from compressed air through a unique PSA process. The compressed air flows through a filter assembly before the air enters the adsorber vessels. A particulate filter removes condensed water, oil, dirt, scale, and other undesirable components from the feed air, and then, a separate coalescing filter removes additional oil and water vapor.

### Ozone Generator

The oxygen is directed to the ozone generator. The ozone generator is provided with a shell, local control panel, high voltage (HV) transformer, and inverter Power Supply Unit (PSU). Oxygen gas is converted to ozone in the generator shell. The generator shell contains dielectrics that create an electric field to complete the conversion. Heat is generated in this process and cooling water from the water chiller system is required to dissipate heat from the generator. The outlet of the ozone generator is connected to the ozone header piping, where ozone is introduced to the process water.

### Water Chiller

The water chiller system includes a heat exchanger to transfer heat and pumps to provide water flow through the equipment. The water chiller is a critical component for running the ozone generator.

### Ozone Contactor

Ozone gas can be introduced when the system is operating at either half flow (550 gpm) or full flow (1100 gpm). There are separate piping and injection systems for half and full flow and automated isolation valves that need to be aligned for each flow condition. Once injected into the process water, there is a static mixer designed to increase mixing and promote plug flow. Afterwards, ozonated water proceeds through the ozone contactor where disinfection contact time occurs.

### Off-gas and Destruct System

Gas in the ozone contactor and BAC Influent Tank contain residual levels of ozone that need to be treated prior to discharge into the atmosphere. Main components of the destruct system include the degas lines, air blower, water trap, ozone monitor, heater, and destruct catalyst. The air blower pulls gas from

the ozone contactor and BAC Influent Tank. Water is removed from the offgas by water traps before the offgas passes through the air blower. Water traps are located by the ozone contactor and BAC Influent Tank and are used to remove entrained liquid from gas. Moisture in the destruct catalyst will poison the catalyst material and prevent ozone destruction. The heater heats the media in the destruct catalyst and decomposes the ozone gas to oxygen as the gas passes through the catalyst. There are two ozone monitors that measure the ozone residual in the offgas. One measures residual going into the destruct catalyst, and one measures residual coming out of it. If the ozone monitor reads levels higher than 0.1 ppm ozone residual in the catalyst discharge, it may be unsafe to continue running the ozone system.

The destruct skid is equipped with a Local Control Panel that enables local operation and interface with the Ozone Generators Main PLC.

### Biological Activated Carbon Influent Tank

The Biological Activated Carbon (BAC) influent tank stores ozone-treated water and provides flow to the BAC filters.

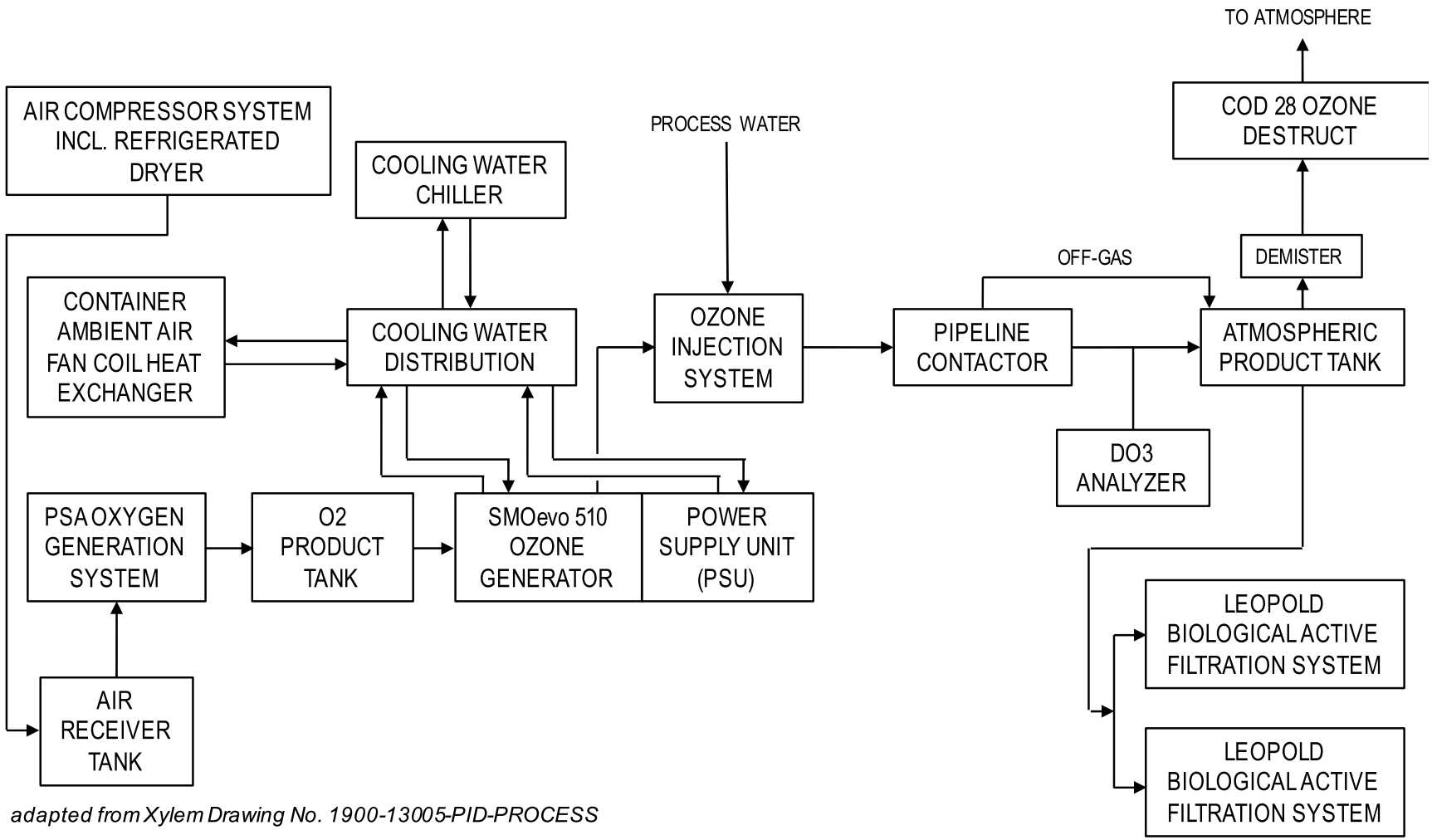


**Figure 4. Ozone/Filtration System Schematic**

## OZONE SYSTEM OPERATING MODES

Ozone has four positions of operation: remote, off, purge, and local. Operation modes for ozone can be selected using the Remote/Off/Purge/Local Switch, which is a physical switch on the generator control panel. The ozone generator has 2 modes of operation: manual and automatic. The system is also equipped with an emergency stop pushbutton (E-Stop) that triggers a shutdown sequence different from the normal shutdown sequence.

### Operation Positions and Modes

### Purge Position

Purge mode can be used to remove ozone and humidity from gas lines and ozone generator vessel. During purge mode, oxygen gas is injected into process water. Purge mode is suitable for troubleshooting, after prolonged periods of non-usage, and after Safety Relay Tripped alarms.

### Remote Position

Generator is turned on remotely via a hardwired start signal or from a “soft” signal from the DPWF main programmable logic controller (PLC), 28-CP-101 (also known as PLC 101).

### Local Position

Generator is turned on locally at the ozone generator control enclosure.

### Off Position

When in the off position, the ozone system will remain off unless the position is changed locally to purge, remote, or local.

### Manual and Automatic Mode

The automatic and manual modes of operation are available in the Remote, Local, and Purge position. Proportional-integral-derivative (PID) loop control for gas flow, chiller, injector, generator, ozone production, and destruct is utilized in automatic mode. The generator start and stop sequence is independent of the automatic and manual modes. When the selector is in the Off position, no part of the generating system will operate. The Destruct skid, however, will remain in operation.

### Start-Up and Shutdown Sequences

For ozone startup, the following conditions must be met:

- Advanced Water Treatment (AWT; the block consisting of microfiltration, ultrafiltration, reverse osmosis Trains A and B, and the ultraviolet advanced oxidation process systems) run permissive from

PLC 101 (see Section Communication Block Diagrams for details on run permissives).
- Ozone is ready (no shutdown alarms, dewpoint is ready).
- BAC system is ready to filter.

If all above conditions are met and the ozone system receives the command to start, the following steps will take place:

1. Upon permissive from PLC 101 the feed flow control valve will open to 100%.
2. Oxygen flow will purge trough the generator and vent out to atmosphere.
3. The PSA system and compressor will turn on from idle status and resume operation.
4. The chiller and its cooling water recirculation pump turn on.
5. After an operator resets the “Ozone/BAC reset” button on HMI 101, feed pump(s) turns on.
6. Feed flow control valve closes to 60% to provide backpressure for the first 30 seconds.
7. Solenoid injector valve opens to pre-purge gas in the system into the process water flow.
8. Pre-purging of oxygen continues while the feed pump and feed flow control valve adjust to meet the flow rate setpoint.
9. The digital converter DICON turns on.
10. The inverter turns on if the system is in ozone production mode (Remote). If the system is in Purge Mode, the inverter will not turn on and oxygen will continue being injected into the water.
11. Main contactor turns on and ozone production begins. The ozone production PID will now take over to meet the operator-set doses and gas flow rates.

The ozone system will shut down automatically if there is a critical alarm on the ozone, BAC, or destruct system. The system will also shutdown if it is not operating within the bounds of operational setpoints. Critical alarms and conditions causing shutdown are provided in Section 2.6.

Normal shutdown proceeds as follows:

1. The inverter will turn off and stop the ozone generator.
2. Post-purging starts in order to evacuate the ozone gas still in the pipes.
3. The feed pump shuts down.
4. The chiller and cooling water pump shut down.
5. Post purging ends.
6. System is off.

The main difference between normal and emergency stop situations is that the emergency stop does not go through a purging process. Therefore, there will still be ozone gas remaining in the ozone generator. The Emergency Stop should only be utilized in situations where there is a danger to people or the ozone generator system and not as a standard method for system shutdown.

## Ozone System Human Machine Interface Screens

### Generator Human Machine Interface Screens

The ozone generator human machine interface (HMI) is used to access information and set operational parameters. All ozone setpoints are local to the ozone HMI screens. This section describes contents of the HMI screens.

### Passwords for Screen Access

There are some screens that require a login name and password. The ozone generator has two Login Access Levels:

**Table 3. Password and Login Information**

| |
|---|
| Operator Access |
| Login Name: OP |
| Password: 4488 |
| WEDECO Access |
| Login Name: not for customer use |
| Password: not for customer use |

Refer to Section 2.4.4 for the Login Screen.

### Main Menu Screen

No password is required for access.

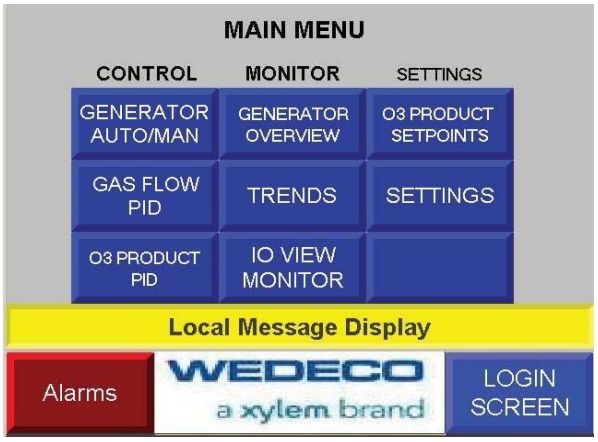


**Figure 5. Main Menu Screen**

The following screens require the OPERATOR password:

- Generator Auto/Man
- Gas Flow PID
- O3 Product PID
- O3 Product Setpoints
- Settings

**Login Screen**

Accessible from LOGIN SCREEN pushbutton located on the MAIN MENU screen. No password is required for access.

**Figure 6. Login Screen**

- (Image item 1) - Pushbuttons for LOGIN and LOGOUT: The username and password keypad will appear when pressing the LOGIN pushbutton. Refer to Section 2.4.2 for username and passwords. Display to show username and password status (Image item #2) -
    - OPERATOR ACCESS
    - WEDECO ACCESS (for WEDECO personnel only)

  The login period will expire after HMI is idle for 10 minutes.
- (Image item #3) - Pushbutton to check the Alarm and System Running Pilot Light: If the pilot light(s) do not turn on when the button is pressed, replace the light bulb.
- (Image item #4) - Pushbutton to shutdown the Panelview Plus application to access the HMI configuration menus: This function is for troubleshooting purposes only. Do not shutdown the application while the generator is in operation.
- (Image item #5) – Leads to the Main Menu screen of the ozone system.

**Ozone Overview Screen**

Accessible from GENERATOR OVERVIEW pushbutton located on the MAIN MENU screen. No password is required for access. The following parameters are displayed on the overview screen:

- Dewpoint temperature
- Ambient air ozone concentration
- Gas flow
- Cooling water flow
- Cooling water temperature
- Ozone concentration percent weight

- Generator power
- Ozone production setpoint
- Actual ozone production
- Flow setpoint

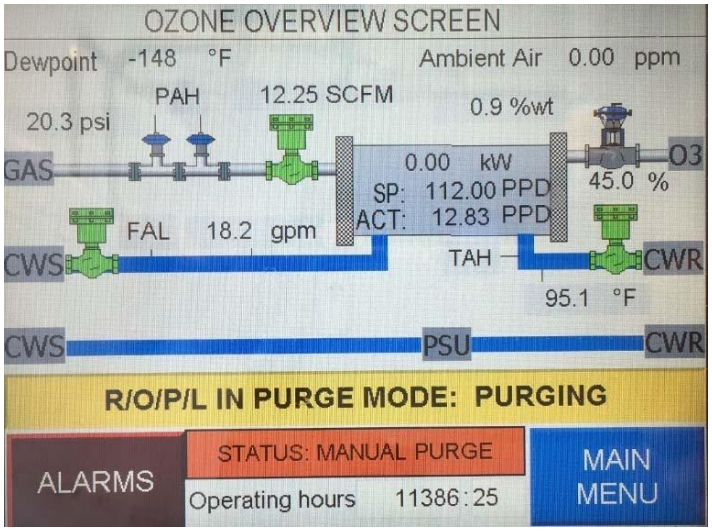


**Figure 7. Ozone Overview Screen**

This screen displays the process parameters, valve open/close status, alarm status, and operating hours.

### Ozone Production Setpoints Screen

Accessible from O3 PRODUCT SETPOINTS pushbutton located on the MAIN MENU screen. Screen access requires OPERATOR or WEDECO passwords. This screen allows the operator to enter the ozone production setpoint in pounds per day (PPD), "Half Flow" or "Full Flow" setpoints, and the ozone concentration setpoint in %wt.

### Generator Auto/Manual Screen

Accessible from GENERATOR AUTO/MANUAL pushbutton located on the MAIN MENU screen. Screen access requires OPERATOR or WEDECO passwords. This screen displays the status of the ozone generator mode and allows the operator to set the system to “AUTO” or “MANUAL” modes. In AUTO, the generator will ramp up or down based on analog inputs from the gas flow meter, power meter, and percent $O_3$ in gas meter. In MANUAL, the generator will remain at the operator set power level regardless of changes in gas flow or actual ozone dose. **NOTE: It is dangerous to operate the ozone generator in MANUAL mode!**

**Figure 8. Generator Auto/Manual Screen**

### Feed Gas Flow Proportional-Integral-Derivative Screen

Accessible from GAS FLOW PID pushbutton located on the MAIN MENU screen. Screen access requires OPERATOR or WEDECO passwords.

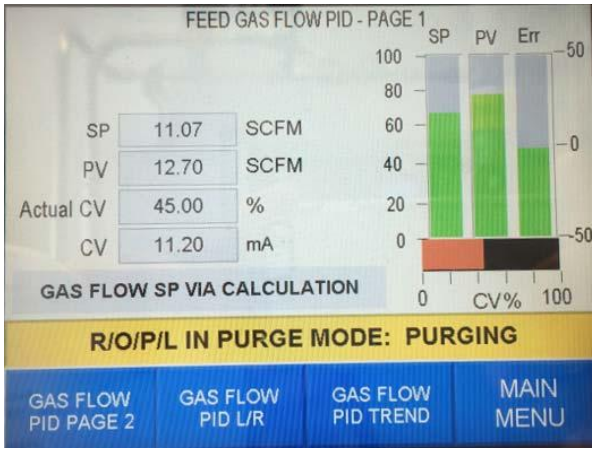


**Figure 9. Feed Gas Flow Proportional-Integral-Derivative Screen – Page 1**

The Feed Gas Flow PID Screen-Page 2 is accessible from GAS FLOW PID PAGE 2 pushbutton located on the FEED GAS FLOW PID PAGE 1 screen. Screen access requires OPERATOR or WEDECO passwords.

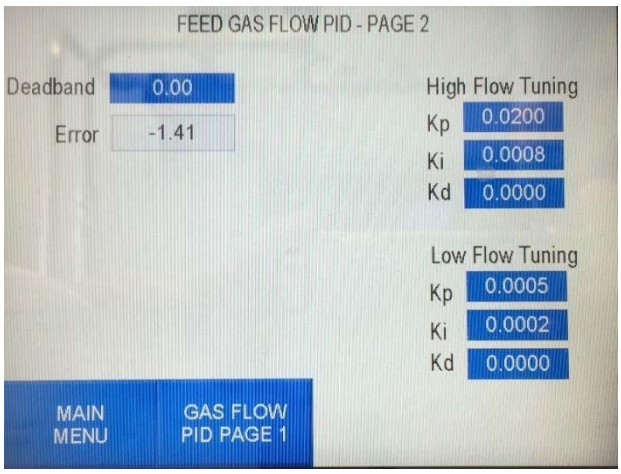


**Figure 10. Feed Gas Flow PID Screen – Page 2**

Figure 11 shows the PID tuning values. $k_p$, $k_i$, and $k_d$ are the coefficients for the proportional integral and derivative terms the loop uses to offset the error from the desired setpoint over time. Deadband defines a lower limit gas flow rate.

### Feed Gas Flow Proportional-Integral-Derivative Trend Screen

Accessible from GAS FLOW PID TREND pushbutton located on the FEED GAS FLOW PID (PAGE 1 OR PAGE 2) screen. No password is required for access.

**Figure 11. Feed Gas Flow PID Trend Screen**

### Ozone Production Proportional-Integral-Derivative Screen

Accessible from OZONE PRODUCT PID pushbutton located on the MAIN MENU screen. Screen access requires OPERATOR or WEDECO passwords.

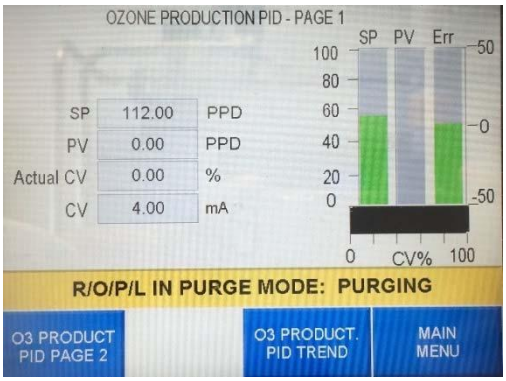


**Figure 12. Ozone Production PID Screen – Page 1**

The Ozone Production PID Screen-Page2 is accessible from OZONE PRODUCT PID PAGE 2 pushbutton located on the Ozone Production PID-Page 1 screen. Screen access requires OPERATOR or WEDECO passwords.

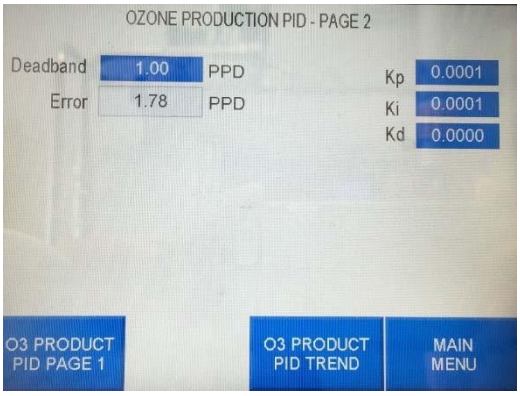


**Figure 13. Ozone Production PID Screen – Page 2**

### Ozone Production Proportional-Integral-Derivative Trend Screen

Accessible from OZONE PRODUCT PID TREND pushbutton located on the OZONE PRODUCT PID (PAGE 1 OR PAGE 2) screen. No password is required for access.

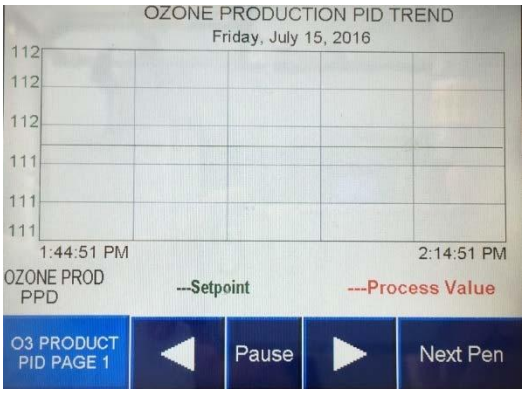


**Figure 14. Ozone Production PID Trend Screen**

### Ozone System Diagrams

The ozone system electrical, process, and piping and instrumentation diagrams (P&IDs) can be found on the record drawings provided with the reference documents. The sheet numbers associated with the diagrams are summarized in Table 4.

**Table 4. Ozone System Record Drawings**

| Diagram | Document Source | Sheet Number |
|---|---|---|
| P&ID Legend | Ozone Generation and Filtration System Operations & Maintenance Manual | 1 |
| Ozone and BAC Process Flow P&ID | Ozone Generation and Filtration System Operations & Maintenance Manual | 8 |
| Oxygen Generation System P&ID | Ozone Generation and Filtration System Operations & Maintenance Manual | 9 |
| Ozone Generation System P&ID | Ozone Generation and Filtration System Operations & Maintenance Manual | 10 |
| Power Unit Supply P&ID | Ozone Generation and Filtration System Operations & Maintenance Manual | 11 |
| Cooling Water Chiller P&ID | Ozone Generation and Filtration System Operations & Maintenance Manual | 12 |
| Ozone Injection System P&ID | Ozone Generation and Filtration System Operations & Maintenance Manual | 13 |
| Off-Gas Treatment (Destruct) System P&ID | Ozone Generation and Filtration System Operations & Maintenance Manual | 15 |

### Ozone System Alarms and Warnings

Critical alarms and warning alarms are generated by the Ozone Generator programmable logic controller (PLC) to alert the operator of potential problems.

**Critical Alarms**: Critical alarms have a major effect on the ozone production process. They can reflect failure of equipment or failure of the ozone production process. The production of ozone may stop in the event of a critical alarm. The Alarm Pilot Light turns on in the event of a critical alarm. Critical alarms halt ozone production and these alarms cause shutdown of the ozone system if ozone production is enabled in the remote position.

**Warning Alarms**: Warning alarms are generally provided for events that have little effect on the ozone production process. However, warning alarms do need immediate attention. Warning alarms may be a prelude to critical alarms, which have a potential to stop ozone production.

If one or more critical alarms or warning alarms are present, then:

Refer to the Alarms/Warnings table in this section for a description and solution to correct the alarm/warning. An example Ozone Alarm History Screen is shown below:

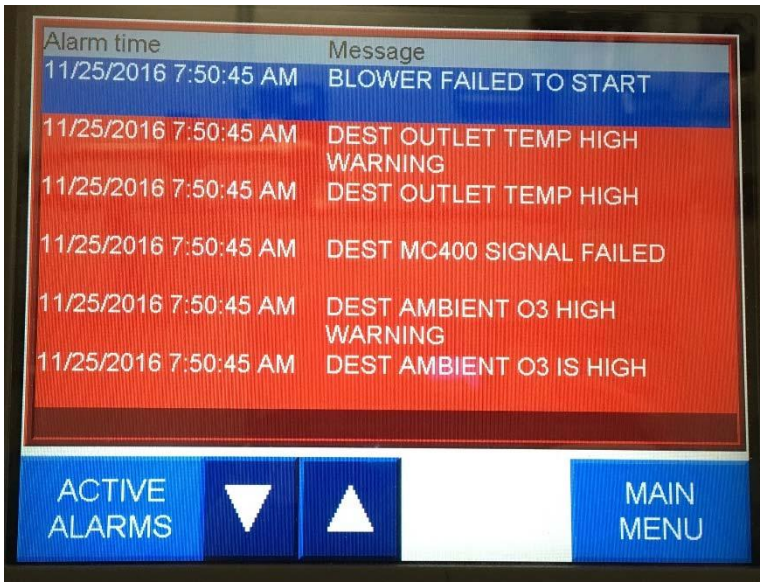


Figure 15. Ozone Alarm History Screen

**Alarm Messages**

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| 24V POWER SUPPLY FAILURE | The 24V Power Supply has failed.<br>-The 24VDC Power Supply Unit may be faulty.<br>-The associated fuse may have blown.<br>-There may be a short in the 24VDC circuit. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check 24VDC power supply unit.<br>-Check 24V circuit for shorts.<br>-Replace fuse for 24VDC Power Supply Unit if necessary.<br>-Press Alarm Reset. |
| +1G1 ENCLOSURE TEMPERATURE HIGH | The Enclosure Temperature has exceeded the alarm limit. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Reduce temperature in control room.<br>-Press Alarm Reset. |
| PHASE MONITOR FAILURE | The phase monitor has detected a fault. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check and correct phase rotation.<br>-Check incoming power for loss of phase.<br>-Press Alarm Reset. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| ACTIVE FILTER FAULT | The active filter has failed. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Refer to Fault Code displayed on Active Filter.<br>-Refer to Active Filter operations and maintenance (O&M) for corrective action.<br>-Press Alarm Reset. |
| GENERATOR CAPACITOR TEMPERATURE HIGH | Capacitor temperature too high.<br>-Enclosure temperature may be too high. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check cooling water flow.<br>-Check heat exchanger for proper operation.<br>-Press Alarm Reset. |
| RECTIFIER DC NOT OK | -Supply power may be irregular.<br>-Inverter contactor may be faulty.<br>-Fuses may have blown.<br>-Rectifier board may have failed. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Troubleshoot and fix.<br>-Press Alarm Reset. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| CHILLER NOT IN AUTO | The Chiller is not set to be in Auto via the HMI screen. | -Post warning message on HMI.<br>-Generator continues to operate normally. | - At Chiller screen, set mode to Auto. |
| MAIN INJECTOR SOLENOID NOT IN AUTO | The Main Injector Solenoid is not set to be in Auto via the HMI screen. | -Post warning message on HMI.<br>-Generator continues to operate normally. | - At Injector screen, set solenoid to Auto. |
| INJECTOR SOLENOID No 1 NOT IN AUTO | The Injector Solenoid No 1 is not set to be in Auto via the HMI screen. | -Post warning message on HMI.<br>-Generator continues to operate normally. | - At Injector screen, set solenoid to Auto. |
| INJECTOR SOLENOID No 2 NOT IN AUTO | The Injector Solenoid No 2 is not set to be in Auto via the HMI screen. | -Post warning message on HMI.<br>-Generator continues to operate normally. | - At Injector screen, set solenoid to Auto. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| DICON IS NOT OK | -DICON may be missing control voltage.<br>-DICON may be have fault. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check control voltage to DICON.<br>-Replace DICON if necessary.<br>-Reset DICON.<br>-Press Alarm Reset. |
| DICON OPERATION NOT OK (INVERTER FAULT) | Inverter has experienced a fault.<br>-Control voltage may be missing. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check control voltage to DICON -Reset DICON.<br>-Press Alarm Reset. |
| GENERATOR TRANSFORMER TEMPERATURE HIGH | -Temperature of Inverter HV transformers too high.<br>-Enclosure temperature may be too high.<br>-Heat exchangers may not be working properly. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check cooling water flow.<br>-Check heat exchanger for proper operation.<br>-Press Alarm Reset. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| SAFETY RELAY TRIPPED | -Emergency (E-stop) Pushbutton may be pressed.<br>-Inverter Enclosure doors may be opened. | -Initiate alarm.<br>-Ozone Generator shuts down immediately.<br>-Inverter is OFF.<br>-Feed Gas stops flowing. | **If E-Stop pressed:**<br>-Ensure that it is safe to operate generator.<br>-Pull E-stop pushbutton.<br>-Press Alarm Reset.<br>**If inverter enclosure door was opened:**<br>-Ensure that it is safe to operate generator.<br>**If enclosure door open:**<br>-Close enclosure door.<br>-Press Alarm Reset. |
| EXTERNAL DEVICE FAULT | The external device associated with the ozone generator has failed. | -Initiate alarm.<br>-Ozone Generator shuts down immediately.<br>-Inverter is OFF.<br>-Feed Gas stops flowing. | -Check external device for failure and perform corrective action.<br>-Press Alarm Reset. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| FEED GAS PRESSURE HIGH | The feed gas pressure is too high:<br>-The feed gas pressure high switch is hardwired to the feed gas solenoid valve and feed gas control valve. | -Initiate alarm.<br>-Ozone Generator shuts down immediately.<br>-Inverter is OFF.<br>-Feed Gas stops flowing. | -Check feed gas supply.<br>-Check outlet gas valves.<br>-Press reset button on feed gas pressure.<br>-Press Alarm Reset. |
| GENERATOR COOLING WATER FLOW LOW | The cooling water for generator and heat changer is too low. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check cooling water supply.<br>-Ensure that cooling water valves are open.<br>-Press Alarm Reset. |
| Power Supply Unit (PSU) COOLING WATER FLOW LOW | The cooling water flow for the PSU is too low. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check cooling water flow.<br>-Press Alarm Reset. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| OZONE MONITOR FAILURE | The ozone monitor may have failed.<br>-The ozone monitor may not have power. | -Initiate alarm.<br>Refer to Ozone Monitor Failure Setup Screen:<br>**If Generator Shutdown on Monitor Fail = Yes, then**<br>-Inverter turns OFF<br>-Feed Gas continues to flow<br>**If Generator Shutdown on Monitor Fail = No, then**<br>-Ozone generator continues to run, but with a current limit.<br>-The generator PLC will send a fixed control value to the inverter to continue producing ozone. | -Refer to Ozone Monitor operations and maintenance (O&M) for corrective action.<br>-Ensure that power is on to the ozone monitor.<br>-Press Alarm Reset. |
| FEED GAS PRESSURE LOW | The feed gas pressure is too low. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check feed gas supply.<br>-Ensure that feed gas valves are open.<br>-Check pressure regulator.<br>-Press Alarm Reset. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| FEED GAS DEWPOINT HIGH | The feed gas dewpoint is too high. | -Initiate alarm.<br>-Generator shuts down.<br>-Inverter turns OFF.<br>-Feed Gas stops flowing.<br>-Dewpoint valve opens. | -Check feed gas supply dewpoint.<br>-Check the air dryer.<br>-Press Alarm Reset. |
| GENERATOR COOLING WATER TEMPERATURE HIGH | The cooling water for the generator is too hot. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check cooling water supply.<br>-Press Alarm Reset. |
| FEED GAS FLOW LOW | The feed gas flow is too low. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check feed gas supply.<br>-Ensure that feed gas valves are open.<br>-Check pressure regulator.<br>-Press Alarm Reset. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| AMBIENT OZONE CONCENTRATION HIGH | The ambient ozone concentration is too high.<br>-DANGER: People shall not be exposed to high ozone concentration.<br>Vent area immediately. | -Initiate alarm.<br>-Ozone horn and beacon activate and vents open.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Vent area immediately.<br>-Do not return to area until ozone concentration is reduced.<br>-Check ozone process piping for leaks.<br>-Press Alarm Reset. |
| SIGNAL FAILURE: AMBIENT OZONE CONCENTRATION | The 4-20mA signal to Generator PLC is missing. (The analog input signal < 3mA).<br>-Possible problem with the ambient ozone concentration monitor.<br>-Power supply to ozone concentration monitor may have failed.<br>-The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Initiate alarm.<br>-Inverter turns OFF.<br>-Feed Gas continues to flow. | -Check ambient ozone concentration monitor for failure.<br>-Check power supply for ambient ozone concentration monitor.<br>-Check analog wiring.<br>-Press Alarm Reset. |
| SIGNAL FAILURE: DEWPOINT MONITOR | The 4-20mA signal to Generator PLC is missing (The analog input signal < 3mA). | -Initiate alarm.<br>-Inverter turns OFF. | -Check dewpoint monitor for failure. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| | -Possible problem with the dewpoint monitor.<br>-Power supply to dewpoint monitor may have failed.<br>-The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Feed Gas continues to flow. | -Check power supply for dewpoint monitor.<br>-Check analog wiring.<br>-Press Alarm Reset pushbutton to clear alarm. |
| SIGNAL FAILURE:<br>FEED GAS FLOW | The 4-20mA signal to Generator PLC is missing (The analog input signal < 3mA).<br>-Possible problem with the feed gas flow transmitter<br>-Power supply to feed gas flow transmitter may have failed.<br>-The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Initiate alarm.<br>-Generator shuts down<br>-Inverter turns OFF<br>-Feed Gas stops flowing. | -Check feed gas flow<br>transmitter<br>-Check power supply<br>for feed gas flow transmitter<br>-Check analog wiring<br>-Press Alarm Reset |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| SIGNAL FAILURE: FEED GAS<br>PRESSURE | The 4-20mA signal to Generator PLC is missing (The analog input signal < 3mA).<br>-Possible problem with the feed gas pressure transmitter<br>-Power supply to feed gas pressure transmitter may have failed.<br>-The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Initiate alarm.<br>-Generator shuts down<br>-Inverter turns OFF<br>-Feed Gas stops flowing. | -Check feed gas pressure transmitter<br>-Check power supply<br>for feed gas pressure transmitter<br>-Check analog wiring<br>-Press Alarm Reset |
| SIGNAL FAILURE: INJECTOR PRE-PRESSURE SIGNAL | The 4-20mA signal to the injector pressure transmitter is out of range (The analog input signal < 3mA).<br>-Possible problem with transmitter.<br>-Power supply to the transmitter may have failed.<br>-The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Initiate alarm.<br>-Feed Gas continues to flow | -Ensure that power is on to the transmitter<br>-Press Alarm Reset after condition has cleared. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| SIGNAL FAILURE: INJECTOR POST PRESSURE SIGNAL | The 4-20mA signal to the injector pressure transmitter is out of range (The analog input signal < 3mA).<br>-Possible problem with transmitter.<br>-Power supply to the transmitter may have failed. -The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Initiate alarm.<br>-Feed Gas continues to flow. | -Ensure that power is on to the transmitter<br>-Press Alarm Reset after condition has cleared. |
| SIGNAL FAILURE: INJECTOR FLOW SIGNAL | The 4-20mA signal to the injector flow transmitter is out of range (The analog input signal < 3mA).<br>-Possible problem with the transmitter.<br>-Power supply to the transmitter may have failed.<br>-The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Initiate alarm.<br>-Generator will shut down. | -Ensure that power is on to the transmitter<br>-Press Alarm Reset after condition has cleared. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| SIGNAL FAILURE:<br>OZONE MONITOR | The 4-20mA signal to Generator PLC is missing<br>(The analog input signal < 3mA).<br>-Possible problem with the ozone monitor.<br>-Power supply to ozone monitor may have failed.<br>-The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Initiate alarm.<br>Refer to Ozone Monitor Failure Setup Screen:<br>**If Generator Shutdown on Monitor Fail = Yes, then:**<br>-Inverter turns OFF<br>-Feed Gas continues to flow<br>**If Generator Shutdown on Monitor Fail = No, then**:<br>-Ozone generator continues to run, but with a current limit.<br>-The generator PLC will send a fixed control value to the inverter to continue producing ozone. | -Refer to Ozone Monitor O&M for corrective action<br>-Ensure that power is<br>on to the ozone monitor<br>-Press Alarm Reset |
| LIQUID SEPARATOR LEVEL IS HIGH | Liquid level in the tank is above the high limit. | -Initiate alarm.<br>-Ozone generator will shut down. | -Drain the tank using the manual ball valve.<br>-Press Alarm Reset after condition has cleared. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| CHILLER ALARM | Fault in chiller system. Liquid cannot be cooled. | -Initiate alarm.<br>-Ozone generator will shut down. | -View the chiller control panel for specific alarm<br>-Press Alarm Reset after condition has cleared. |
| PSA ALARM | Fault in air/ozone system. Air supply cannot be maintained. | -Initiate alarm.<br>-Ozone generator will shut down. | -View the PSA control panel for specific alarm.<br>-Press Alarm Reset after condition has cleared. |

**Warning Messages**

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| FEED GAS PRESSURE LOW | Feed gas pressure is below warning setpoint:<br>-Feed gas pressure has potential to get lower and may compromise ozone production. | -Post warning message on HMI.<br>-Generator continues to operate normally.<br>-When feed gas pressure is above warning setpoint, the warning message is cleared. | -Check feed gas supply line. |
| FEED GAS DEWPOINT HIGH | Feed gas dewpoint is above warning setpoint:<br>-Feed gas dewpoint has potential to get higher and may compromise ozone production. | -Post warning message on HMI.<br>-Generator continues to operate normally.<br>-When feed gas dewpoint is below warning setpoint, the warning message is cleared. | -Check feed gas supply line.<br>-Decrease the feed gas dewpoint. |
| GENERATOR COOLING WATER TEMPERATURE HIGH | Generator cooling water temperature is above warning setpoint:<br>-Cooling water temperature has potential of getting higher and may compromise ozone production. | -Post warning message on HMI.<br>-Generator continues to operate normally.<br>-When generator cooling water temperature is below warning setpoint, the warning message is cleared. | -Check cooling water supply.<br>-Decrease temperature of cooling water. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| AMBIENT OZONE CONCENTRATION HIGH | The ambient ozone concentration is above warning setpoint:<br>-Ambient ozone concentration has potential to get higher.<br>-DANGER: People shall not be exposed to high ozone concentration.<br>Vent area immediately. | -Post warning message on HMI.<br>-Generator continues to operate normally.<br>-If equipped, the alarm beacon will turn ON.<br>-When ambient ozone concentration is below warning setpoint, the warning message is cleared.<br>-If equipped, the alarm beacon will turn OFF. | -Vent area immediately.<br>-Check ozone process piping for leaks. |
| SIGNAL FAILURE: GENERATOR COOLING WATER TEMPERATURE | The 4-20mA signal to Generator PLC is missing<br>(The analog input signal < 3mA).<br>-Possible problem with the temperature transmitter.<br>-Power supply to temperature transmitter may have failed.<br>-The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Post warning message on HMI.<br>-Generator continues to operate normally.<br>-When Generator cooling water temperature signal is restored, the warning message is cleared. | -Check temperature transmitter.<br>-Check power supply for temperature transmitter.<br>-Check analog wiring. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| SIGNAL FAILURE: POWER MONITOR | The 4-20mA signal to Generator PLC is missing (The analog input signal < 3mA).<br>-Possible problem with the power monitor.<br>-Power supply to power monitor may have failed.<br>-The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Post warning message on HMI.<br>-Generator continues to operate normally.<br>-When power monitor signal is restored, the warning message is cleared. | -Check power monitor.<br>-Check power supply for power monitor.<br>-Check analog wiring. |
| SIGNAL FAILURE: RAW WATER FLOW | The 4-20mA signal to Generator PLC is missing (The analog input signal < 3mA).<br>-Possible problem with the flow meter (provided by customer).<br>-Power supply to flow meter may have failed.<br>-The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Post warning message on HMI.<br>-The generator PLC is unable to calculate the ozone production setpoint.<br>-Generator will operate at minimum setting.<br>-When raw water flow signal is restored, the warning message is cleared. | -Check raw water flow meter.<br>-Check power supply for raw water flow meter.<br>-Check analog wiring. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| SCADA COMMUNICATION FAILURE | The Generator PLC has not received a “heartbeat” via PLC 101 within a certain time period.<br>-PLC 101 may have failed.<br>-The communications cable may have damage.<br>-The communications module for the generator PLC or PLC 101 may have failed. | -Post warning message on HMI.<br>-The generator PLC is unable to get operation setpoints (if applicable) from PLC 101.<br>-Generator will operate at minimum setting.<br>-When ozone setpoint signal is restored, the warning message is cleared. | -Check communication cable.<br>-Check PLC 101. |
| SIGNAL FAILURE: GENERATOR COOLING WATER FLOW | The 4-20mA signal to Generator PLC is missing (The analog input signal < 3mA).<br>-Possible problem with the flow meter.<br>-Power supply to flow meter may have failed.<br>-The analogue signal wiring may be disconnected.<br>-Analogue input module may be faulty. | -Post warning message on HMI.<br>-Generator continues to operate normally.<br>-When Generator cooling water flow signal is restored, the warning message is cleared. | -Check flow meter.<br>-Check power supply for flow meter.<br>-Check analog wiring. |
| PSA NOT IN AUTO | The PSA is not set to be in Auto via the HMI screen. | -Post warning message on HMI.<br>-Generator continues to operate normally. | - At PSA screen, set mode to Auto. |

## Ozone System Control Philosophy

### Power Supply Unit

The Power Supply Unit (PSU) houses the rectifiers, high voltage transformer, and other critical components that generate the electrical energy required to produce ozone. The Power Supply Unit P&ID is included in the Ozone System Record Drawings section of the Appendix, sheet number 11.

The ozone generator programmable logic controller (PLC) monitors several components in the PSU for safety reasons.

The inverter turns OFF, but the feed gas oxygen continues flow if one or more of the following alarms occur:

- 24V Power Supply Failure
- Active Filter Fault
- Generator Capacitor Temperature High Alarm
- Rectifier DC Not OK Alarm
- Digital Converter (DICON) is Not OK Alarm
- DICON Operation Not OK Alarm
- Generator Transformer Temperature High Alarm
- PSU Cooling Water Flow Low Alarm

### Feed Gas Line

The feed gas is supplied through the manual ball valve located on exit of oxygen supply tank, which shall be open at all times during normal operation. After the valve is an inline filter to remove fine particulates and excess oil in the gas. The feed gas line is included in the Ozone Generation System P&ID in the Ozone System Record Drawings section of the Appendix, sheet number 10.

The Generator PLC monitors the feed gas pressure from the pressure transmitter. If feed gas pressure is too low, the following occurs:

- Alarm Pilot Light ON
- HMI Alarm Message: *Feed Gas Pressure Low*
- Inverter Turns OFF
- Feed gas continues to flow

Two pressure switches are fixed safety switches for the ozone generator vessel. The pressure switches are redundant (wired in series). If the feed gas pressure exceeds the alarm setpoint, the following occurs:

- Alarm Pilot Light ON
- HMI Alarm Message: *Feed Gas Pressure High*
- Ozone Generator shuts down

The flow transmitter displays the gas volume flow of the feed gas. It is used as a process value for the feed gas PID to control the ozone outlet line flow control valve.

If feed gas flow is less than the warning setpoint, the following occurs:

- HMI Alarm Message: *Feed Gas Flow Low*

If feed gas flow is less than the alarm setpoint, the following occurs

- Alarm Pilot Light ON
- HMI Alarm Message: *Feed Gas Flow Low*
- Inverter Turns OFF
- Feed gas continues to flow

The solenoid valve opens and closes the feed gas path into the ozone generator vessel. During normal conditions, the solenoid valve is controlled by the ozone generator PLC.

**Dewpoint Monitor**

The dewpoint analyzer monitors the dew point of the feed gas. It is important that the ozone generator is operated with dry gas per WEDECO feed gas specification. The ozone generator PLC receives a 4-20mA signal from the analyzer. The dewpoint monitor is included in the Ozone Generation System P&ID in the Ozone System Record Drawings section of the Appendix, sheet number 10.

If the dew point is above the warning setpoint and below the alarm setpoint, the following occurs:

- HMI Alarm Message: *Dewpoint is High*

If the dew point is above the alarm setpoint, the following occurs:

- Alarm Pilot Light ON
- HMI Alarm Message: *Dewpoint is High*
- Ozone Generator shuts down
- Dewpoint solenoid valve opens; feed gas is vented to atmosphere

**Ozone Generator Vessel**

The Ozone Generation System P&ID is included in the Ozone System Record Drawings section of the Appendix, sheet number 10. The feed gas flows into the ozone generator vessel where the feed gas is converted to ozone by means of silent electrical discharge. The vessel includes piping for the flow of cooling water to remove the heat generated by the production of ozone.

If the pressure in the vessel exceeds the rated pressure, the pressure relief valve opens and vents the gases out of the vessel. This ensures that the pressure inside the vessel does not exceed the rated pressure per the manufacturer. The pressure can build up inside the vessel even when the generator is off, due to thermal expansion.

NOTE: The pressure relief valve protects the generator vessel's integrity and the safety of operators and the environment. Its setting must never be changed!

### Ozone Outlet Line

The ozone outlet line is included in the Ozone Generation System P&ID in the Ozone System Record Drawings section of the Appendix, sheet number 10. The solenoid valve for the ozone monitor is controlled by the generator PLC. When the ozone generator is ON, the solenoid valve is open. When the ozone generator is OFF or shuts down, the solenoid valve closes. The operating pressure is measured by a pressure gauge. The flow control valve modulates the flow out of the ozone generator vessel. The feed gas PID sets the valve position via a 4-20mA signal. The check valve protects the ozone system against backflow in the outlet line. The isolation ball valve completes the ozone outlet line and should be open during normal operations.

### Cooling Water (Generator)

The ozone generators are equipped with a closed loop cooling water system to remove the heat from the ozone generation vessel. The cooling water generator is included in the Cooling Water Chiller P&ID in the Ozone System Record Drawings section of the Appendix, sheet number 12.

The cooling water flows through butterfly flow valves. When the ozone generator is ON, the butterfly flow valves open. When the ozone generator is OFF or shuts down, the butterfly flow valves close. The cooling water flow is monitored by a flow transmitter. The flow is displayed on the HMI. If the flow low switch senses a low flow condition, the following occurs:

- Alarm Pilot Light ON
- HMI Alarm Message: *Generator Cooling Water Flow Low*
- Inverter Turns OFF
- Feed gas continues to flow

The temperature transmitter monitors the temperature of the cooling water leaving the ozone generator vessel. The temperature is displayed on the HMI. If the cooling water temperature exceeds the alarm setpoint, the following occurs: - Alarm Pilot Light ON

- HMI Alarm Message: *Generator Cooling Water Temperature High*
- Inverter Turns OFF
- Feed gas continues to flow

If the cooling water temperature exceeds the warning setpoint, the following occurs:

- HMI Alarm Message: *Generator Cooling Water Temperature High*

### Cooling Water (Heat Exchanger)

The PSU is equipped with heat exchangers to keep the enclosures cool as well as protecting them from excess humidity. The cooling water supply is separate from the cooling water supply for the generator. The cooling water heat exchanger is included in the Cooling Water Chiller P&ID in the Ozone System Record Drawings section of the Appendix, sheet number 12.

If a heat exchanger fails or the temperature within the PSU enclosure exceeds 95 °F (35°C), the following occurs:

- Alarm Pilot Light ON.
- HMI Alarm Message: *Inverter Enclosure Temperature High/Heat Exchanger Failure*
- Inverter Turns OFF
- Feed gas continues to flow

### Cooling Water (Inverter Block)

A cooling water system is integrated into the ozone system to keep the PSU inverter block cool. The cooling water system for the inverter block uses the same cooling water source as the heat exchangers in the PSU enclosure. The cooling water inverter block is included in the Cooling Water Chiller P&ID in the Ozone System Record Drawings section of the Appendix, sheet number 12.

If the inverter is on and the flow low switch senses a low flow condition, the following occurs:

- Alarm Pilot Light ON
- HMI Alarm Message: *PSU Cooling Water Flow Low*
- Inverter Turns OFF
- Feed gas continues to flow

The temperature controller controls the cooling water flow through the inverter block by controlling the solenoid valve.

### Ambient Air Concentration Monitor

The ozone generator is equipped with an Ambient Air Concentration Monitor, which is a safety device that measures the ozone concentration of the air. The monitor is located locally at the generator skid. The ozone generator PLC receives a 4-20mA signal from the room air monitor and the ozone concentration is displayed on the HMI. The ozone ambient air concentration monitor is included in the Ozone Generation System P&ID in the Ozone System Record Drawings section of the Appendix, sheet number 10.

If the ambient air concentration is greater than the warning setpoint, the following occurs:

- HMI Alarm Message: *Ambient Ozone Concentration High*

If the ozone concentration exceeds alarm limit, the following occurs:

- Alarm Pilot Light ON
- HMI Alarm Message: *Ambient Ozone Concentration High*
- Inverter Turns OFF
- Feed gas continues to flow

### Flashing Light and Horn System

The Flashing Light and Horn system, as equipped at the DPWF, provides visual and audio warnings along with an ambient air ozone concentration reading in ppm and mg/L that can be used in areas prior to entry into an ozone producing area for example. This system is required as per the 2015 Fire Code. The Flashing Light and Horn system alerts personnel if there is an ozone leak measured by the ambient air concentration monitor that results in unsafe conditions for entry. The system activates when the ambient ozone concentration inside the container is greater than 0.1 parts per million.

When activated, the alarm Horn sounds for a time period and then automatically silences. The alarm Flashing Light illuminates continuously until the reset switch on the generator control panel is operated or when the ambient air concentration is less than the warning setpoint. The display shows the ambient air ozone concentration whether an alarm is present or not.

### HC400 Plus Ozone Monitor

The HC400plus ozone monitor measures the ozone concentration in WT% or g/Nm3. The monitor requires piping from the ozone outlet line as well as zero reference gas. The ozone concentration is displayed on the HC 400plus as well as on the ozone generator HMI via 4-20mA signal. Analog signal from the HC400plus is one of the process variables that is targeted by the PID loops in the ozone PLC. The PLC will ramp the ozone production or the feed gas flow to meet the process' setpoint of % gas. The HC400 Plus ozone monitor is included in the Ozone Generation System P&ID in the Ozone System Record Drawings section of the Appendix, sheet number 10.

### Ozone Injection System

Automated isolation valves on the two injection systems control whether the half or full flow injection system will be utilized. When the flow set point is set to "Half Flow," the automated isolation valves on the half flow injection system open and the automated isolation valves on the "Full Flow" injection system close. When the flow set point is set to "Full Flow," the automated isolation valves on the full flow injection system open and the automated isolation valves on the "Half Flow" injection system close.

If a BAC filter enters a backwash, the following occurs:

- Half Flow setpoint is automatically selected
- Half Flow injection system isolation valves open
- Full Flow injection system isolation valves close

- The ozone system PLC automatically adjusts the feed gas flow setpoint to meet the concentration setpoint.

# Appendix C. Biological Activated Carbon System

## Biological Activated Carbon System Overview

Biological activated carbon (BAC) removes bulk organics mainly through biodegradation of organics. Exhausted granular activated carbon (GAC) is used for acclimation of biomass that removes biodegradable organic matter, which can be enhanced by preozonation. The BAC system consists of two gravity-fed filters, each with 6.5 feet of GAC and a surface area of 180 square feet. The GAC media is a reagglomerated coal-based carbon.

Backwashes are initiated either manually or automatically when terminal headloss, filter run time, or poor filtrate turbidity is reached. All other processes must be switched to half flow to perform a backwash. The backwash sequence consists of an air scour, concurrent air scour and low rate backwash, high rate backwash, and a final low rate backwash. Filtrate is routed to the drain for about 10 minutes following a backwash, until turbidity returns to the normal level (filter-to-waste). The following parameters in Table 5 are relevant to process performance and design criteria are summarized in Table 6.

**Table 5. BAC system operating ranges**

| Parameter | Operating Range |
|---|---|
| Filter effluent flow | 500-550 gpm per filter |
| Filter headloss | 20 inches-120 inches |
| Product runtime | 0-168 hours |
| Filter feed TOC | 5.8-11.4 mg/L |
| Filter effluent TOC | 3.8-7.4 mg/L |
| Filter feed Turbidity | 0.09-1.00 NTU |
| Filter effluent Turbidity | 0.06-0.75 NTU |

**Table 6. BAC system design criteria**

| Parameter | Value |
|---|---|
| Number of Filters | 2 |
| Area per Filter | 180 sf |
| Media Depth | 6.5 ft |
| Filter Loading Rate | 3.05 gpm/sf at 1100 gpm<br>1.53 gpm/sf at 550 gpm |
| Empty Bed Contact Time | 15 min at 1100 gpm<br>30 min at 550 gpm |
| Filter Media | Granular Activated Carbon (GAC)<br>31 tons of 8 x 20 mesh<br>(Effective Size of 0.8 – 1.0 mm) |
| Air Scour Rate | 720 scfm |
| Backwash Rate – High Rate | 12 gpm/sf (2160 gpm) |

### Biological Activated Carbon System Major Components

The BAC P&ID is included in the BAC System Record Drawings section of the Appendix, sheet number 14.

### Filter 1 & 2

There are two filter units in parallel. During production, feed flow is split evenly between the filters and rest periods alternate between the filters. Backwashes can only be performed on one filter at a time.

### Air Blower

The air blower is only used during backwash mode to provide air for the air scour.

### Product Tank

The product tank acts as an equalization (EQ) tank between the BAC unit and the MF/UF/RO/UV block of the facility during production. Its overflow ties into the backwash supply system to provide BAC filtrate when a filter backwashes.

### Overflow Sump and Pump

The overflow sump captures overflow from the product tank. The BAC Filtrate Tank overflow continuously since the BAC filters produce more than the MF/UF systems require. Higher contributions to the overflow sump from the product tank occur when a MF or UF rack enters a backwash or performs a pressure decay test. The overflow sump pump transfers the contents of the overflow sump to the BAC backwash supply tank. Level switches in the overflow sump control the overflow sump pump such that it starts upon high level and stops upon low level.

### BAC Backwash Supply Tank and Pump

The BAC backwash supply tank stores up to 40,000 gallons of BAC filtrate, enough for one filter backwash. The BAC backwash supply pump transfers the stored BAC filtrate to a BAC filter when in backwash mode. The BAC backwash supply pump is controlled by the BAC filter PLC. A variable frequency drive (VFD) on the BAC backwash pump adjusts its motor speed to meet the high and low flow rates as required by the BAC filter PLC during a backwash.

### Biological Activated Carbon System Operating Modes

The BAC system has three main governing processes: production, backwash, and rest periods.

### Forward Mode

There are two modes filter forward modes that can be set in the BAC set points screens: Constant Level (denoted as 0) or Constant Flow (denoted as 1). Operating in Constant Level provides more stable operation and constant head through the filter bed. This is preferred over Constant Flow, which will change the filter level and produce variable headloss.

For Constant Level, the effluent valve will modulate and vary flow to maintain an operator-set filter level. For Constant Flow, the filter level will vary as the effluent valve modulates to maintain an operator-set effluent flow. For both modes, there is a minimum filter level that, when reached, will close the effluent valve to prevent draining the filter(s) and stop production until the filter level reaches an acceptable level.

### Backwash

Backwashes are initiated either manually or automatically when terminal headloss, filter run time, or poor filtrate turbidity is reached. For this system, terminal headloss is ~100 inches WC. The filter control panel BACKWASH REQUIRED pilot light will also be illuminate. The BACKWASH REQUIRED pilot light will illuminate for the following reasons: high turbidity, high headloss, or filter runtime exceeded. An operator adjustable time delay (minutes) shall prevent a filter from automatically backwashing immediately after its rest period. Another operator adjustable time delay (minutes) shall prevent a filter from automatically backwashing immediately following DPWF startup. The filter level must be above 30 inches to initiate a backwash. Backwashes cannot start for a filter below 30 inches and the operator will have to refill the filter to satisfy the requirement. Control interlocks prevent a BAC filter from entering a backwash when the other BAC filter is in backwash mode or out of service. An interlock also prevents a backwash from occurring if the BAC backwash supply tank level is too low.

To initiate a backwash, all other processes within the DPWF have to be operating at half flow and placed into Backwash as the operation mode. Backwashes can be initiated in Manual, Semi-automatic, or Automatic mode. In automatic mode, the programmable logic controller (PLC) executes the following steps

independent of operator intervention. Only one filter may be backwashed at a time. The main steps of the backwash are summarized below.

1. Filter Level will drain down.
2. Air blower will start and air scour alone.
3. BAC backwash supply pump will start and ramp up to low rate wash with air scour up to a set filter height.
4. Air scour will stop and BAC backwash supply pump will ramp up to the high rate wash for set duration.
5. BAC backwash supply pump will ramp down and do a second low rate wash.

During the backwash, if any of the steps fail, all valves will close and all motors will stop. Common failures that halt backwashes include pump failure, valve failure, air blower failure, and under filling the BAC backwash supply tank. Once issue is resolved, reset the filter by switching the “Mode” switch to the “Manual” position and return to the Semi-automatic mode of operation. Aborted backwashes cannot be resumed. To complete a full backwash, a new backwash will have to be initiated.

### Rest Periods

Air binding in BAC media causes inflated headloss measurements. Rest periods are automated to stop production to release air from filter bed. The frequency of rest periods can be set in the BAC set points. Typically, rest periods are set for 90 seconds every hour and alternates between Filter 1 and 2. Control interlocks prevent a filter from entering its rest period during a backwash.

### Start-Up & Shutdown Sequences

There are different start-up and shutdown sequences for filters in constant level and constant flow mode. Start up and stop sequence for the BAC filters are related to ozone operations. Flow from ozone-treated water is stored in the BAC Influent Tank and feeds the filters by gravity if tank level is high enough. The influent valve stays fully open in semi-automatic mode unless the system is in Backwash mode. Once the filters start receiving flow, filtration can begin in the forward mode. The filters shutdown is related to the filter level. Filters shutdown when filter level reaches the minimum level. Filter level can be reached either in normal operations or if the ozone system has been stopped and there is no longer feed to supply the filter.

### Biological Activated Carbon System Human Machine Interface Screens

Human machine interface (HMI) screens for the BAC system are included with the ozone system HMI. There are six HMI screens—one screen for filter status (Figure 17), one screen for BAC Influent Tank levels (Figure 17), one the BAC backwash system, and three screens for filter operations setpoints (Figure 18, Figure 19, and Figure 20).

### Biological Activated Carbon Filter Status Screen

On the BAC filter status screen, the following parameters are displayed:

- Effluent flow (“flowrate”)
- Filter headloss (“headloss”)
- Filter influent turbidity (“Filter 2 turbidity”)
- Effluent turbidity (“Filter 1 turbidity”)
- Filter level (“level”) E
- Effluent valve position (“eff valve pos”)
- Backwash service time

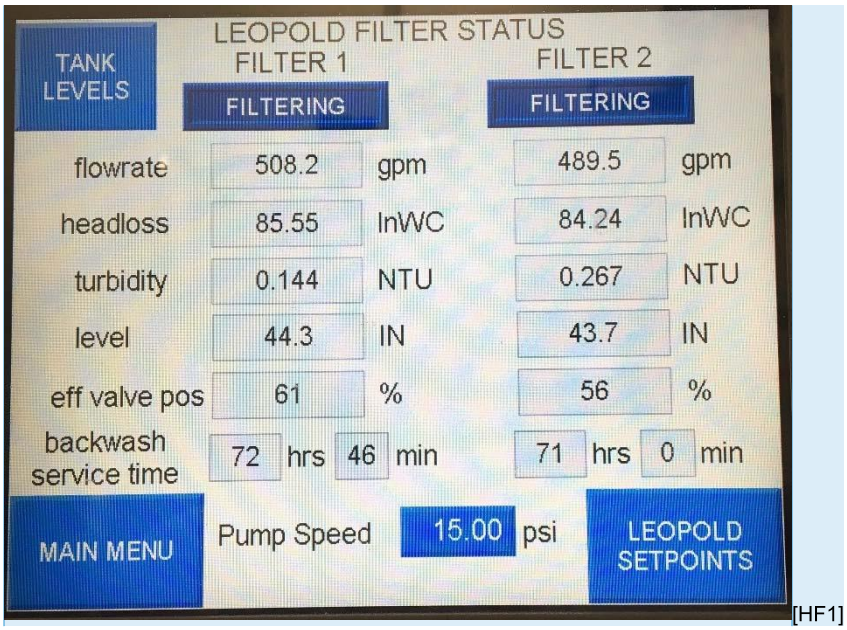


**Figure 16. BAC Filter Status Screen**

### Biological Activated Carbon Influent Tank Levels Screen

The tank levels screen shows the level of the filter influent feed tank and the filter product tank (also known as EQ tank). High, low, and unlatch (setpoints which clear alarm conditions) setpoints are also accessible on this screen. The filter low setpoint and filter low setpoint backwash are also accessible on this screen.

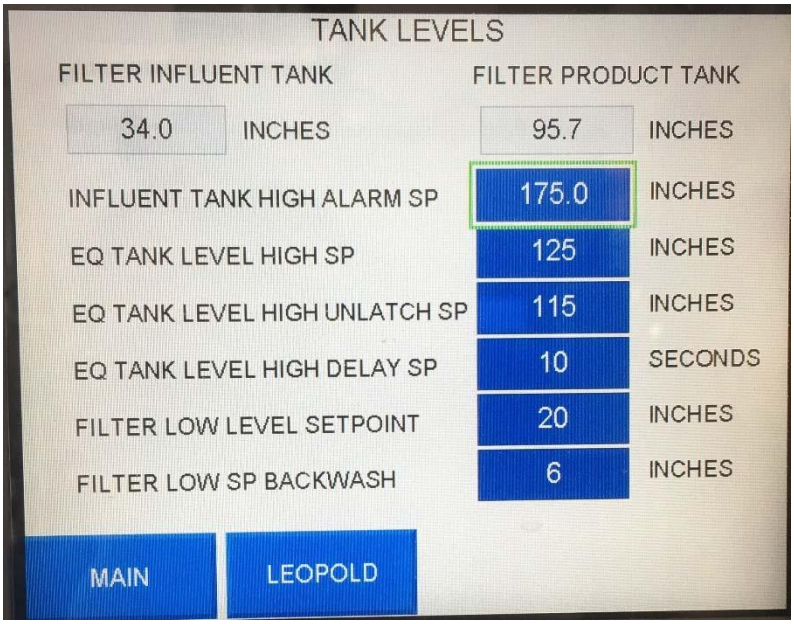


**Figure 17. BAC Influent Tank Levels Screen**

### BAC Backwash System Screen

The BAC backwash system screen shows the level of the BAC backwash supply tank (analog signal from level transmitter) and the overflow sump (discrete signals from level switches). High-high, high, low, and low-low setpoints are also accessible on this screen. (The unlatch setpoints for these tanks are the high for the high-high alarm and low for the low-low alarm conditions.) This screen also contains the following for the BAC backwash supply pump:

- Pump speed setpoint for high rate backwash
- Pump speed setpoint for 1st low rate backwash
- Pump speed setpoint for 2nd low rate backwash
- Running status
- Start-stop command

Finally, this screen also contains the operator adjustable time delay setpoints to prevent a backwash from transpiring immediately following a filter pause or immediately following DPWF startup.

### Biological Activated Carbon Filter Setpoints Screen

"Filter setpoints 1" screen allows operators to review and set the following parameters:

- Filter runtime
- Air scour alone time during backwash
- 1st low rate of flow during backwash
- Duration of 1st low rate backwash
- High rate of flow during backwash
- Duration of high rate backwash
- 2nd low rate of flow, and duration of 2nd low rate backwash

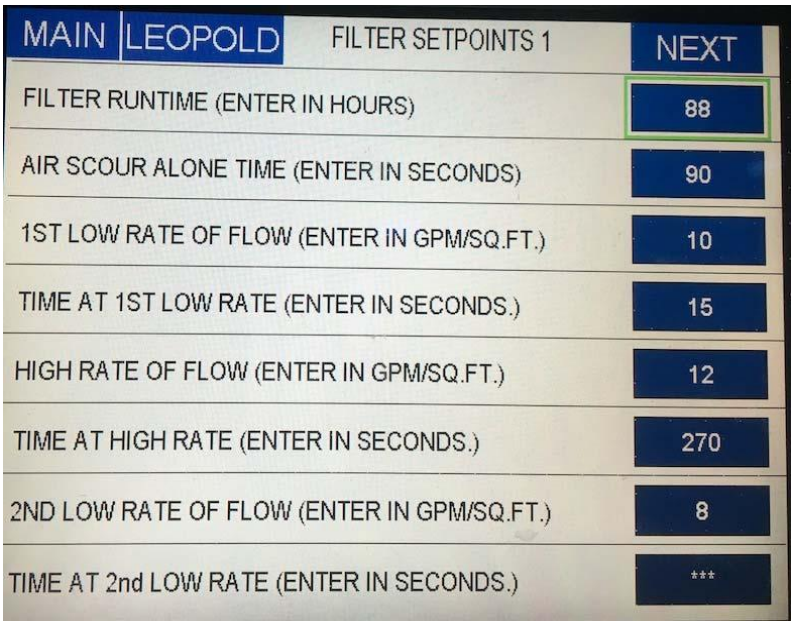


**Figure 18. BAC Filter Setpoints 1 Screen**

"Filter setpoints 2" allows the operator to review and set the following parameters:

- Filter rest period frequency
- Duration of rest period
- Filter operating level
- Filter low level
- Filter drawdown level during backwash
- Air scour cutoff level during backwash
- High headloss level alarm
- High headloss level alarm delay

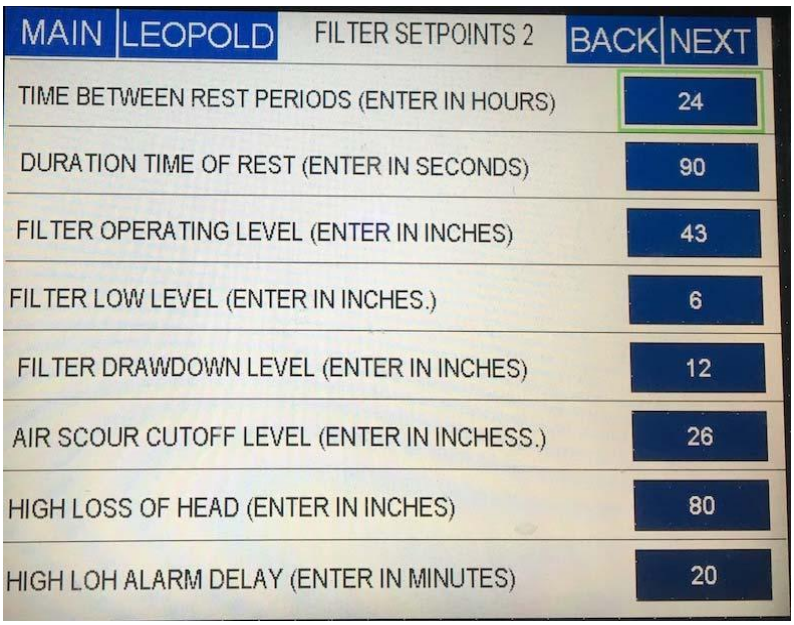


**Figure 19. BAC Filter Setpoints 2 Screen**

"Filter Setpoints 3" screen allows the operator to review and set the following parameters:

- Effluent control mode (Constant Level vs. Constant Flow)
- Flow setpoint if operating in Constant Flow mode

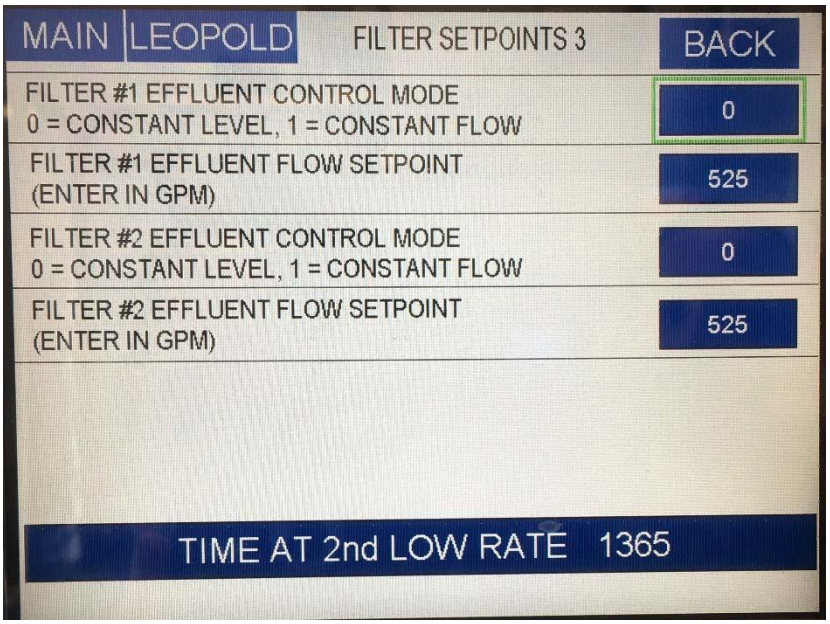


**Figure 20. BAC Filter Setpoints 3 Screen**

### Biological Activated Carbon System Diagrams

The BAC system electrical, process, and piping and instrumentation diagrams (P&IDs) can be found on the record drawings provided with the reference documents. The sheet numbers associated with the diagrams are summarized in Table 7.

**Table 7. Biological Activated Carbon Record Drawings**

| Diagram | Document Source | Sheet Number |
|---|---|---|
| BAC P&ID | Ozone Generation & Filtration System Operations & Maintenance Manual | 14 |

### Biological Activated Carbon System Alarms & Setpoints

Alarms related to the BAC system occur on a local level and do not escalate to a plant level alarm. Most alarms related to the BAC occur during backwashes and affect status of backwash and the filters as well, some alarms can occur during normal operation, but they are generally local monitoring alarms.

**Table 8. BAC Alarms**

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| Blower fail to start | Blower fail to start during BAC backwash. | Backwash aborts. | Must reset filter and restart backwash from beginning. |
| Pump fail to start | Pump fail to start during BAC backwash. | Backwash aborts. | Must reset filter and restart backwash from beginning. |
| Valve fail to open/close | Timed out before valve reached desired orientation. | Backwash aborts. | Must reset filter and restart backwash from beginning. |
| EQ tank high | EQ water level higher than 125”. | Backwash aborts. | Must reset filter and restart backwash from beginning. |
| EQ tank low | EQ tank water level at or lower than 24”. | AWT part shuts down. | This is only during forward flow. Need to restart AWT. |
| Filter headloss high | The accumulated headloss is above 80 inches of water for more than 20 minutes. | Alert operators. | Prepare to backwash the filters. |
| Filter level low | Water level in the filter is at or below 6”. | Backwash will not start. | Place the ozone BAC in forward mode and refill the filters, then restart the backwash. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| Overflow Sump level low-low | Water level in the overflow sump is at or below1'-2.5". | N/A | Stop overflow sump in field. |
| Overflow Sump level high-high | Water level in the overflow sump is higher than 5'-0". | N/A | Investigate overflow piping for clogging or closed valves. Repair. |
| Overflow Sump Pump discharge pressure high | Overflow sump pump discharge high pressure switch tripped. | Overflow sump pump stopped. | Investigate suction and discharge piping for clogging or closed valves. Repair. |
| Overflow Sump Pump fail | Overflow sump pump moisture detection tripped. | Overflow sump pump stopped. | Pull pump and investigate enclosure. Repair. |
| BAC Backwash Supply Tank level low-low | Water level in the BAC Backwash Supply Tank is at or below 0'-0". | Backwash aborts/will not start. | Must fill tank, reset filter, and restart backwash from beginning. |
| BAC Backwash Supply Tank level high-high | Water level in the filter is higher than 13'-6". | N/A | Investigate tank overflow line for clogging. Repair. |
| BAC Backwash Supply Pump VFD fail | BAC backwash supply pump VFD fault. | Backwash aborts/will not start. | Investigate VFD as well as suction and discharge piping for clogging or closed valves. Repair. |
| BAC Backwash Supply Pump fail | BAC backwash supply pump temperature or motor winding fault. | Backwash aborts/will not start. | Investigate pump as well as suction and discharge piping for clogging or closed valves. Repair. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| BAC Backwash Supply Pump low flow | BAC backwash supply pump low flow sensor tripped. | Backwash aborts. | Investigate suction and discharge piping for clogging or closed valves. Repair. |

Alarms that occur during a backwash will abort the backwash and the affected filter must be reset to either restart a failed backwash or restart filter operation in forward mode. Failed backwashes must be restarted from the beginning of the backwash sequence.

**Table 9. BAC Setpoints**

| Message | Comments | PLC Response |
|---|---|---|
| Overflow Sump level low | Water level in the overflow sump is at or below 1’-8.5”. | Overflow sump pump turns off |
| Overflow Sump level high | Water level in the overflow sump is higher than 4’-6”. | Overflow sump pump turns on |
| BAC Backwash Supply Tank level low | Water level in the BAC Backwash Supply Tank is at or below 0'-6”. | BAC backwash supply tank turns off |
| BAC Backwash Supply Tank level high | Water level in the BAC Backwash Supply Tank is higher than 10’-5”. | N/A |

## Biological Activated Carbon System Control Philosophy

### Forward Mode

#### Constant Level

For constant level, the effluent valve will modulate to maintain a constant operator-set filter level. Effluent valve opens if filter level higher than setpoint and effluent valve closes if filter level lower than setpoint. Effluent valve will close when minimum filter level is reached and stop production until the filter level reaches an acceptable level.

### Constant Flow

For constant flow, the filter level will vary as the effluent valve modulates to maintain an operator-set effluent flow. Effluent valve opens to increase flow rate if lower than setpoint and effluent valve closes to decrease flow rate if higher than setpoint. Effluent valve will close when minimum filter level is reached and stop production until the filter level reaches an acceptable level.

### Backwash

Backwashes are completed in the following sequence.

1. Influent valve closes.

2. Filter drained so that water level 6 inches above media.

3. Effluent valve closes.

4. Waste valve opens. Status of WASTE valve must be OPEN to proceed to the next step.

5. Air scour blower starts. Air blower status must be running to proceed to next step.

6. Air inlet valve opens.

7. Air vent valve closes.

8. Air scour alone for operator-set time.

9. Backwash pump starts. Pump status must be running to proceed to next step.

10. Backwash inlet opens.

11. Backwash control valve opens to ramp up to 1$^{st}$ LOW RATE (typically 5 GPM/FT$^2$). The backwash control valve status must be partially or fully open to proceed to the next step.

12. Wash at low rate until AIR SCOUR CUTOFF LEVEL is reached.

13. Air vent valve opens.

14. Air inlet valve closes.

15. Air scour blower stops.

16. Backwash pump come on and ramps up to HIGH RATE.

17. The high rate backwash can be extended for an additional two minutes. The extend backwash pushbutton will flash and will illuminate steadily once the operator has pressed the button and the PLC has acknowledged the command.

18. Backwash control valve closes to ramp down to 2nd LOW RATE. Second pump ramps down and turns off.

19. Backwash at 2nd LOW RATE for at least one minute.

20. Waste valve closes.

21. Filter level will rise until refill level is reached or 2nd low rate completes before proceeding to the next step.

22. Backwash pump stops. Pump status must be off to proceed to the next step.

23. Backwash inlet valve closes.

24. Influent valve opens.

All steps must be carried out to completion before proceeding to the next step. If any of the devices fail to respond to a PLC command within a predetermined time, or any of the critical alarms are triggered, the backwash will abort. All valves will close and all motors will stop. Once issue is resolved, reset the filter by switching the “Mode” switch to the “Manual” position and return to the semi-automatic mode of operation. Aborted backwashes cannot be resumed. To complete a full backwash, a new backwash must be initiated.

### Rest Periods

During a rest period, the effluent valve will close and halt production for operator-set duration. Once the rest period timer runs out, the filter that was at rest will resume production mode.

### Start-Up and Shutdown

### Constant Level

The effluent valve will remain closed until the filter level set point has been reached and the level is also increasing. Once these two conditions have been met, the proportional-integral-derivative (PID) loop will maintain constant operator-set filter level by modulating the effluent valve to allow more production (decrease level) or decrease production (increase level). The shutdown sequence occurs indirectly by ozone system control. When the ozone is in the off

position, the feed pump will turn off and water flow will stop. The filters will continue receiving flow from the BAC Influent Tank until tank level is no longer sufficient to continue flow by gravity. When the filter begins draining and the filter level is less than the operator set level, the effluent valve will continue to close, since it is trying to maintain constant level, until it fully closes and stops filtration.

**Constant Flow**

If the filter level is above the minimum filter level (6 inches), the effluent valve will open and try to maintain the flow set point. Filter operation stops when the filter level is below the minimum level set point.

# Appendix D. Microfiltration System

### Microfiltration Overview

The microfiltration (MF) system removes turbidity, bacteria, cysts, and particles using hollow fiber membranes. The system is automated to complete the following processes: normal production (30 minute cycles), backwash (air scour, reverse filtration) at the end of production cycles, and daily membrane Integrity Tests. Over time, membranes will foul with organic and inorganic matter. Fouling occurs when particles deposit and adhere to the membrane surface and cause operating pressure to increase. Clean-in-places (CIPs) utilize caustic soda (sodium hydroxide or NaOH) and citric acid ($C_6H_8O_7$) cleans to restore flux. The following parameters in Table 10 are relevant for process monitoring and design criteria are summarized in Table 11.

**Table 10. MF system operating ranges**

| Parameter | Operating Range |
|---|---|
| Feed pressure | 12-30 psi |
| Filtrate pressure | 7-9 psi |
| Feed turbidity | 0.1-0.75 NTU |
| Filtrate Turbidity | 0-0.15 NTU |
| Integrity Test pressure decay results | 0-0.1 psi/min* |
| Flux | 29-55 gfd |
| Specific Flux | 1.5-7 gfd/psi |
| Water Temperature | 20-30 °C |
| Transmembrane Pressure | 5-20 psi |
| Recovery | 95%-99% |
| Backwash interval | 0-30 min. |
| Filtrate total chlorine residual | 0.5-3.5 mg/L |
| Filtrate ORP | 400-650 mV |
| Filtrate ammonium residual | 0.2-0.7 $NH_4$-N mg/L |

*Applicable for a target flux of 55 gfd.

**Table 11. MF system design criteria**

| Parameter | Value |
|---|---|
| Net Product Flow | 0.625 MGD |
| Nominal Pore Size | 0.1 µm |
| Number of Modules | 50 |
| Area per Module | 538 sf |
| Instantaneous Flux | 29 gfd |
| Recovery | 93% |
| Enhanced Flux Maintenance, Backwash Chemicals | None |
| Chemical Cleaning Frequency | > 3 months |
| Manufacturer | Pall Corporation |

### Microfiltration System Major Components

A MF System Overview P&ID is included in the MF System Record Drawings section of the Appendix, sheet number 2.

### Feed (Recirculation) Pump

There are two types of pumps available for providing feed to the MF system, depending on the feed source. EDR pumps 105 and 106 are available to provide tertiary effluent. A transfer pump provides water pretreated with biological activated carbon (BAC) or ozone and BAC from the BAC product tank. Pumps are controlled by their respective variable frequency drives (VFDs).

### MF/UF Filtrate Tank

The filtrate tank, also known as the microfiltration/ultrafiltration (MF/UF) filtrate tank, is a cylindrical high density polyethylene (HDPE) tank which includes:

- A sealed cover with fasteners and an ethylene propylene diene monomer (EPDM) gasket
- A tank fill valve
- A level sensor
- A vent filter designed to keep the tank contents clean while preventing the potential of the tank drawing a vacuum

The MF/UF filtrate tank stores produced filtrate and provides a source of filtered water to use during the reverse flow process step.

### Reverse Filtration (RF) Pump

Reverse filtration is driven by a centrifugal pump controlled by a variable frequency drive (VFD) through a flow controller. Flow measurements determine automatic control of the pump. This pump provides the fluid flow into the top of the hollow fiber modules during the backwashing steps.

### Backwashing Strainer

Feed water from the passes through a backwashing strainer before entering the hollow fiber modules. The strainer backwashes automatically based on time or differential pressure (dP).

### Module Rack with Multiple Hollow Fiber Modules

The module rack holds 50 Microza USV-6203 membrane modules. A cutaway of the MF module is shown in Figure 22, and the MF module components are shown in Table 12 and Figure 23.

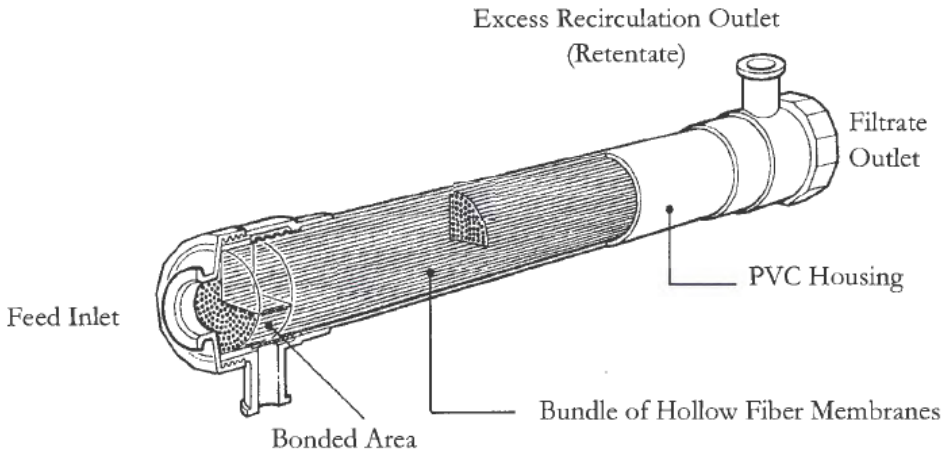


**Figure 21. Microza Hollow Fiber Module**

**Table 12. Microfiltration Module Parts**

| Item Number | Description |
|---|---|
| 1 | Module End Cap |
| 2 | Module End Nut |
| 3 | Module End Nut O-Ring |
| 4 | Adapter Coupling/Filtrate |
| 5 | XR Nut/Blind Plate/Gasket |
| 6 | Piping Assembly/Reject |
| 7 | Clamp/Feed Inlet |
| 8 | Module End Cap |
| 9 | MF Module |

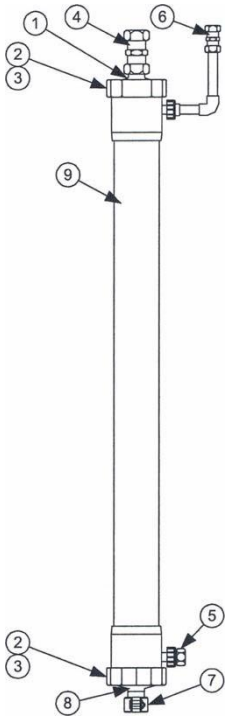


**Figure 22. Microza USV – 6203**

### Microfiltration System Operating Modes

The MF has four main processes during normal operations: filtration, backwash, Integrity Test (IT), and clean-in-place (CIP). Each filtration cycle is 30 minutes and ends with a backwash. Backwashes help remove foulants and rejected particulates that may accumulate on the surface of the membrane during the filtration cycle. The backwash cycle lasts about 1.5-2 minutes and a new filtration cycle begins afterwards if an IT is not the next process in queue. ITs are performed once a day and will initiate on a 24-hour timer. When the timer runs out, the IT will proceed after the current filtration and queued backwash cycles are complete. ITs are performed to detect broken fibers that will compromise system performance.

CIPs are performed on an as-needed basis. Although backwashes will remove many particulates and foulants during operations, the membranes will foul and a more rigorous clean is required to recover performance. A CIP is required when the transmembrane pressure (TMP) exceeds 25 psi. CIPs are not performed automatically and procedures for performing a CIP can be found in the Demonstration Pure Water Facility (DPWF) master standard operating procedures (SOPs). Filtration, backwash, and ITs can be initiated by an operator at any time during operations.

### Filtration Mode

During filtration, feed water enters through the bottom of the module and the water is distributed evenly on the outside of the fibers. While pressurized, water passes through the surface of the membrane and the filtrate exits at the top of the module. Most, if not all, of the feed water exits as filtered water. Control of the filtration is set mainly by the feed pump and inlet valve to maintain feed pressure and filtrate flow set points. As the membranes foul and foulants accumulate on the module filaments, higher feed pressure is required to maintain the filtrate flow setpoint. Eventually, the feed pressure required will exceed the maximum output of the feed pump and filtrate production will decrease.

### Backwash

Backwash mode consists of an air scrub cycle, followed by reverse filtration. During the backwash, waste is diverted to the drain. A detailed schematic of the MF system can be found in the MF System P&ID in the MF System Record Drawings section of the Appendix, sheet number 2. The Microza Module Specification Sheet can also be found in the MF System Record Drawings section of the Appendix. The sequence of events occurs as follows:

1. Feed flow control valve FCV1 closes.
2. The air scrub cycle begins.
3. Steps 3 through 7 happen simultaneously: Filtrate product valve V5 is closed.
4. Air injection valve V7 opens, and air is injected into the feed side of the module.
5. Reverse filtration valve V6 is opened.
6. Backwash pump P2 turns on, and ramps up to meet an operator-set flow rate.
7. Concentrate backwash valve V3 is opened to drain.
8. Backwash pump P2 turns off, air scrub cycle ends, and reverse filtration cycle begins.
9. Steps 9 through 11 happen simultaneously: Air injection valve V7 closes.
10. Skid feed to drain valve V4 opens.
11. Backwash pump P2 turns on and ramps up to meet an operator-set flow rate.
12. Backwash pump P2 turns off. Reverse filtration cycle ends.
13. The skid goes back to forward flow. Steps 14 through 18 happen simultaneously:
14. Feed flow control valve FCV1 opens to 100%.
15. Reverse filtration valve V6 closes.
16. Filtrate product valve V5 opens.
17. Concentrate valve V3 closes.
18. Skid feed to drain valve closes.
19. After 10 seconds the feed flow control valve FCV1 closes to 13%, and the PID takes over. Skid is now in forward flow and FCV1 will adjust its position to meet an operator-set permeate flow rate.

### Integrity Test

Integrity Tests (ITs) assess fiber integrity with an air-pressure-holding test. Air is introduced upstream of the filtrate side and the air displaces water in the modules until the pressure setpoint is met (pressure is set to achieve complete water displacement). During the test, air will vent out of the filtrate side of the module. After air injection ends, the system will monitor the rate of pressure decay as air vents out of the module. If there are any breaches in fiber integrity, the pressure decay rate will exceed acceptable limits.

The sequence of events occurs as follows:

1. Feed flow control valve FCV1 closes.
2. Depending on which process occurred before IT, all the currently open valves close.
3. Valves V7, V20, and V5 open and air is introduced to the feed side of the membrane.
4. IT timer starts and air is flowing into the membrane for an operator-set number of seconds.
5. After 40 seconds, valve V5 closes and valve V6 opens.
6. Once the timer lapses out, valve V7 closes and the system waits for another 30 seconds to stabilize. The IT continues in this configuration for the next 300 seconds.
7. After 300 seconds, valve V4 will open intermittently to release the pressure in the system.
8. Once all the pressure is relieved, the IT is over and a Fill cycle begins to bring the system back into Production mode.

### Clean-in-Place

Foulants that accumulate on the surface of the membrane may consist of organic, biological, and inorganic material. The CIP process utilizes two cleaning solutions, an acidic solution (2% citric) and a caustic solution (1% NaOH) with chlorine (3000-5000 ppm). The caustic clean targets organic foulants and the acid clean targets inorganic precipitates. Typically, it is recommended to perform the caustic CIP first before the acid CIP. The CIP for the MF system is semi-automated and the main steps are summarized below.

1. Fill hot water tank with reverse osmosis (RO) permeate.
2. Heat water.
3. Pump hot water to Cleaning Tank and begin chemical injection into Chemical Tank.
4. Recirculate heated CIP solution through MF system.
5. Drain CIP solution to waste (plumbed to NCWRP plant drain).
6. Flush MF system with MF feed water.

Detailed step-by-step procedures can be found in the DPWF master SOP.

**Start-Up & Shutdown Sequences**

The system starts up by going through the following steps:

1. The operator puts the system in Auto Filter mode and confirms valve position (No real valves to confirm since we don't have them installed).
2. Feed flow control valve FCV1 opens to 25% - Fill Cycle.
3. Valves V3, V5, and V20 open.
4. Once the Fill Cycle timer elapses, FCV1 closes to 10% and the PID takes over.
5. Valve V3 closes.
6. System is now in Forward Flow mode.

For shutdowns, the MF system can be shut down locally at the MF human machine interface (HMI) or remotely by the main programmable logic controller (PLC). In both scenarios, the feed flow control valve FCV1 will close and followed by the rest of the valves on the skid. The feed pump will ramp down if the UF remains on, or will shut down completely if no other process is running.

### Microfiltration System Human Machine Interface Screens

System information, setpoints, and status can be accessed through the HMI screens.

### Microfiltration System User Login

Access to screens requires the proper credentials. Login name is “opr” and password is “opr” once the Login pushbutton is selected.

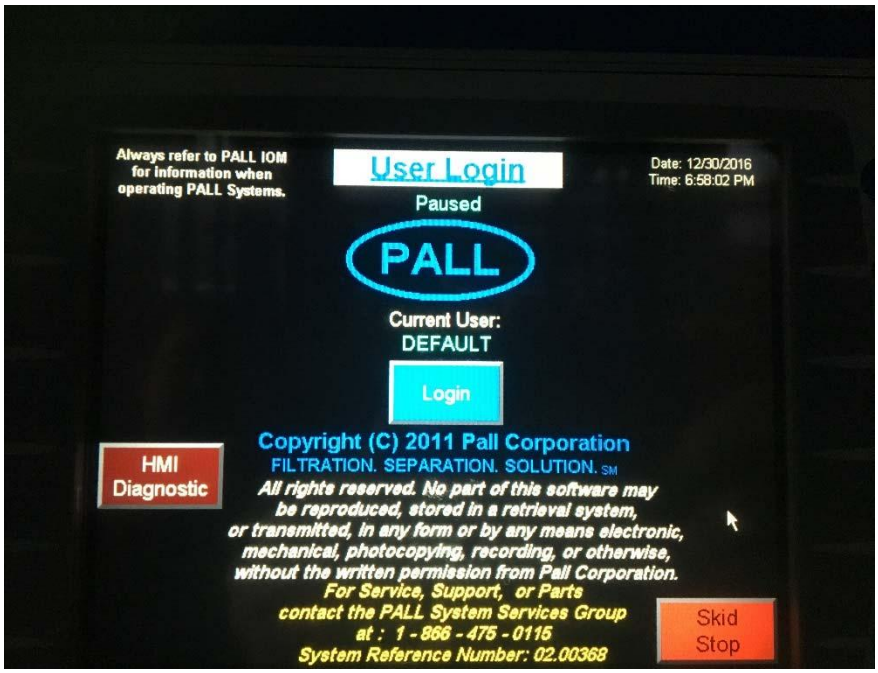


**Figure 23. MF Login Screen**

### Main Navigation Menu Screen

Once credentials are approved in the login screen, the navigation menu can be accessed. The navigation menu provides access to navigation screens, skid control screens, skid setpoint screens, skid information screens, and skid alarm screens.

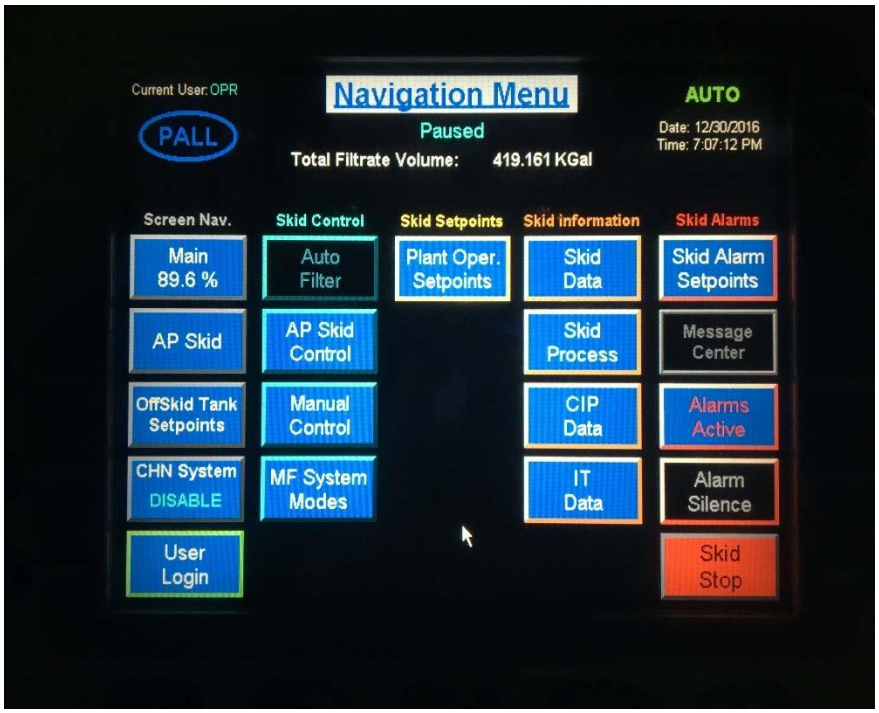


**Figure 24. MF Navigation Menu Screen**

### Screen Navigation Screens

The main overview screen shows system operation mode, process status and operational parameters.

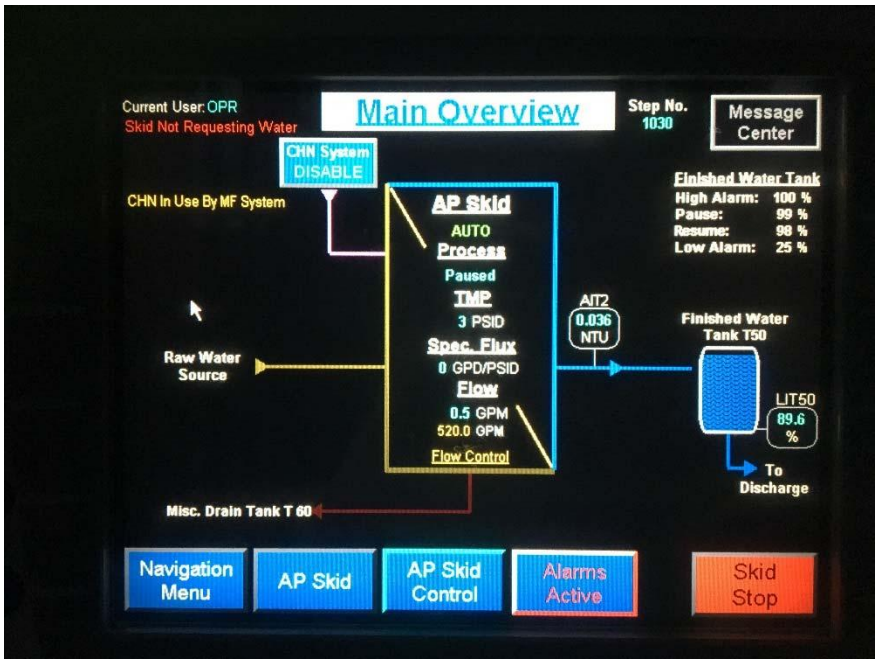


**Figure 25. MF Main Overview Screen**

The Aria Pall (AP) Skid screen shows a diagram of the layout of major components, valves, and piping. Operational parameters including flow, pressure, process water temperature and produced filtrate turbidity is displayed on this screen as well.

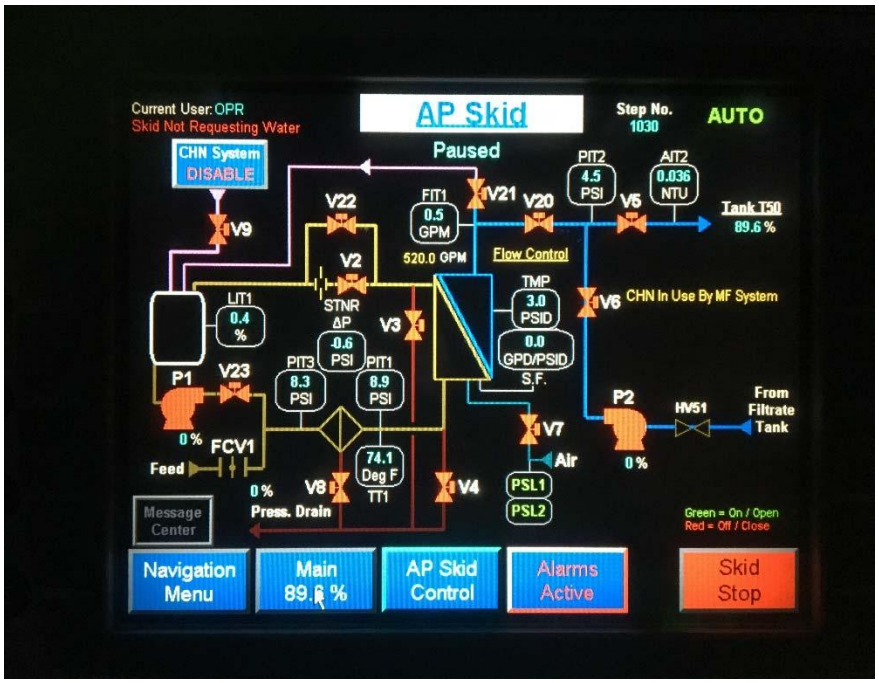


**Figure 26. MF AP Skid Screen**

Off Skid tank setpoints can be accessed in the Off Skid Tank Setpoints screen. However, control of the MF skid through filtrate tank level setpoints are disabled.

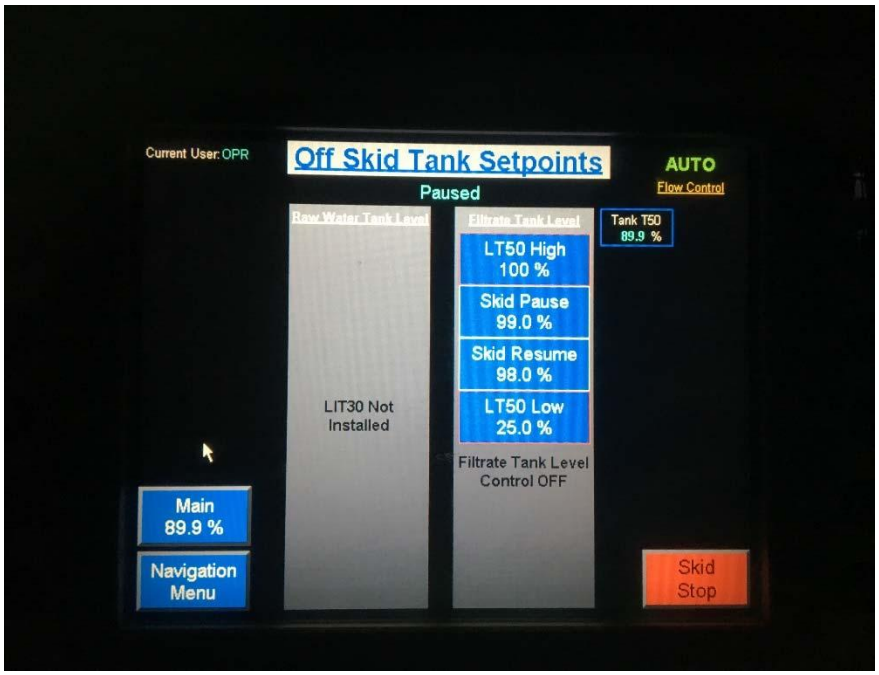


**Figure 27. MF Off Skid Tank Setpoints Screen**

Major components, piping, and meters associated with the hot water system are displayed on the Hot Water System screen and accessed from the “CHN System” pushbutton on the Navigation Menu Screen. Control of the hot water system is also accessible on this screen. Through this screen, operators may disable or enable the skid, choose to run the hot water system in manual or auto mode, enable operation of the heater, and override remote control of the chemical, hot water, neutralization (CHN) skid.

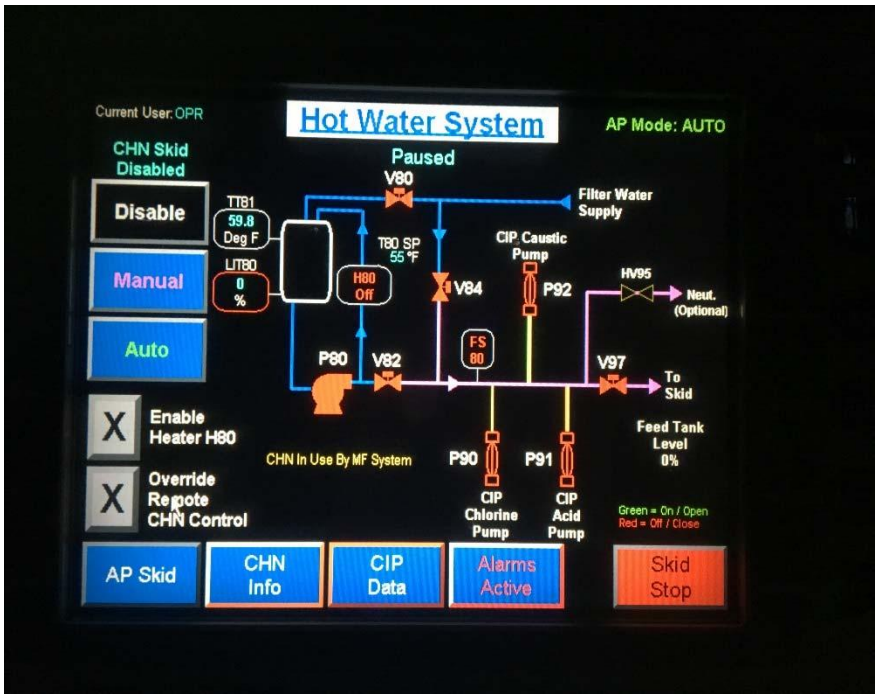


**Figure 28. MF Hot Water System (CHN System) Screen**

### Microfiltration System Skid Control Screens

Control of the skid and selection of system modes are accessible on the skid control screens.

The AP skid control screen shows current process and status of skid and also allows operators to enable and disable the skid and also select operation mode. Modes of operation include manual and auto. Processes may also be initiated from this screen.

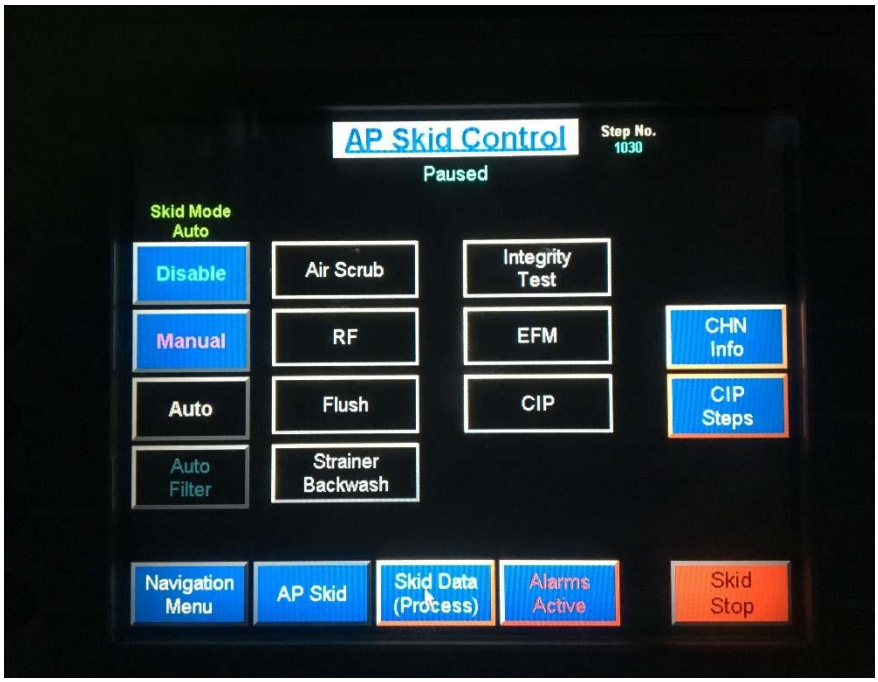


**Figure 29. MF AP Skid Control Screen**

Manual settings can be accessed on the Skid Manual Control screen. In Manual mode, the feed pump speed, reverse filtration pump speed, and feed flow control valve position can be adjusted to an operator-defined setpoint.

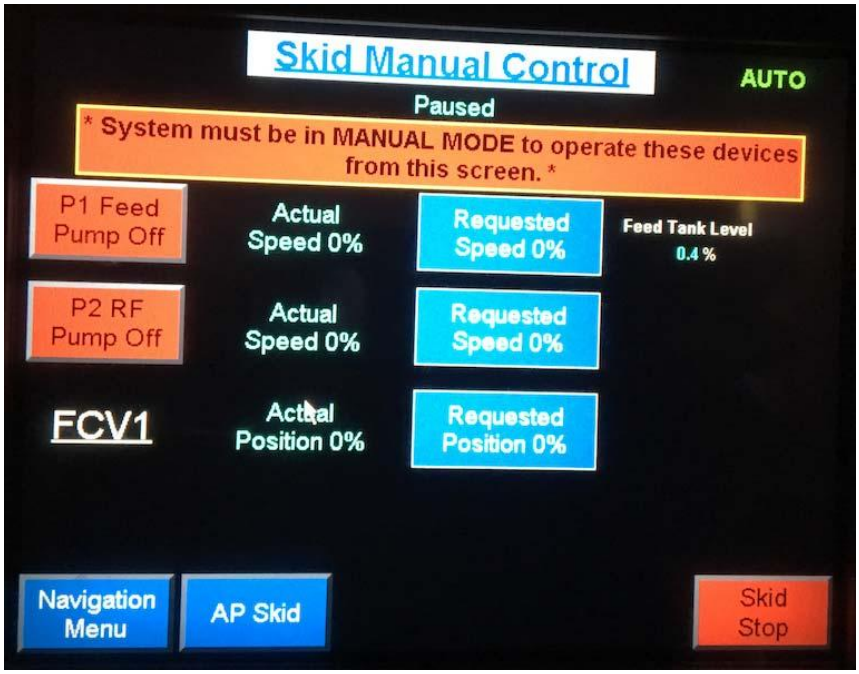


**Figure 30. MF Skid Manual Control**

The current status and control of system modes for the AP skid and CHN skid can be accessed on the System Modes screen.

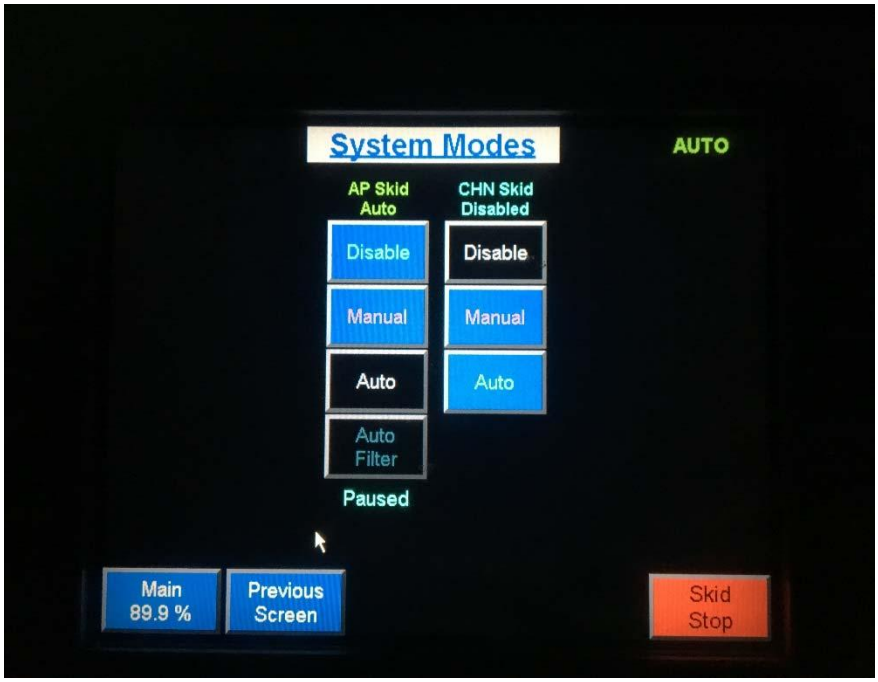


**Figure 31. MF System Modes Screen**

### Skid Setpoints Screens

MF Skid Setpoints screens for Process, CHN (Clean Heat Neutralize system), Enhanced Flux Maintenance (EFM), CIP, Integrity Test (IT), and Flux Maintenance (FM) setpoints are accessed via the “Plant Oper. Setpoints” pushbutton under Skid Setpoints on the main Navigation Menu screen. FM is the general term used by Pall to describe the reverse filtration and air scrub cycle. EFM makes use of chemicals to enhance backwash efficacy every predetermined number of backwashes. Due to the feed water quality to the DPWF, and the ozone BAC pretreatment, EFM is not necessary.

The feed valve FCV1 position fill setpoint, fill time setpoint, flow control setpoint, and time between Integrity Test parameters can be set on the Process Setpoints screen. AN operator is also able to enable/disable the following: MF flow setpoint from Plant PLC, MF flow setpoint form Pall HMI, MF flow control, and MF level control.

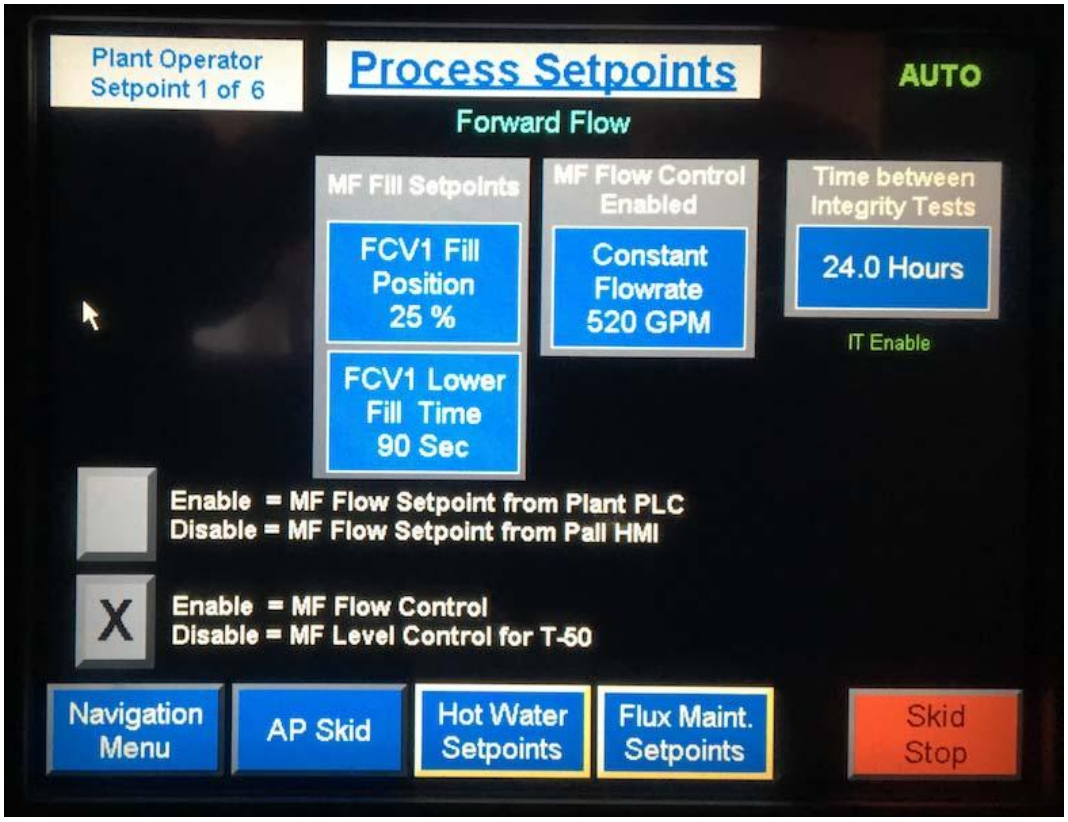


**Figure 32. MF Process Setpoints Screen**

The heater and hot water tank setpoints associated with the hot water system can be accessed on the CHN Setpoints screen.

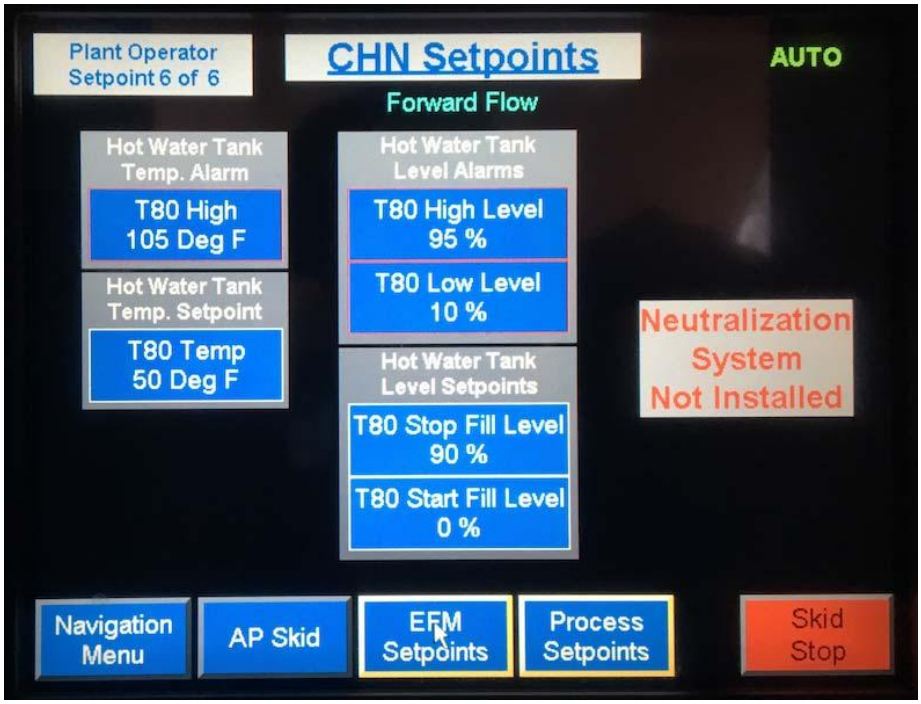


**Figure 33. MF CHN Setpoints Screen**

Setpoints related to the EFM can be accessed on the EFM setpoints screen. EFM intervals, chemical quantities, and EFM cycle setpoints can be adjusted on this screen.

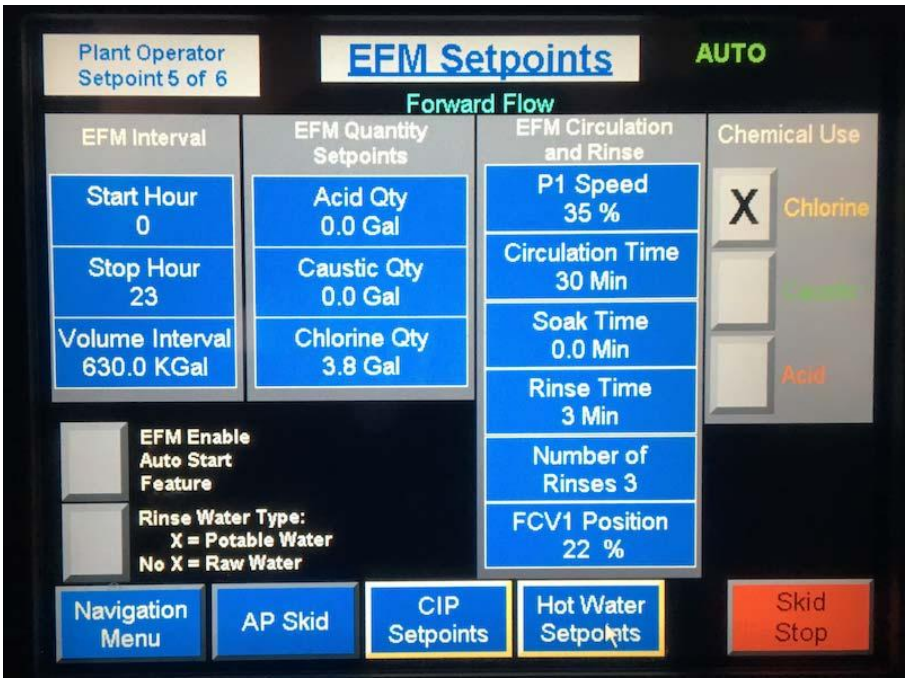


**Figure 34. MF EFM Setpoints Screen**

CIP pump, chemical quantities, and time setpoints are accessible on the CIP Setpoints screen.

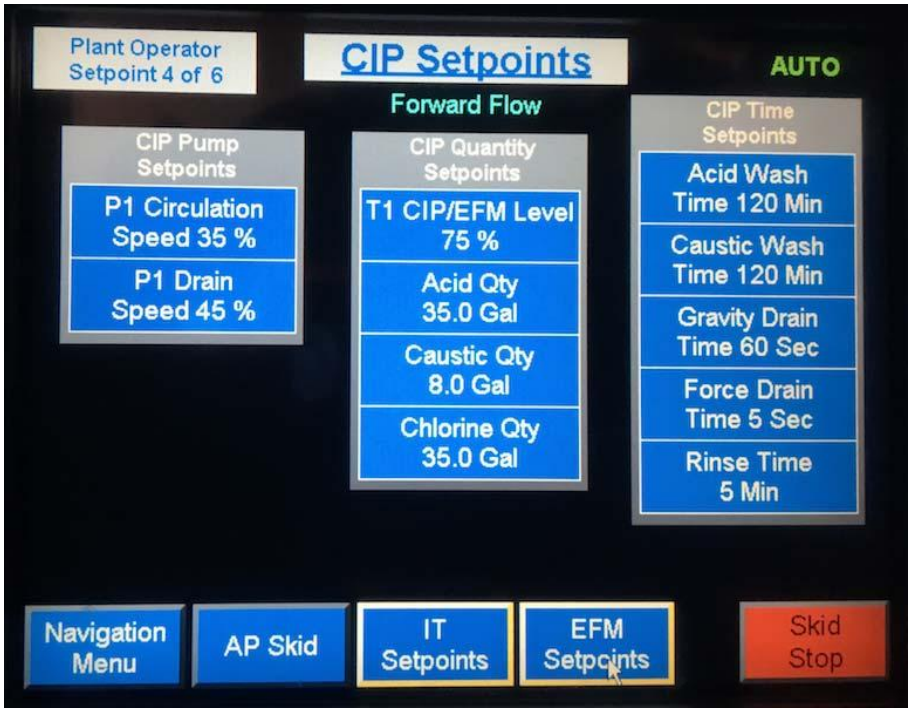


**Figure 35. MF CIP Setpoints Screen**

IT frequency, date and time of last IT test, time remaining before next IT, and real-time tracking of the IT test can be accessed on the IT Setpoints screen.

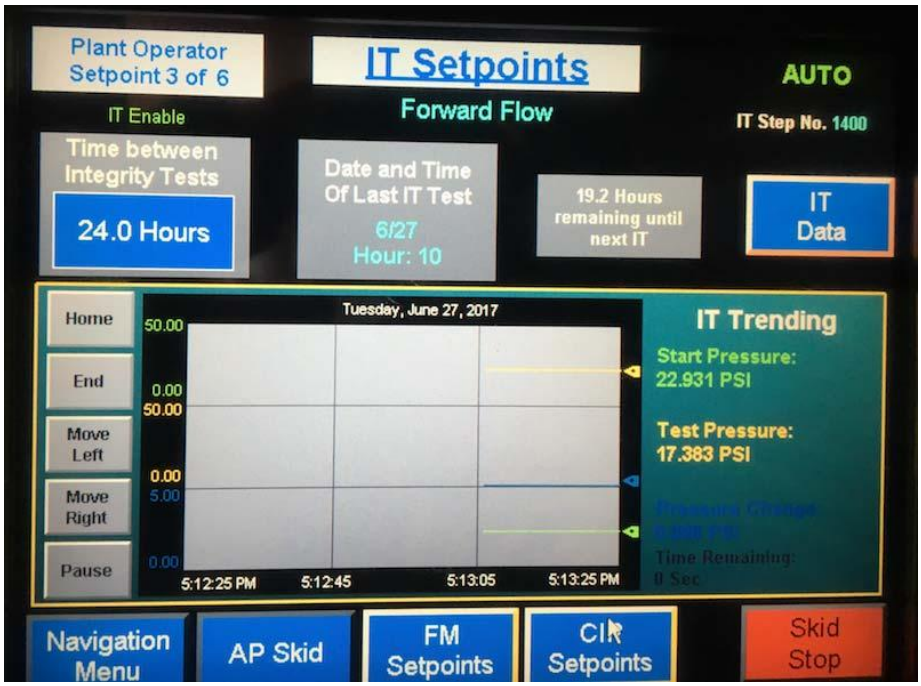


**Figure 36. MF IT Setpoints Screen**

FM setpoints can be accessed on the FM Setpoints screen. Setpoints for the FM interval, air scrub duration and flowrate, Post CIP reverse filtration duration, flush duration and feed flow control valve position, reverse filtration duration and flowrate, and strainer backwash setpoints.

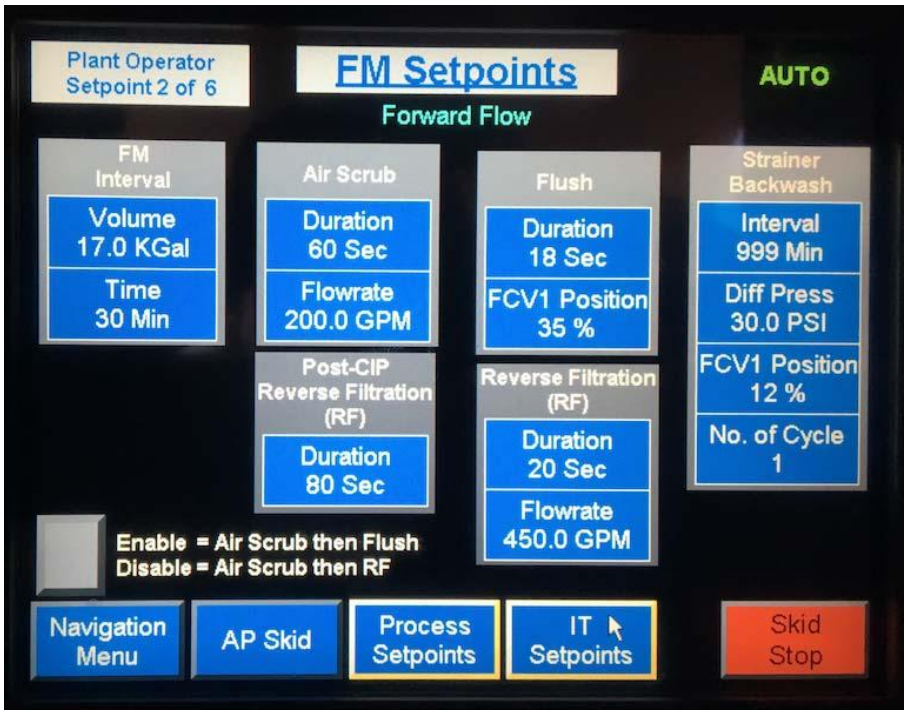


**Figure 37. MF FM Setpoints Screen**

### Skid Information Screens

Skid Information screens contain data on the skid, the process, IT, CIP, and CHN data.

The Skid Data screen includes information on parameters related to filtrate production.

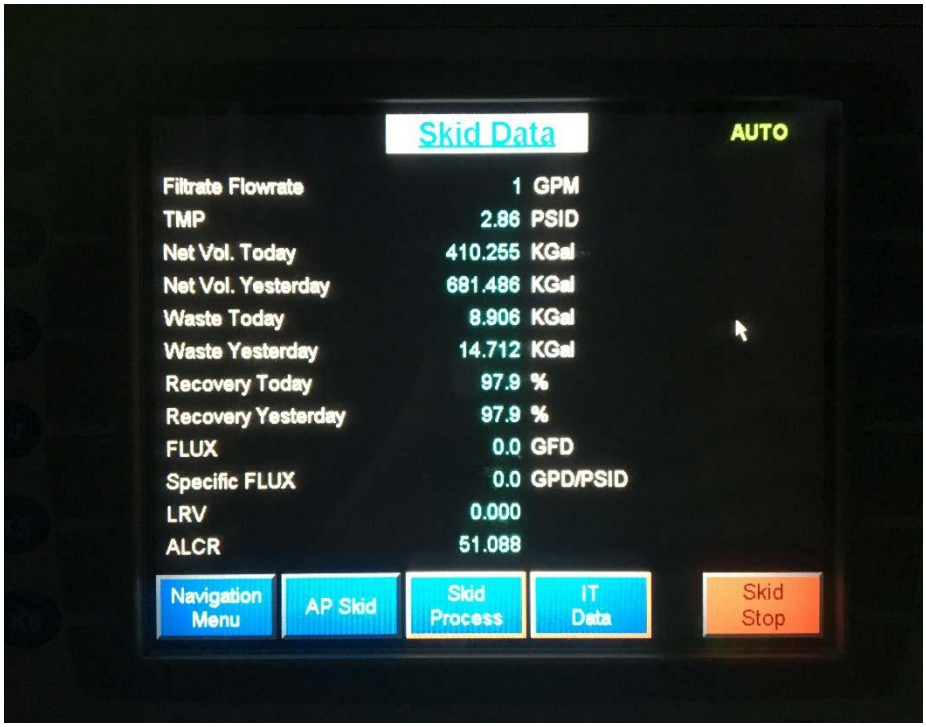


**Figure 38. MF Skid Data Screen**

The Skid Process Data screen contains information on the current process active and timers counting down other processes in queue.

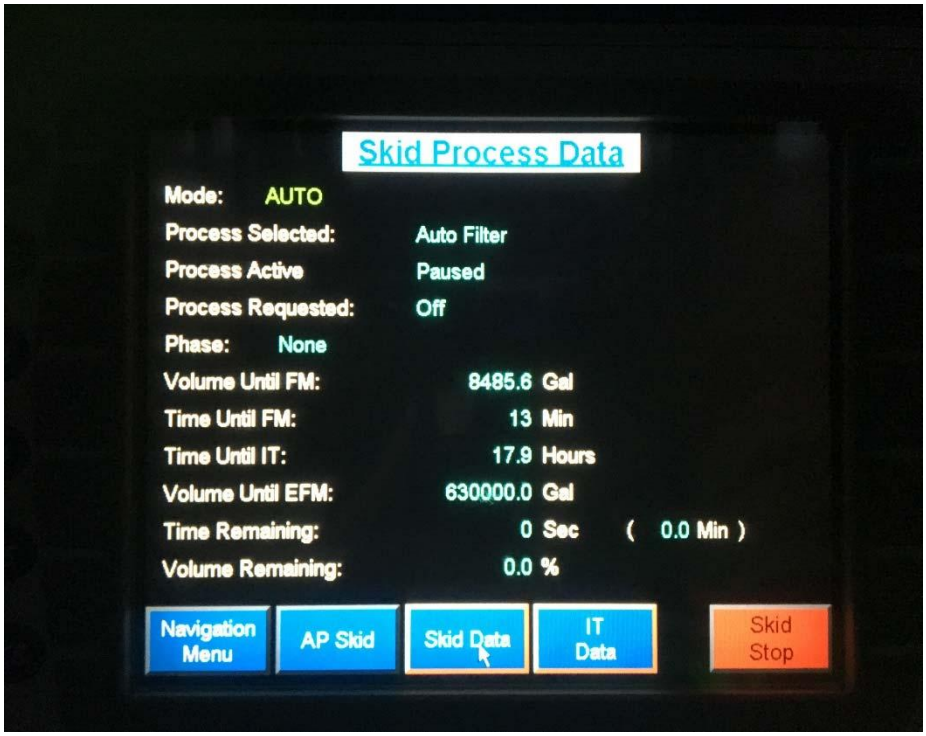


**Figure 39. MF Skid Process Data Screen**

Past CIP data and steps performed on the last CIP are displayed on the Skid CIP Data screen.

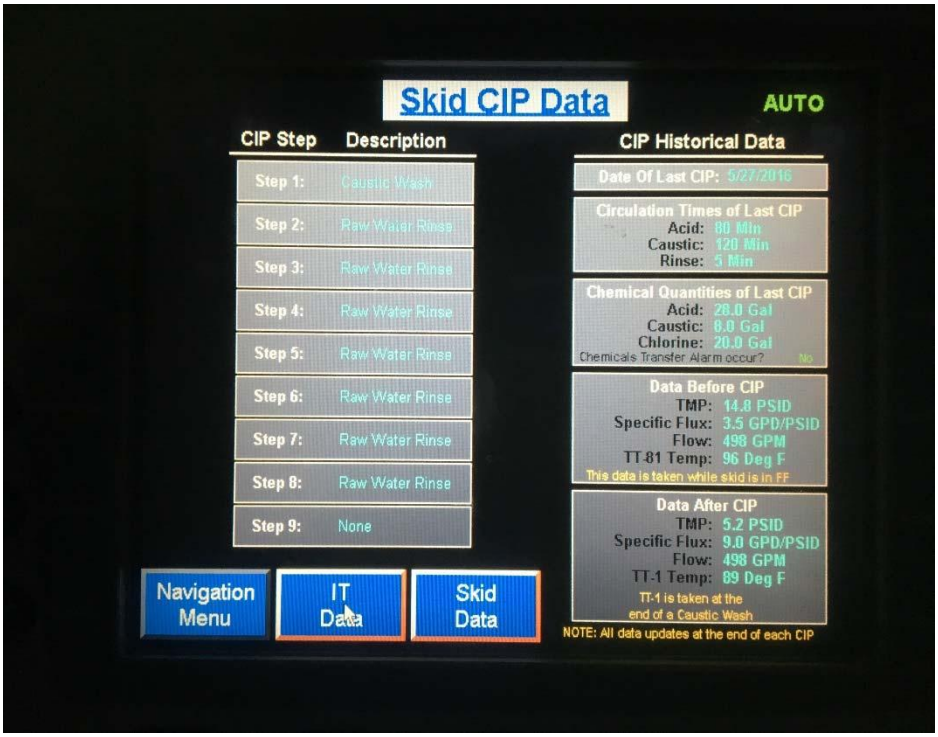


**Figure 40. MF Skid CIP Data**

Past IT data and results are presented on the Skid IT Data screen.

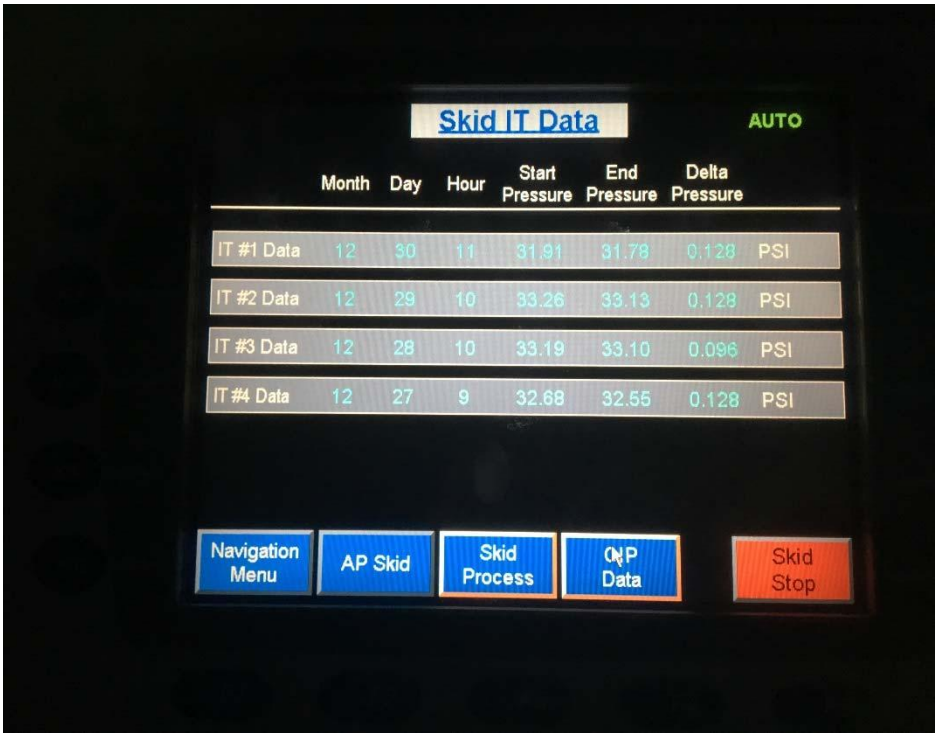


**Figure 41. MF Skid IT Data Screen**

The CHN Information screen shows the current process being performed by the hot water system and the status of parameters relevant to the CHN skid.

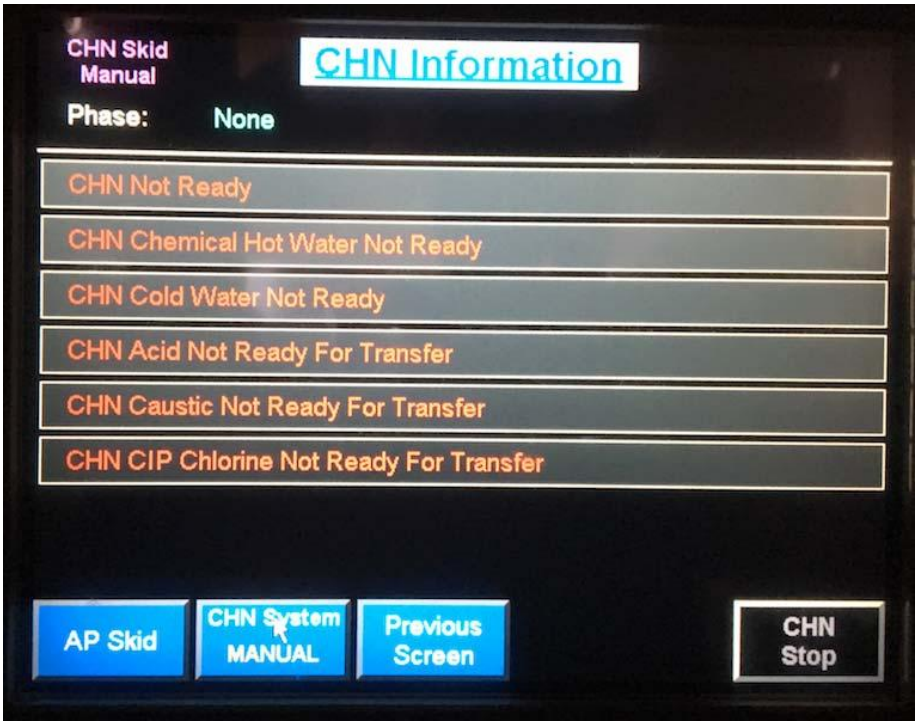


**Figure 42. MF CHN Information Screen**

Setpoints for producing a system alarm are included in AP Skid Alarms on 3 different screens. The screens can be accessed from the Main Navigation Menu Screen (Section 4.4.2) on the upper right hand corner.

Screen 1 of skid alarms includes setting alarm limits for the CIP feed tank (T1), Integrity Test, log removal value (LRV) alarms, TMP, and watchdog timers.

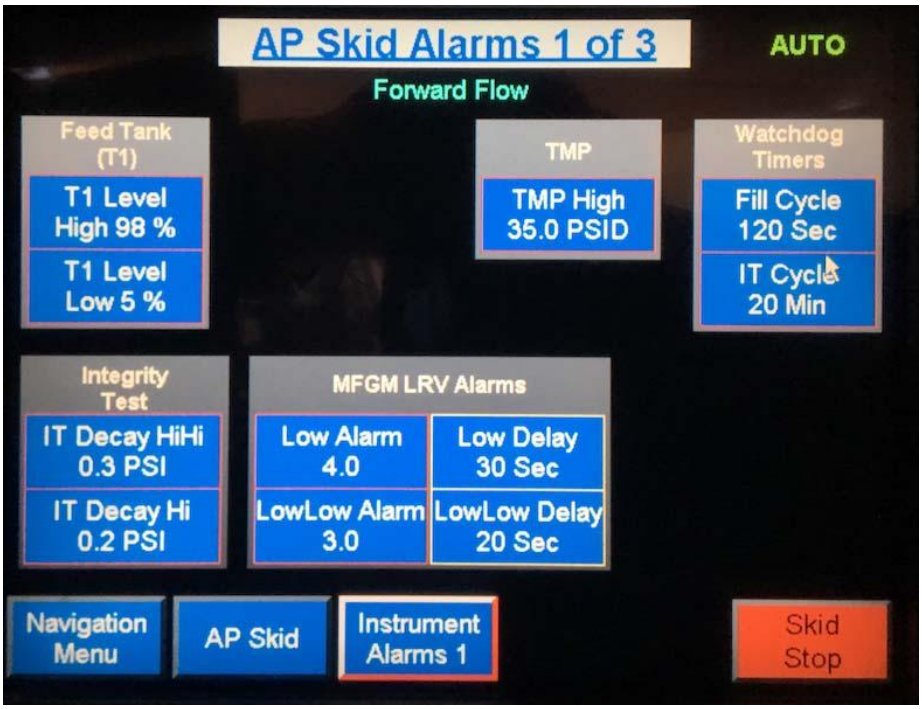


**Figure 43. MF AP Skid Alarms 1 of 3**

The second alarm setpoints page allows operators to input the high limits and delay for alarming for the filtrate turbidity.

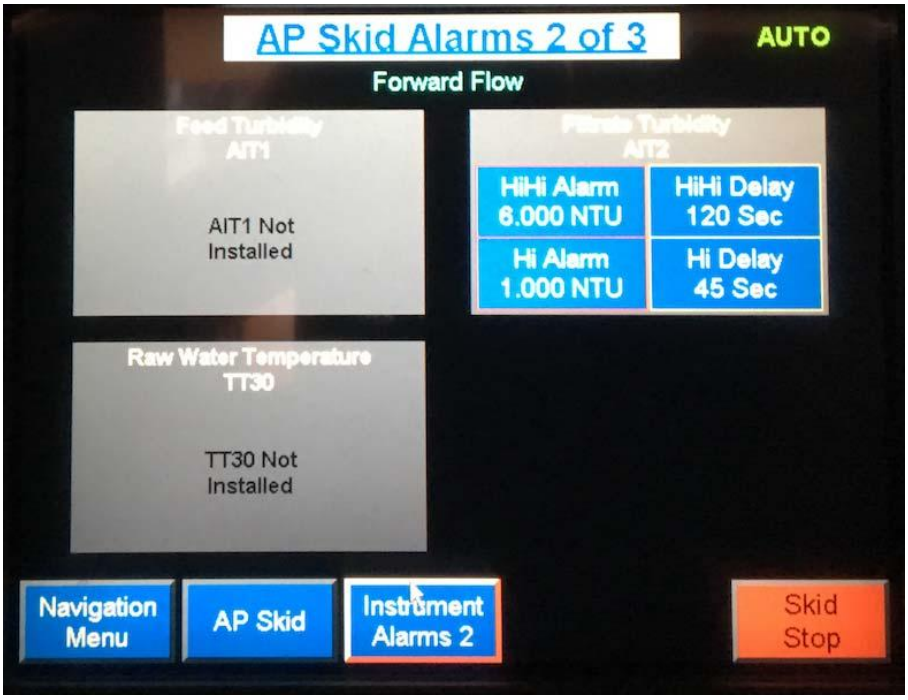


**Figure 44. MF AP Skid Alarms 2 of 3 Screen**

The third alarm setpoints page includes setpoints for components not included on the skid onsite.

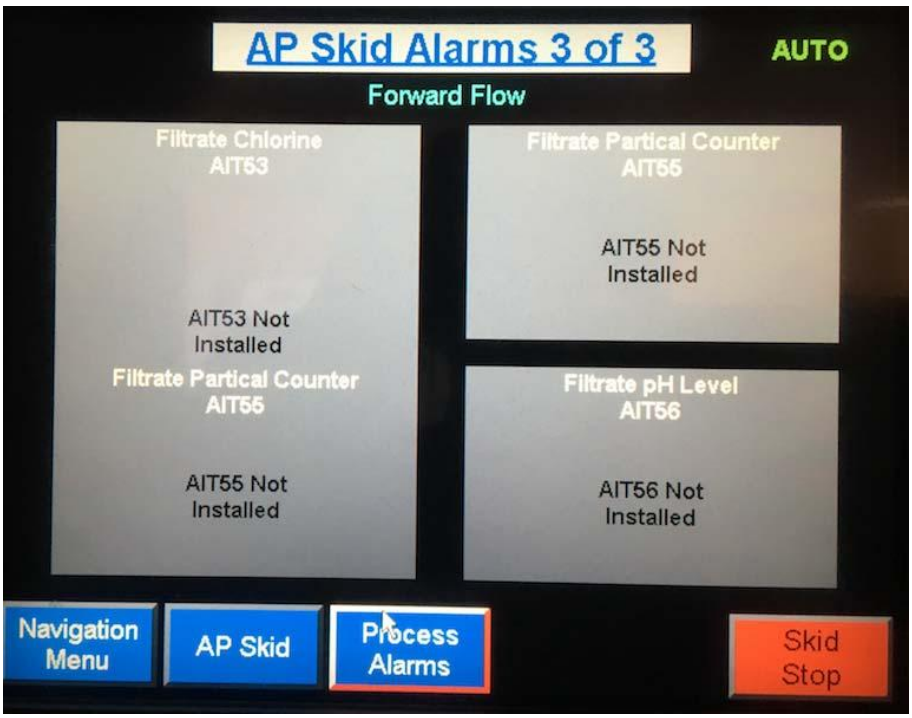


**Figure 45. MF AP Skid Alarms 3 of 3 Screen**

The Message Center screen is accessed when performing a CIP. A push button shortcut to the Message Center appears on several screens including: Main Navigation Menu Screen, MF Overview Screen, and AP Skid screen (Figure 24, Figure 25, Figure 26). The different steps of a CIP can be initiated, paused, and completed through this screen. This screen also shows the current CIP phase and time and volume remaining for the current phase.


**Figure 46. MF Message Center Screen**

Active alarms can be viewed, silenced, and acknowledged on the Alarms Active screen. Messages along with their acknowledgement time are listed in order of occurrence.

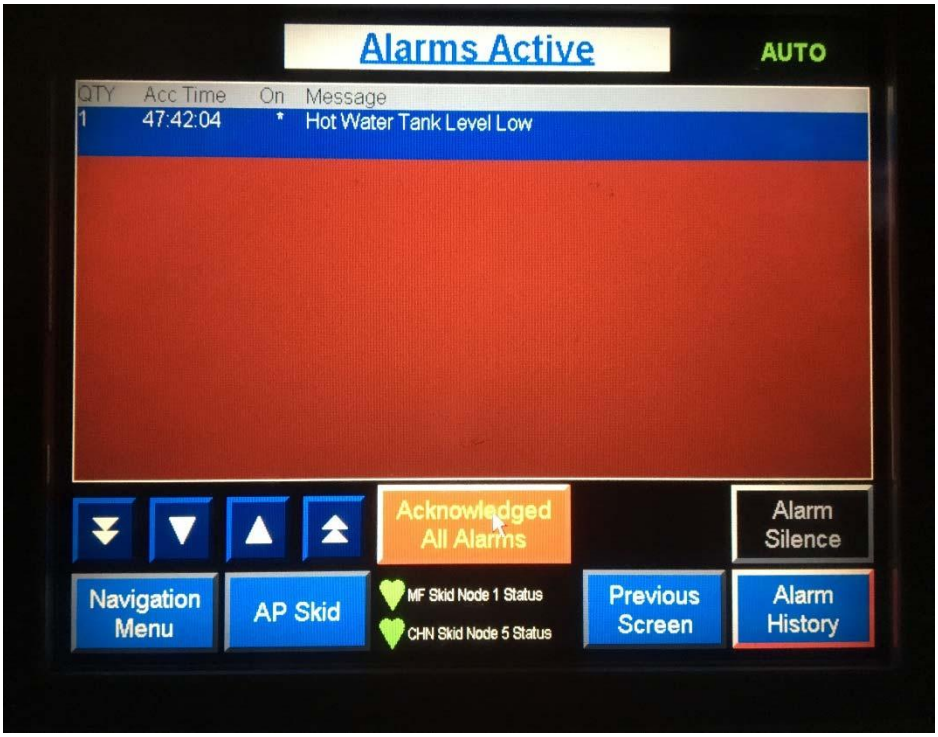


**Figure 47. MF Alarms Active Screen**

A log of alarms is presented on the Alarms History screen. The alarm history contains a log of all past alarms as well as current active alarms. The log may be cleared through this screen.

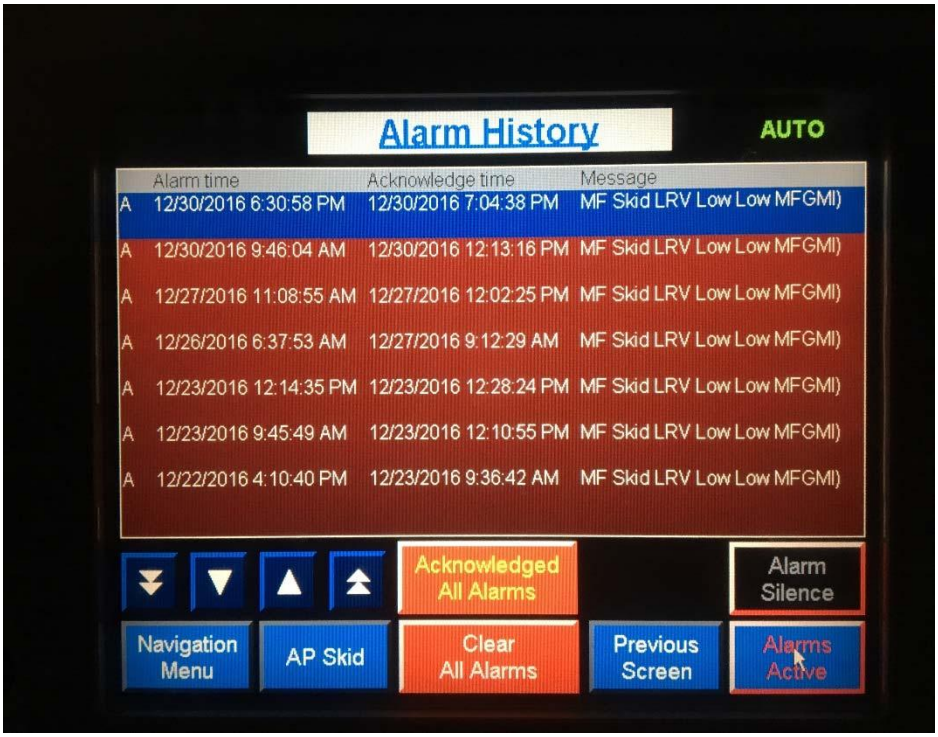


**Figure 48. MF Alarms History Screen**

### Microfiltration System Diagrams

MF system process flow diagrams, module specification sheets, and piping and instrumentation diagrams (P&IDs) are provided with the reference documents. The record drawings and source documents are summarized in Table 13.

**Table 13. MF System Record Drawings**

| Diagram | Document Source | Sheet Number |
|---|---|---|
| MF System Overview | MF and UF Procurement Documents | 2 |
| MF System P&ID | MF and UF Procurement Documents | 3 |
| MF CIP System P&ID | MF and UF Procurement Documents | 4 |
| MF Compressed Air System P&ID | MF and UF Procurement Documents | 5 |
| MF P&ID legend | MF and UF Procurement Documents | 6 |

**Microfiltration System Alarms**

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| Feed Turbidity High | Exceeded the High Setpoint Level for the number of seconds on the Timer preset. | MF system can continue operating at high feed turbidity. Local alarm is generated. | Confirm turbidity meter is receiving adequate flow and that feed strainer is not clogged. |
| Feed Turbidity High-High | Exceeded the High-High turbidity Setpoint Level for the number of seconds on the Timer preset. | MF system can continue operating at high feed turbidity. Local alarm is generated. | Confirm turbidity meter is receiving adequate flow and that feed strainer is not clogged. |
| Filtrate Flow Low | Not enough water is passing through the membranes. | MF system can continue operating at low filtrate flow. Local alarm is generated. | 1) If the TMP is increasing, initiate a reverse filtration cycle with air scrub and if necessary a CIP cycle to reduce the TMP and increase the filtrate production.<br>2) Check the operation of VFD and the proper operation of the feed/transfer pump. |
| Filtrate Flow High | Excessive flow through the membranes. | MF system can continue operating at high filtrate flow. Local alarm is generated. | 1) Check the calibration/operation of the flow meter and recalibrate/replace as required.<br>2) Replace the hollow fiber module that has failed. |
| Feed Pressure Low | Low pressure in the Feed Line downstream of the Recirculation pump. | MF system can continue operating at low feed pressure. Local alarm is generated. | 1) Check the pressure on the pressure gauges on the strainer inlet and outlet. Complete a strainer backwash cycle if there is a high differential pressure (dP) between these two points.<br>2) Check and eliminate any line blockages.<br>3) Check pressure transmitter operation. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| Feed Pressure High | Excess pressure in the Feed Line downstream of the pressure transmitter. | MF skid shutdown. | 1) Check the pressure gauges on the strainer inlet and outlet. Complete a strainer backwash cycle if there is a high differential pressure between strainer inlet and outlet.<br>2) Check and eliminate any line blockages.<br>3) Check pressure transmitter operation. |
| Filtrate Pressure Low | Low pressure | System keeps running. Local alarm is generated. | 1) Check feed pressure on the pressure gauges on strainer inlet and outlet. Complete a backwash cycle if there is a high differential pressure between strainer inlet and outlet<br>2) Check and eliminate any other line blockages<br>3) Check the operation of the pressure transmitter. |
| Filtrate Pressure High | High pressure | System keeps running. Local alarm is generated. | 1) Check feed pressure on the pressure gauges on the strainer inlet and outlet. Complete a backwash cycle if there is a high differential pressure between strainer inlet and outlet.<br>2) Check and eliminate any other line blockages.<br>3) Check the operation of the pressure transmitter. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| Filtrate Temperature High | The filtrate temperature has exceeded the safe high temperature allowed during cleaning. The maximum allowable temperature is 40 ˚C. | CIP aborts. | Reduce the temperature of the cleaning solution to within the acceptable limits by reducing the heater setpoint on the CHN setpoints screen or disabling the CHN system (which disables the heater) before continuing the cleaning cycle. |
| System TMP High | Differential pressure across the hollow fiber modules is too high. | Local alarm is generated. | Perform a CIP process. |
| System TMP High-High | Differential pressure across the hollow fiber modules is too high. | Local alarm is generated. | Perform a CIP process. |
| Filtrate High-High Turbidity | The microfiltration filtrate quality has become too poor or turbidimeter malfunctioning. | Local alarm is generated. | 1) Confirm that Turbidity Meter is functioning properly.<br>2) Perform an Integrity Test. Perform an Integrity Test failure follow-up if necessary. |
| Feed Pump VFD Fault | There is a problem with the Variable Speed Drive (VFD) that controls Feed pump. | System shutdown. | Contact staff electricians to investigate. If further support is needed, contact Pall Technical Support. |
| Reverse Filtration Pump VFD Fault | There a problem with the Variable Speed Drive that controls reverse filtration pump. | System shutdown. | Contact staff electricians to investigate. If further support is needed, contact Pall Technical Support. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| Fill Watchdog Fault | The microfiltration system piping and modules have not filled with water within the required time while preparing to return to forward after a draining event (such as after the IT process). | System shutdown. | Confirm that hand-actuated valves and check valves on the process water piping are fully open. |
| "**EMERGENCY STOP**" Blinks across the top of the operator interface screen | Emergency Stop alarm has been initiated. | System shutdown. | 1) Pull out Emergency. Stop button, then press 'ESTOP RESET' button.<br>2) Restore power and reset critical alarm.<br>3) Cycle power and reset critical alarm.<br>4) Determine cause and correct; replace fuse. |
| Transmitter Fault | Transmitter is no longer sending a signal to PLC input. | System shutdown. | 1) Check for cause and replace fuse.<br>2) Check that all terminations are securely made and correct any that are.<br>3) Contact Pall Technical Support. |

## Microfiltration System Control Philosophy

### Auto and Manual Modes

The human machine interface (HMI) will display current status, as well as countdown timers showing the time to the next process in queue. The display will also show daily totals of filtrate and waste flow through a flow-indicating transmitter. While in Auto Mode, the operator may initiate backwash, or Strainer backwash at any time if the system is currently in a Filtrate Forward Process.

In “Manual” mode, the operator has control of all pumps and actuated valves, and can adjust speeds as required, as a result, running the train in “Manual” mode is not recommended. It can be useful to run in “Manual” when troubleshooting and the skid is off.

### Flow Control

System control is governed by the filtrate flow setpoint controls. The feed valve will modulate to provide sufficient flow to match the operator-set filtrate flow setpoint.

### The Fill Process

The Fill Process purges any air from the system on startup and after an integrity test (IT) or a CIP process. A watchdog timer on the Fill Process will shut the system down if flow meter on filtrate line is not satisfied within 90 seconds.

### The Auto Filter (Filtrate Forward) Process

In “Auto” Mode, after completion of the Fill Process, the system automatically initiates the Auto Filter or Filtrate Forward Process.

During Auto Filter, the feed valve and filtrate valve open. The feed valve modulates to provide sufficient flow and pressure to match the operator-set filtrate flow setpoint.

### Reverse Filtration

A Reverse Filtration Process automatically occurs based upon total flow volume since the last reverse filtration process. The basis of the reverse filtration volume setpoint is on the number of modules installed.

During reverse filtration, the feed pump stops and the reverse filtration pump directs filtrate from the MF/UF filtrate tank through the modules in the reverse direction. The operator sets the reverse filtration target flowrate setpoint, with a maximum of 22 gpm per module. The operator also enters a setpoint for the reverse filtration duration time — typically 15-30 seconds. The filtrate flow transmitter measures this flow rate.

The spent reverse filtration water flows through the upper and lower drains at roughly equal flow rates. The mechanical stop on the reverse filtration drain valve

adjusts until the drain flow meter measures 40 to 60% of the total target flowrate setpoint.

### Air Scrub

The operator can set up the system to perform an Air Scrub Process prior to every reverse filtration Process or every other Process by adjusting the reverse filtration/air scrub Ratio. Air Scrubs, when they occur, always precede the reverse filtration Process. The operator can initiate an Air Scrub at any time when the system is in an Auto Filter Process cycle by selecting the Air Scrub button on the Rack Auto Menu screen. The Air Scrub will then proceed automatically and the operator does not need to change or adjust any settings. Air Scrub will not begin if the ultrafiltration (UF) skid is performing a backwash or PDT. The Air Scrub Process will be followed by a reverse filtration or Flush Process, depending on how the system is configured.

The required amount of air for an Air Scrub is directly proportional to the number of modules in the rack. The manufacturer recommends 3 SCFM per module.

During the Air Scrub Process, air is introduced into the feed side of the modules. At the same time, filtrate is introduced into the module at the setpoint for Air Scrub pump speed for the Air Scrub with water duration (currently 60 seconds).

### Forward Flush

After Air Scrub, a Forward Flush is applied to rid the module of any air and debris remaining after the Air Scrub is complete. With valves in position, the feed pump runs at setpoints for Air Scrub flush speed and Air Scrub flush duration.

### Integrity Test

IT frequency is set by the operator on the appropriate setpoints screen. On the same screen, the operator can set whether the system continues operating or shuts down on an IT failure.

The operator can also perform an Integrity Test manually at any time when the system is in “Auto” Mode and not in Air Scrub or Reverse Filtration. When an IT test is initiated, the previous step halts and the feed valve closes. Air is introduced to the module and the skid is pressurized to the operator-set IT pressure setpoint. After pressure stabilization, the start and end pressure after 5 minutes is recorded. The appropriate valves open to depressurize the system to complete the IT test.

# Appendix E. Ultrafiltration System

## Ultrafiltration System Overview

The ultrafiltration (UF) system removes bacteria, cysts, and particles using hollow fiber membranes. The system is automated to complete the following processes: normal production (30 minute cycles), backwash (air scour, reverse filtration) at the end of production cycles, and daily membrane Pressure Decay Tests. Over time, membranes will foul with organic and inorganic matter. Fouling occurs when particles deposit and adhere to the membrane surface and cause operating pressure to increase. Clean-in-places (CIPs) utilize caustic soda (sodium hydroxide or NaOH) and citric acid ($C_6H_8O_7$) cleans to restore flux. The following parameters in Table 14 are relevant to process performance and design criteria for the system are summarized in Table 15.

**Table 14. UF system operating ranges**

| Parameter | Operating Range |
|---|---|
| Feed pressure | 11-30 psi |
| Filtrate pressure | 7-9 psi |
| Feed turbidity | 0.1-0.75 NTU |
| Filtrate Turbidity | 0-0.15 NTU |
| Pressure Decay Test results | 0-0.35 psi/min* |
| Flux | 33-73 gfd |
| Specific Flux | 2.5-9.5 gfd/psi |
| Water Temperature | 20-30 °C |
| Transmembrane Pressure | 4-20 psi |
| Recovery | 95%-99% |
| Backwash interval | 0-30 min. |
| Filtrate total chlorine residual | 0.0-3.5 mg/L |
| Filtrate ORP | 400-650 mV |
| Filtrate ammonium residual | 0.2-0.7 $NH_4$-N mg/L |

*Applicable only for a target flux of 70 gfd

**Table 15. UF system design criteria**

| Parameter | Value |
|---|---|
| Net Product Flow | 0.625 MGD |
| Nominal Pore Size | 0.015 µm |
| Number of Modules | 33 |
| Area per Module | 775 sf |
| Instantaneous Flux | 33 gfd |
| Recovery | 95% |
| Enhanced Flux Maintenance, Backwash Chemicals | None |
| Chemical Cleaning Frequency | > 3 months |
| Manufacturer(s) | Toray (modules), H2O Innovation (system) |

### Ultrafiltration System Major Components

The UF system components are included in the UF Plumbing and Instrumentation Diagrams in the UF System Record Drawings section of the Appendix, sheet numbers 1-5.

### Feed Pump

There are two types of pumps available for providing feed to the UF system, depending on the feed source. EDR pumps 105 and 106 are available to provide tertiary effluent. A transfer pump provides water pretreated with biological activated carbon (BAC) or ozone and BAC from the equalization (EQ) tank. Pumps are controlled by their respective variable frequency drives (VFDs).

### MF/UF Filtrate Tank

The filtrate tank, also known as the microfiltration/ultrafiltration (MF/UF) filtrate tank, is a cylindrical high density polyethylene (HDPE) tank, it includes:

- A sealed cover with fasteners and an ethylene propylene diene monomer (EPDM) gasket
- A tank fill valve
- A level sensor
- A vent filter designed to keep the tank contents clean while preventing the potential of the tank drawing a vacuum

The MF/UF filtrate tank stores produced filtrate and provides a source of filtered water to use during the reverse flow process step.

### Reverse Filtration Pump

The reverse filtration pump consists of a centrifugal pump controlled by a variable frequency drive (VFD) through a flow controller. Flow measurements determine automatic control of the pump. This pump provides fluid flow into the top of the hollow fiber modules during the backwashing steps.

### Backwashing Strainer

Feed water passes through a backwashing strainer before entering the hollow fiber modules. The strainer backwashes automatically based on time or differential pressure (dP).

### Module Rack with Multiple Hollow Fiber Modules

The module rack holds the Toray HFS-2020 modules.

### Ultrafiltration System Modes of Operation

The UF has four main processes during normal operations: filtration, backwash, Pressure Decay Test (PDT), and clean-in-place (CIP). Each filtration cycle is 30 minutes and ends with a backwash (BW). Backwashes remove foulants and rejected particulates that may accumulate on the surface of the membrane during the filtration cycle. The backwash cycle lasts approximately 1.5 minutes to 2 minutes and a new filtration cycle begins afterwards if a PDT is not the next process in queue. PDTs are performed once a day and will initiate on a 24-hour timer. When the timer runs out, the PDT will proceed after the current filtration and queued backwash cycles are complete. PDTs are performed to detect broken fibers that will compromise system performance.

CIPs are performed on an as-needed basis. Although backwashes will remove many particulates and foulants during operations, the membranes will foul and a more rigorous clean is required to recover performance. A CIP is required when the transmembrane pressure (TMP) exceeds 25 psi. Filtration, backwash, and PDTs can be initiated by an operator at any time during operations.

### Filtration Mode

During filtration, feed water enters through the bottom of the module and the water is distributed evenly on the outside of the fibers. While pressurized, water passes through the surface of the membrane and the filtrate exits at the top of the module. Most of the feed water exits as filtered water. Control of the filtration is set mainly by the feed pump and inlet valve to maintain feed pressure and filtrate flow set points. As the membranes foul and foulants accumulate on the module filaments, higher feed pressure is required to maintain the filtrate flow setpoint. Eventually, the feed pressure required will exceed the maximum output of the feed pump and filtrate production will decrease.

### Backwash Mode

Backwashes mainly consist of three steps, reverse filtration (backwash), air scour, and forward flush. During this cycle, all BW waste is diverted to the drain which is plumbed to the NCWRP plant drain. The sequence of events for the UF backwash occurs as follows:

1. Valve FV240B remains open from the previous filtration cycle while FV240F closes.
2. Once FV240F closes, FV240B closes, FV240A opens, and then FV240C opens. Backwash pump turns on and Backwash upper for 30 seconds.
3. FV240E and FV280 open and FV240A close and BW pump stops. Air scour proceeds for 30 seconds.
4. FV240E and FV280 closes. FV240D opens and drains for 50 seconds. FV240D closes and FV240F opens. Forward flush for 40 seconds to drain.
5. FV240D closes and FV240 C closes.
6. If going into production: Production flush for 30 seconds. FV240C closes and FV240B opens.
7. If going into PDT: FV240B remains open while FV240F closes. Status stays on forward flush until FV240F closes. Goes into PDT sequence.

### Pressure Decay Test Mode

Pressure Decay Tests (PDTs) assess fiber integrity with an air-pressure-holding test. PDTs are similar to Integrity Tests (ITs) in the MF system, but the differences in naming conventions shown in this document reflect specific manufacturer terminology. Air is introduced upstream of the filtrate side and the air displaces water in the modules until the pressure setpoint is met (pressure is set to achieve complete water displacement). Once the setpoint is achieved, there is a timed delay to allow the pressure to stabilize before the system begins monitoring the rate of pressure decay as air diffuses through the membrane pores. If there are any breaches in fiber integrity, the pressure decay rate will exceed acceptable limits.

The sequence of events for the UF PDT occurs as follows:

1. Once UF BW completes, a PDT drain sequence begins. FV240B closes and FV240C and FC240D open. Drains for 80 seconds.
2. FV240E and FV240B open and FV240C and FC240D close. FV280 opens to pressurize the modules until pressure setpoint is reached. Once reached, FV280, FV240E, and FV240B close. PDT delay timer starts for 50 seconds to allow pressure to stabilize.
3. When a PDT starts, FV240B opens and timer starts at 300 seconds to measure the pressure at the beginning and end of 300 seconds.
4. Once PDT test is done, FV240B close and FC240C and FC240D open to depressurize PDT for 10 seconds.
5. FV240D closes and FC240C remains open. FC240F opens for PDT rinse for 18 seconds.

6. Production flush for 30 seconds (same valves open).
7. FV240B opens and FV240C closes. PDT is complete and system resumes production.

**Clean-in-Place Mode**

Foulants that accumulate on the surface of the membrane may consist of organic, biological, and inorganic material. The CIP process utilizes two cleaning solutions, an acidic solution (2% citric) and a caustic solution (1% NaOH) with chlorine (3000-5000 ppm). The caustic clean targets organic foulants and the acid clean targets inorganic precipitates. Typically, it is recommended to perform the caustic CIP first before the acid CIP. The UF system does not have dedicated CIP system and shares equipment with the reverse osmosis (RO) system. The basic procedure is summarized below.

1. Fill hot water tank with RO permeate
2. Heat water in hot water tank
3. Inject chemicals in hot water tank to create CIP solution
4. Align valves for UF recirculation
5. Recirculate heated CIP solution through UF system
6. Drain CIP solution to waste
7. Flush UF system with raw feed water

Detailed procedures can be found in the Demonstration Pure Water Facility (DPWF) master SOP.

**Start-Up & Shutdown Sequence Modes**

The system starts up by going through a forward flush cycle. The forward flush cycle flushes stagnant water and particulates in the module out before production and also fills the module with fresh raw water. The water that is flushed out is diverted to drain. Once this is complete, a filtration cycle will begin and operations will continue until a shutdown. For shutdowns, the UF system can be shut off by an operator or by the main DPWF programmable logic controller (PLC), 28-CP-101 or PLC 101. In both scenarios, the feed pump will ramp down, and all valves will close. The start-up sequence is as follows:

1. Feed flow control valve FV240F will open to 50% and valve FV240C will open to let the flush water out to drain.
2. After the flush cycle timer has elapsed (currently 30 seconds) valve FV240C will close and valve FV240B will open.
3. The skid is now in Filtration mode.

**Ultrafiltration System Screens**

The following screens are part of the UF human machine interface (HMI):

- Overview
- Chemicals
- Control
- Data
- Setpoints
- Alarms

The overview screen as shown in Figure 49 displays the process diagram of the UF skid and its components. The following components and parameters are shown on the overview screen:

- Strainer
- BW pump
- Flow transmitters
- Pressure transmitters
- Valves
- Flow readings
- Pressure readings
- Valve positions
- UF modules
- UF skid piping
- Current UF status
- Time remaining on current UF process (if applicable)

The navigation bar at the bottom of the screen provides navigation to the following screens: CHEMICALS, CONTROL, DATA, SET POINTS, P250 VFD, and ALARM.

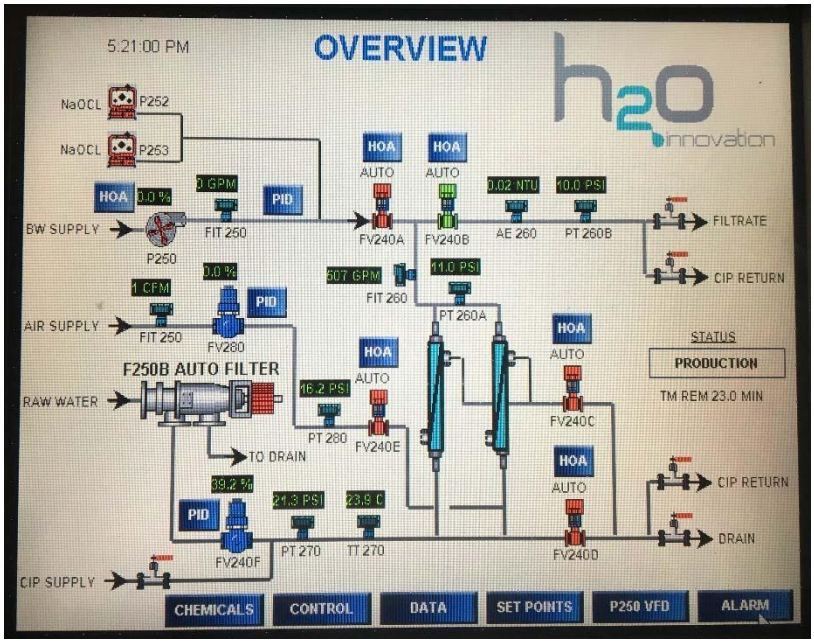


**Figure 49. UF Overview Screen**

The chemical screen shown in Figure 50 included with the system includes controls for processes with sodium hypochlorite addition. Sodium hypochlorite is no longer used for backwashes, but the controls remain in place and are currently disabled for this system.

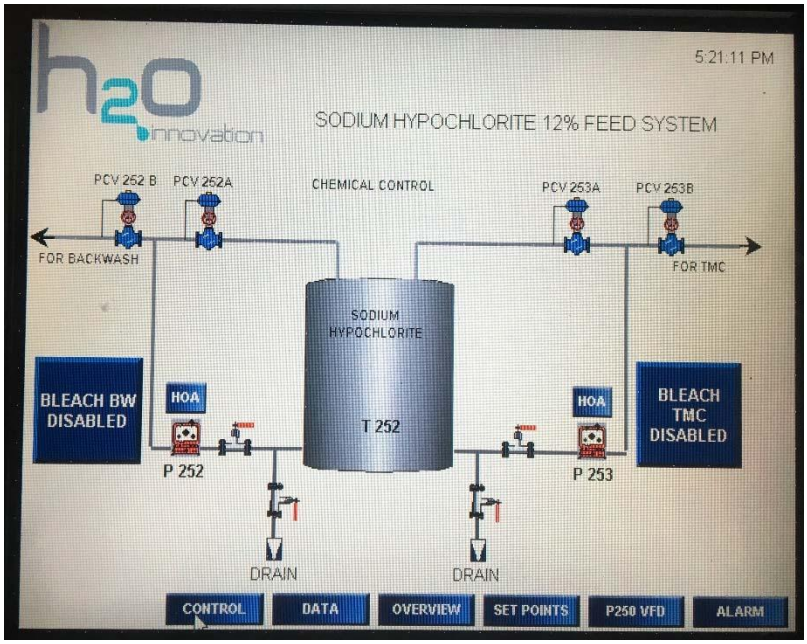


**Figure 50. UF Chemical Screen**

System controls shown in Figure 51 can be accessed on the Control screen. The operator may initiate processes and control startup or shutdown of the system. The following controls are available on this screen:

- System on/off
- Hand/Auto operation
- Enable/disable PDT
- Start PDT
- Start Backwash
- Start TMC After Next BW
- TMC Soak Step Advance

The number of modules in service and current system permeability are also displayed on this screen.

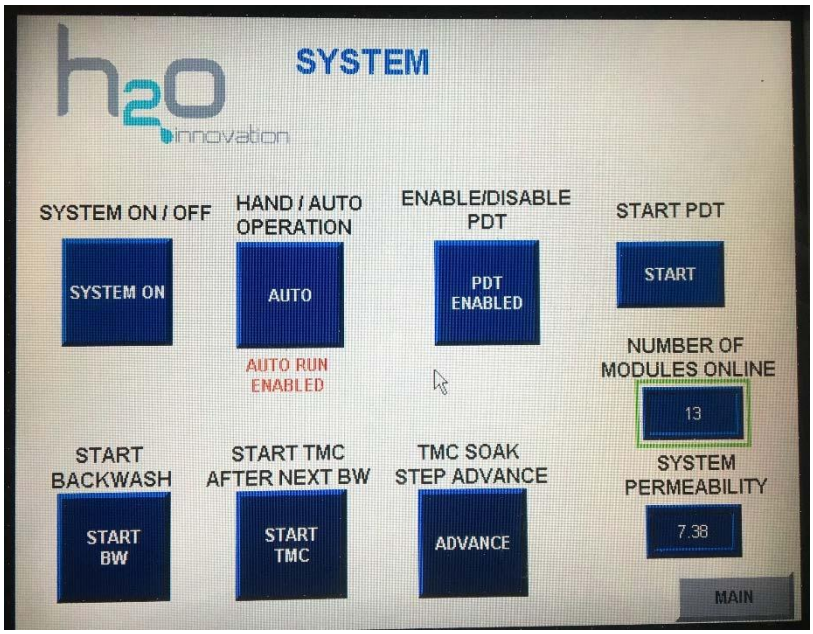


**Figure 51. UF System Controls Screen**

An overview of all data related to the UF system shown in Figure 52 is displayed on the HFUF Data Overview screen. Operational parameters, performance data, and timers for different system processes are included in this screen.

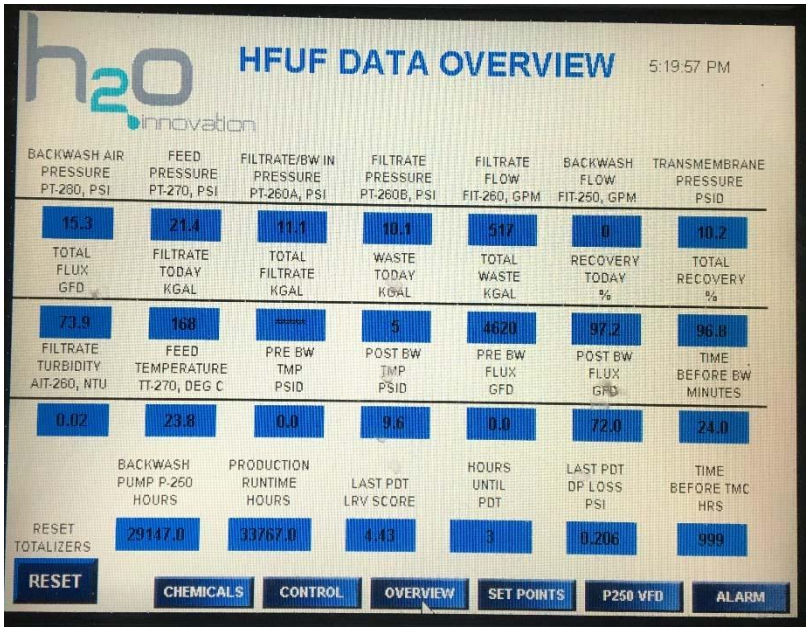


**Figure 52. HFUF Data Overview Screen**

All setpoints related to control and operations of the UF system are accessible on the Setpoints screen shown in Figure 53. Setpoints related to production, backwashes, TMCs, and PDTs are available on this screen.

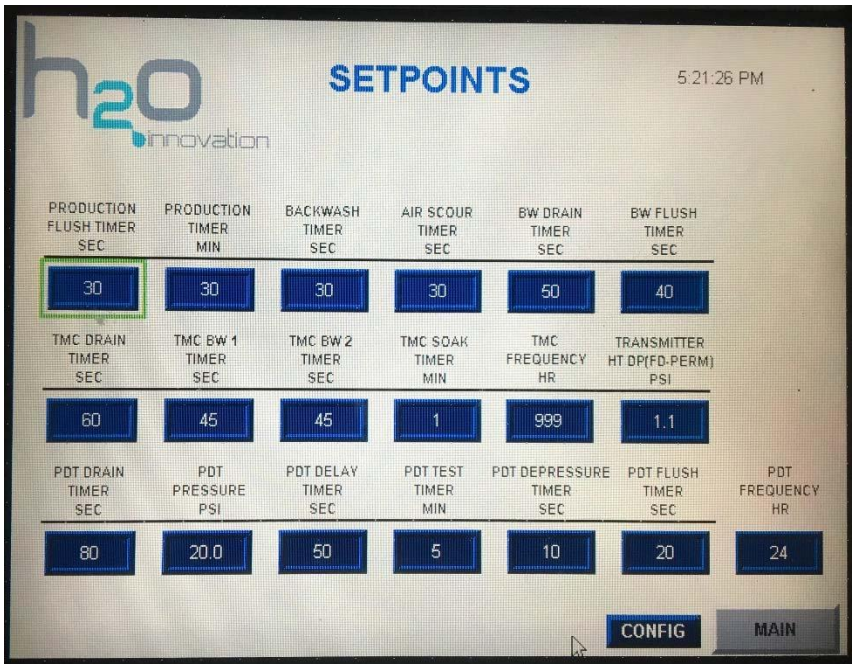


**Figure 53. UF Setpoints Screen**

Setpoints for proportional-integral-derivative (PID) controlled components (pumps, air valve, flow control valve) can be accessed by selecting the component on the Overview screen. Screens are organized with the following: PID value setpoints, and trending with actual performance. An example screen for a pump VFD is shown below in Figure 54.

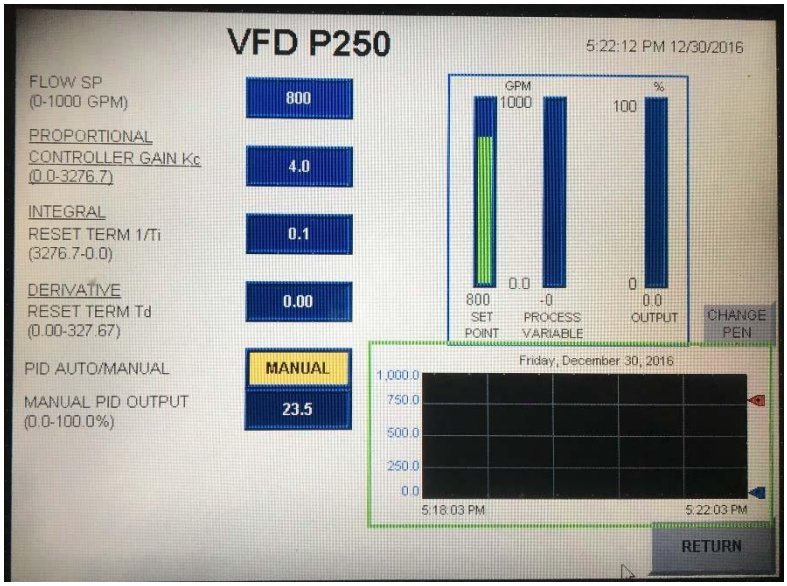


**Figure 54. Example Component PID Settings Screen**

The alarm history and current active alarms are displayed on the Alarms screen as shown in Figure 55. Critical alarms can be reset on this screen to resume operations.

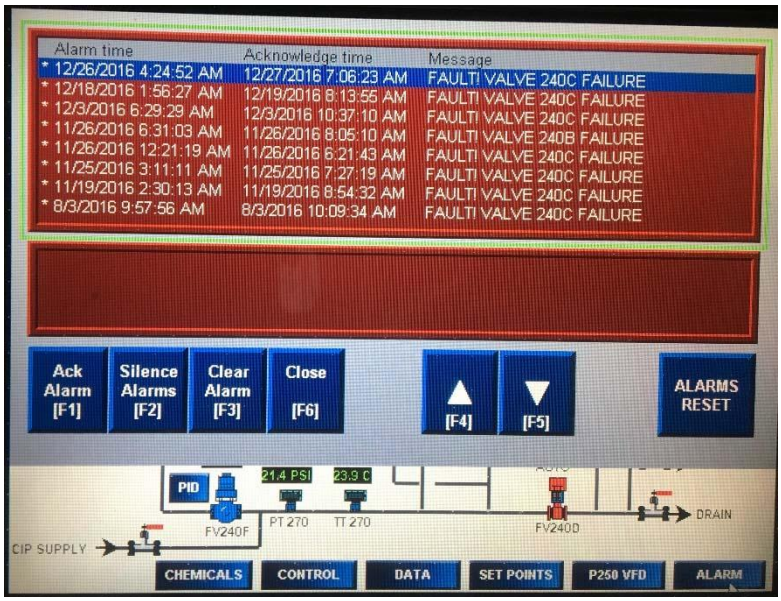


**Figure 55. UF Alarms Screen**

### Ultrafiltration System Diagrams

UF system process flow diagrams, module specification sheets, and piping and instrumentation diagrams (P&IDs) are provided in in the reference documents. The record drawings and source documents are summarized in Table 16.

**Table 16. UF System Record Drawings**

| Diagram | Document Source | Sheet Number |
|---|---|---|
| Plumbing and Instrumentation Diagram | MF/UF Procurement Drawings | 1-5 |

### Ultrafiltration System Alarms

Critical alarms causing ultrafiltration (UF) system shutdown are summarized below in Table 17. In the event of a critical alarm, the UF system initiates a shutdown sequence.

**Table 17. Ultrafiltration Critical Alarm Summary**

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| BW Pump Fault | Backwash pump did not start when called. | UF system shuts down. | Contact I&C to troubleshoot electrical connections. |
| UF High TMP | TMP High | UF system shuts down. | Perform CIP. |
| High Feed Pressure Fault | Feed pressure high | UF system shuts down. | Flush strainer. Perform CIP. |
| Valve Failure | Valve failed to modulate to intended position before time out. | Depending on the valve, UF system may shut down, or generate a local alarm. | Check valve and solenoid operational. |
| Communication Failure | UF PLC communication failure with Main PLC | UF system shuts down. | Contact I&C to troubleshoot. |
| Power Failure | No power | UF system shuts down. | Check UPS. Contact I&C. |

## Ultrafiltration System Control Philosophy

### Automatic and Manual Modes

In “Automatic” mode, the system will automatically initiate different processes based on timer counters and the backwash pump and automatic valves are controlled by the system programmable logic controller (PLC). In “Manual” mode, the operator can control valve positions and the backwash pump. It is not recommended to run the skid in “Manual” mode. “Manual” mode should only be used for troubleshooting when the skid is off.

### Flow Control

System control is governed by the filtrate flow setpoint controls. The feed valve will modulate to provide sufficient flow and pressure to match the operator-set filtrate flow setpoint.

### The Auto Filter Process

The “Auto Filter” mode proceeds directly after a fill process, or a backwash cycle. During Auto Filter, the feed valve and filtrate valve open. The feed valve modulates to provide sufficient flow and pressure to match the operator-set filtrate flow setpoint.

### Backwash

Air scour flow rate is controlled by a positioner on the air feed valve. The positioner can be controlled through a PID or set manually on the UF HMI. The reverse filtration flow rate can be controlled by the backwash pump PID or set manually on the UF HMI.

### Pressure Decay Test

The Pressure Decay Test (PDT) frequency is set by the operator on the appropriate setpoints screen. When initiated, air is introduced to the modules and pressurized to the 20 psi pressure setpoint. Pressure stabilization occurs for 60 seconds before pressure decay is monitored. Once the pressure stabilization has concluded, the start and end pressure of the pressure decay over 5 minutes is recorded. When the PDT concludes, the system is depressurized before moving on to the next process.

# Appendix F. Reverse Osmosis System

## Overview

Reverse osmosis (RO) system uses semi permeable membrane that rejects larger salt molecules and allows water to pass through. The feed water is split into two streams after filtration: filtered product water (permeate) and reject water (concentrate). The elements are spiral wound, thin composite film housed in pressure vessels. Elements are organized in series and consist of either 6 or 7 elements per vessel.

The onsite RO system consists of multiple trains: Train A, a 2-stage system, and Train B, a 3-stage system. Each train treats 50% of the microfiltration/ ultrafiltration (MF/UF) effluent to remove salts/minerals and organic matter. Occasional chemical cleans are performed on the system to remove scale. The following parameters in Table 18 are relevant to process performance and design criteria for the RO trains are summarized in Table 19.

**Table 18. RO system operating ranges**

| Parameter | Operating Range |
|---|---|
| Feed Flow | 0.634-0.662 MGD (440-460 gpm) per train |
| Permeate Flow | 0.49-0.55 MGD per train (338-383 gpm, depending on recovery) |
| Concentrate Flow | 0.10- 0.16 MGD per train (68-112 gpm, depending on recovery) |
| Feed water Conductivity | 1420-1990 uS/cm |
| Permeate water Conductivity | 20-200 uS/cm (RO membranes must maintain 1-log rejection of TDS minimum to comply with current potable reuse regulations) |
| Permeate water TOC | 0.010-0.200 mg/L |
| Feed water pH | 6.5-7.2 (depending on sulfuric acid dosing) |
| Feed water Temperature | 20-30$^{o}$C |
| Recovery | 75-80% without sulfuric acid, 85% with sulfuric acid |

| Parameter | Operating Range |
|---|---|
| Specific Flux | 0.1-0.2 gfd/psi |
| Antiscalant Dose | 0-3 mg/L in RO feed |
| RO feed water ORP | 450-600 mV (depending on chloramines residual |
| RO Feed free chlorine | 0.0 mg/L (Free chlorine is detrimental to RO membranes) |

**Table 19. RO system design criteria**

| **Reverse Osmosis Train A** | |
|---|---|
| Net Product Flow | 0.5 MGD |
| Membrane Manufacturer and Type | Toray TMG20D-400 |
| Number of Elements | 105 |
| Area per Element | 400 sf |
| Number of Elements per Vessel | 7 |
| Number of Vessels | 10 (Stage 1); 5 (Stage 2) |
| Instantaneous Flux | 12 gfd |
| Recovery | 85% |
| Chemical Cleaning Frequency | > 3 months |
| Manufacturer (System) | EnAqua |
| **Reverse Osmosis Train B** | |
| Net Product Flow | 0.5 MGD |
| Membrane Manufacturer and Type | Toray TMG20D-400 |
| Number of Elements | 108 |
| Area per Element | 400 sf |
| Number of Elements per Vessel | 6 |
| Number of Vessels | 10 (Stage 1); 5 (Stage 2), 3 (Stage 3) |
| Instantaneous Flux | 12 gfd |
| Recovery | 85% |
| Chemical Cleaning Frequency | > 3 months |
| Manufacturer (System) | EnAqua |

### Reverse Osmosis System Major Components

The RO system components and process diagrams are included in the RO System Record Drawings section of the Appendix.

### Reverse Osmosis Feed Pumps

There are 2 feed pumps available for RO train operations. Each feed pump is plumbed directly to the RO train it is feeding. The pumps are 80 horsepower vertical five-stage pumps. The pumps provide the driving pressure needed to overcome the osmotic pressure. Each pump is controlled by a variable frequency drive (VFD) that targets a permeate flow setpoint on a PID loop.

### Reverse Osmosis Flush Pump

There is one flush pump that supplies permeate flow to the RO membranes during a flush cycle. The permeate is stored in the permeate tank and is reserved for the flush cycle. The dedicated flush pump is a 15 horsepower centrifugal pump. The pump operates at a fixed flow rate and has a simple on/off operation regulated by a timer.

### Reverse Osmosis Controller

A human machine interface (HMI) controller adjacent to the feed pumps is provided to allow for local controls and access to alarms, operations data, and performance data.

### Mechanical Valves

Each train contains 4 mechanical valves that open and close when called to do so by the RO system's PLC. The valves are: RO feed pump feed valve, RO train feed valve, permeate flush feed valves, and RO concentrate valve bypass. There is also a mechanical valve installed on piping going into the RO permeate tank and opens when the tank level falls below 70%.

### Reverse Osmosis CIP Pump

The CIP pump is a 20 horsepower centrifugal pump that is controlled by a VFD. The VFD in turn, is controlled by the operator from the HMI on the RO skid. The CIP pump is used by the operator when cleaning the RO membranes and is also used when performing a CIP on the ultrafiltration skid.

### Reverse Osmosis System Modes of Operation

### Startup, Production, and Shutdown Sequence Modes

When startup is initiated, the feed pumps ramp up to meet the operator-set flow setpoint. When a shutdown is initiated, the RO feed pump and chemical feed pumps turn off and a permeate flush cycle begins.

### Flush Mode

A permeate flush will occur after a RO train shuts down without alarm. The flush cycle will not occur under the following conditions:

- There is insufficient water in permeate flush tank
- Programmable logic controller (PLC) disables permeate flush cycle
- Permeate flush on HMI is disabled

### Clean-in-Place Mode

Foulants that accumulate on the surface of the membrane may consist of organic, biological, and inorganic material. The clean-in-place (CIP) process utilizes two cleaning solutions, an acidic solution (2% citric) and a caustic solution (0.5% NaOH). The caustic clean targets organic foulants and the acid clean targets inorganic precipitates. Typically, it is recommended to perform the caustic CIP first before the acid CIP. The RO system shares CIP equipment with the UF system. To initiate a CIP, the train must be in the OFF position and permeate flush cycle completed. CIPs can only be performed on one stage at a time. Detailed procedures for each stage can be found in the Demonstration Pure Water Facility (DPWF) Master Standard Operating Procedures (SOP). The main steps in the procedure are summarized below:

1. Heat RO Permeate and inject chemical to create cleaning solution in Cleaning Tank
2. Recirculate cleaning solution in stage being cleaned
3. Soak membranes in cleaning solution
4. Recirculate cleaning solution in stage being cleaned
5. Stop recirculation and empty Cleaning Tank to drain
6. Rinse and flush modules being cleaned with RO feedwater and empty to drain.
7. Repeat until cleaning solution is removed from membrane.

## Reverse Osmosis System Human Machine Interface Screens

### Main Menu

This screen provides a menu for all operations and controls accessible to the operator as shown in Figure 56. The “CONFIG MODE” button allows the operator to manually configure the touch screen properties.

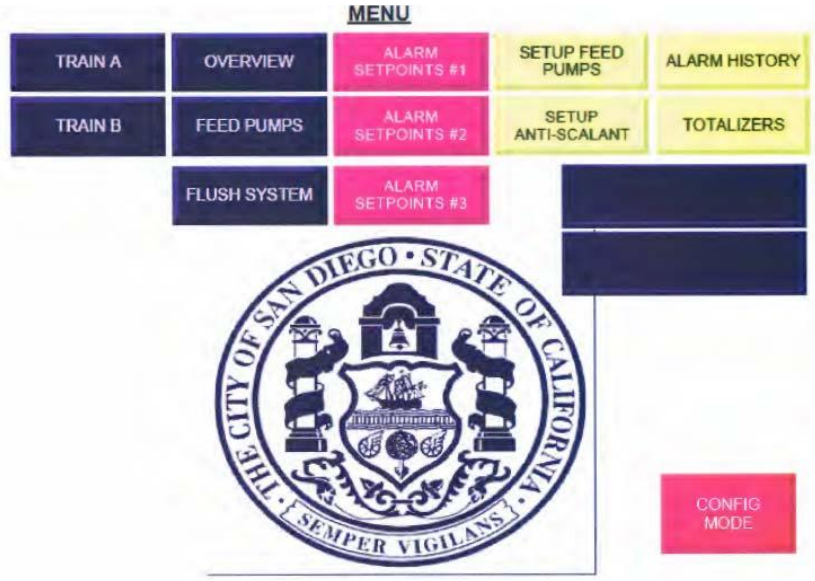


**Figure 56. RO HMI Main Menu Screen**

### Reverse Osmosis System Overview Screen

This screen provides the plant operator essential process data as well as information as to which trains are online and the sequence status of each online train.


**Figure 57. RO HMI System Overview Screen**

### Reverse Osmosis Train A and B Screens

This screen provides plant operation data for each train as well as the sequence status for each train. The screens shown in Figure 58 and Figure 59 are typical for Train A and B.

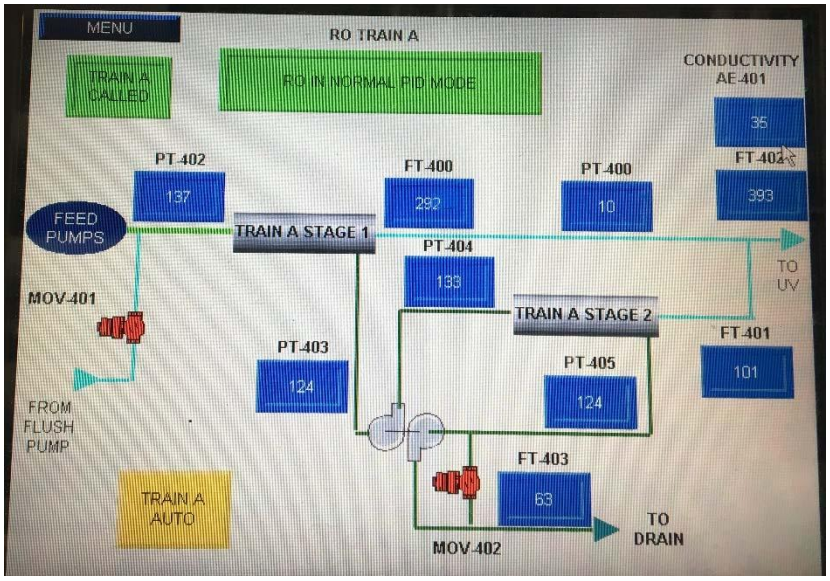


**Figure 58. RO Train A Screen**

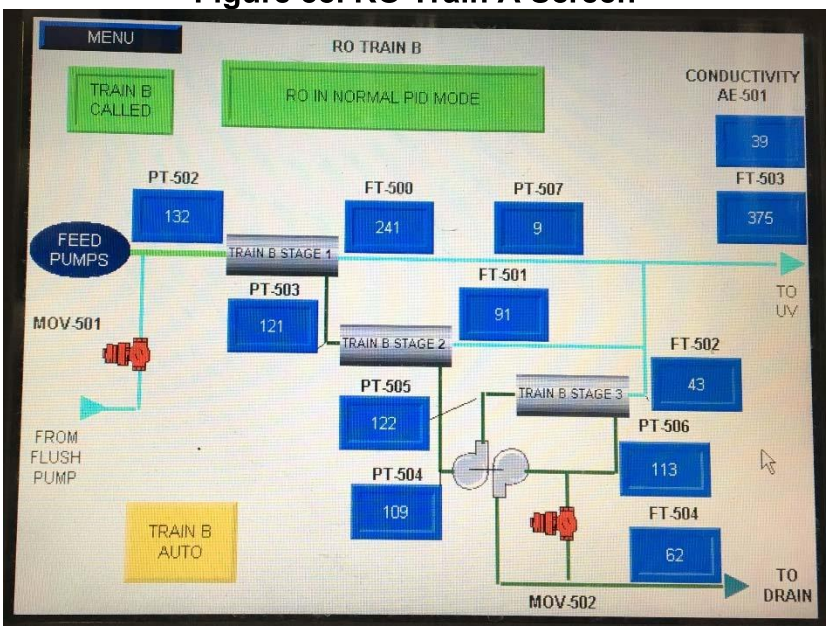


**Figure 59. RO Train B Screen**

### Reverse Osmosis Feed Pump Screen

This screen shown in Figure 59 allows the plant operator to monitor which pumps are online as well as access to antiscalant and RO feed pump configuration menus. For information on the sulfuric acid feed system controls, please refer to Section Sulfuric Acid and Sulfuric Acid Control Strategy.

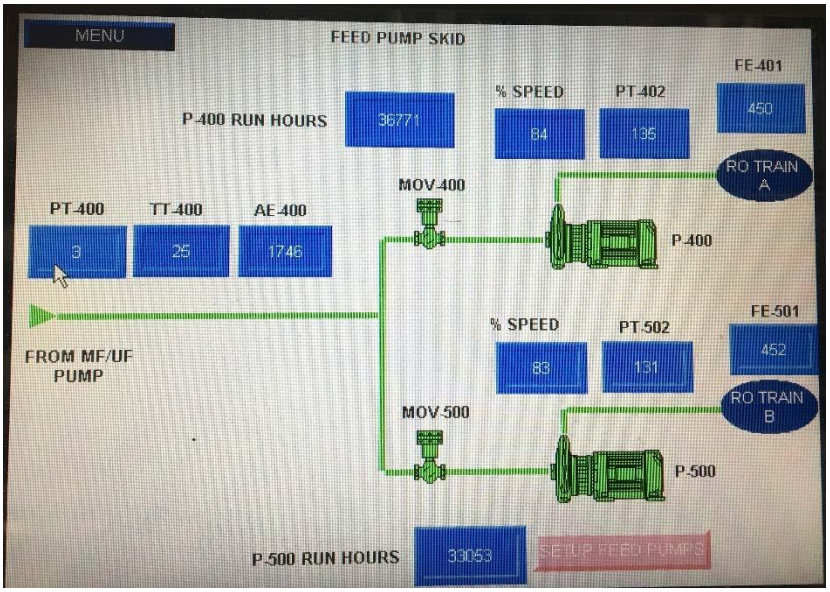


**Figure 60. RO Feed Pump Screen**

### Antiscalant Dosing Controls Screen

This screen shows the details for the RO pretreatment chemical. This screen requires the plant operator to input the required dose of antiscalant chemical as well as the dilution (%) of the chemical in the feed tank. Additionally, the plant operator is required to input the stroke setting (%) for the chemical feed pump. The PLC will then adjust the speed for the chemical feed pump to maintain a constant dose (ppm). Antiscalant control is ultimately not controlled through this screen and is controlled through PLC101. Refer to chapter 8 for antiscalant controls philosophy.

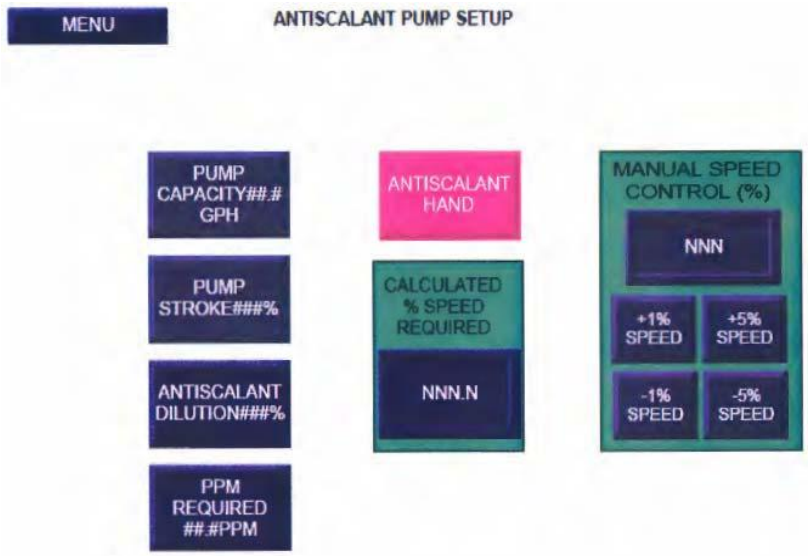


**Figure 61. Antiscalant Dosing Controls Screen**

### Reverse Osmosis Permeate Flush and Clean-in-Place System

This screen allows for the manual operation of the permeate flush and CIP system. Typically, both systems will be left in Auto. However, this system allows the permeate flush pump and CIP pump to be started manually from the screen.

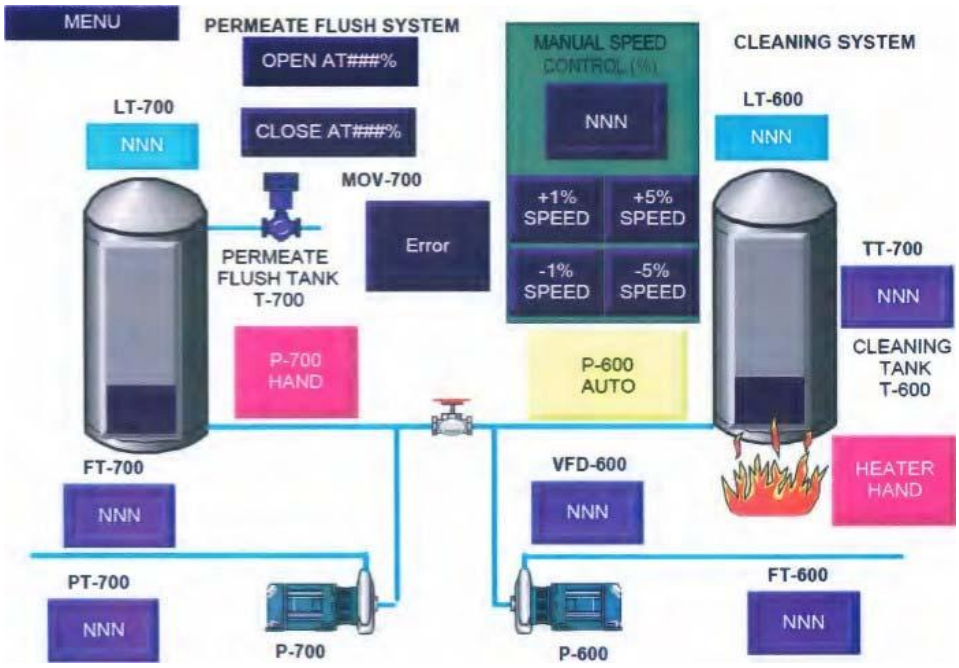


**Figure 62. RO Permeate Flush and CIP Screen**

### Feed Pump Operating Parameter Entry Screen

This screen allows the operator to locally control the equipment on each RO Train as well as provides input for several key operational inputs as shown in Figure 63. Each of the various inputs are described below. P-500 inputs are analogous to P-400.

P-400 Gain: Proportional band for proportional-integral-derivative (PID) loop controlling VFD-400.
P-400 Reset: Integral gain for the PID loop Controlling VFD-400.
P-400 Rate: Derivative gain for the PID loop controlling VFD-400.
P-400 Ramp Speed: Constant startup speed P-400 will run at when Train A first comes online.
P-400 Ramp Duration: Time P-400 will run at constant speed when Train A first comes online.
P-400 Flow Setpoint: P-400 will increase and decrease speed to maintain this flow setpoint.
P-400 Max CV (Control Value): Maximum pump output allowable in “AUTO” mode.
P-400 Min CV: Minimum pump output allowable in “AUTO” mode.
P-400 Flush Duration: Sets the permeate flush duration for Train A.

P-400 Start Delay: Delay before P-400 will start when Train A comes online.

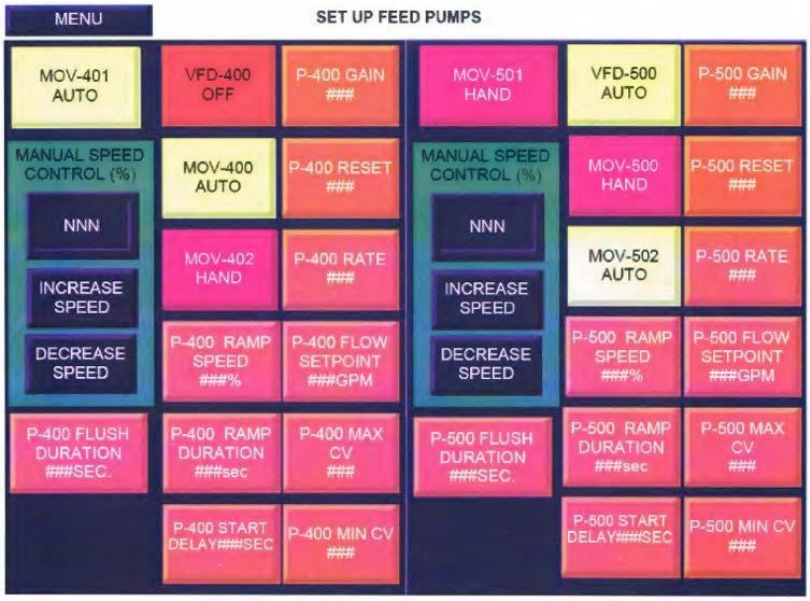


**Figure 63. Feed Pump Operating Parameter Entry Screen**

### Flow Totalizers

The totalizers sum the flow from each of the trains' flow meters and can display it per stage or per train as shown in Figure 64. The instantaneous flow measurements can be read on the specific train overview screens (Figures 59 and 60).

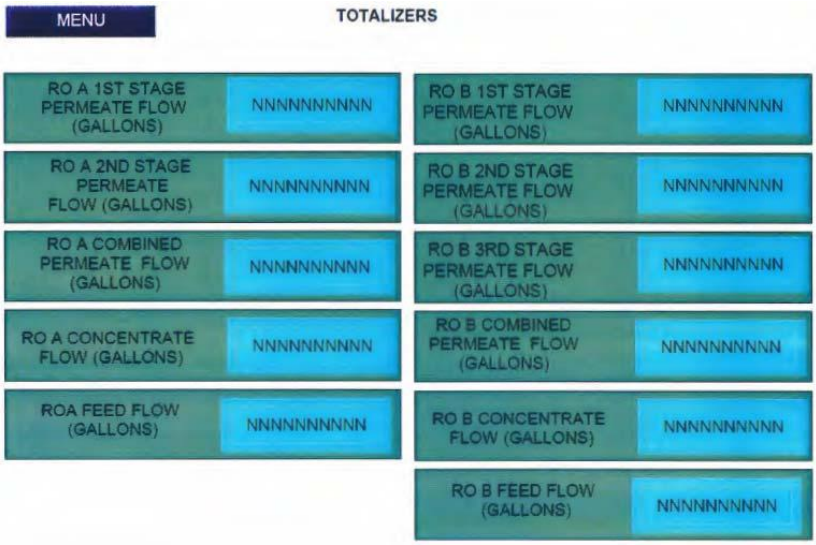


**Figure 64. Flow Totalizers Screen**

### Alarm History

The alarm history screen as shown in Figure 65 gives a summary of current active alarms as well as a log of previous alarms. This provides the operator a time stamp as to when the alarm first occurred as well as a description of the alarm.

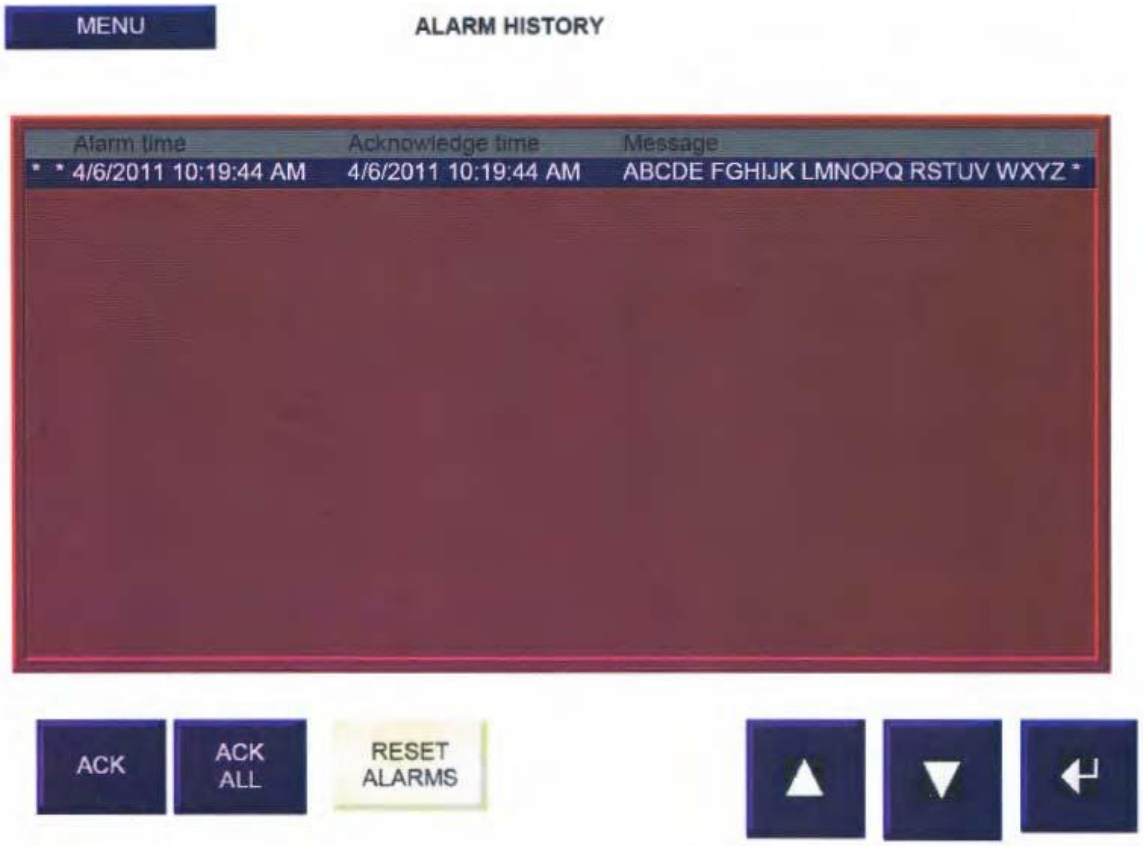


**Figure 65. RO Alarm History Screen**

### Reverse Osmosis System Diagrams

RO system process flow diagrams and piping and instrumentation diagrams (P&IDs) are provided in the reference documents. The record drawings and source documents are summarized in Table 20.

**Table 20. RO System Record Drawings**

| Diagram | Document Source | Sheet Number |
|---|---|---|
| General Notes and Legends | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 2 |
| General Abbreviations | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 3 |
| MF/UF Filtrate Storage Tanks and RO Feed P&ID | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 43 |
| RO System-Feed Pumps P&ID | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 44 |
| RO Train A P&ID | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 45 |
| RO Train B P&ID | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 46 |
| ROP Flush System P&ID | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 47 |

## Reverse Osmosis System Alarms

### Reverse Osmosis Alarms Summary

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| FEED WATER TEMPERATURE HIGH/LOW | Shared feed for train A and B. | Local minor alarm. | Verify temperature with handheld meter. Contact I&C to troubleshoot probe. |
| FEED WATER CONDUCTIVITY HIGH/LOW | Shared feed for train A and B. | Local minor alarm. | Verify conductivity with handheld meter. Contact I&C to troubleshoot probe. |
| FEED WATER PRESSURE HIGH/LOW | Shared feed for train A and B. | Local minor alarm. | Verify pressure with analog gauge. Contact I&C to troubleshoot probe. |
| PUMP DISCHARGE PRESSURE HIGH/LOW | Separate alarm for each train. | Critical alarm. RO shutdown. | Troubleshoot system for blockage or closed valves. Contact maintenance to troubleshoot pump. |
| STAGE 1 BRINE PRESSURE HIGH/LOW | Separate alarm for each train. High pressure is a critical alarm. Low pressure is a local minor alarm. | RO shutdown on high pressure. Local alarm for low pressure. | Troubleshoot with the analog pressure gauges. |
| STAGE 2 FEED PRESSURE HIGH/LOW | Separate alarm for each train. High pressure is a critical alarm. Low pressure is a local minor alarm. | RO shutdown on high pressure. Local alarm for low pressure. | Troubleshoot with the analog pressure gauges. |
| STAGE 2 BRINE PRESSURE HIGH/LOW | Separate alarm for each train. High pressure is a critical alarm. Low pressure is a local minor alarm. | RO shutdown on high pressure. Local alarm for low pressure. | Troubleshoot with the analog pressure gauges. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| STAGE 1 PRODUCT FLOW HIGH/LOW | Separate alarm for each train. Low flow is a critical alarm. High flow is a local minor alarm. | RO shutdown on low flow. Local alarm for high flow. | Troubleshoot with external flow meter. Contact I&C if flow meter is faulty. |
| STAGE 2 PRODUCT FLOW HIGH/LOW | Separate alarm for each train. Low flow is a critical alarm. High flow is a local minor alarm. | RO shutdown on low flow. Local alarm for high flow. | Troubleshoot with external flow meter. Contact I&C if flow meter is faulty. |
| COMBINED PRODUCT FLOW HIGH/LOW | Separate alarm for each train. Low flow is a critical alarm. High flow is a local minor alarm. | RO shutdown on low flow. Local alarm for high flow. | Troubleshoot with external flow meter. Contact I&C if flow meter is faulty. |
| STAGE 2 BRINE FLOW HIGH/LOW | Alarm only for train A. Low flow is a critical alarm. High flow is a local minor alarm. | RO shutdown on low flow. Local alarm for high flow. | Troubleshoot with external flow meter. Contact I&C if flow meter is faulty. |
| COMBINED PRODUCT CONDUCTIVITY HIGH/LOW | Separate alarm for each train. | Local minor alarm. | Verify conductivity with handheld meter. Contact I&C to troubleshoot probe. |
| COMBINED PRODUCT PRESSURE HIGH/LOW | Separate alarm for each train. High pressure is a critical alarm. Low pressure is a local minor alarm. | RO shutdown on high pressure. Local alarm for low pressure. | Troubleshoot with the analog pressure gauges. |
| STAGE 3 FEED PRESSURE HIGH/LOW | Alarm only for train B. High pressure is critical alarm. Low pressure is local minor alarm. | RO shutdown on high pressure. Local alarm for low pressure. | Troubleshoot with the analog pressure gauges. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| STAGE 3 BRINE PRESSURE HIGH/LOW | Alarm only for train B. High pressure is critical alarm. Low pressure is local minor alarm. | RO shutdown on high pressure. Local alarm for low pressure. | Troubleshoot with the analog pressure gauges. |
| STAGE 3 PRODUCT FLOW HIGH/LOW | Alarm only for train B. Low flow is a critical alarm. High flow is a local minor alarm. | RO shutdown on low flow. Local alarm for high flow. | Troubleshoot with external flow meter. Contact I&C if flow meter is faulty. |
| STAGE 3 BRINE FLOW HIGH/LOW | Alarm only for train B. Low flow is a critical alarm. High flow is a local minor alarm. | RO shutdown on low flow. Local alarm for high flow. | Troubleshoot with external flow meter. Contact I&C if flow meter is faulty. |
| PERMEATE FLUSH TANK LEVEL HIGH/LOW | Tank level exceeds or is below high and low level setpoints. Both high and low are local minor alarms | Local minor alarm for high/low levels. | Verify tank level with the external mechanical float. If sensor is faulty contact I&C. If level is low, troubleshoot the mechanical valve that diverts water to fill the tank during RO operation. |
| PERMEATE FLUSH PRESSURE HIGH/LOW | High pressure is critical alarm. Low pressure is local minor alarm. | RO flush will abort on high pressure. Local alarm for low pressure | Troubleshoot with the analog pressure gauges. |
| PERMEATE FLUSH FLOW HIGH/LOW | Permeate flush flow exceeds or is below high and low level setpoints. Both high and low are local minor alarms | Local minor alarm for both high and low flows | Troubleshoot with external flow meter. Contact I&C if flow meter is faulty. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| CLEANING FLOW HIGH/LOW | Cleaning flow exceeds or is below high and low level setpoints. Both high and low are local minor alarms | Local minor alarm for both high and low flows | Troubleshoot with external flow meter. Contact I&C if flow meter is faulty. |

**Reverse Osmosis System Control Philosophy**

**Startup, Production, and Shutdown Sequence**

For startup, the pump(s) must be in the "AUTO" position. The RO system should not be operated in Manual mode due to the hazardous potential of the feed pumps. The startup sequence is as follows:

1. Automatic Feed Pump Isolation valve (MOV-400, MOV-500) opens.
2. RO Feed Pump (P-400, P-500) for enabled trains turns on.
3. Chemical feed pump turns on and PID control loop operates chemical pumps based on feed flow rate.
4. RO feed ramps up slowly and operates at operator-set initial speed for an initial operator-set duration.
5. After initial ramp up, the pumps will complete ramp up to meet product water flow setpoints.
6. Once the product water flow setpoint is met, the system is in "Production".

During shutdown, the following occurs:

1. RO feed pump (P-400, P-500) and chemical feed pumps turn off.
2. After 30 seconds, the Feed Pump Isolation valve (MOV-400, MOV-500) closes.
3. After the feed pump isolation valves close, the RO train(s) go(es) into a permeate flush.

Emergency shutdown occur when any of the following scenarios occur:

- Emergency pushbutton is engaged.
- Remote emergency shutdown button is engaged.
- An emergency shutdown bit is received from PLC101.
- Communication failure between the RO PLC and PLC101.

In an emergency shutdown, the following occurs:

1. RO Feed Pump (P-400, P-500) turns off.
2. RO Permeate flush pump (P-700) turns off.
3. Cleaning pump (P-600) turns off if on.
4. Close all automatic valves.

**Permeate Flush Mode**

During a permeate flush, the following will occur:

1. The permeate flush valve (MOV-401, MOV-501) and the concentrate flush valve (MOV-402, MOV502) will open for the shut-down train(s).
2. The permeate flush pump (P-700) will start and will flush for a given duration set on the HMI. The permeate flush pump (P-700) will shut off at the end of the cycle.
3. The permeate flush valve (MOV-401, MOV-501) and concentrate flush valve (MOV-402, MOV502) will close after a 10 second delay
4. The permeate flush will terminate immediately if the permeate tank reaches the low level before the flush is complete.

# Appendix G. Ultraviolet Advanced Oxidation Process System

### Ultraviolet Advanced Oxidation Process System Overview

Ultraviolet light (UV) Advanced Oxidation Process (AOP) system provides disinfection and removal of trace organics. The main components include a UV chamber, a system control center (SCC) and Power Distribution Center (PDC). The Each UV chamber consists of 72 UV lamps and is powered by the PDC. The SCC monitors and controls the UV and hydrogen peroxide ($H_2O_2$) addition process that was originally packaged with the system to provide advanced oxidation. The hydrogen peroxide addition system was disabled and sodium hypochlorite (NaOCl) is currently in use for the AOP portion of the treatment, which is controlled by the main DPWF programmable logic controller, PLC 101. The following parameters in Table 21 are relevant to process performance and design criteria for the system are summarized in Table 22.

**Table 21. UV system operating ranges**

| Parameter | Operating Range |
|---|---|
| Feed Flow | 375-800 gpm. Design flow 750 gpm |
| Feed water UVT | 95-100%. Design UVT 95% |
| UV intensity meter | 42 – 95 mW/cm$^2$ |
| UV power level | 60-100% = 10.64 - 18.5 kW |
| Oxidant dose | 0-3 mg/L free chlorine |

**Table 22. UV/AOP system design criteria**

| Ultraviolet Light (UV) / Advanced Oxidation Process (AOP) | |
|---|---|
| Design Flow | 1.0 MGD |
| Number of Lamps | 72 |
| Watts per Lamp | 240 watts |
| Total Power | 17.3 kW |
| Design UVT | 95% |
| Electrical Energy per Order (EE/O) for NDMA | 0.18 kWh/kgal |
| EE/O for 1,4-Dioxane | 0.46 kWh/kgal |
| Manufacturer | TrojanUV |
| AOP Oxidant | Sodium Hypochlorite (NaOCl) |

## Ultraviolet Advanced Oxidation Process System Major Components

### Ultraviolet Chamber

Each UV chamber is provided with an inlet flange, outlet flange, end caps, and the reactor assemblies. Reactor assemblies are shipped with the lamp sleeves installed.

The UV chamber is designed for a maximum operating pressure as described in the Specification Chapter. A hydrostatic pressure test certificate is furnished with each UV chamber.

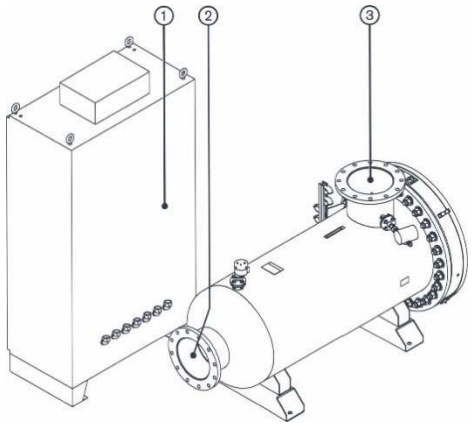


**Figure** 66**. UV Chamber**

### Lamp Holder Assembly

The lamp holder assembly functions as a support for the lamps and sleeves and can be removed completely to allow for servicing and/or inspection. The lamp connector plugs and wiring are covered by the end cap. Each lamp holder assembly consists of the following:

- Quartz sleeves
- Lamps
- End plate
- UV sensor
- Temperature switch


**Figure 67. Lamp Holder Assembly**

The ends of the lamps, lamp connector plugs, wiring, and wiping system drive (if applicable) are protected (covered) by the end cap. Power is provided to each UV reactor zone from the corresponding Power Distribution Center (PDC).

### Ultraviolet Lamps

The lamps are designed to produce zero levels of ozone, withstand shock and vibration and are constructed of materials resistant to UV. The lamp is a low pressure, high intensity amalgam lamp.

### Quartz Sleeve

Each lamp assembly is contained within its own quartz sleeve. One end of the quartz sleeve is a closed domed shape. The open end is sealed against the UV chamber end plate by means of an O-ring compressed by the sleeve bolt.

To prevent any water from entering and contacting the lamps, it is very important to use the proper size O-rings and to use the correct torque when tightening the sleeve bolt during sleeve replacement.

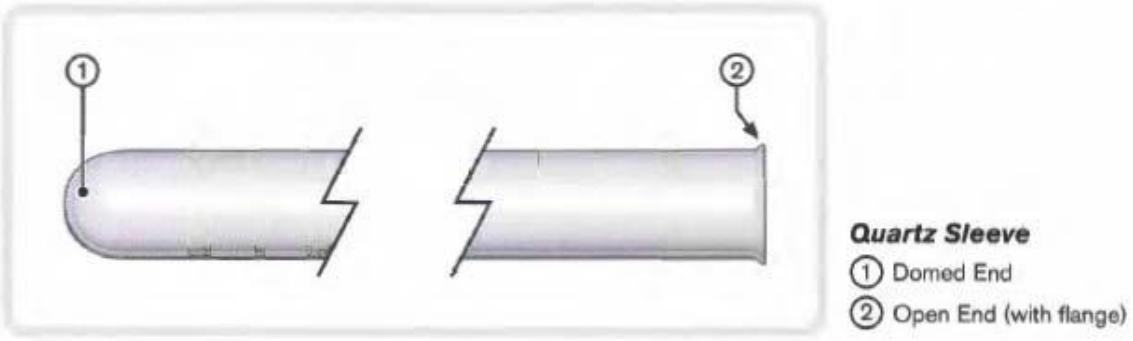


**Figure 68. UV System Quartz Sleeve**

### Temperature Switch

The temperature switch is designed to trigger an alarm and shutdown the system if the system is overheating. The switch is externally mounted to the highest point on the end plate.

The high operating temperature of the UV lamps demands that water flow is maintained through the UV chamber to cool the lamps. If the water flow is shut off for any reason, the lamps must be shut off to prevent overheating.

The temperature switch will trigger a critical alarm and shut down the system if the wall temperature of the UV chamber exceeds 1220°F (500°C). This alarm will be displayed on the PDC and SCC operator interface.

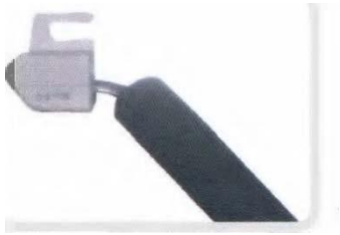

**Figure 69. UV System Temperature Switch**

### Temperature Sensor/Gauge

The temperature sensor/gauge acts as a redundant system safety feature, to the temperature switch. The sensor portion is inserted into the reaction chamber and measures the actual temperature of the water leaving the UV chamber. This information is displayed on the integrated gauge. The sensor also sends a 4-20 mA analog signal back to the PDC providing continuous monitoring of the water temperature at the SCC.

In the event that the reading is above that of the high temp set point on the SCC, a critical alarm will be activated and the controller will initiate a shut down.

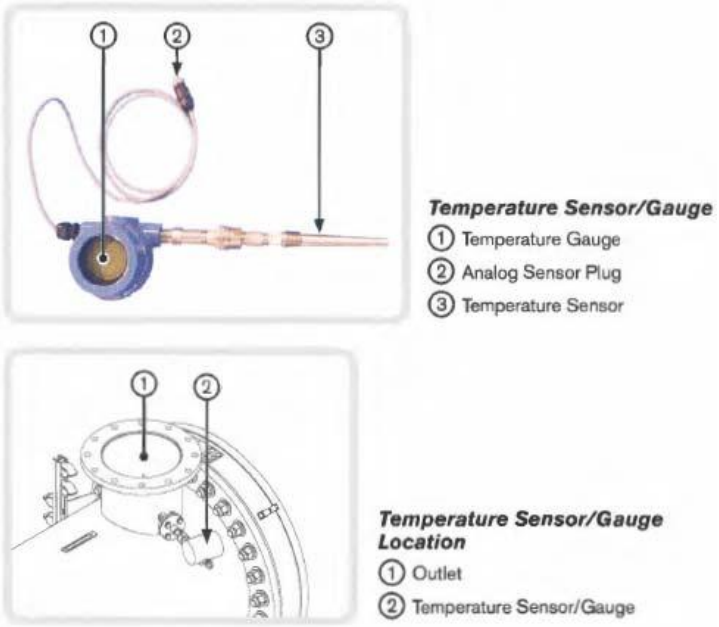


**Figure 70. UV System Temperature Sensor/Gauge**

### End Cap Switch

A safety interlock switch is provided on the end cap to automatically disconnect power to the UV reactor if the end cap is removed.

**Figure 71. UV System End Cap Switch**

### Ultraviolet Sensor

The UV sensor continuously measures the UV intensity adjacent to one lamp. The purpose of the UV sensor is to indicate changes in UV output due to fluctuations in water quality or due to a drop in UV lamp output which is typically

caused by a combination of lamp aging, sleeve fouling, and reduced ballast power.

The UV intensity sensor converts the UV light into a robust 4-20mA instrumentation signal. This signal is continuously displayed on the operator interface in $mW/cm^2$. The sensor is grounded and shielded. The connection to the sensor board is through a shielded cable and twisted pair wire to minimize susceptibility to noise.

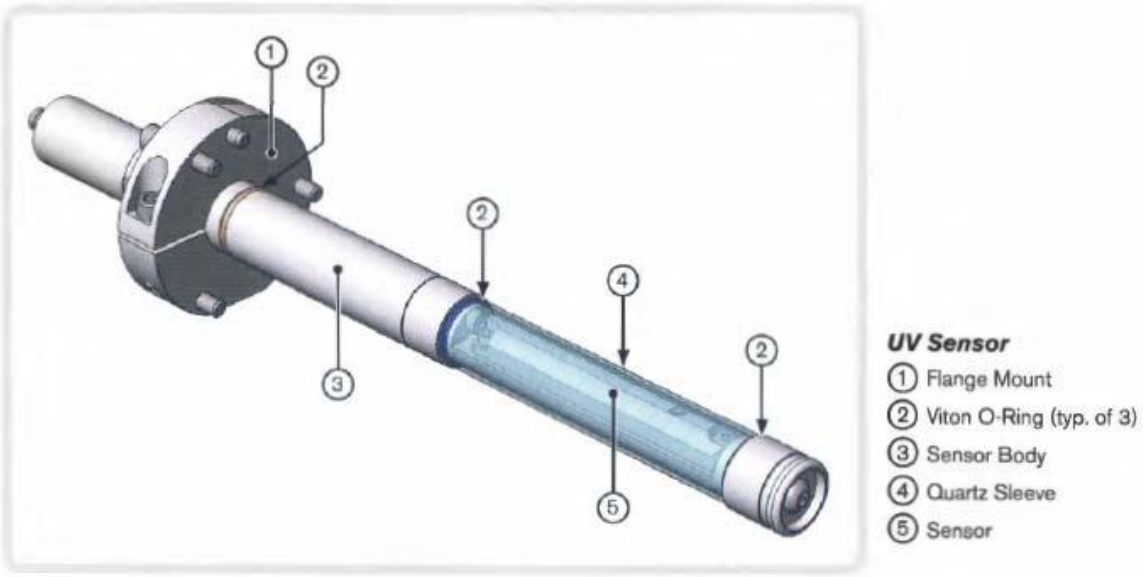


**Figure 72. UV Sensor**

### Water Level Sensor

The water level sensor ensures that the water level is maintained in the system. It is always located on the top of the chamber.

### Power Distribution Center

Each Power Distribution Center (PDC) provides power distribution for one UV reactor zone. The PDC houses the ballasts (power supplies) and the communications boards.

An OFF/LOCAL/REMOTE or OFF/ON selector switch is provided on the door of each PDC. This selector switch is used to select the mode of UV reactor control (e.g. local control via the PDC). Each PDC comes equipped with overcurrent protection and a lockable disconnect handle. Cooling for the PDC is provided by a fan.


**Figure 73. Power Distribution Center**

### Control Board

The control board display is located on the door of the Power Distribution Center (PDC). The control board provides monitoring and local display of the associated chamber. The board sends status information to the System Control Center (SCC) and also receives commands from the SCC via an integral RS-485 port.

The Operator Interface includes a Florescent Display that is programmed with custom screens. The Operator may navigate through the different screens using the 5-button Keypad, as shown in Figure 74.


**Figure 74. Control Board**

### Power Distribution Center Selector Switch

Each PDC is provided with an OFF/LOCAL/REMOTE selector switch for each of its associated UV reactor zones. When in the “Local” position, the UV reactor zone is energized and may be controlled locally via the PDC. When in “Remote” position, the UV reactor zone is controlled remotely by the SCC. Operation of the system can be switched from local to remote and back again without shutting the system off. The “OFF” switch is in the left most position.


**Figure 75. PDC Selector Switch**

### Fan and Filter

Cooling for the PDC is provided by a fan. The fan exhausts hot air and replaces it with cool air entering through the door mounted intake louvers.

### System Control Center

The System Control Center (SCC) is an enclosure that houses the Programmable Logic Controller (PLC). The PLC is programmed to continuously monitor the UV system and to provide control of the UV reactor(s) and associated equipment. The PDC provides the SCC with the necessary input of system parameters such as: ballasts operation, number of lamps online, and power usage. The communication between the PDC and SCC is done via the control board.

The operator interface is a color touchscreen (located on the door of the SCC) that displays the system status, alarm set points, and allows for manual operator control.

The SCC coordinates communication with:

- PLC 101 (via an Ethernet communications protocol as described in the Controls Philosophy)
- PDCs (via remote I/O and Ethernet communications protocol)
- UV Reactor(s)
- Flow meter(s)
- Inlet/Outlet Valves


**Figure 76. System Control Center**

### Sodium Hypochlorite Injection System

The oxidant used in the advanced oxidation process is sodium hypochlorite (NaOCl). For details about the sodium hypochlorite storage and feed system as well as system control strategies, refer to Section Sodium Hypochlorite and Section Flow-Paced Control Strategy.

### Ultraviolet System Modes of Operation

Although the UV System is comprised of one system with one train consisting of one reactor and one control center, there exist several levels of control modes.

### System-Level Control Modes

There are three modes of UV System control that can be selected via the Operator Interface Terminal (OIT): "Remote", "Local", and "Off'. The Operator must enter a password on the OIT to change the UV System mode.

### Remote Mode

With the UV System in "Remote" mode, Start Up and Shut Down requests are initiated by the Plant via commands from the main DPWF programmable logic controller, PLC 101. The UV Train will be placed into "Automatic" mode.

### Local Mode

With the UV System in "Local" mode, all plant control PLC 101 commands are disabled. The UV Train can be operated in "Manual" or "Automatic" mode, selectable via the OIT and will be manually placed in and out of service.

### Off Mode

With the UV System in "Off" mode, the UV Train will be placed into "Off' mode. The train will not be functional in "Off" mode. All valves and UV Reactors will be de-energized. Only local controls at the devices will be operational.

### System-Level Control States and Transitions

The UV System can be in one of five different states; "Offline", "Standby", "Warming", "Online", or "Shutdown". The following diagram illustrates the UV System states and their transitional relationships.

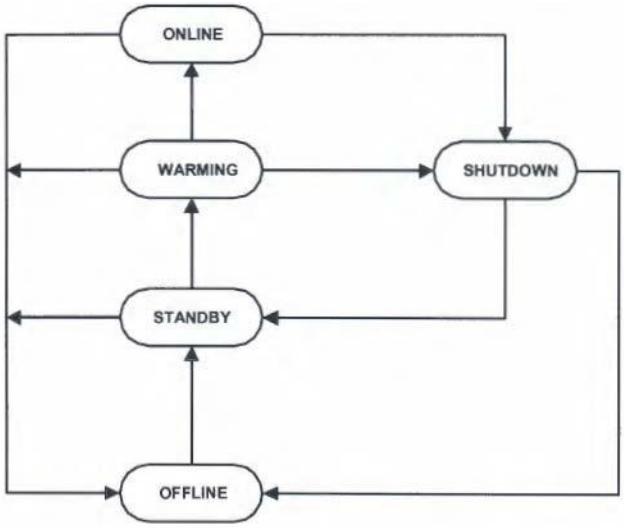


**Figure 77. System-Level Control States Schematic**

### Offline State

The UV system will be placed in the "Offline" state when any of the following conditions are met:

- The UV System mode is set to "Off"
- Any system-level critical alarm is active
- The train is not available

### Standby State

The UV system is ready to begin the warming sequence. The UV System will be placed in the "Standby" state from the "Offline" or "Shutdown" states when all the following conditions are met:

- The UV System mode is changed from "Offline" to "Local" or "Remote"
- There are no active System-level Critical alarms
- The minimum number of required trains are available

### Warming State

The UV System will change states from "Standby" to "Warming" when a UV System online request has been initiated. When the UV System is in "Remote" mode, the "Online" request originates from the Plant PLC. When the UV System is in "Local" mode, the UV System will be placed in the "Warming" state by the UV System control algorithm as soon as any UV Train goes into the "Warming" state. Therefore, when the UV System is in "Local" mode, the transition from "Standby" to "Warming" is dependent on the UV Train modes and is controlled at the OIT. The UV train remains in the “Warming” state for 5 minutes at 100% BPL.

### Online State

The UV System is ready to treat water. The UV System will be placed in the "Online" state when the UV train has completed the "Warming" cycle.

### Shutdown State

The UV System will remain in the "Shutdown" state until the UV train has transitioned to their respective "Offline" state. The UV System will change states from "Online" to "Shutdown" when any of the following conditions occur:

- The UV System mode is set to "Off”
- A System-level Critical alarm is active
- The minimum number of required trains is not available

Depending on the reason for the shutdown, the state of the UV System will transition to either the "Standby" or "Offline" states.

### Train-Level Control Modes

There are three modes of UV Train control that can be selected via the OIT depending on the current UV System control mode. The UV Train modes are: "Automatic", "Manual" and "Off”. The Operator must enter a password on the Operator Interface Panel to change UV Train modes.

### Automatic Mode

With the UV Train Mode selected to "Automatic" mode, train start-up and shutdown commands are initiated from the UV System Controller as required by the UV System control algorithm. Additionally, the UV Reactor ballast power level

(BPL) is automatically adjusted from the Train BPL algorithm. UV Train "Automatic" mode is automatically selected when the UV System Mode is placed in "Remote" mode and can be locally selected to "Automatic" with the UV System Mode in "Local" mode.

### Manual Mode

With the UV Train Mode selected to "Manual" mode, train start-up and shutdown commands are initiated from the OIT. Additionally, the UV Reactor BPL is also set from the OIT. Placing the UV Train into "Manual" requires that the UV System be in "Local" mode. Note: “Manual” mode should only be used for troubleshooting or under supervision. The lamps create excessive heat that could be detrimental to the pipes and reactors without water flow.

### Off Mode

With the UV Train Mode selected to "Off” mode, all UV Reactors within the train will de-energize and will be placed into the "Offline" State. Note that a Train critical fault will automatically place a train into the "Off” mode.

The UV Train can be in one of five different states; "Offline", "Standby", "Warming", "Online", or "Shutdown". Figure 78 illustrates the UV Train states and their transitional relationships.

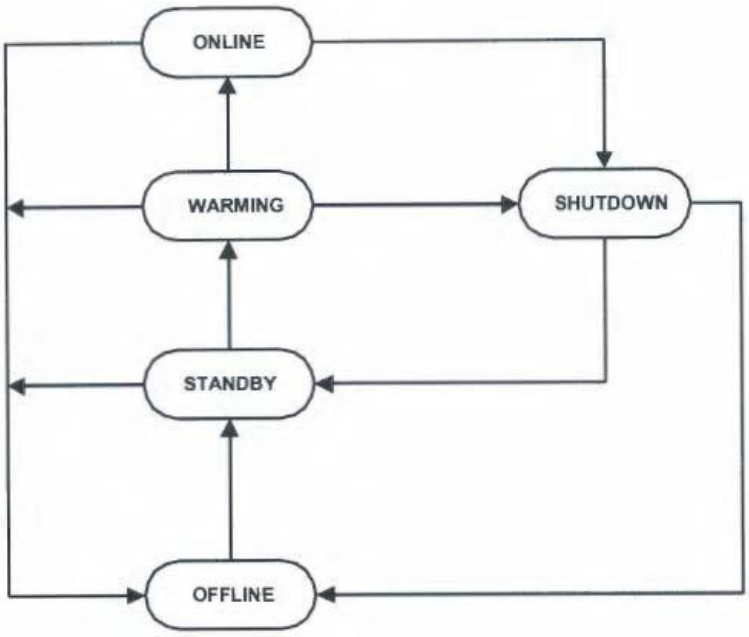


**Figure 78. Train-Level Control States Schematic**

### Offline State

The UV Train will be placed in the "Offline" state when any of the following conditions are met:

- The UV System mode is set to "Off"
- The UV Train mode is set to "Off"
- Any System-level Critical alarm is active
- Any UV Train-level Critical alarm is active

### Standby State

The UV Train is ready to begin the warming sequence. The UV Train will be placed in the "Standby" state from the "Offline" or "Shutdown" states when all of the following conditions are met:

- The UV Train mode is changed from "Off" to "Automatic" or "Manual"
- There are no active System or Train-level Critical alarms
- The minimum number of required reactors are available

### Warming State

The UV Reactor is in the "Warming" state. The UV Train will remain in this state until the UV Reactor has completed the warming sequence.

### Online State

The UV Train is ready to treat water. The UV Train will be placed in the "Online" state when the UV Reactor has completed the "Warming" cycle.

### Shutdown State

The UV Train will remain in the "Shutdown" state until measured train flow is zero and the UV Reactor has transitioned to their respective "Offline" state. The UV Train will change states from "Online" to "Shutdown" when any of the following conditions occur:

- The UV System mode is set to "Offline"
- The UV Train mode is set to "Offline"
- A System-level Critical alarm is active
- A Train-level Critical alarm is active
- The minimum number of required reactors are not available

Depending on the reason for the shutdown, the state of the UV Train will transition to either the "Standby" or "Offline" states.

### Reactor-Level Control Modes

There are three modes of UV Reactor control that can be selected via the Communication Control Board (CCB) display located on the PDC. The UV Reactor modes are: "Local", "Remote" and "SCADA".

### Local Mode

With the UV Reactor Mode selected to "Local" mode, the reactor is energized with all lamps energized at 100% power level. In "Local" mode, the reactor will not respond to control commands from the UV System controller. The electrical safety interlocks are still active and will shut down the reactor in this mode in event of an alarm. The CCB will continuously communicate and the UV Reactor status is always sent back to the UV System controller over a serial link.

### Remote Mode

With the UV Reactor Mode selected to "Remote" mode, reactor start-up and shutdown commands are initiated from a discrete input on the CCB. With the discrete input high, the reactor will be initiated to start-up and conversely, setting the discrete input low will cause the reactor to shutdown. With the UV Reactor in "Remote" mode and the UV Train in "Automatic" mode, the reactor power level is adjusted by the UV System Controller automatic BPL algorithm. If the UV Train is in "Manual" mode, the reactor power level is adjusted manually from the Operator Interface Terminal (OIT).

### SCADA Mode

With the UV Reactor selected to "SCADA" mode, reactor start-up and shutdown commands are initiated from the UV System Controller via a serial Modbus RS485 network. With the Train in "Automatic" mode, the reactor power level is adjusted by the UV System Controller automatic BPL algorithm. If the UV Train is in "Manual" mode, the reactor power level is adjusted manually from the OIT. The CCB will continuously communicate and the UV Reactor status is continuously sent back to the UV System controller over the serial link.

### Reactor-Level Control States

The UV Reactor can be in one of five different states; "Offline", "Standby", "Warming", "Online". Figure 79 illustrates the UV Reactor states and their transitional relationships.

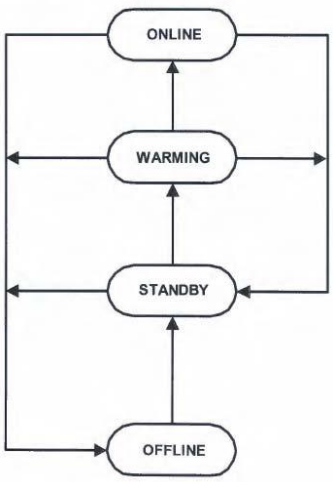


**Figure 79. Reactor-Level Control States Schematic**

### Offline State

The UV Reactor will be placed in the "Offline" state when any of the following conditions are met:

- The UV System mode is set to "Off"
- The UV Train mode is set to "Off"
- Any system-level critical alarm is active
- Any UV Train-level critical alarm is active
- Any UV Reactor-level critical alarm is active

### Standby State

The UV Reactor is ready to begin the warming sequence with all the lamps de-energized. The UV Reactor will be placed in the "Standby" state from the "Offline" state when all the following conditions are met:

- The UV Train mode is changed from "Off" to "Automatic" or "Manual"
- There are no active System, Train or Reactor-level critical alarms
- The PDC Disconnect is on
- The UV Train is filled with water

The UV Reactor will change state to "Standby" from "Online" or "Warming" if the UV Reactor is no longer required for operation in Train "Automatic" mode or the Operator selects standby command in the Train "Manual" mode.

### Warming State

The UV Reactor will change states from "Standby" to "Warming" when an online request has been initiated. In Train "Manual" mode the Operator will request the UV Reactor to go online from the OIT. In Train "Automatic" mode the Train control algorithm will request the UV Reactor to go online. During the warming cycle, the UV Reactor will be energized with the BPL set at 100%.

### Online State

The UV Reactor will automatically change from "Warming" state to the "Online" state when the warming cycle timer expires. The UV Reactor will remain energized in the "Online" state. In Train "Manual" mode the BPL will remain at 100% until it is adjusted from the Operator Workstation. In Train "Automatic" mode the BPL will be automatically adjusted by the Train BPL algorithm.

## Ultraviolet Advanced Oxidation Process System Human Machine Interface Screens

### System Overview

The “System Overview” screen provides a graphical representation of the train and instrumentation comprising the UV control system. The following parameters are displayed on the screen: system flow, total flow capacity, UVT, total power, log reduction, EE/O, train mode, and train status as shown in Figure 80. Navigation to other screens can be shown on the bottom of the screen.

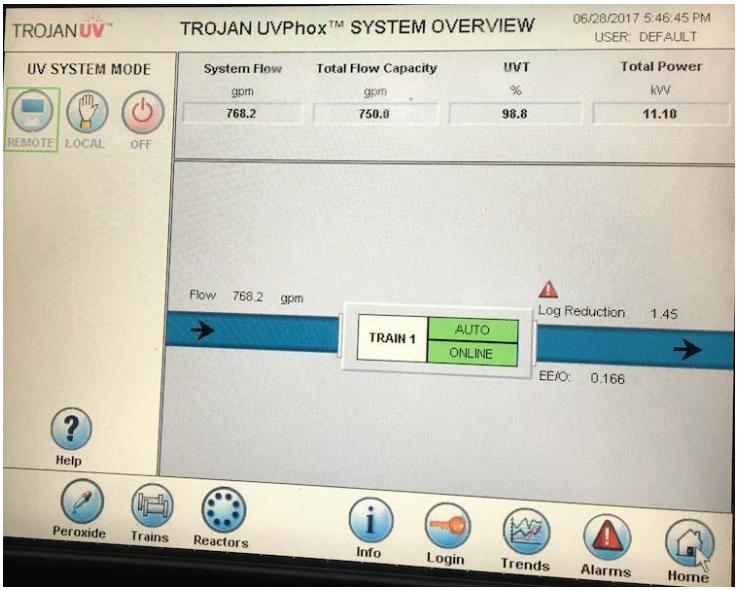


**Figure 80. UV/AOP System Overview Screen**

### Train Screen

The “Train” screen shown in Figure 81 displays information specific to the selected train. This screen shows the following parameters: flow, UVT, water temperature, target log reduction, actual log reduction, EE/O, EED, target power, present power, present power ratio, train status, reactor ballast power level, train run time, and on/off cycles.

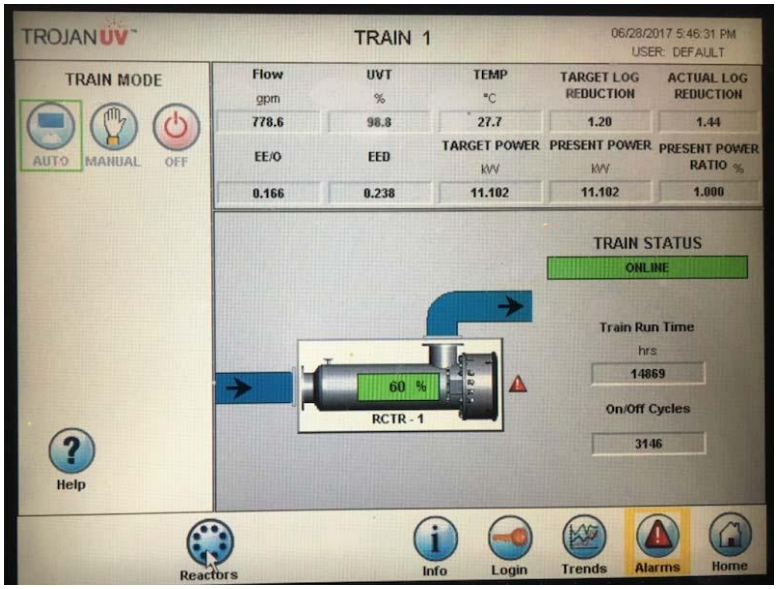


**Figure 81. UV/AOP System Train Screen**

### Ultraviolet Advanced Oxidation Process System Train Modes

The user can select the mode of operation by pushing the TRAIN AUTO, TRAIN MANUAL or TRAIN OFF button.

### Automatic Mode

When “Auto” control is selected, the SCC/PLC will calculate the required power level of the train's reactor. The operator cannot change a train's operating power level when under “Auto” control.

### Manual Mode

When in “Manual” mode, the user can place the reactor in “ON-LINE” and “OFFLINE” mode via the push buttons on the Reactor screen. The operator may manually change the train's reactor power level via the Reactor screen. Reactor operating power levels under “Manual” control can be varied from 60% to 100% percent in 2% power level increments. Any invalid values are rounded up to the nearest valid value (e.g. 35% is rounded to 60%, 63% is rounded to 64%)

### Off-line Mode

The UV reactor is de-energized in the “OFFLINE” mode. The table below summarizes the various train modes:

| Train Control | Requirements | Operation |
|---|---|---|
| AUTO | Reactor must have its operational mode selector switch in the REMOTE position | Power level is controlled by the SCC/PLC |
| MANUAL | Reactor must have its operational mode selector switch in the REMOTE position | Power level is manually controlled by the operator |
| OFF | None | Reactor de-energized |

### Ultraviolet Advanced Oxidation Process System Reactor Detail Screen

The Reactor detail screen is selected by touching the appropriate Reactor icon on the Train screen.

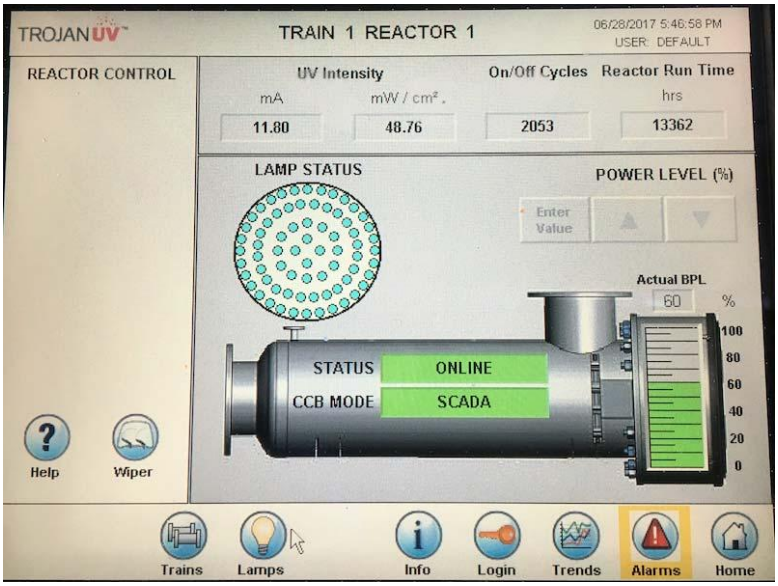


**Figure 82. UV/AOP System Reactor Detail Screen**

### Reactor Control Functions

**GO TO On-line/Standby:** When in On-line Mode it shows “Go to Standby” and when in Standby Mode it shows “Go to On-Line”.

On-line Mode is only active when the train is in “TRAIN MANUAL” mode. Provided power is available to the unit, the ballasts are energized and treatment initiates.

Standby is only active when the train is in “TRAIN MANUAL” mode. Power is available to the unit but the ballasts are not energized. The unit can be brought on-line, following the normal warm-up cycle.

**Enter power Level Value:** In “TRAIN MANUAL” mode, the user may enter a value for the reactor power. Selection of the “ENTER VALUE” button will prompt a numeric keypad to be presented where the appropriate values can be selected. The value will be taken when the user selects the “enter” key on the keypad. A valid value is an even, whole number between 60% and 100%. Invalid values are rounded to the nearest higher power level (e.g. 35% is rounded to 60%, 63% is rounded to 64%).

**Arrows to Increase/Decrease Power**: The user can manually adjust power level when in TRAIN Manual mode in increments of 2% between the values of 60% and 100%. This is accomplished by pushing on the “up” and “down” arrows displayed in the Power Level area of the screen.

**Reset Reactor Latched Alarms:** The critical alarms, PDC communication fault, lamp faults, ballast faults, and wiper faults are latched alarms meaning they will not clear automatically once the fault condition is restored. This ensures that these faults are investigated and addressed prior to restoring normal operation. Once a fault is thought to be corrected, the operator should select the “RESET REACTOR LATCHED ALARMS” button to clear the fault. The fault will reappear if the fault condition is still present. In “AUTO MODE” this is a necessary step to restore automatic control and to allow the system to be brought back on-line through normal operation after a critical alarm has been activated (i.e. it is not necessary that the reset lamp, ballast, or wiper alarms for the system to come back on, just the critical alarms).

### Information Displayed

**Reactor Mode:** Indicates the PDC selector Switch Position as “Off”, “Local”, or “Remote”

**Reactor Status:** There are four possible status conditions that a reactor can be in at any given time. The four status conditions are described as follows:

| Status | Status Description |
|---|---|
| **Off-line** | The local operation mode selector switch is in the “Off” position.<br>Note: a critical alarm will place the UV Reactor into “OFFLINE” from warm-up or online mode. (Exception: Critical value equals zero, system ramps to 100%) |
| **Standby** | The local reactor operational mode selector switch is in the “Remote” or “Local” position, power is available to the unit but the ballasts are not energized and the unit can be brought on-line, following the normal warm-up cycle. |
| **Warm-up** | During the warm-up cycle the ballasts are powered at 100%. When the warm-up cycle is complete the reactor is considered to be on-line and its power level adjusted by the control system in “Auto” mode or by the operator from the HMI in “Manual” mode. |
| **On-line** | The local operational mode selector switch is in the “Remote” Or “Local” position, power is available to the unit and the ballasts are energized and treatment is in progress. |

**Power Level:** Displays the current power level of the reactor as a percent. This may be the entered value if in “TRAIN MANUAL” or the automatically selected level when in “TRAIN AUTO” mode.

**UV Sensor Intensity:** Displays the measured UV intensity for the UV reactor. Intensity is shown in engineering units (mW/cm2) and in raw form (mA).

**Reactor Run Time:** Refers to the accumulated runtime on the lamps in a UV reactor. When a UV reactor is turned on, the lamp hours are increased With every hour of operation. This value will increase until the lamps are changed and the value is reset to zero. The value displayed the average lamp hours for the reactor.

**On/Off Cycles:** Displays the number of on/off cycles that the UV reactor has experienced over time.

**Lamps Out:** Indicates the number of failed lamps in the UV reactor.

**Ballast Out:** Indicates the number of failed ballasts in the UV reactor.

**PDC Temperature:** Displays a continuous reading of the PDCs internal air temperature.

**Warming Time Remaining:** Displays the amount of time left during lamp warm-up. This is only on while lamps are in Warm-Up Mode.

### Lamp Status Screen

The Lamp Status detail screen is selected by touching the LAMP STATUS button on the Reactor screen. The screen provides an overview of the status of each individual lamp in the UV reactor. The displayed color-coding reflects changing lamp status.

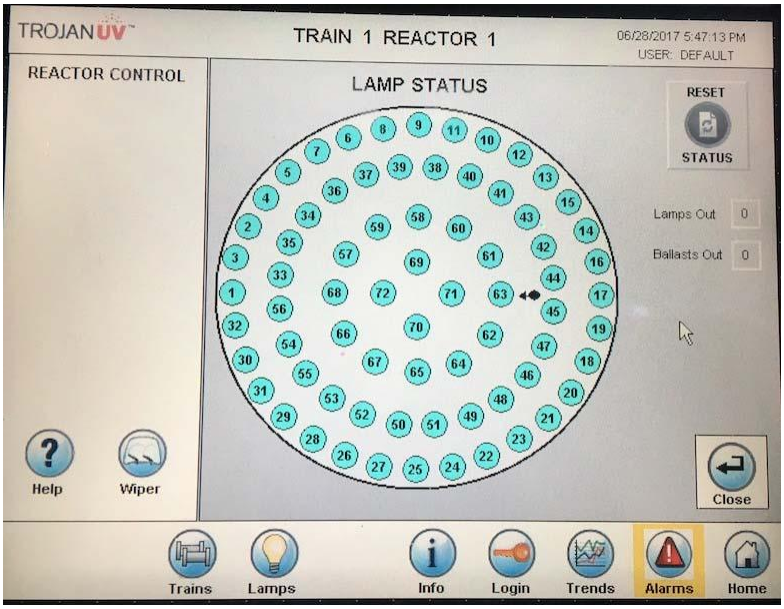


**Figure 83. UV/AOP System Lamp Status Screen**

**Reset Lamp Alarms:** The lamp alarms are latched. This ensures that the operator knows which lamps are faulted even in the event of a power failure. Once a lamp fault is corrected (e.g. a faulty lamp is replaced), the alarms should be reset by selecting the button.

**Individual Lamp/Ballast Status:** Color is used to indicate the status of each lamp and ballast in the UV reactor.

**Lamps Out:** Indicates the number of failed lamps in the reactor.

**Ballasts Out:** Indicates the number of failed ballasts in the reactor.

### Trend Screens

The Trend screens provide a means to analyze and troubleshoot the system in the event of an alarm. Trend screens for the system, train, and reactor can be accessed from the trend menu. The trend menu is shown in Figure 84 and trend screens are shown in Figure 85.

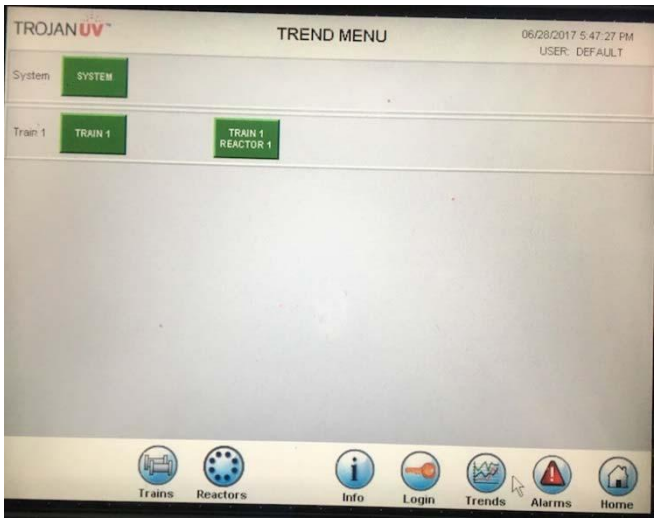


**Figure 84. UV Trend Menu**

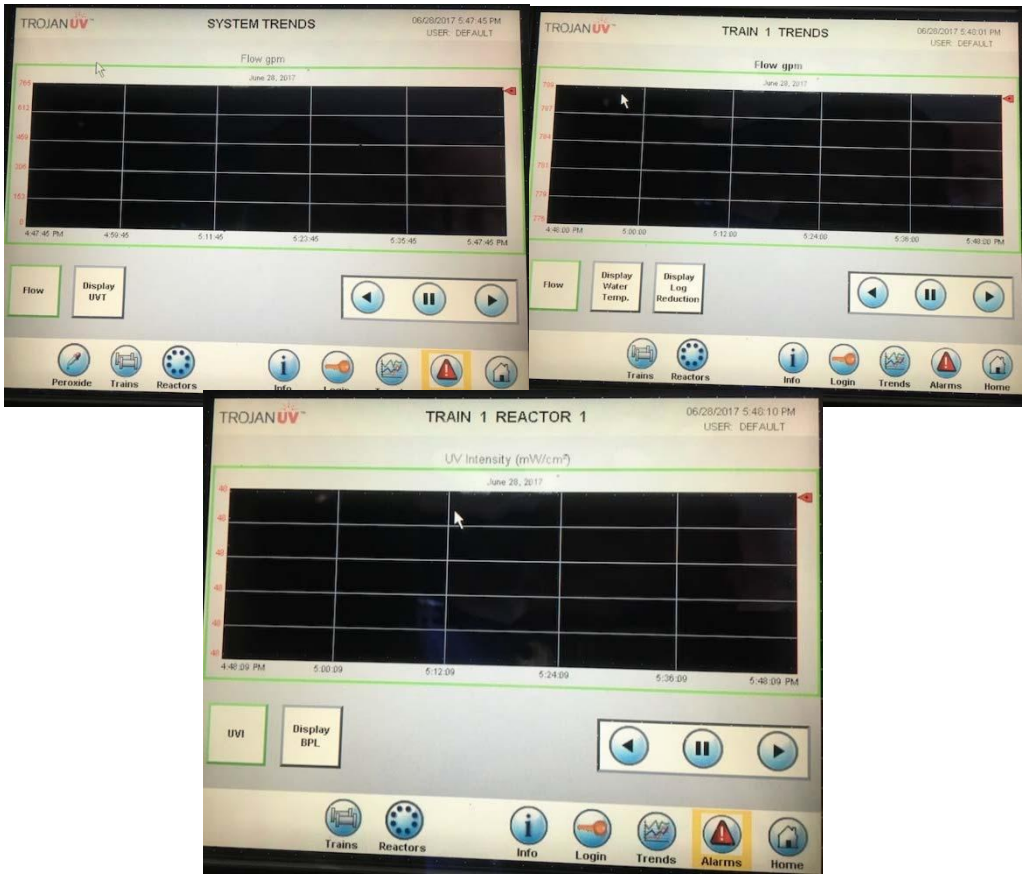


**Figure 85. UV System Trend Screens**

### Ultraviolet Advanced Oxidation Process System Settings Screens

Operational parameters may be modified by the operator, technician or a Trojan technician. Depending on the users access level, different buttons will appear on the navigation bar at the bottom of the screens. Settings for control, flow, UVT, temperature, UVI, lamps, dose, valves, wiper, Communication Control Board (CCB), system, and counters can be accessed in the settings screen and are presented below.

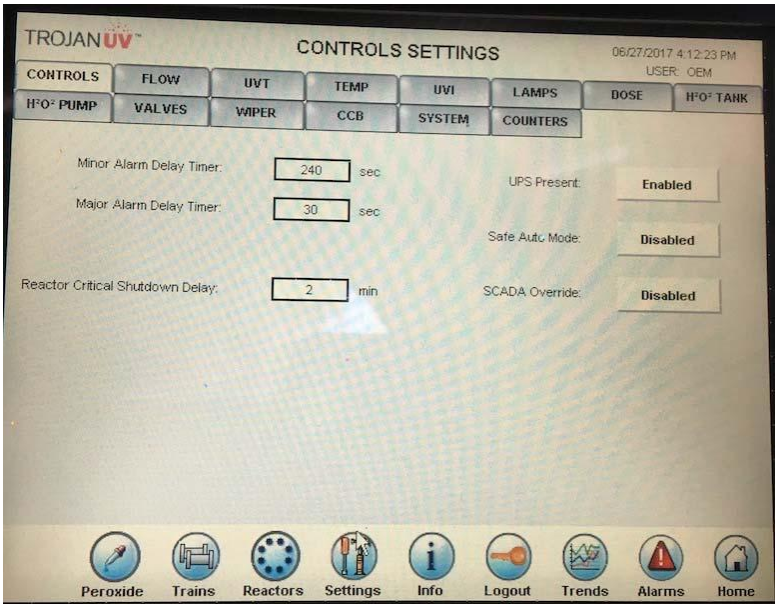


**Figure 86. UV/AOP System Controls Screen**

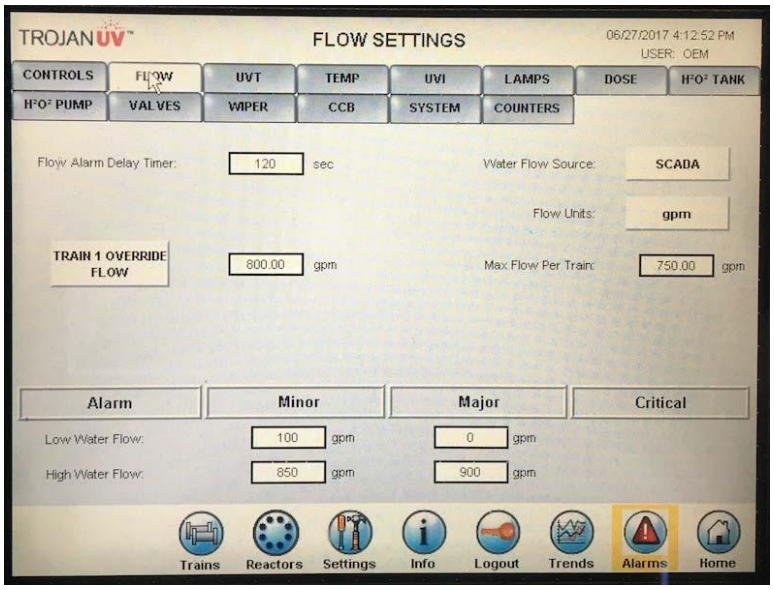


**Figure 87. UV/AOP System Flow Screen**

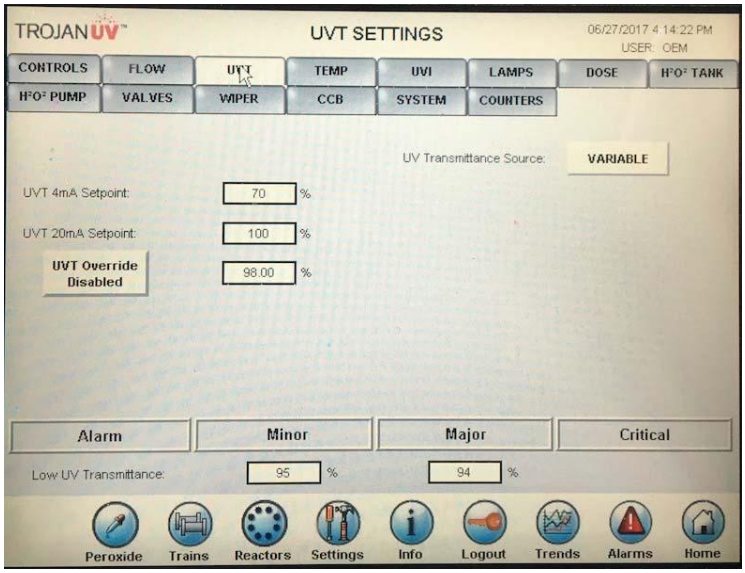


**Figure 88. UV/AOP System UVT Screen**

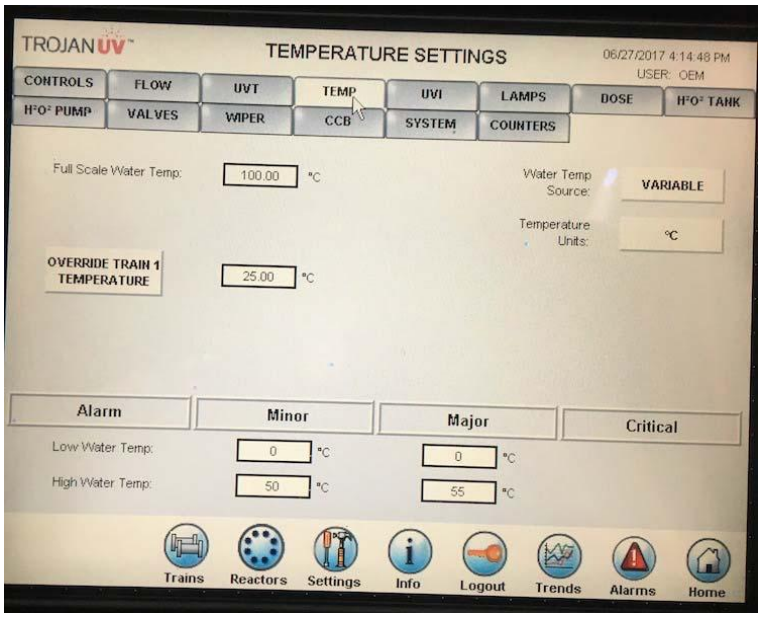


**Figure 89. UV/AOP System Temp Screen**

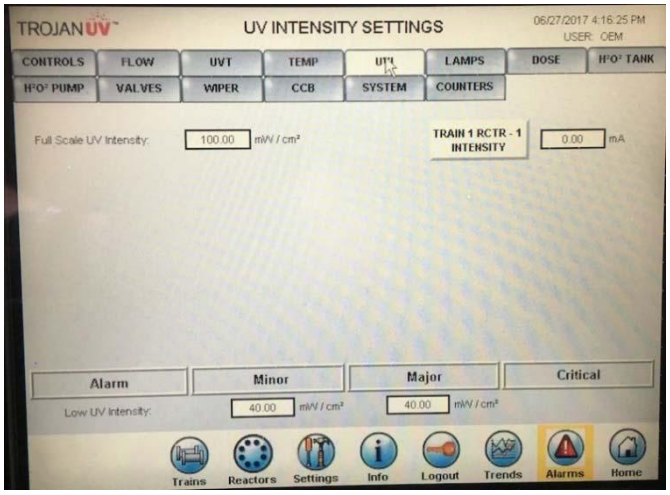


**Figure 90. UV/AOP System UVI Screen**

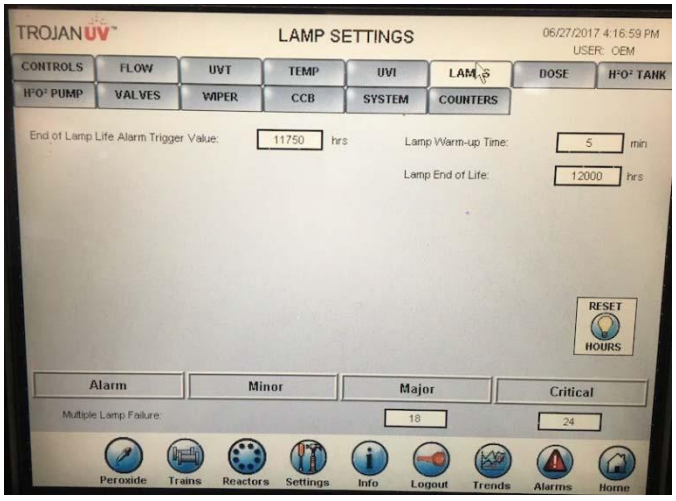


**Figure 91. UV/AOP System Lamps Screen**

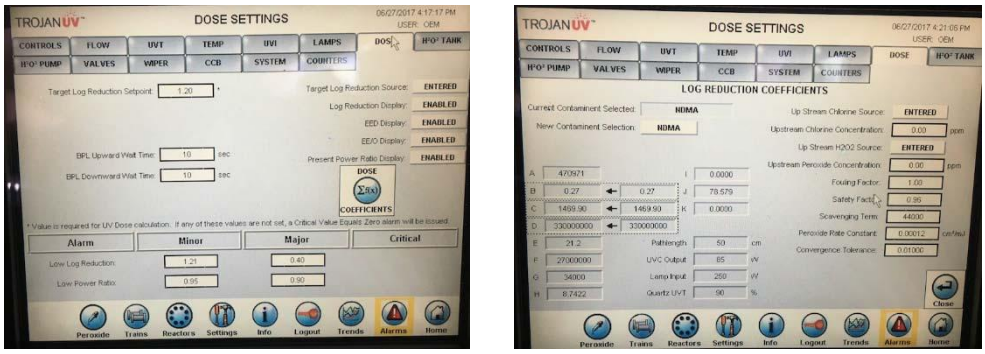


**Figure 92. UV/AOP System Dose Screen**

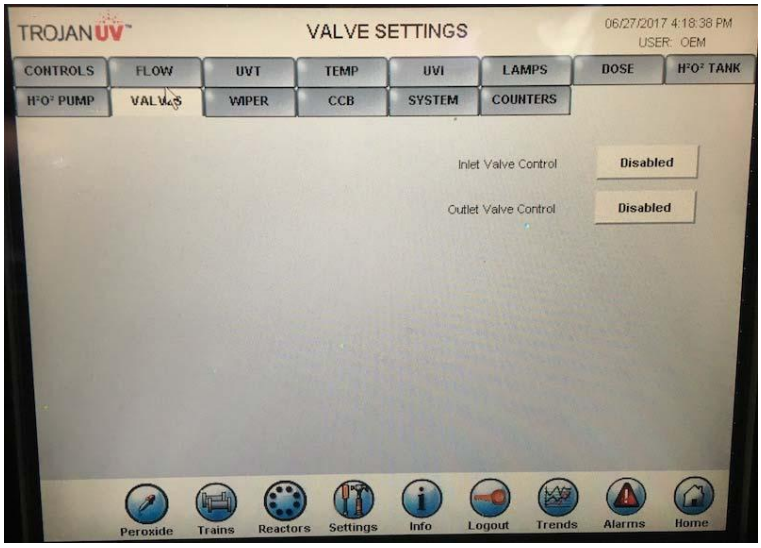


**Figure 93. UV/AOP System Valves Screen**

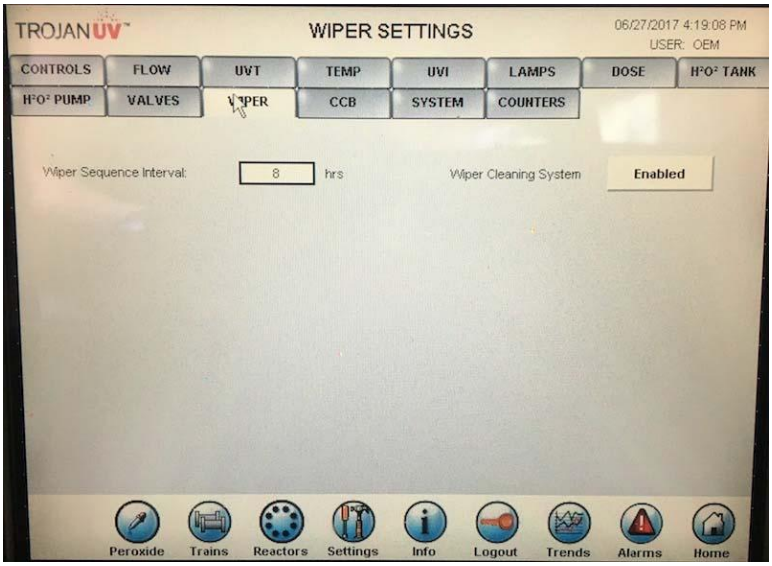


**Figure 94. UV/AOP System Wiper Screen**

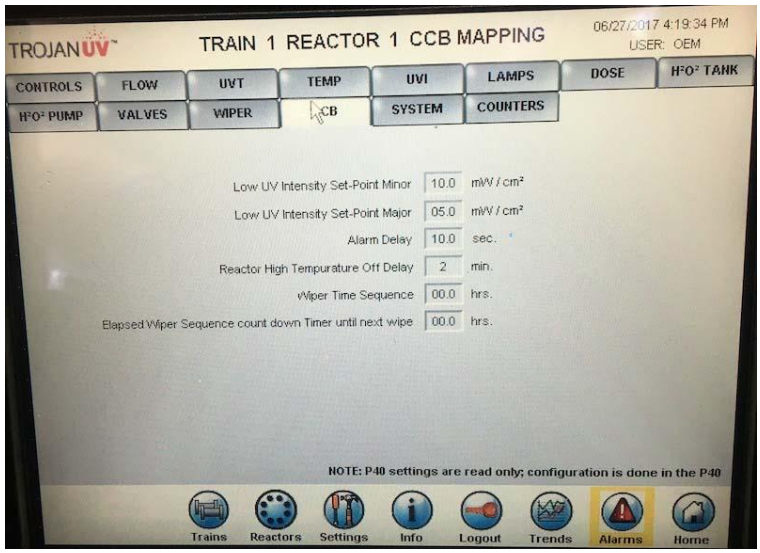


**Figure 95. UV/AOP System CCB Screen**

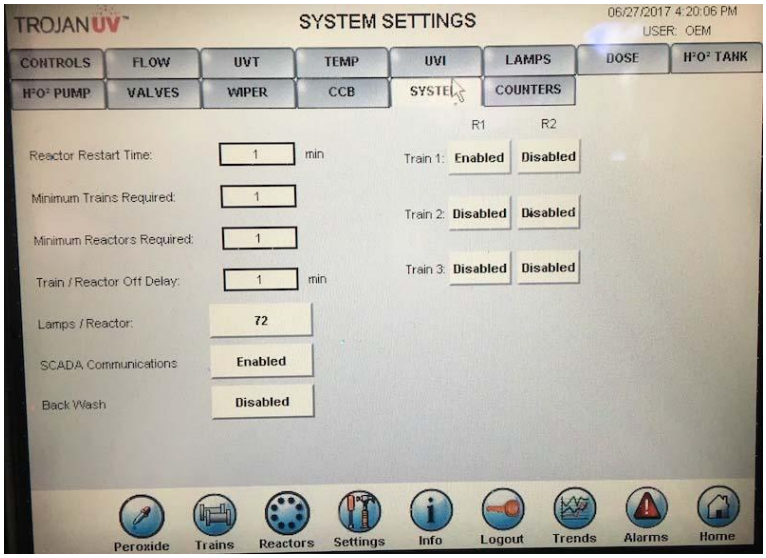


**Figure 96. UV/AOP System Screen**

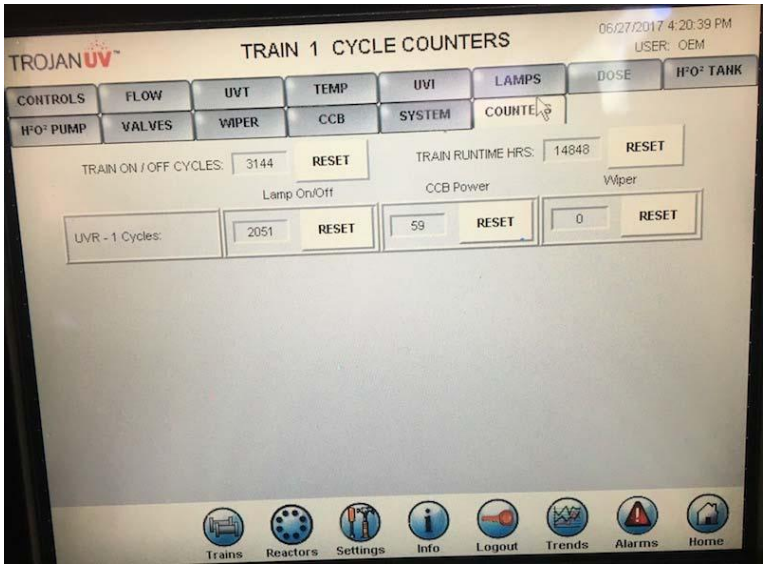


**Figure 97. UV/AOP System Counters Screen**

### Ultraviolet Advanced Oxidation Process System Alarm Screens

The alarms displayed on the alarm screens are color-coded as follows:

- YELLOW indicates a minor alarm
- ORANGE indicates a major alarm
- RED indicates a critical alarm condition

An alarm banner will display the message of the last alarm activated across the bottom of the screen.

### Current Alarms Screen

The Current Alarms screen displays alarms that are active. This screen is accessible from the System Overview screen. Up and Down arrows are used to scroll through the list of alarms. Once an alarm condition has been cleared it is removed from the Current Alarms screen.

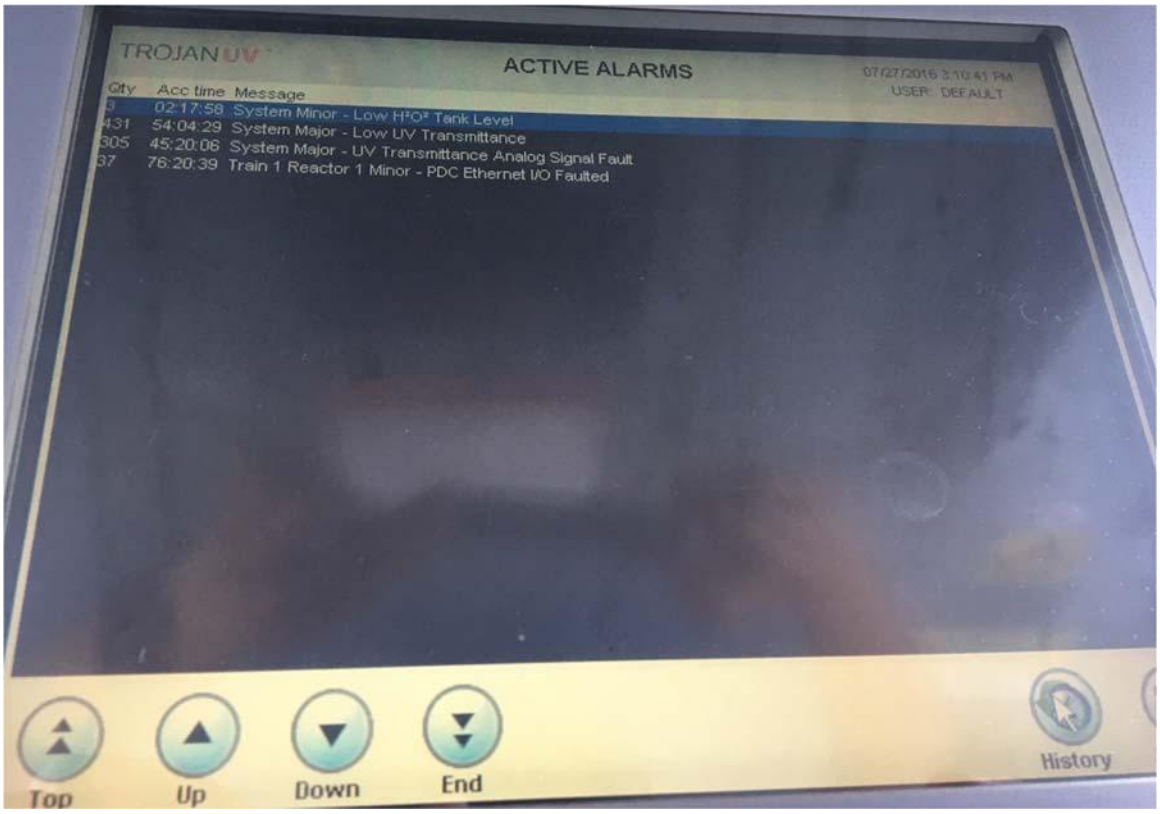


**Figure 98. UV/AOP System Active Alarms Screen**

### Alarm History Screen

The Alarm History screen displays all alarms, both current and historical. Operators may 'Acknowledge' individual or all alarms by touching the appropriate button:

Up and down arrows are used to scroll through the list of alarms. The Alarm History screen displays the time that the alarm occurred, when it was acknowledged and a message describing the alarm.

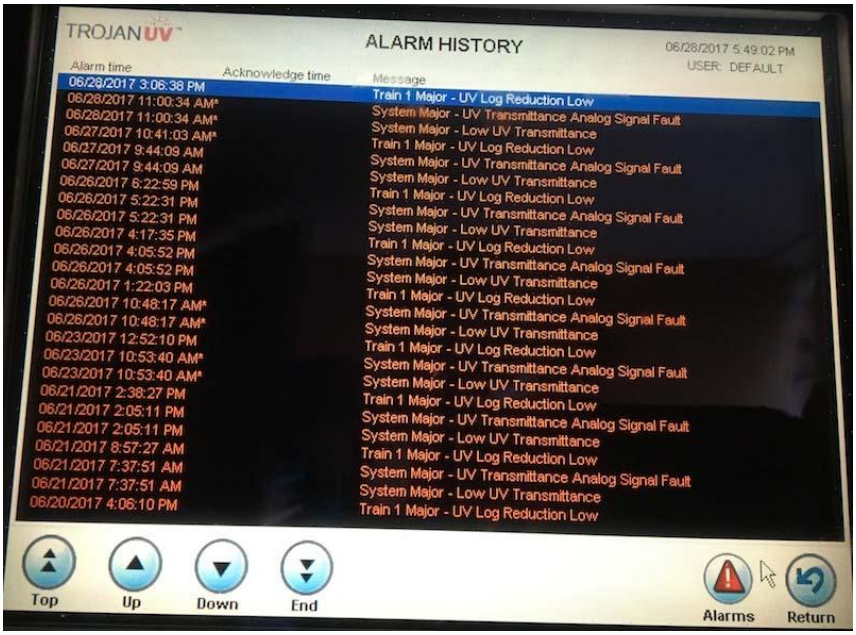


**Figure 99. UV/AOP System Alarm History Screen**

### UV/AOP System Diagrams

UV/AOP system process flow diagrams and piping and instrumentation diagrams (P&IDs) are provided in the reference documents. The record drawings and source documents are summarized in Table 23.

**Table 23. UV/AOP System Record Drawings**

| Diagram | Document Source | Sheet Number |
|---|---|---|
| UV/AOP System Feed P&ID | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 48 |
| UV/AOP System P&ID | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 49 |

### Module Alarms

The UV/AOP System alarms are summarized in Table 24.

**Table 24. UV/AOP System Alarms**

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| CCB COMMUNICATION FAULT ALARM | CCB is not responding to the SCC PLC communication commands. Communication lost. | Major alarm activated.<br>UV system will try to operate at 100% power in default mode until communication is reestablished. | 1) Contact I&C to troubleshoot electrical connections.<br>2) Cycle power. |
| PDC COMMUNICATION FAULT ALARM | Failure of the communication heartbeat.<br>Communication is lost between the SCC PLC and PDC Remote I/O. | Major alarm activated.<br>UV system will try to operate at 100% power in default mode until communications is reestablished.<br>The SCC PLC no longer knows what is happening at the Reactor-level. | 1) Cycle power to 120V PDC panel.<br>2) Contact I&C. |
| UV CHAMBER TEMPERATURE HIGH ALARM | UV Reactor temperature sensor switch senses temperature greater than 122ºF (50ºC). | UV system shuts down. | Touch reactor with the back of your hand. If not hot, contact I&C to troubleshoot the sensors or connections. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| PDC TEMPERATURE HIGH ALARM | PDC Panel internal temperature sensor detects a temperature greater than 131ºF (55ºC). | UV system shutdown. | 1) Confirm if there is a high temperature at the PDC Ensure fans are operating.<br>2) Ensure climate control devices are operating.<br>3) Ensure there are no obstructions limiting air flow in the panel.<br>4) Contact I&C. |
| UV REACTOR BALLAST FAILURE ALARM | Ballast is reporting a ballast not "OK" condition to the CCB, When any ballast(s) have failed. | Minor alarm is activated. System ramps up to 100% since 2 lamps are now off. | Check lamp status on HMI and try resetting the latched alarms. Contact I&C to replace ballast/lamps. |
| UV REACTOR END CAP REMOVED ALARM | Switch behind End Cap was engaged (End Cap removed). | Critical alarm. UV system shutdown. | Replace cap and reset latched alarm on HMI. If switch is bad contact I&C. |
| UV REACTOR END OF LAMP LIFE EXCEEDED ALARM | Total accumulated runtime hours exceeded the recommended life span. | Minor alarm activated. UV system keeps running normally. | Replace lamps and reset timer. |
| UV REACTOR LAMP FAILURE MINOR ALARM | A ballast is reporting a lamp is not “OK”. | Minor alarm activated. System keeps running normally. | Reset alarm. If it doesn’t clear, replace lamp. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| UV REACTOR MULTIPLE LAMP FAILURE ALARM | Between 2-7 lamps have failed. | Major alarm activated. UV system ramps up to 100% power. | Reset alarm. If it doesn't clear, replace lamps. |
| UV REACTOR NOT IN REMOTE ALARM | UV system is not in the "Remote" position. | Minor alarm activated. System keeps running. PLC cannot control the reactor. | Return selector to "Remote" position. If alarm doesn't clear, contact I&C. |
| UV REACTOR UV INTENSITY LOW MINOR ALARM | UV intensity is low, or UV intensity probe is faulty. | Minor alarm activated. System keeps running normally. | Confirm reading is lower than setpoint. If so, contact I&C. If not, adjust setpoint. |
| UV TRANSMITTANCE LOW – MAJOR ALARM | UV intensity is low, or UV intensity probe is faulty. | Major alarm is activated. UV system ramps up to 100% power. | Confirm reading is lower than setpoint. If so, contact I&C. If not, adjust setpoint. |
| CRITICAL VALUE EQUALS ZERO ALARM | Target Dose, Dose Deadband, End of Lamp Life Set-point, or Peak Flow values are invalid. | Major alarm is activated. UV system ramps up to 100% power. | Cycle power to SCC PLC. Reset latched alarm. If alarm doesn't clear, contact I&C. |
| DOSE LOW – MAJOR ALARM | Calculated UV dose is below the desired setpoint. | Major alarm is activated. UV system ramps up to 100% power. | Ensure the sleeves are clean. Ensure the UVT meter is functioning properly. Contact I&C. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| PLANT PLC COMMUNICATION FAULT | Communication is lost between PLC101 and the SCC PLC. Failure of the communication heartbeat. | Minor alarm is activated. The system will continue operating in the current mode. | Contact I&C. |
| Power Failure | No power. | UF system shuts down. | Check UPS. Contact I&C. |

## Ultraviolet Advanced Oxidation Process System Control Strategy

### System-Level Control

The main control logic of the UV System is divided into three main levels; System-Level Control, Train-Level Control, and Reactor-Level Control.

System-level control will normally include the following functionality:

- Control system Start up and Shut down sequences based on commands from the Plant operator and system status
- Manage multiple UV Trains based on plant flow requirements and UV System flow capacity
- Provide System monitoring and operator control functions through a panel mounted operator interface
- Detect and respond to UV System-level fault conditions
- Provide System status, including alarm annunciations via the panel mounted operator interface and/or to the Plant PLC via the PLC 101
- Monitor, and respond when applicable to data received from the plant via the PLC 101 connection
- Monitor System UVT signal
- Monitor System Water Temperature

### Ultraviolet Transmittance Input Signal

An ultraviolet transmittance (UVT) signal is required to provide Dose Pacing functionality for the UV System. The UV System will use one (1) UVT signal input for the system and assume that the effluent flow through all operating UV Trains is at the same UVT value. A 4-20mA analog UVT signal option is available on all systems. A manually entered UVT value is available to all operators and may be selected if an online value is not available. A third option is for the UV system to receive the UVT value through the plant PLC 101 protocol.

If the UVT is received as a 4-20 mA analog signal, the input signal is scaled to a fixed 0 to 100% engineering units range. In analog input mode, the input signal is passed through a smoothing algorithm that reduces the effect of temporary spikes and drops in UVT. A manually entered UVT value will be used when selected by the operator. A default value will be used when some UVT fault conditions occur.

### Temperature Input Signal

A temperature value is required in order to provide Dose Pacing functionality for the UV System. The UV System will normally be configured to use one (1) temperature signal input for the system, and assume that the effluent temperature through all operating UV Trains is at the same value. Alternatively, the system can be configured for a temperature sensor for each UV Train. Most commonly, the temperature is received as a 4-20 mA signal. In this mode, the input signal is scaled to a configurable engineering units range. Temperature can be displayed in degrees Fahrenheit or degrees Celsius. Alternately, a

temperature signal may be passed from a Plant network through a configured SCADA system (PLC 101) to a designated address in the UV PLC. In either of these modes, a manually entered temperature value may be used to override the measured value upon operator demand. A default value will be used if a fault condition (4-20 flow input) or communication fault (PLC 101 input) occurs.

### Train-Level Control

Train-level control will normally include the following functionality:

- Train Start up and Shut down sequences based on commands from the UV System control algorithm
- Manage multiple UV Reactors based on UV log reduction requirements for the train
- Provide Train monitoring and operator control functions through a panel mounted operator interface
- Detect and respond to UV Train fault conditions
- Provide Train status, including alarm annunciations via the panel mounted operator interface and/or to the Plant PLC via the PLC 101
- Monitor UV Train effluent flow and water level

### Flow Input Signal

A flow signal is required in order to provide Dose Pacing functionality for the UV System. The UV System will use one (1) flow signal input for each UV Train. Most commonly, the flow is received as a 4-20 mA signal. In this mode, the input signal is scaled to a configurable engineering units range. Flow can be displayed in US mgd, L/S, $m^3$/Day, gpm or MLD units as standard options. The input signal is passed through a smoothing algorithm that reduces the effect of temporary spikes and drops in flow. Alternately, a flow signal may be passed from a Plant network through a configured SCADA system (PLC 101) to a designated address in the UV PLC. When flow is received from PLC 101, the smoothing algorithm will not be used. In either of these modes, a manually entered flow value may be used to override the measured flow value upon operator demand. A default flow value will be used if a flow fault condition (4-20 flow input) or communication fault (PLC 101 flow input) occurs.

### Water Level Input Signal

As an equipment protection feature, a water level input signal is required to ensure the UV Train is filled with water prior to operation. There will be one water level sensor for per train and its location will be on the highest reactor chamber for stacked systems. During normal start-up procedures, trains being requested to go into operation will be filled first should the level sensor not be detecting adequate water level within the train. If during train operation, the level sensor indicates "Low Water Level", the train will be commanded to shutdown in a controlled fashion following the Controlled Shutdown Sequence.

### Reactor-Level Control

Reactor-Level control will normally include the following functionality:

- Reactor Start up and Shut down sequences based on commands from the UV Train control algorithm
- Manage BPL based on UV Log Reduction, EE/O requirements for the reactor
- Provide Reactor monitoring and operator control functions through a panel mounted operator interface
- Detect and respond to UV Reactor fault conditions
- Provide Reactor status, including alarm annunciations via the panel mounted operator interface and/or to the Plant PLC via the PLC 101 connection
- Communicate to the CCB, control and monitor the reactor lamps and monitor UV Intensity Signal

### Communication Control Board Interface

The UV System PLC communicates to the communication control board(s) (CCBs) located within a PDC via an MODBUS RS485 network. The PLC acts as the master on the network and sends command data packets to each PDC.

### Lamp Control and Monitoring

Each UV Reactor will respond to a power level signal, which will instruct the lamp ballast to adjust to the correct power level as determined by the controller. Each lamp is controlled directly from the lamp ballast, which is fully modulated between minimum and maximum power levels for each UV Reactor. Note that all lamps for the UV Reactor will be turned on/off together if commanded by the controller and will all operate at the same power level.

Specially designed current sensing circuits detect lamp on/off status. The status of each individual lamp is displayed via the UV Reactor control screen on the Operator Interface. Faulted lamps are indicated graphically on the UV Reactor control screen. A local display of lamp status is also provided on each PDC.

When switched on, lamps are initially energized to the high power setting for a warm-up period regardless of Train control mode (i.e. Manual or Automatic). After the warm-up period has expired, the lamps are automatically switched to the requested power level. The "lamp warm-up" timer controls this time period and can be set between 3 to 8 minutes; defaulted to 5 minutes.

# Appendix H. Chemical Addition Systems

## Overview

Chemicals are added along the treatment train to enhance performance for several unit processes. Chemical addition systems onsite include skids for sodium bisulfite, sodium hypochlorite, ammonium hydroxide, antiscalant, sulfuric acid, and hydrogen peroxide. Sodium bisulfite ($NaHSO_3$) is added ahead of the biological activated carbon (BAC) to quench ozone residual present in process water to prevent BAC inoculation. Sodium hypochlorite and ammonium hydroxide are dosed upstream of microfiltration/ultrafiltration (MF/UF) to form chloramines to prevent biofouling in membrane processes. Antiscalant is added in the reverse osmosis (RO) feed water to prevent scale formation on RO membranes. Sulfuric acid is also added to the RO feed water to lower the pH to enable higher RO recovery without increasing scaling associated with running at higher recovery. The hydrogen peroxide system has been decommissioned and is no longer operational. Sodium hypochlorite is currently the primary oxidant for the ultraviolet advanced oxidation (UV/AOP) process. Chemical addition points are shown below in Figure 100.

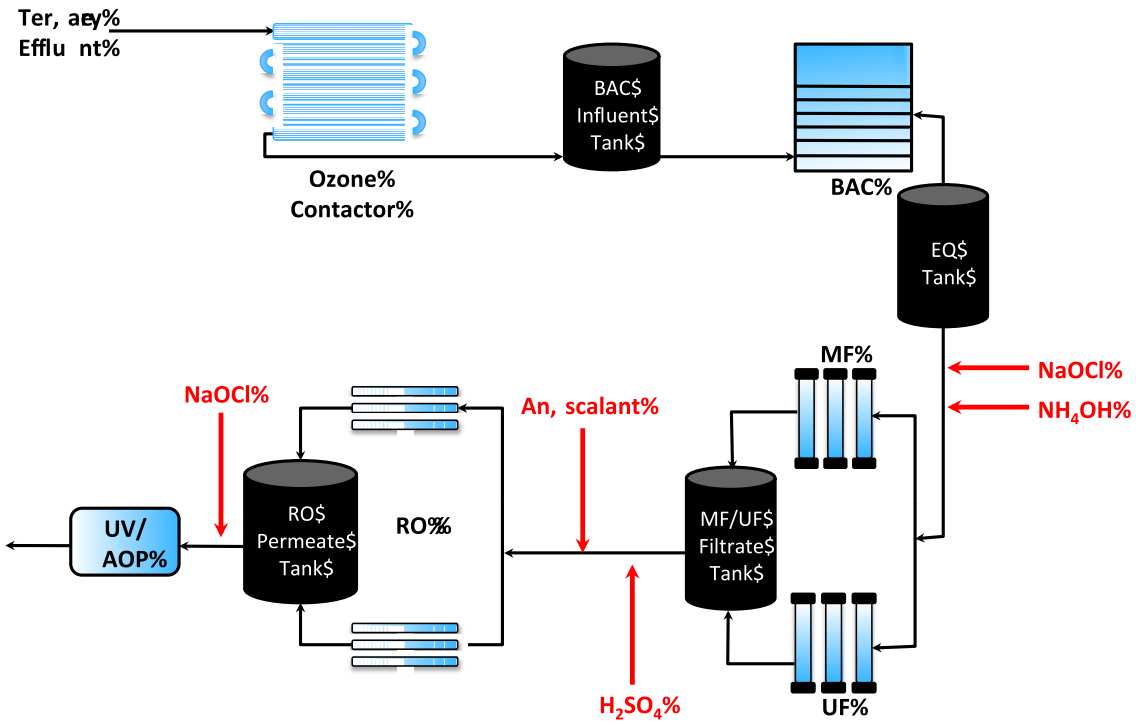


**Figure 100. Chemical Addition Points**

### Sodium Hypochlorite

Sodium hypochlorite is metered to two different locations in the treatment train using two separate diaphragm pumps. The sodium hypochlorite system includes 2 pump skids, 2 pump control panels, and 1 storage tank. Remote control is accessed via the human machine interface (HMI) on the main PLC 101 if pump is operated in remote mode. The following parameters in Table 25 are relevant for sodium hypochlorite operations.

**Table 25. Sodium hypochlorite operating ranges**

| Parameter | Operating Range |
|---|---|
| MF/UF influent chemical feed rate | 0-110 mL/min = 0-5 mg/L dose |
| UV/AOP influent chemical feed rate | 0-110 mL/min = 0-5 mg/L dose |
| Tank level limits | HiHi alarm on - 3.7’ / off - 3.6’<br>High alarm on - 3.4’ / off - 3.3’<br>Low level alarm on - 0.6’ / off - 0.7’ |

### Ammonium Hydroxide

The ammonium hydroxide system includes a pump skid, pump control panel, chemical storage tank, and tank controller. Remote control is accessed via the HMI on the main PLC if pump is operated in remote mode. The following parameters in Table 26 are relevant for ammonium hydroxide operation.

**Table 26. Ammonium hydroxide operating ranges**

| Parameter | Operating Range |
|---|---|
| Chemical feed rate | 0-35 mL/min |
| Tank level limits | HiHi alarm on-3.0’ / off-2.95’<br>High alarm on-2.9’ / off-2.8’<br>Low level alarm on-0.4’ / off-0.5’ |

### Antiscalant

The antiscalant system includes a pump skid and pump control panel. Remote control is accessed via the HMI on the main PLC if pump is operated in remote mode. The antiscalant dosing system has now tank but rather uses a set of day tanks that are filled on an as-needed basis by the operators.

The antiscalant system is designed to feed the chemical into the RO feed at a maximum rate of 0-20 mL/min. The following parameters in Table 27 are relevant to antiscalant operations.

**Table 27. Antiscalant operating ranges**

| Parameter | Operating Range |
|---|---|
| Chemical feed rate | 0-20 mL/min |
| Tank level limits | Not stored in a tank. |

### Sulfuric Acid

The system is designed to store and inject sulfuric acid into piping that feeds the RO membrane with influent water. The system is designed to feed acid with a concentration over 93% at flows ranging between 0.3 and 6.5 gallons per hour (GPH). The system consists of:

- Sulfuric acid storage tank (Tank), 28-T-300
- Acid fill station with automatic fill shut off solenoid valve, 28-SV-911
- Sulfuric acid pump skid, 28-P-911
- Secondary acid tank containment area with level switch, LS-913
- Double walled acid feed piping with moisture sensor, LS-914
- pH sensor for monitoring and controlling sulfuric acid fee, AE-304A

The Sulfuric Acid System Control (Control) is designed to monitor and control the following:

- Fill and volume of the sulfuric acid storage tank
- Sulfuric acid pump feed rate.

The fill and volume of the Tank stored acid is controlled by fill control Panel 28-CP-910, the acid feed pump is primarily controlled by system operational logic resident in the programmable logic controller (PLC) located in the existing DPWF control Panel 28-CP-101. The following parameters in Table 28 are relevant for sulfuric acid parameters.

**Table 28. Sulfuric acid operating ranges**

| Parameter | Operating Range |
|---|---|
| Chemical feed rate | 0-410 mL/min |
| Tank level limits | HiHi alarm on-7.7' / off-7.5'<br>High alarm on-7.2' / off-7.1'<br>Low level alarm on-2.5' / off-2.6'<br>LoLo level alarm on-0.5' / off-0.6' |
| Other control parameters | Trim PID loop tied to the RO feed pH meter |

### Chemical System Diagrams

Chemical system process flow diagrams and piping and instrumentation diagrams (P&IDs) are provided in the reference documents. The record drawings and source documents are summarized in Table 29.

**Table 29. Chemical System Record Drawings**

| Diagram | Document Source | Sheet Number |
|---|---|---|
| Sodium Hypochlorite Storage and Feed System P&ID | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 50 |
| Sulfuric Acid Storage and Feed System P&ID | North City Advanced Water Purification Demonstration Facility Studies (Sulfuric Acid System Addition) | 20 |
| Antiscalant and Ammonium Hydroxide Storage and Feed System | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 51 |

## Chemical Addition Systems Alarms

### Sodium Hypochlorite

There are no critical alarms associated with the sodium hypochlorite system. Warning alarms include the following:

- Tank Low Level
- Tank High Level
- Pump Speed Feedback
- Pump Failure
- High Pressure

The pump status/alarms for sodium hypochlorite injection preceding MF and UF is accessible on the sodium hypochlorite pump motor control screen shown below.

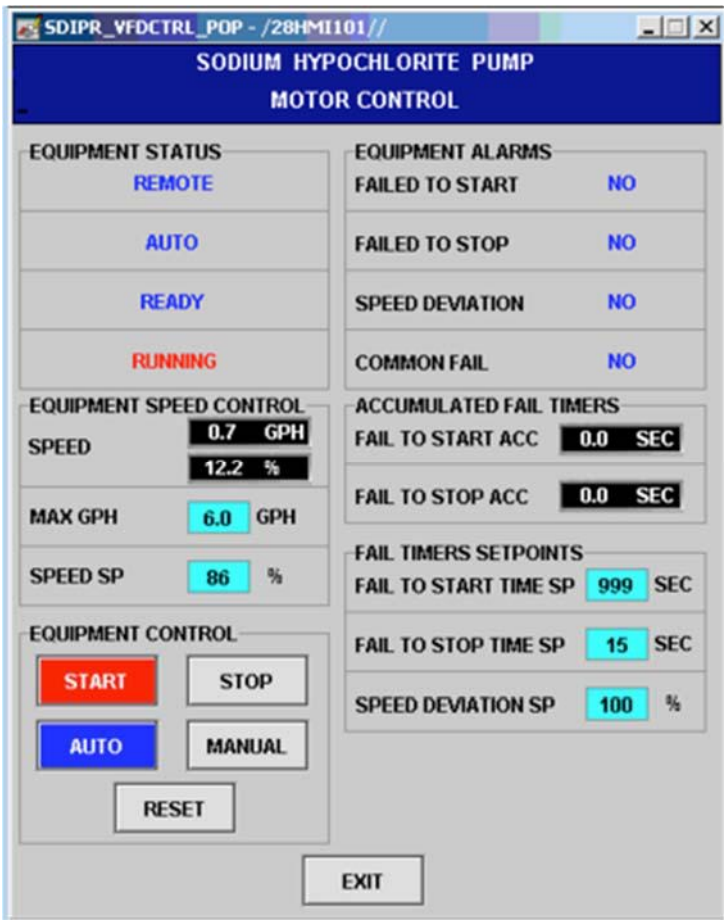


**Figure 101. Sodium Hypochlorite Pump Motor Control Screen**

### Ammonium Hydroxide

There are no critical alarms associated with the ammonium hydroxide system. Warning alarms include the following:

- Tank Low Level
- Tank High Level
- Pump Speed Feedback
- Pump Failure
- High Pressure

The pump status/alarms for ammonium hydroxide injection preceding MF and UF is accessible on the ammonium hydroxide pump motor control screen shown below.

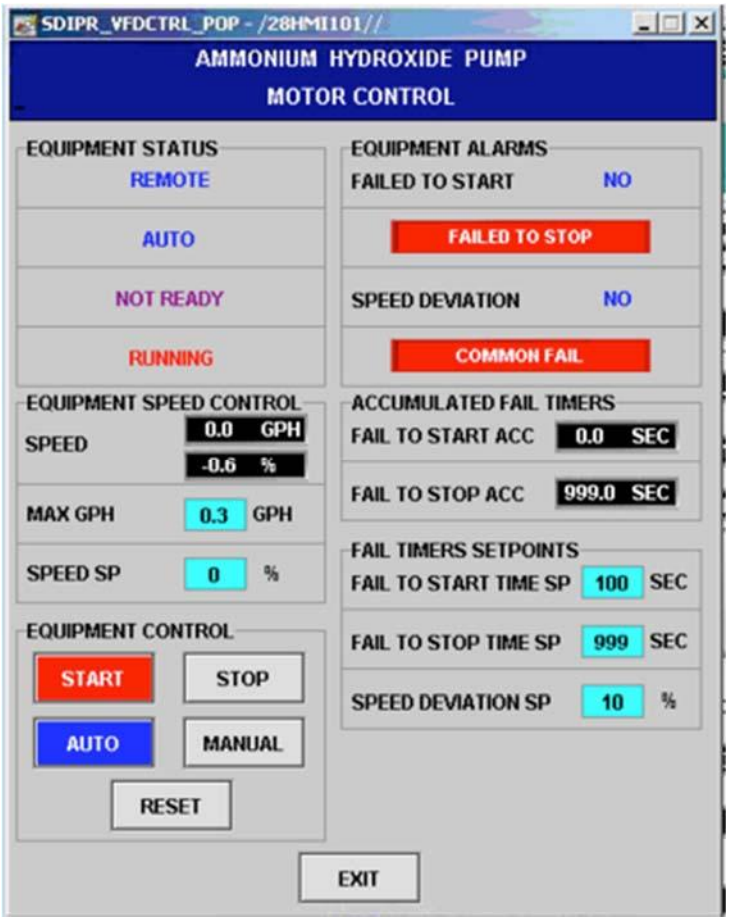


**Figure 102. Ammonium Hydroxide Pump Motor Control Screen**

### Antiscalant

There are no critical alarms associated with the antiscalant system. Warning alarms include the following:

- Tank Low Level
- Tank High Level
- Pump Speed Feedback
- Pump Failure
- High Pressure

### Sulfuric Acid

There are critical alarms associated with the sulfuric acid system. Critical alarms will trigger shutdown of the advanced water treatment (AWT; the block consisting of microfiltration, ultrafiltration, RO Trains A and B, and the UV/AOP systems) portion of the DPWF if sulfuric acid dosing is enabled. Critical alarms include the following:

- Tank Low Low Level
- Pump Speed Feedback
- Pump Failure

Warning alarms do not trigger AWT shutdown but may precede critical alarms if warning not addressed. Warning alarms include the following:

- Tank Low Level
- Tank High Level
- Tank Level Signal Fail
- Containment Leak
- High Pressure

LOOP 28-T-910 and LSH-913 control acid storage tank and containment alarms and produce the following results when triggered. Tank level is continuously monitored by LE -911. The Low-Low Level is used to shut down acid feed pump 28-P-911. The Low Level signal is used to produce a notification warning for Plant staff to order new acid delivery. High Level will produce alarm to alert for acid fill shut down and High-High Level alarm will close solenoid valve 28-SV-911. Liquid in the Tank containment area will be sensed by LSH-913 and produce an alarm signal to PLC 101 at main control Panel 28-CP-101. PLC shall be programmed to alarm the Demonstration Pure Water Facility (DPWF) operator on the liquid presence in the sulfuric acid tank containment.

## Chemical Addition Systems Control Strategy

### Flow-Paced Control Strategy

Remote control of sodium hypochlorite to the AWT feed, ammonium hydroxide to the AWT feed, antiscalant to the RO feed, and sodium hypochlorite to the UV influent can be accessed on the HMI on the main PLC, 28-CP-101 or PLC 101. The chemical control screen on the HMI is shown below in Figure 103. Control of

sodium hypochlorite and ammonium hydroxide feed systems are controlled by flow to the AWT. Detection of flow to the AWT feed initiates sodium hypochlorite and ammonium hydroxide pumps. A correction factor is applied to scale the speed of the pump to the flow. RO permeate production initiates the UV/AOP feed sodium hypochlorite pump and the applied correction factor scales the speed of the pump to the flow. The Sodium Hypochlorite, Antiscalant, and Ammonium Hydroxide Storage and Feed System P&IDs which include the process flows used for flow pacing can be found in the Chemical System Record Drawings section of the Appendix, sheets 50-51.

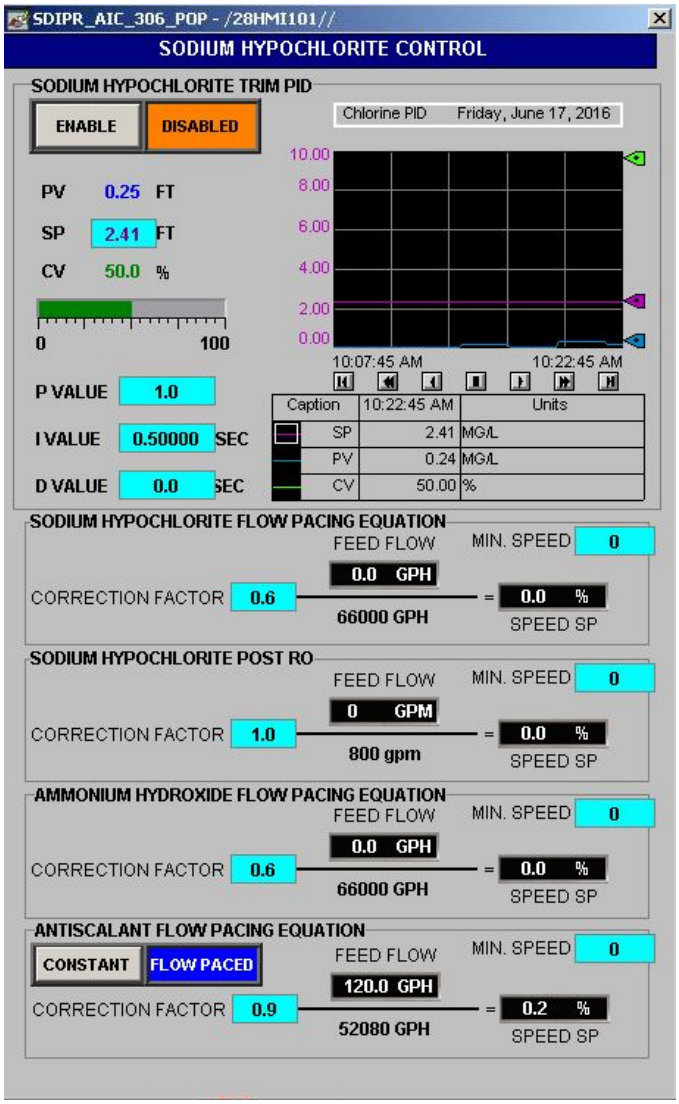


**Figure 103. Chemical Control Screen**

### Multiple Modes of Operation Control Strategy

There are different modes of operations available for the sulfuric acid and antiscalant system. The modes of operations are described in the subsequent sections.

### Sulfuric Acid Control Strategy

Sulfuric acid control is accessible on the sulfuric acid control screen shown below. The sulfuric pump control can be disabled on this screen as well. When disabled, all critical shutdown alarms associated with the sulfuric acid pump/dosing system are ignored. When enabled, the AWT will shut down in the event of any alarms associated with the sulfuric acid injection system. The pump can also be set to pump at a constant rate versus flow-paced. When running on the flow-paced mode, the trim proportional-integral-derivative (PID) will adjust the pump output so that the pH setpoint is met.

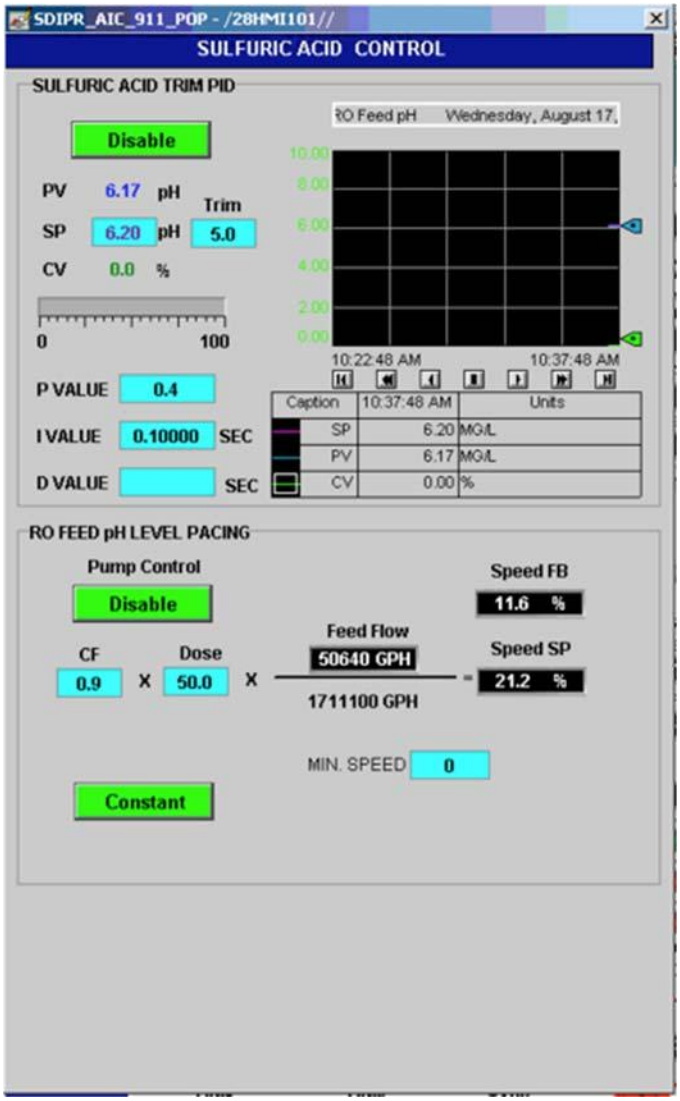


**Figure 104. Sulfuric Acid Control PLC Screen**

The feed system is controlled by LOOP 28-P-911, PSH-912, LSH-914, and AE-304A. Control of the acid injection system is as follows:

Manual:

Pump will be operated manually when “Mode 1: Manual” is selected from Pump’s Control Pad.

Follow the O&M Manual for the Pump 28-P-911 for manual operation.

Interlock:

- Pump 28-P-911 is shut off by the HydroRanger (28-PC-910) at Low-Low tank level

Automatic:

- Pump will be operated in auto mode when “Mode 2: 4-20mA Input” is selected from the Pump’s Control Pad.
- When on auto mode, the Pump will start and stop running when initiated by the Plant operator from Panel 28-CP-101.
- Pump will speed up at signal from AE-304A when pH of the RO feed water is above desired range.
- Pump will slow down speed at signal from AE-304A when pH of the RO feed water is below desired range.
- Pump will shut down on high discharge pressure signal from PSH-912. Typically above 35 psi.

**Antiscalant Control Modes**

The antiscalant (A/S) system can be run in 2 modes, “Dual Mode On” and “Dual Mode Off.” When dual mode is off, a single antiscalant pump provides antiscalant dosing to both RO trains. When dual mode is on, two independent antiscalant pumps provide antiscalant dosing to a single RO train. The two configurations are shown below.

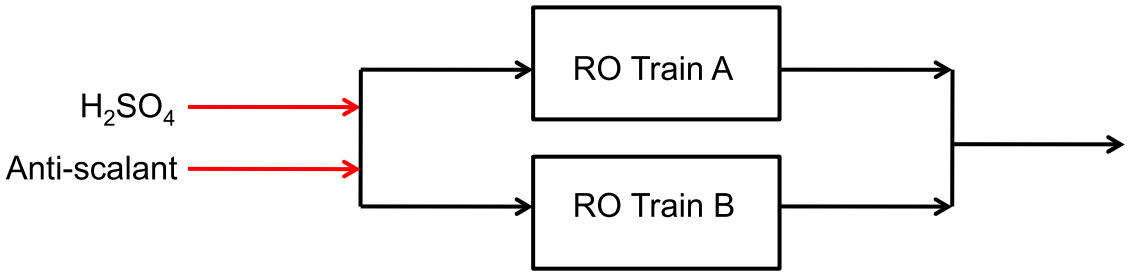


**Figure 105. Antiscalant Dual Mode Off Dosing Configuration**

### Module Alarms

The UV/AOP System alarms are summarized in Table 24.

**Table 24. UV/AOP System Alarms**

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| CCB COMMUNICATION FAULT ALARM | CCB is not responding to the SCC PLC communication commands. Communication lost. | Major alarm activated.<br>UV system will try to operate at 100% power in default mode until communication is reestablished. | 1) Contact I&C to troubleshoot electrical connections.<br>2) Cycle power. |
| PDC COMMUNICATION FAULT ALARM | Failure of the communication heartbeat.<br>Communication is lost between the SCC PLC and PDC Remote I/O. | Major alarm activated.<br>UV system will try to operate at 100% power in default mode until communications is reestablished.<br>The SCC PLC no longer knows what is happening at the Reactor-level. | 1) Cycle power to 120V PDC panel.<br>2) Contact I&C. |
| UV CHAMBER TEMPERATURE HIGH ALARM | UV Reactor temperature sensor switch senses temperature greater than 122ºF (50ºC). | UV system shuts down. | Touch reactor with the back of your hand. If not hot, contact I&C to troubleshoot the sensors or connections. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| PDC TEMPERATURE HIGH ALARM | PDC Panel internal temperature sensor detects a temperature greater than 131ºF (55ºC). | UV system shutdown. | 1) Confirm if there is a high temperature at the PDC Ensure fans are operating.<br>2) Ensure climate control devices are operating.<br>3) Ensure there are no obstructions limiting air flow in the panel.<br>4) Contact I&C. |
| UV REACTOR BALLAST FAILURE ALARM | Ballast is reporting a ballast not "OK" condition to the CCB, When any ballast(s) have failed. | Minor alarm is activated. System ramps up to 100% since 2 lamps are now off. | Check lamp status on HMI and try resetting the latched alarms. Contact I&C to replace ballast/lamps. |
| UV REACTOR END CAP REMOVED ALARM | Switch behind End Cap was engaged (End Cap removed). | Critical alarm. UV system shutdown. | Replace cap and reset latched alarm on HMI. If switch is bad contact I&C. |
| UV REACTOR END OF LAMP LIFE EXCEEDED ALARM | Total accumulated runtime hours exceeded the recommended life span. | Minor alarm activated. UV system keeps running normally. | Replace lamps and reset timer. |
| UV REACTOR LAMP FAILURE MINOR ALARM | A ballast is reporting a lamp is not “OK”. | Minor alarm activated. System keeps running normally. | Reset alarm. If it doesn’t clear, replace lamp. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| UV REACTOR MULTIPLE LAMP FAILURE ALARM | Between 2-7 lamps have failed. | Major alarm activated. UV system ramps up to 100% power. | Reset alarm. If it doesn't clear, replace lamps. |
| UV REACTOR NOT IN REMOTE ALARM | UV system is not in the "Remote" position. | Minor alarm activated. System keeps running. PLC cannot control the reactor. | Return selector to "Remote" position. If alarm doesn't clear, contact I&C. |
| UV REACTOR UV INTENSITY LOW MINOR ALARM | UV intensity is low, or UV intensity probe is faulty. | Minor alarm activated. System keeps running normally. | Confirm reading is lower than setpoint. If so, contact I&C. If not, adjust setpoint. |
| UV TRANSMITTANCE LOW – MAJOR ALARM | UV intensity is low, or UV intensity probe is faulty. | Major alarm is activated. UV system ramps up to 100% power. | Confirm reading is lower than setpoint. If so, contact I&C. If not, adjust setpoint. |
| CRITICAL VALUE EQUALS ZERO ALARM | Target Dose, Dose Deadband, End of Lamp Life Set-point, or Peak Flow values are invalid. | Major alarm is activated. UV system ramps up to 100% power. | Cycle power to SCC PLC. Reset latched alarm. If alarm doesn't clear, contact I&C. |
| DOSE LOW – MAJOR ALARM | Calculated UV dose is below the desired setpoint. | Major alarm is activated. UV system ramps up to 100% power. | Ensure the sleeves are clean. Ensure the UVT meter is functioning properly. Contact I&C. |

| Message | Comments | PLC Response | Operator Response |
|---|---|---|---|
| PLANT PLC COMMUNICATION FAULT | Communication is lost between PLC101 and the SCC PLC. Failure of the communication heartbeat. | Minor alarm is activated. The system will continue operating in the current mode. | Contact I&C. |
| Power Failure | No power. | UF system shuts down. | Check UPS. Contact I&C. |

## Ultraviolet Advanced Oxidation Process System Control Strategy

### System-Level Control

The main control logic of the UV System is divided into three main levels; System-Level Control, Train-Level Control, and Reactor-Level Control.

System-level control will normally include the following functionality:

- Control system Start up and Shut down sequences based on commands from the Plant operator and system status
- Manage multiple UV Trains based on plant flow requirements and UV System flow capacity
- Provide System monitoring and operator control functions through a panel mounted operator interface
- Detect and respond to UV System-level fault conditions
- Provide System status, including alarm annunciations via the panel mounted operator interface and/or to the Plant PLC via the PLC 101
- Monitor, and respond when applicable to data received from the plant via the PLC 101 connection
- Monitor System UVT signal
- Monitor System Water Temperature

### Ultraviolet Transmittance Input Signal

An ultraviolet transmittance (UVT) signal is required to provide Dose Pacing functionality for the UV System. The UV System will use one (1) UVT signal input for the system and assume that the effluent flow through all operating UV Trains is at the same UVT value. A 4-20mA analog UVT signal option is available on all systems. A manually entered UVT value is available to all operators and may be selected if an online value is not available. A third option is for the UV system to receive the UVT value through the plant PLC 101 protocol.

If the UVT is received as a 4-20 mA analog signal, the input signal is scaled to a fixed 0 to 100% engineering units range. In analog input mode, the input signal is passed through a smoothing algorithm that reduces the effect of temporary spikes and drops in UVT. A manually entered UVT value will be used when selected by the operator. A default value will be used when some UVT fault conditions occur.

### Temperature Input Signal

A temperature value is required in order to provide Dose Pacing functionality for the UV System. The UV System will normally be configured to use one (1) temperature signal input for the system, and assume that the effluent temperature through all operating UV Trains is at the same value. Alternatively, the system can be configured for a temperature sensor for each UV Train. Most commonly, the temperature is received as a 4-20 mA signal. In this mode, the input signal is scaled to a configurable engineering units range. Temperature can be displayed in degrees Fahrenheit or degrees Celsius. Alternately, a

temperature signal may be passed from a Plant network through a configured SCADA system (PLC 101) to a designated address in the UV PLC. In either of these modes, a manually entered temperature value may be used to override the measured value upon operator demand. A default value will be used if a fault condition (4-20 flow input) or communication fault (PLC 101 input) occurs.

### Train-Level Control

Train-level control will normally include the following functionality:

- Train Start up and Shut down sequences based on commands from the UV System control algorithm
- Manage multiple UV Reactors based on UV log reduction requirements for the train
- Provide Train monitoring and operator control functions through a panel mounted operator interface
- Detect and respond to UV Train fault conditions
- Provide Train status, including alarm annunciations via the panel mounted operator interface and/or to the Plant PLC via the PLC 101
- Monitor UV Train effluent flow and water level

### Flow Input Signal

A flow signal is required in order to provide Dose Pacing functionality for the UV System. The UV System will use one (1) flow signal input for each UV Train. Most commonly, the flow is received as a 4-20 mA signal. In this mode, the input signal is scaled to a configurable engineering units range. Flow can be displayed in US mgd, L/S, $m^3$/Day, gpm or MLD units as standard options. The input signal is passed through a smoothing algorithm that reduces the effect of temporary spikes and drops in flow. Alternately, a flow signal may be passed from a Plant network through a configured SCADA system (PLC 101) to a designated address in the UV PLC. When flow is received from PLC 101, the smoothing algorithm will not be used. In either of these modes, a manually entered flow value may be used to override the measured flow value upon operator demand. A default flow value will be used if a flow fault condition (4-20 flow input) or communication fault (PLC 101 flow input) occurs.

### Water Level Input Signal

As an equipment protection feature, a water level input signal is required to ensure the UV Train is filled with water prior to operation. There will be one water level sensor for per train and its location will be on the highest reactor chamber for stacked systems. During normal start-up procedures, trains being requested to go into operation will be filled first should the level sensor not be detecting adequate water level within the train. If during train operation, the level sensor indicates "Low Water Level", the train will be commanded to shutdown in a controlled fashion following the Controlled Shutdown Sequence.

### Reactor-Level Control

Reactor-Level control will normally include the following functionality:

- Reactor Start up and Shut down sequences based on commands from the UV Train control algorithm
- Manage BPL based on UV Log Reduction, EE/O requirements for the reactor
- Provide Reactor monitoring and operator control functions through a panel mounted operator interface
- Detect and respond to UV Reactor fault conditions
- Provide Reactor status, including alarm annunciations via the panel mounted operator interface and/or to the Plant PLC via the PLC 101 connection
- Communicate to the CCB, control and monitor the reactor lamps and monitor UV Intensity Signal

### Communication Control Board Interface

The UV System PLC communicates to the communication control board(s) (CCBs) located within a PDC via an MODBUS RS485 network. The PLC acts as the master on the network and sends command data packets to each PDC.

### Lamp Control and Monitoring

Each UV Reactor will respond to a power level signal, which will instruct the lamp ballast to adjust to the correct power level as determined by the controller. Each lamp is controlled directly from the lamp ballast, which is fully modulated between minimum and maximum power levels for each UV Reactor. Note that all lamps for the UV Reactor will be turned on/off together if commanded by the controller and will all operate at the same power level.

Specially designed current sensing circuits detect lamp on/off status. The status of each individual lamp is displayed via the UV Reactor control screen on the Operator Interface. Faulted lamps are indicated graphically on the UV Reactor control screen. A local display of lamp status is also provided on each PDC.

When switched on, lamps are initially energized to the high power setting for a warm-up period regardless of Train control mode (i.e. Manual or Automatic). After the warm-up period has expired, the lamps are automatically switched to the requested power level. The "lamp warm-up" timer controls this time period and can be set between 3 to 8 minutes; defaulted to 5 minutes.

# Appendix H. Chemical Addition Systems

## Overview

Chemicals are added along the treatment train to enhance performance for several unit processes. Chemical addition systems onsite include skids for sodium bisulfite, sodium hypochlorite, ammonium hydroxide, antiscalant, sulfuric acid, and hydrogen peroxide. Sodium bisulfite ($NaHSO_3$) is added ahead of the biological activated carbon (BAC) to quench ozone residual present in process water to prevent BAC inoculation. Sodium hypochlorite and ammonium hydroxide are dosed upstream of microfiltration/ultrafiltration (MF/UF) to form chloramines to prevent biofouling in membrane processes. Antiscalant is added in the reverse osmosis (RO) feed water to prevent scale formation on RO membranes. Sulfuric acid is also added to the RO feed water to lower the pH to enable higher RO recovery without increasing scaling associated with running at higher recovery. The hydrogen peroxide system has been decommissioned and is no longer operational. Sodium hypochlorite is currently the primary oxidant for the ultraviolet advanced oxidation (UV/AOP) process. Chemical addition points are shown below in Figure 100.

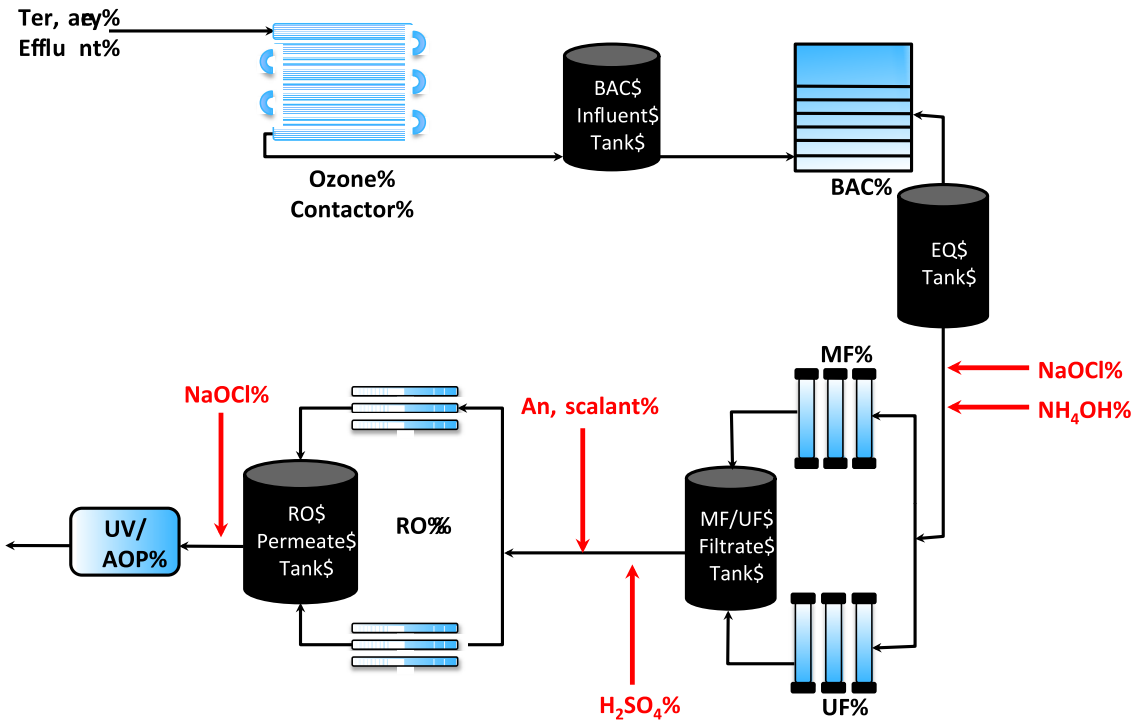


**Figure 100. Chemical Addition Points**

### Sodium Hypochlorite

Sodium hypochlorite is metered to two different locations in the treatment train using two separate diaphragm pumps. The sodium hypochlorite system includes 2 pump skids, 2 pump control panels, and 1 storage tank. Remote control is accessed via the human machine interface (HMI) on the main PLC 101 if pump is operated in remote mode. The following parameters in Table 25 are relevant for sodium hypochlorite operations.

**Table 25. Sodium hypochlorite operating ranges**

| Parameter | Operating Range |
|---|---|
| MF/UF influent chemical feed rate | 0-110 mL/min = 0-5 mg/L dose |
| UV/AOP influent chemical feed rate | 0-110 mL/min = 0-5 mg/L dose |
| Tank level limits | HiHi alarm on - 3.7’ / off - 3.6’<br>High alarm on - 3.4’ / off - 3.3’<br>Low level alarm on - 0.6’ / off - 0.7’ |

### Ammonium Hydroxide

The ammonium hydroxide system includes a pump skid, pump control panel, chemical storage tank, and tank controller. Remote control is accessed via the HMI on the main PLC if pump is operated in remote mode. The following parameters in Table 26 are relevant for ammonium hydroxide operation.

**Table 26. Ammonium hydroxide operating ranges**

| Parameter | Operating Range |
|---|---|
| Chemical feed rate | 0-35 mL/min |
| Tank level limits | HiHi alarm on-3.0’ / off-2.95’<br>High alarm on-2.9’ / off-2.8’<br>Low level alarm on-0.4’ / off-0.5’ |

### Antiscalant

The antiscalant system includes a pump skid and pump control panel. Remote control is accessed via the HMI on the main PLC if pump is operated in remote mode. The antiscalant dosing system has now tank but rather uses a set of day tanks that are filled on an as-needed basis by the operators.

The antiscalant system is designed to feed the chemical into the RO feed at a maximum rate of 0-20 mL/min. The following parameters in Table 27 are relevant to antiscalant operations.

**Table 27. Antiscalant operating ranges**

| Parameter | Operating Range |
|---|---|
| Chemical feed rate | 0-20 mL/min |
| Tank level limits | Not stored in a tank. |

### Sulfuric Acid

The system is designed to store and inject sulfuric acid into piping that feeds the RO membrane with influent water. The system is designed to feed acid with a concentration over 93% at flows ranging between 0.3 and 6.5 gallons per hour (GPH). The system consists of:

- Sulfuric acid storage tank (Tank), 28-T-300
- Acid fill station with automatic fill shut off solenoid valve, 28-SV-911
- Sulfuric acid pump skid, 28-P-911
- Secondary acid tank containment area with level switch, LS-913
- Double walled acid feed piping with moisture sensor, LS-914
- pH sensor for monitoring and controlling sulfuric acid fee, AE-304A

The Sulfuric Acid System Control (Control) is designed to monitor and control the following:

- Fill and volume of the sulfuric acid storage tank
- Sulfuric acid pump feed rate.

The fill and volume of the Tank stored acid is controlled by fill control Panel 28-CP-910, the acid feed pump is primarily controlled by system operational logic resident in the programmable logic controller (PLC) located in the existing DPWF control Panel 28-CP-101. The following parameters in Table 28 are relevant for sulfuric acid parameters.

**Table 28. Sulfuric acid operating ranges**

| Parameter | Operating Range |
|---|---|
| Chemical feed rate | 0-410 mL/min |
| Tank level limits | HiHi alarm on-7.7' / off-7.5'<br>High alarm on-7.2' / off-7.1'<br>Low level alarm on-2.5' / off-2.6'<br>LoLo level alarm on-0.5' / off-0.6' |
| Other control parameters | Trim PID loop tied to the RO feed pH meter |

### Chemical System Diagrams

Chemical system process flow diagrams and piping and instrumentation diagrams (P&IDs) are provided in the reference documents. The record drawings and source documents are summarized in Table 29.

**Table 29. Chemical System Record Drawings**

| Diagram | Document Source | Sheet Number |
|---|---|---|
| Sodium Hypochlorite Storage and Feed System P&ID | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 50 |
| Sulfuric Acid Storage and Feed System P&ID | North City Advanced Water Purification Demonstration Facility Studies (Sulfuric Acid System Addition) | 20 |
| Antiscalant and Ammonium Hydroxide Storage and Feed System | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 51 |

## Chemical Addition Systems Alarms

### Sodium Hypochlorite

There are no critical alarms associated with the sodium hypochlorite system. Warning alarms include the following:

- Tank Low Level
- Tank High Level
- Pump Speed Feedback
- Pump Failure
- High Pressure

The pump status/alarms for sodium hypochlorite injection preceding MF and UF is accessible on the sodium hypochlorite pump motor control screen shown below.

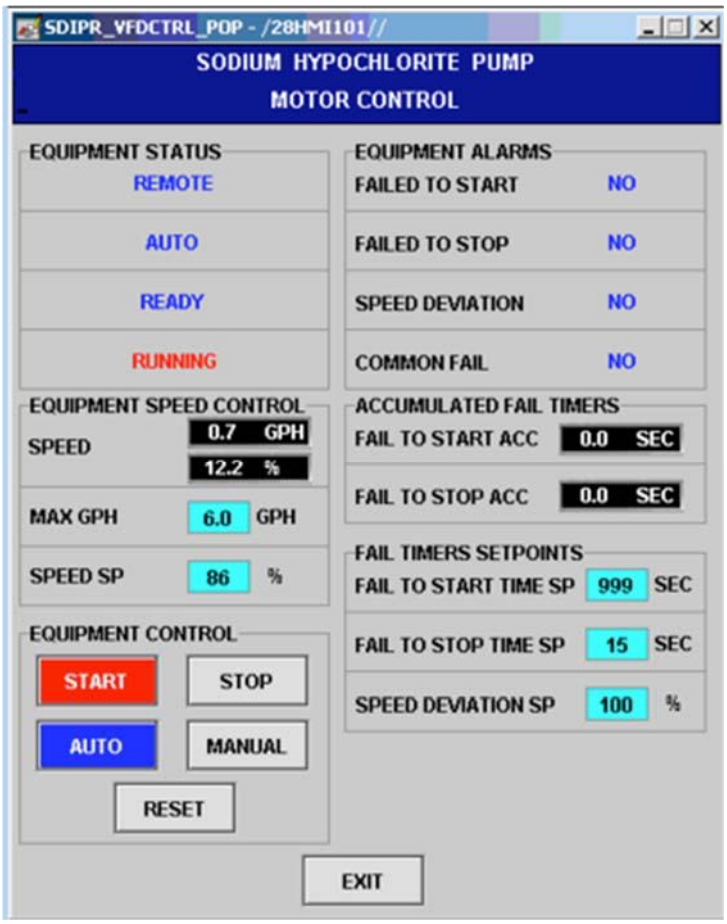


**Figure 101. Sodium Hypochlorite Pump Motor Control Screen**

### Ammonium Hydroxide

There are no critical alarms associated with the ammonium hydroxide system. Warning alarms include the following:

- Tank Low Level
- Tank High Level
- Pump Speed Feedback
- Pump Failure
- High Pressure

The pump status/alarms for ammonium hydroxide injection preceding MF and UF is accessible on the ammonium hydroxide pump motor control screen shown below.

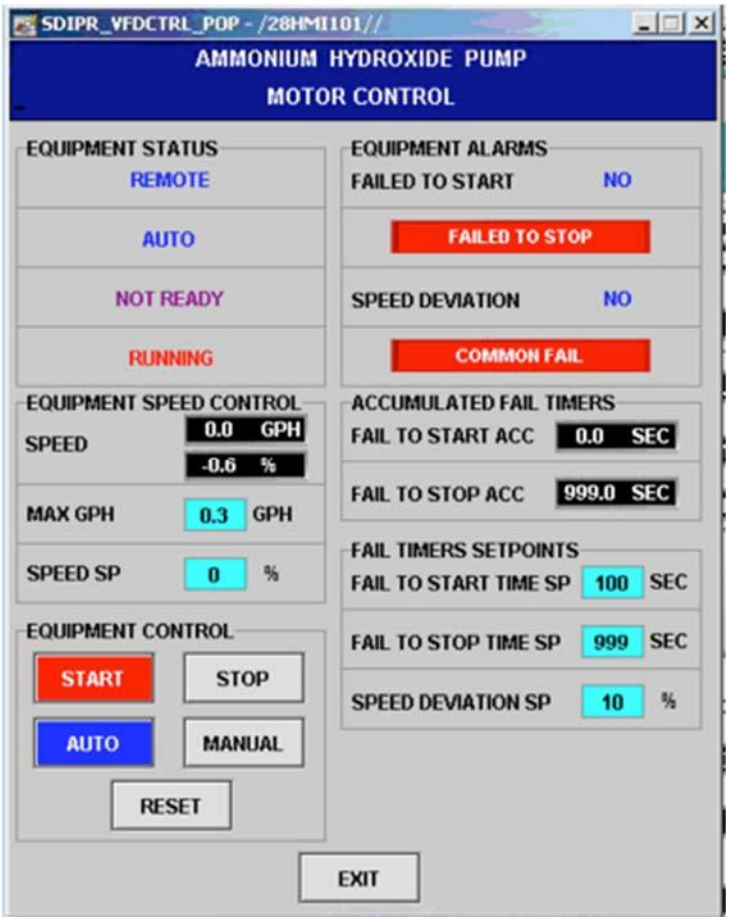


**Figure 102. Ammonium Hydroxide Pump Motor Control Screen**

### Antiscalant

There are no critical alarms associated with the antiscalant system. Warning alarms include the following:

- Tank Low Level
- Tank High Level
- Pump Speed Feedback
- Pump Failure
- High Pressure

### Sulfuric Acid

There are critical alarms associated with the sulfuric acid system. Critical alarms will trigger shutdown of the advanced water treatment (AWT; the block consisting of microfiltration, ultrafiltration, RO Trains A and B, and the UV/AOP systems) portion of the DPWF if sulfuric acid dosing is enabled. Critical alarms include the following:

- Tank Low Low Level
- Pump Speed Feedback
- Pump Failure

Warning alarms do not trigger AWT shutdown but may precede critical alarms if warning not addressed. Warning alarms include the following:

- Tank Low Level
- Tank High Level
- Tank Level Signal Fail
- Containment Leak
- High Pressure

LOOP 28-T-910 and LSH-913 control acid storage tank and containment alarms and produce the following results when triggered. Tank level is continuously monitored by LE -911. The Low-Low Level is used to shut down acid feed pump 28-P-911. The Low Level signal is used to produce a notification warning for Plant staff to order new acid delivery. High Level will produce alarm to alert for acid fill shut down and High-High Level alarm will close solenoid valve 28-SV-911. Liquid in the Tank containment area will be sensed by LSH-913 and produce an alarm signal to PLC 101 at main control Panel 28-CP-101. PLC shall be programmed to alarm the Demonstration Pure Water Facility (DPWF) operator on the liquid presence in the sulfuric acid tank containment.

## Chemical Addition Systems Control Strategy

### Flow-Paced Control Strategy

Remote control of sodium hypochlorite to the AWT feed, ammonium hydroxide to the AWT feed, antiscalant to the RO feed, and sodium hypochlorite to the UV influent can be accessed on the HMI on the main PLC, 28-CP-101 or PLC 101. The chemical control screen on the HMI is shown below in Figure 103. Control of

sodium hypochlorite and ammonium hydroxide feed systems are controlled by flow to the AWT. Detection of flow to the AWT feed initiates sodium hypochlorite and ammonium hydroxide pumps. A correction factor is applied to scale the speed of the pump to the flow. RO permeate production initiates the UV/AOP feed sodium hypochlorite pump and the applied correction factor scales the speed of the pump to the flow. The Sodium Hypochlorite, Antiscalant, and Ammonium Hydroxide Storage and Feed System P&IDs which include the process flows used for flow pacing can be found in the Chemical System Record Drawings section of the Appendix, sheets 50-51.

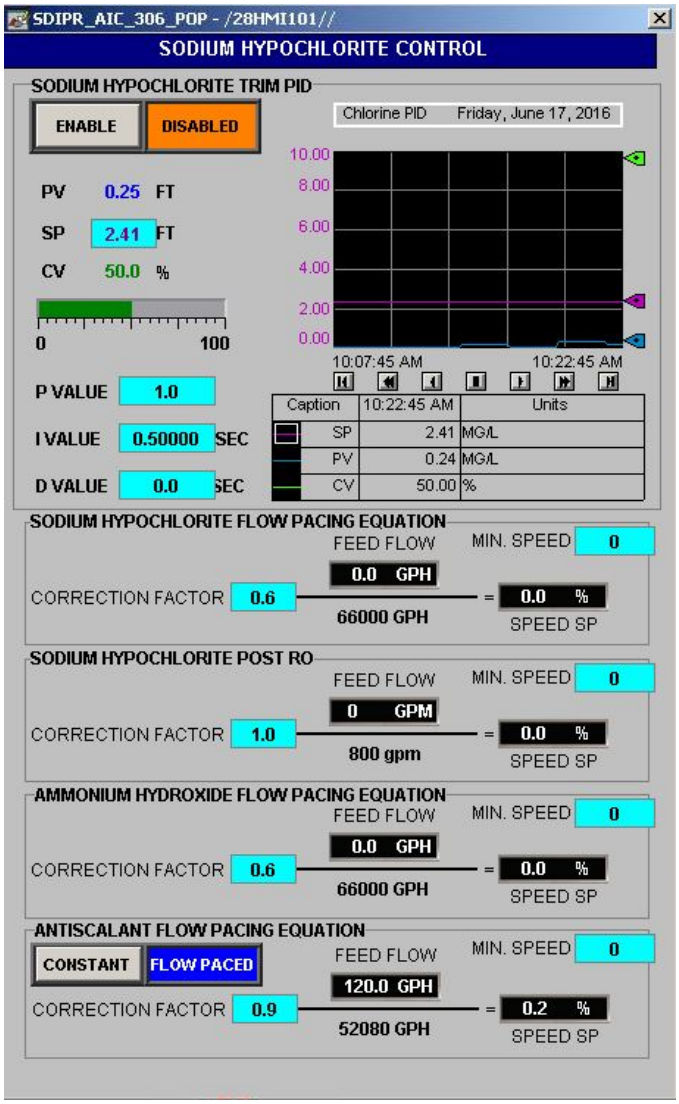


**Figure 103. Chemical Control Screen**

### Multiple Modes of Operation Control Strategy

There are different modes of operations available for the sulfuric acid and antiscalant system. The modes of operations are described in the subsequent sections.

### Sulfuric Acid Control Strategy

Sulfuric acid control is accessible on the sulfuric acid control screen shown below. The sulfuric pump control can be disabled on this screen as well. When disabled, all critical shutdown alarms associated with the sulfuric acid pump/dosing system are ignored. When enabled, the AWT will shut down in the event of any alarms associated with the sulfuric acid injection system. The pump can also be set to pump at a constant rate versus flow-paced. When running on the flow-paced mode, the trim proportional-integral-derivative (PID) will adjust the pump output so that the pH setpoint is met.

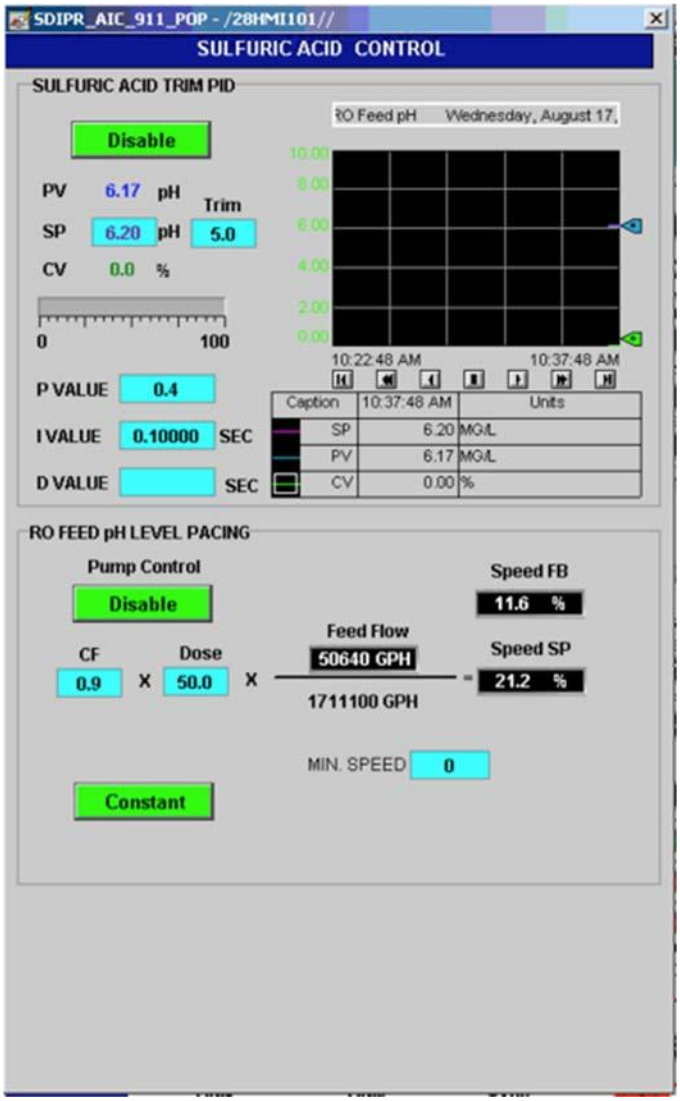


**Figure 104. Sulfuric Acid Control PLC Screen**

The feed system is controlled by LOOP 28-P-911, PSH-912, LSH-914, and AE-304A. Control of the acid injection system is as follows:

Manual:

Pump will be operated manually when “Mode 1: Manual” is selected from Pump’s Control Pad.

Follow the O&M Manual for the Pump 28-P-911 for manual operation.

Interlock:

- Pump 28-P-911 is shut off by the HydroRanger (28-PC-910) at Low-Low tank level

Automatic:

- Pump will be operated in auto mode when “Mode 2: 4-20mA Input” is selected from the Pump’s Control Pad.
- When on auto mode, the Pump will start and stop running when initiated by the Plant operator from Panel 28-CP-101.
- Pump will speed up at signal from AE-304A when pH of the RO feed water is above desired range.
- Pump will slow down speed at signal from AE-304A when pH of the RO feed water is below desired range.
- Pump will shut down on high discharge pressure signal from PSH-912. Typically above 35 psi.

**Antiscalant Control Modes**

The antiscalant (A/S) system can be run in 2 modes, “Dual Mode On” and “Dual Mode Off.” When dual mode is off, a single antiscalant pump provides antiscalant dosing to both RO trains. When dual mode is on, two independent antiscalant pumps provide antiscalant dosing to a single RO train. The two configurations are shown below.

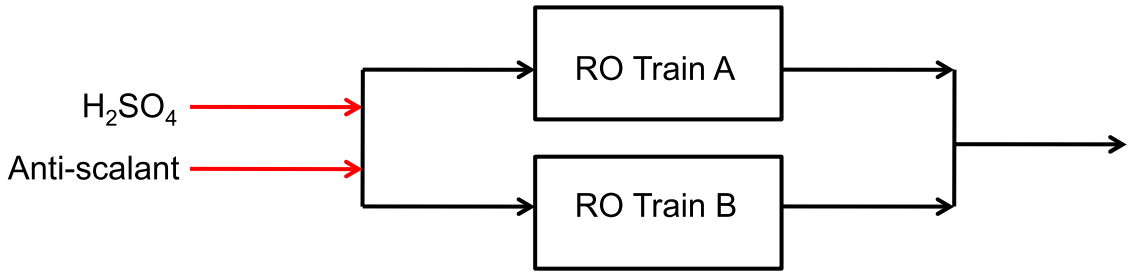


**Figure 105. Antiscalant Dual Mode Off Dosing Configuration**

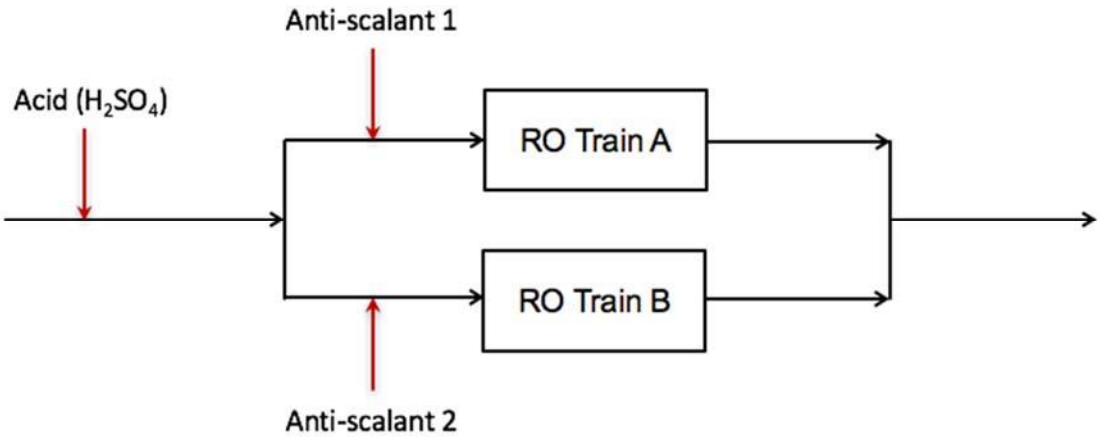


**Figure 106. Antiscalant Dual Mode On Dosing Configuration**

A/S Pump RO-A and A/S Pump RO-B will feed specific antiscalant chemical into respective 8-inch RO pipelines feeding feed pumps for RO Train A and RO Train B. Both pumps feed rate will be controlled by the flow pacing of the respective RO Train A and B. When the pump is in automatic (remote) operating mode, the Plant's PLC located in the panel 28-CP-101 will allow operator to enable the use of dual A/S system, and provide set points for scaling factor which is used in calculation of the pump speed output for the two independent pumps A/S Pump RO-A and A/S Pump RO-B. When, the Dual A/S System use is enabled, PLC101, will **run** A/S Pump RO-A, only if RO Train A is running. Similarly, when the Dual A/S System use is enabled, PLC101, will **run** A/S Pump RO-B, only if RO Train B is running. Thus, if only one RO Train is running, for example Train B, then only A/S Pump RO-B is also running.

If the Dual A/S System use is not enabled in the PLC101 user interface, then PLC101 uses existing single pump A/S dose system that feed A/S chemical into a common pipeline header to RO Train A and B. When Dual A/S System is enabled, the use of existing single pump A/S dose system should remain idle with pump stopped. Some alarms associated with the run status of existing A/S single pump dose system, when RO is running would need to be rendered inactive, if operator selected Dual A/S System use.

PLC 101 will scale each pump dosing rate based the RO feed flow to respective RO Train A or B. An operator can change a scaling factor on the PLC 101 HMI screen to fine tune dosing rate. These control options can be accessed in the RO Anti-Scalant Control screen shown below.

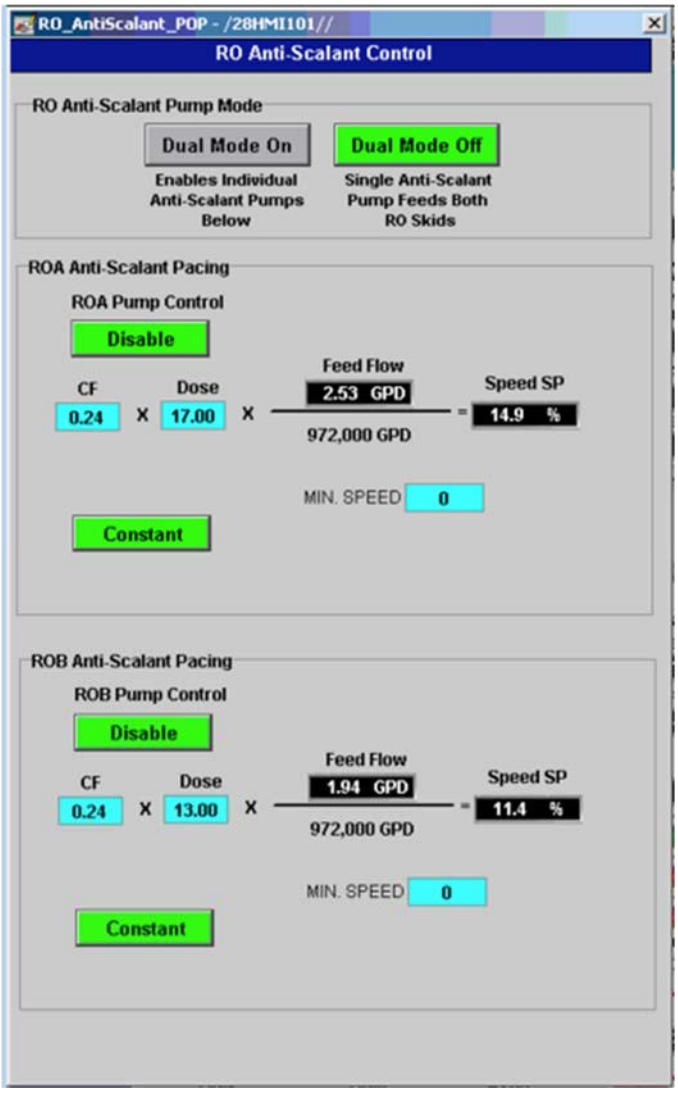


**Figure 107. RO Anti-Scalant Control PLC Screen**

Control for the following modes are described below.

Manual:

Pump will be operated manually when “Mode 1: Manual” is selected from Pump’s Control Pad.

Follow the O&M Manual for manual operation.

Interlocks:

- A/S Pump RO-A is shut off by the PLC 101, if RO Train A is not running
- A/S Pump RO-B is shut off by the PLC 101, if RO Train B is not running

Automatic:

- Both pumps will be operated in auto mode when “Mode 2: 4-20mA Input” is selected from the Pump’s Control Pad.
- When on auto mode, each Pump will start and stop running when initiated by the Plant operator from Panel 28-CP-101 by enabling Dual Anti-Scalant System from Chemical Feed Screen.
- Operator can input a scaling factor to control pump speed to achieve precise dose rate.
- A/S Pump RO-A and RO-B will speed up to reach dose rate that is based upon RO Train A or B feed flow, respectively.
- A/S Pump RO-A and RO-B will slow down based on the actual RO Train A or B feed flow, respectively.
- A/S Pump RO-A and RO-B will shut down, if corresponding RO Train A or B shuts down.

# Appendix I.Real Time Water Quality Monitoring

On-line monitors provide real time tracking of operations and process performance. Meter locations are shown below in Figure 108. Monitoring parameters with an asterisk are critical parameters in terms of operations and have associated setpoints that will cause shutdowns.

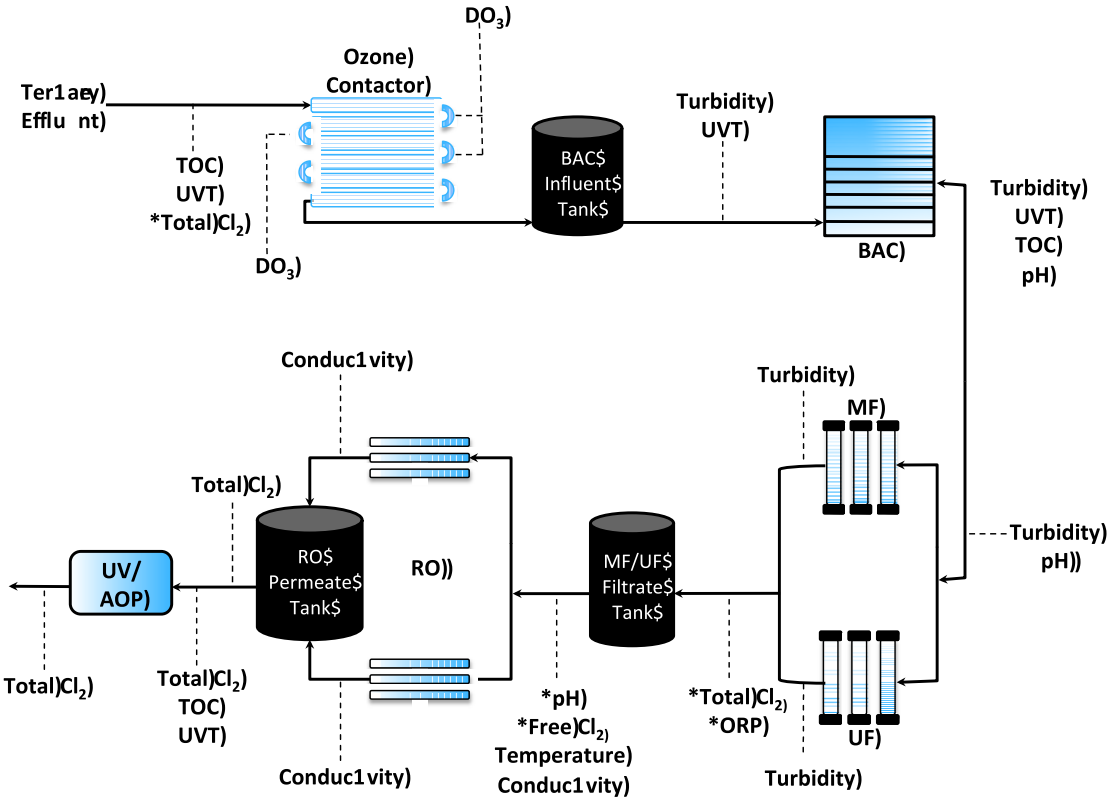


**Figure 108. Treatment train with on-line monitor locations**

Alarms generated and response to alarms when monitors reading outside of setpoints is described in detail in Chapter 10 Section Demonstration Pure Water Facility Global Alarms. Meter outputs and associated tag names are also provided in Chapter 10.

# Appendix J. Demonstration Pure Water Facility Global Control Strategies

## Overview

Control of the demonstration plant is accessible on the main programmable logic controller, PLC 101. Available modes of operation include the following:

- Advanced Water Treatment (AWT)
- Ozone/Filter
- AWT/Ozone/Filter
- Backwash

## Advanced Water Treatment (AWT)

Operation of the microfiltration, ultrafiltration, reverse osmosis (RO) Trains A and B, and the ultraviolet advanced oxidation process (UV/AOP) systems are available in the “AWT” mode. EDR pumps 105 and/or 106 provide feed flow to system. The automatic ozone feed control valve is closed in this mode.

## Ozone/Filter

Operation of the Ozone and biological activated carbon (BAC) filter systems are available in the “Ozone/Filter” mode. EDR pumps 105 and/or 106 provide feed flow to system. The automatic ozone feed control valve is open in this mode. The automated isolation valves open on the ozone full flow injection system and close on the ozone half flow injection system.

## AWT/Ozone/Filter

Operation of the Ozone, BAC filters, microfiltration (MF), ultrafiltration (UF), RO Trains A and B, and the UV/AOP systems are available in the “AWT/Ozone/Filter” mode. Feed flow to the ozone and BAC system is provided by EDR pumps 105 and/or 106 and feed flow to the AWT side (MF, UF, RO, and UV/AOP) by the transfer pump. The automatic ozone feed control valve is open in this mode. The automated isolation valves open on the ozone full flow injection system and close on the ozone half flow injection system.

## Backwash

Operation of one BAC filter in production and one BAC filter in backwash as well as half flow through ozone, full flow through either microfiltration (MF) or ultrafiltration (UF), full flow through either RO Trains A or B, and half flow through the UV/AOP systems are available in the “Backwash” mode. The BAC system PLC controls EDR pumps 105 and 106 in this mode. The automatic ozone feed control valve is open in this mode. The automated isolation valves open on the ozone half flow injection system and close on the ozone full flow injection system.

### Pump Modes

The facility can run with either one or two feed pumps in the following modes: “AWT”, “Ozone/Filter”, and “AWT/Ozone/Filter”. In “Backwash” mode, one feed pump runs, and the VFD on the BAC backwash supply pump will adjust its motor speed automatically when called by the BAC PLC through the ozone PLC to meet the high backwash rate flow setpoint.

## Demonstration Pure Water Facility Major Components

### Feed Pumps

Tertiary effluent is supplied to the facility using the feed pumps. Feed pumps are EDR pumps 105 and 106. Use of a single pump or both pumps simultaneously can be enabled in the main PLC in the “AWT” and “AWT/Ozone/Filter” modes. In “Backwash” mode, a single pump is used. Pressure control of the feed pump and proportional-integral-derivative (PID) tuning is accessible on the feed pump screen on the human machine interface (HMI) also shown below in Figure 109.

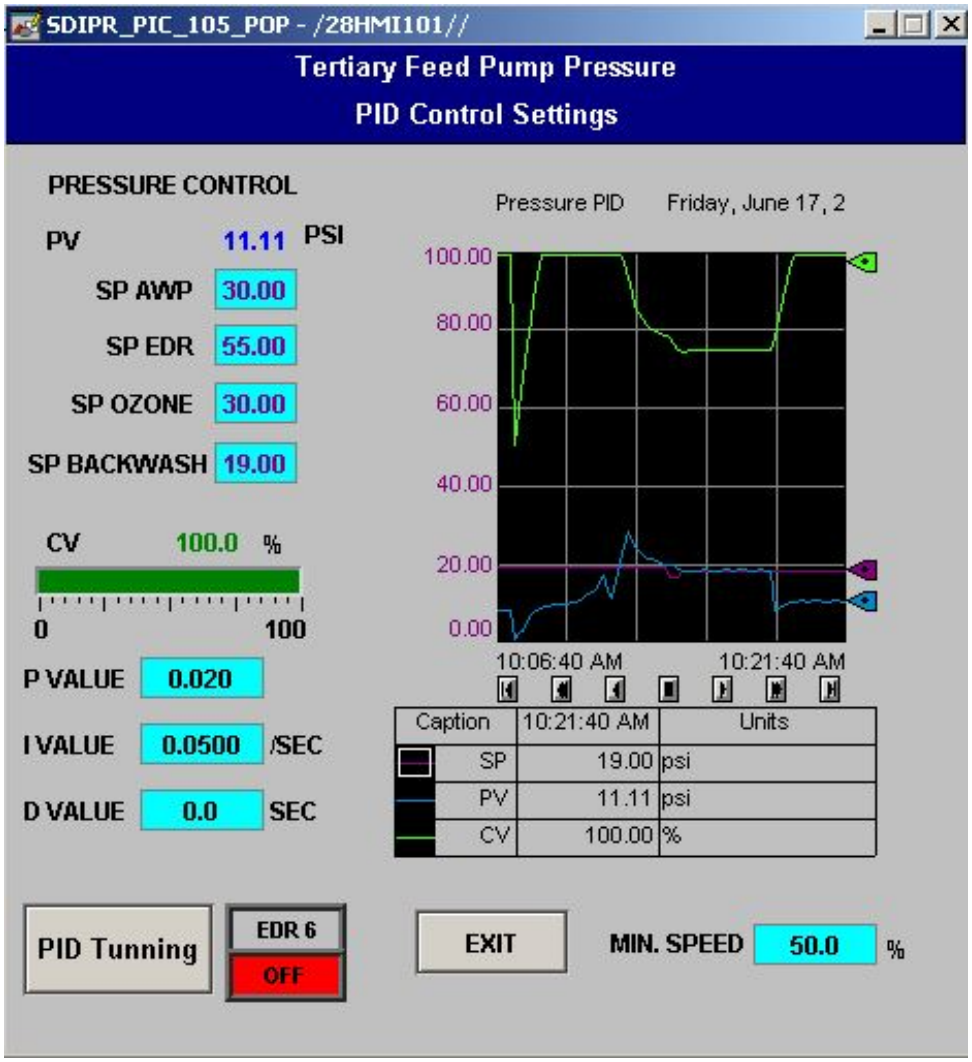


**Figure 109. Feed Pump Screen**

### Transfer Pump

The transfer pump provides Ozone and BAC treated water to the AWT portion of the DPWF (MF/UF, RO, and UV/AOP). The transfer pump is a centrifugal pump that takes water from the BAC Filtrate Tank and delivers process water to the AWT portion of the facility. Pressure control of the transfer pump and PID tuning is accessible on the feed pump screen on the HMI also shown below in Figure 110.

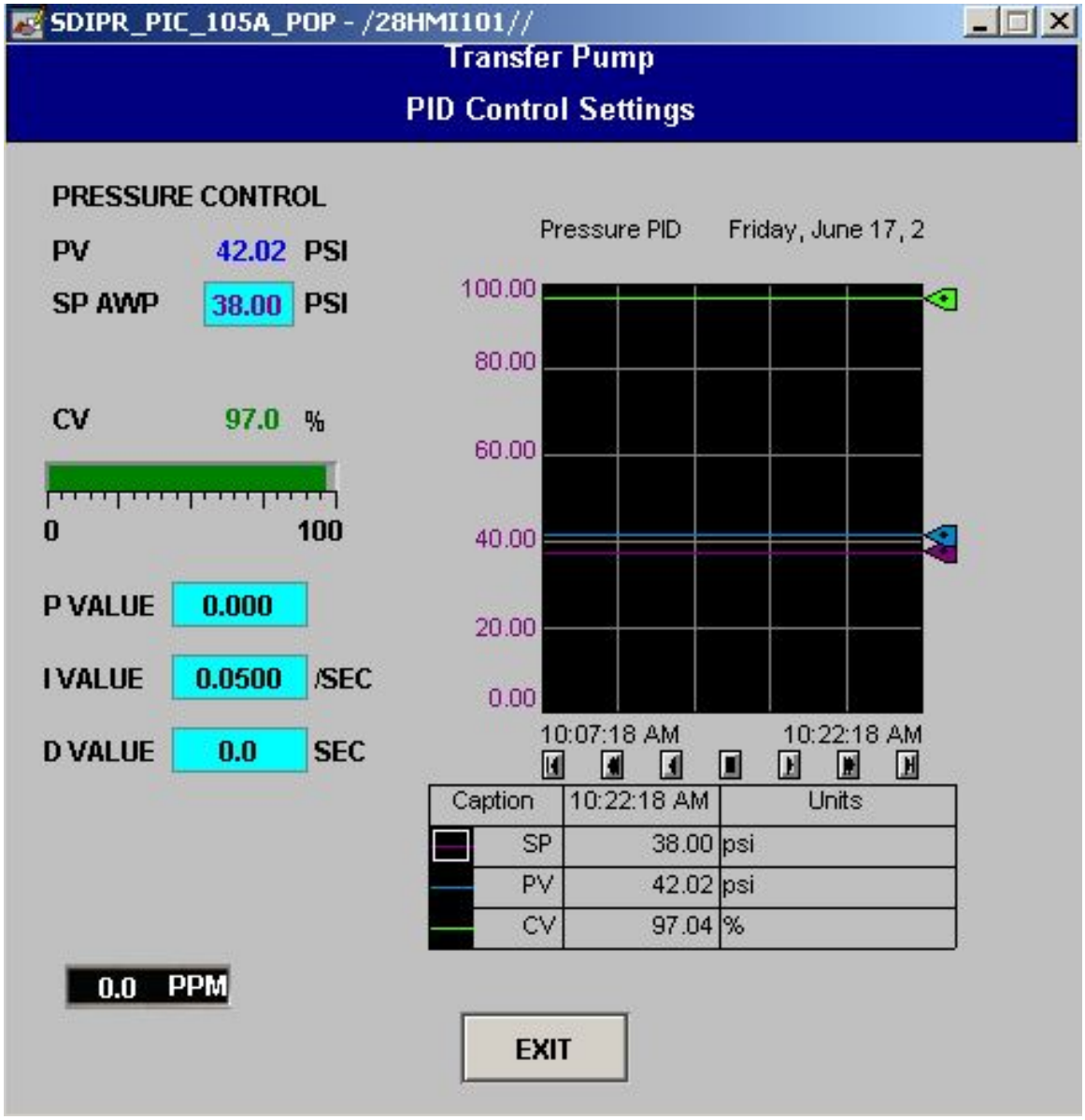


**Figure 110. Transfer Pump Screen**

### Programmable Logic Controllers

There are seven programmable logic controllers (PLCs) and two micro PLCs that control and transmit data and signals. The PLC aliases, names, processes, locations, and descriptions are summarized below in Table 30.

**Table 30. PLC Descriptions**

| Alias | PLC Name & Location | Process/ System | Description/ HMI | IP Address |
|---|---|---|---|---|
| 28-CP-001 | Aria_Skid (located on the MF skid) | Pall MF | 1769-L32E AB CompactLogix, PanelView-Plus 700 | 10.62.13.1 |
| 28-CP-101 | SD28PLC101 (in the control room) | PLC 101 | 1769-L35E AB CompactLogix | 10.62.13.11 |
| 28-CP-201 | North_City _HFUF (located on the UF skid) | H2O Innovation UF | 1769-L32E Compact Logix, PanelView-Plus 700 | 10.62.13.21 |
| 28-CP-401 | RO_Master (located On the RO skid) | Enaqua RO | 1769-L32E CompactLogix, PanelView-Plus 1000 | 10.62.13.41 |
| 28-CP-402 | MCC_Slave (above PLC101 cabinet) | Enaqua RO | 1769-L32E CompactLogix, PanelView-Plus 1000 | 10.62.13.42 |
| PLC_Ozone | Xylem_SMO _Generator (in the ozone container) | Xylem/ Wedeco Ozone | 1769-L72 AB ControlLogix, Panel View-Plus 700 | 10.62.13.50 |
| PLC_BAC | San_Diego _BAF (in the BAC control panel) | Xylem/Leopold BAC | 1769-L35E AB CompactLogix | 10.62.13.53 |
| PLC _Destruct | COD (inside cabinet between BAC filters) | Xylem Catalytical Ozone Destruct | 1766-L32BXB AB MicroLogix 1400, AB C300 | 10.62.13.52 |
| 28-CP-403 | CIP_Slave (Located next to CIP and flush pumps) | Enaqua RO | 1769-L32E AB CompactLogix | 10.62.13.61 |
| 28-CP-801 | UV_Main (inside UV control panel) | Trojan UV | 1769-L35E AB ControlLogix, Panel View-Plus 700 | 10.62.13.81 |
| 28-CP-802 | UV_CCB (inside UV control panel) | Trojan UV | Remote I/O | 10.62.13.83 |

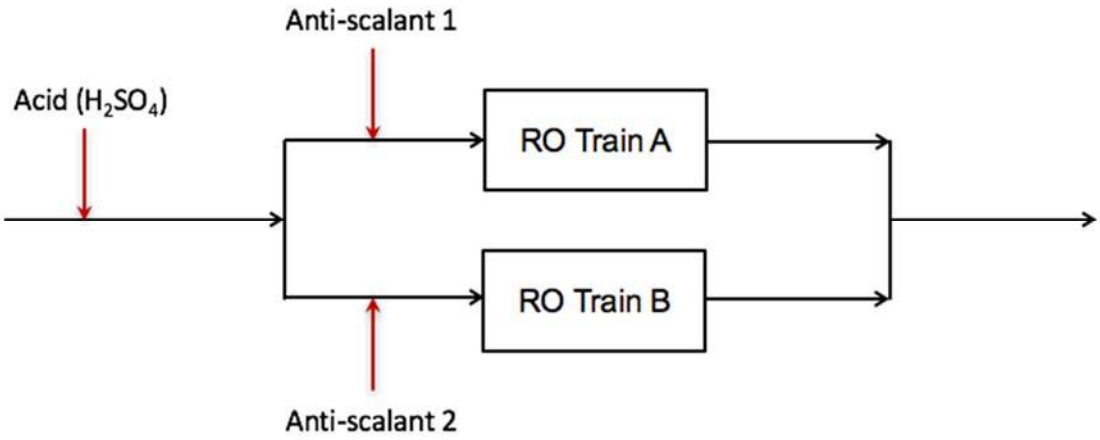


**Figure 106. Antiscalant Dual Mode On Dosing Configuration**

A/S Pump RO-A and A/S Pump RO-B will feed specific antiscalant chemical into respective 8-inch RO pipelines feeding feed pumps for RO Train A and RO Train B. Both pumps feed rate will be controlled by the flow pacing of the respective RO Train A and B. When the pump is in automatic (remote) operating mode, the Plant's PLC located in the panel 28-CP-101 will allow operator to enable the use of dual A/S system, and provide set points for scaling factor which is used in calculation of the pump speed output for the two independent pumps A/S Pump RO-A and A/S Pump RO-B. When, the Dual A/S System use is enabled, PLC101, will **run** A/S Pump RO-A, only if RO Train A is running. Similarly, when the Dual A/S System use is enabled, PLC101, will **run** A/S Pump RO-B, only if RO Train B is running. Thus, if only one RO Train is running, for example Train B, then only A/S Pump RO-B is also running.

If the Dual A/S System use is not enabled in the PLC101 user interface, then PLC101 uses existing single pump A/S dose system that feed A/S chemical into a common pipeline header to RO Train A and B. When Dual A/S System is enabled, the use of existing single pump A/S dose system should remain idle with pump stopped. Some alarms associated with the run status of existing A/S single pump dose system, when RO is running would need to be rendered inactive, if operator selected Dual A/S System use.

PLC 101 will scale each pump dosing rate based the RO feed flow to respective RO Train A or B. An operator can change a scaling factor on the PLC 101 HMI screen to fine tune dosing rate. These control options can be accessed in the RO Anti-Scalant Control screen shown below.

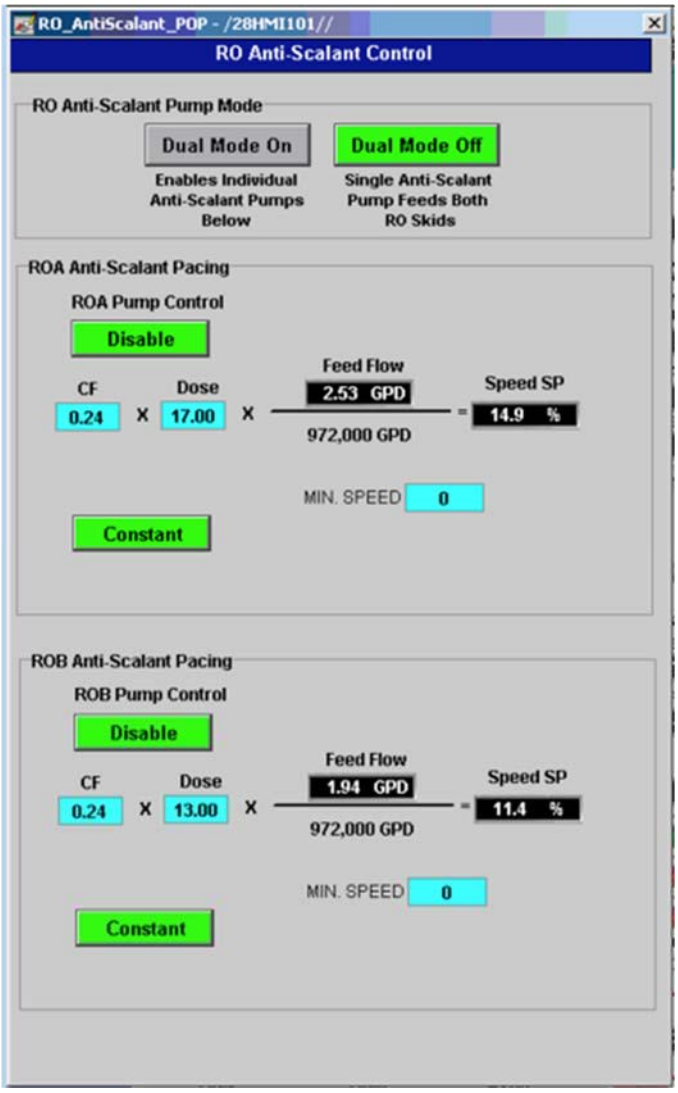


**Figure 107. RO Anti-Scalant Control PLC Screen**

Control for the following modes are described below.

Manual:

Pump will be operated manually when “Mode 1: Manual” is selected from Pump’s Control Pad.

Follow the O&M Manual for manual operation.

Interlocks:

- A/S Pump RO-A is shut off by the PLC 101, if RO Train A is not running
- A/S Pump RO-B is shut off by the PLC 101, if RO Train B is not running

Automatic:

- Both pumps will be operated in auto mode when “Mode 2: 4-20mA Input” is selected from the Pump’s Control Pad.
- When on auto mode, each Pump will start and stop running when initiated by the Plant operator from Panel 28-CP-101 by enabling Dual Anti-Scalant System from Chemical Feed Screen.
- Operator can input a scaling factor to control pump speed to achieve precise dose rate.
- A/S Pump RO-A and RO-B will speed up to reach dose rate that is based upon RO Train A or B feed flow, respectively.
- A/S Pump RO-A and RO-B will slow down based on the actual RO Train A or B feed flow, respectively.
- A/S Pump RO-A and RO-B will shut down, if corresponding RO Train A or B shuts down.

# Appendix I.Real Time Water Quality Monitoring

On-line monitors provide real time tracking of operations and process performance. Meter locations are shown below in Figure 108. Monitoring parameters with an asterisk are critical parameters in terms of operations and have associated setpoints that will cause shutdowns.

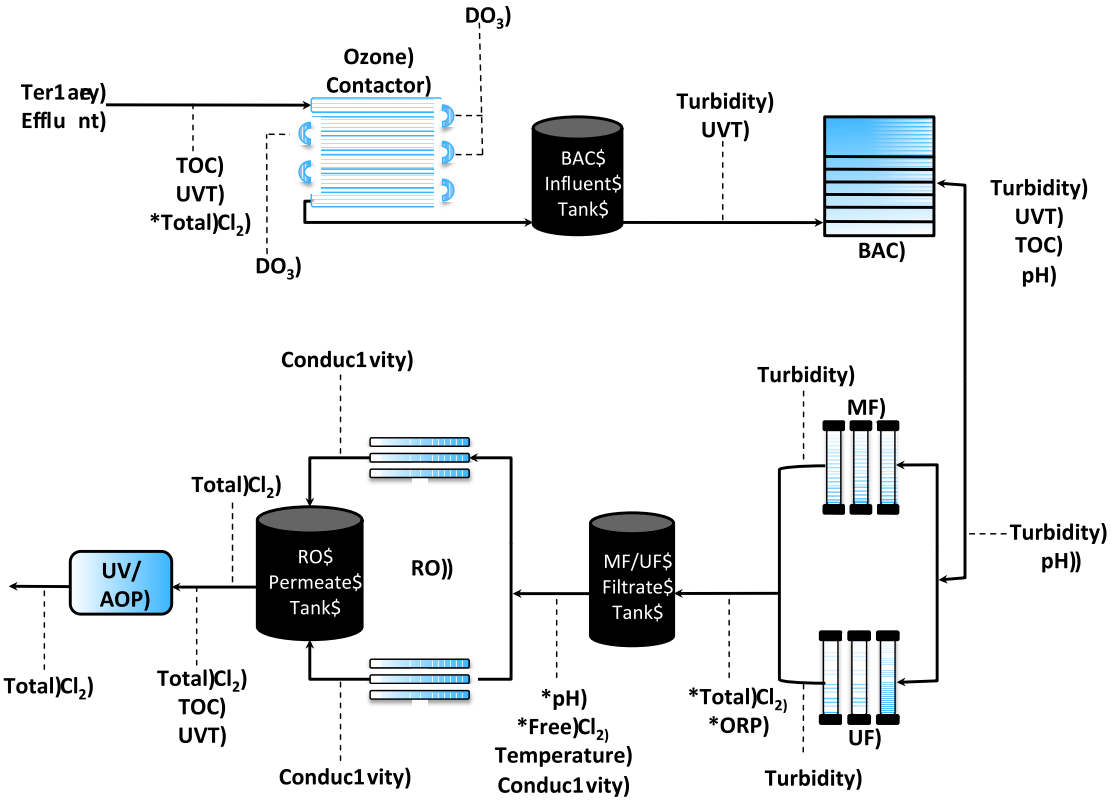


**Figure 108. Treatment train with on-line monitor locations**

Alarms generated and response to alarms when monitors reading outside of setpoints is described in detail in Chapter 10 Section Demonstration Pure Water Facility Global Alarms. Meter outputs and associated tag names are also provided in Chapter 10.

# Appendix J. Demonstration Pure Water Facility Global Control Strategies

### Overview

Control of the demonstration plant is accessible on the main programmable logic controller, PLC 101. Available modes of operation include the following:

- Advanced Water Treatment (AWT)
- Ozone/Filter
- AWT/Ozone/Filter
- Backwash

### Advanced Water Treatment (AWT)

Operation of the microfiltration, ultrafiltration, reverse osmosis (RO) Trains A and B, and the ultraviolet advanced oxidation process (UV/AOP) systems are available in the “AWT” mode. EDR pumps 105 and/or 106 provide feed flow to system. The automatic ozone feed control valve is closed in this mode.

### Ozone/Filter

Operation of the Ozone and biological activated carbon (BAC) filter systems are available in the “Ozone/Filter” mode. EDR pumps 105 and/or 106 provide feed flow to system. The automatic ozone feed control valve is open in this mode. The automated isolation valves open on the ozone full flow injection system and close on the ozone half flow injection system.

### AWT/Ozone/Filter

Operation of the Ozone, BAC filters, microfiltration (MF), ultrafiltration (UF), RO Trains A and B, and the UV/AOP systems are available in the “AWT/Ozone/Filter” mode. Feed flow to the ozone and BAC system is provided by EDR pumps 105 and/or 106 and feed flow to the AWT side (MF, UF, RO, and UV/AOP) by the transfer pump. The automatic ozone feed control valve is open in this mode. The automated isolation valves open on the ozone full flow injection system and close on the ozone half flow injection system.

### Backwash

Operation of one BAC filter in production and one BAC filter in backwash as well as half flow through ozone, full flow through either microfiltration (MF) or ultrafiltration (UF), full flow through either RO Trains A or B, and half flow through the UV/AOP systems are available in the “Backwash” mode. The BAC system PLC controls EDR pumps 105 and 106 in this mode. The automatic ozone feed control valve is open in this mode. The automated isolation valves open on the ozone half flow injection system and close on the ozone full flow injection system.

### Pump Modes

The facility can run with either one or two feed pumps in the following modes: “AWT”, “Ozone/Filter”, and “AWT/Ozone/Filter”. In “Backwash” mode, one feed pump runs, and the VFD on the BAC backwash supply pump will adjust its motor speed automatically when called by the BAC PLC through the ozone PLC to meet the high backwash rate flow setpoint.

## Demonstration Pure Water Facility Major Components

### Feed Pumps

Tertiary effluent is supplied to the facility using the feed pumps. Feed pumps are EDR pumps 105 and 106. Use of a single pump or both pumps simultaneously can be enabled in the main PLC in the “AWT” and “AWT/Ozone/Filter” modes. In “Backwash” mode, a single pump is used. Pressure control of the feed pump and proportional-integral-derivative (PID) tuning is accessible on the feed pump screen on the human machine interface (HMI) also shown below in Figure 109.

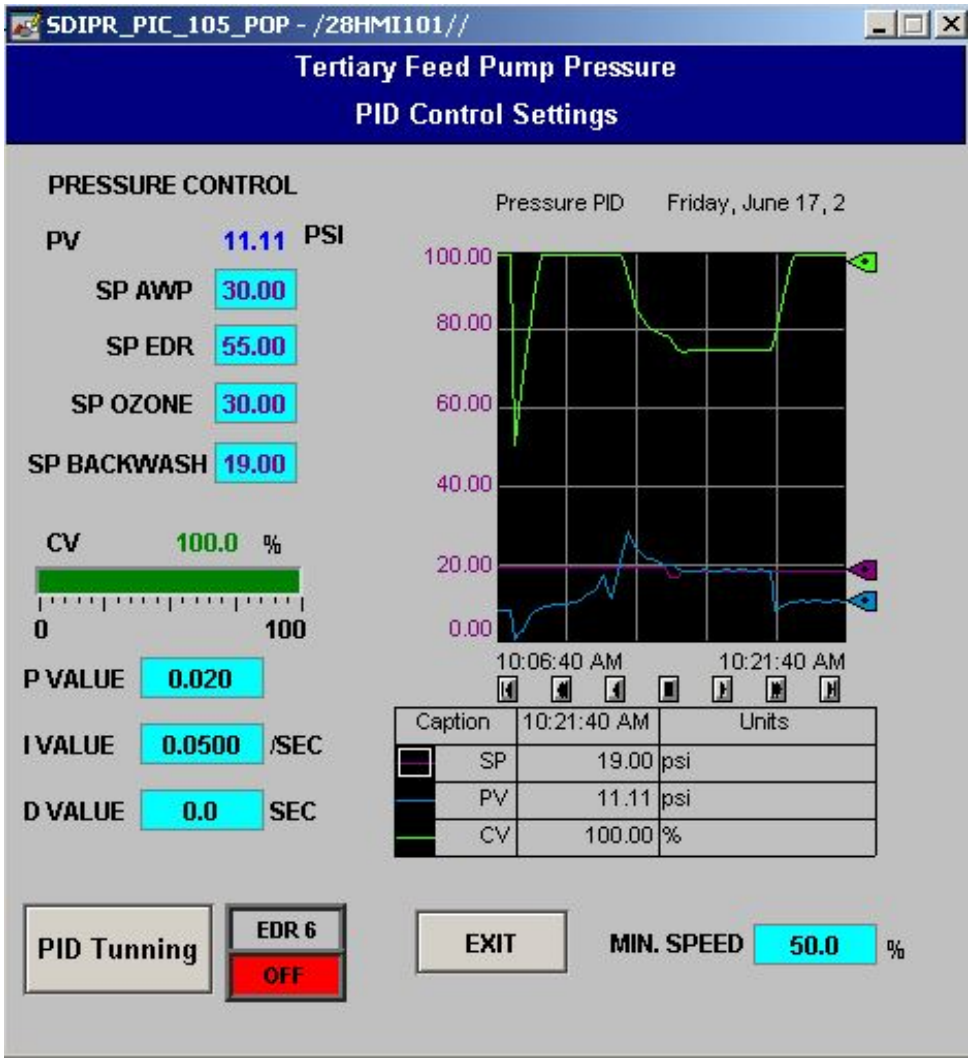


**Figure 109. Feed Pump Screen**

### Transfer Pump

The transfer pump provides Ozone and BAC treated water to the AWT portion of the DPWF (MF/UF, RO, and UV/AOP). The transfer pump is a centrifugal pump that takes water from the BAC Filtrate Tank and delivers process water to the AWT portion of the facility. Pressure control of the transfer pump and PID tuning is accessible on the feed pump screen on the HMI also shown below in Figure 110.

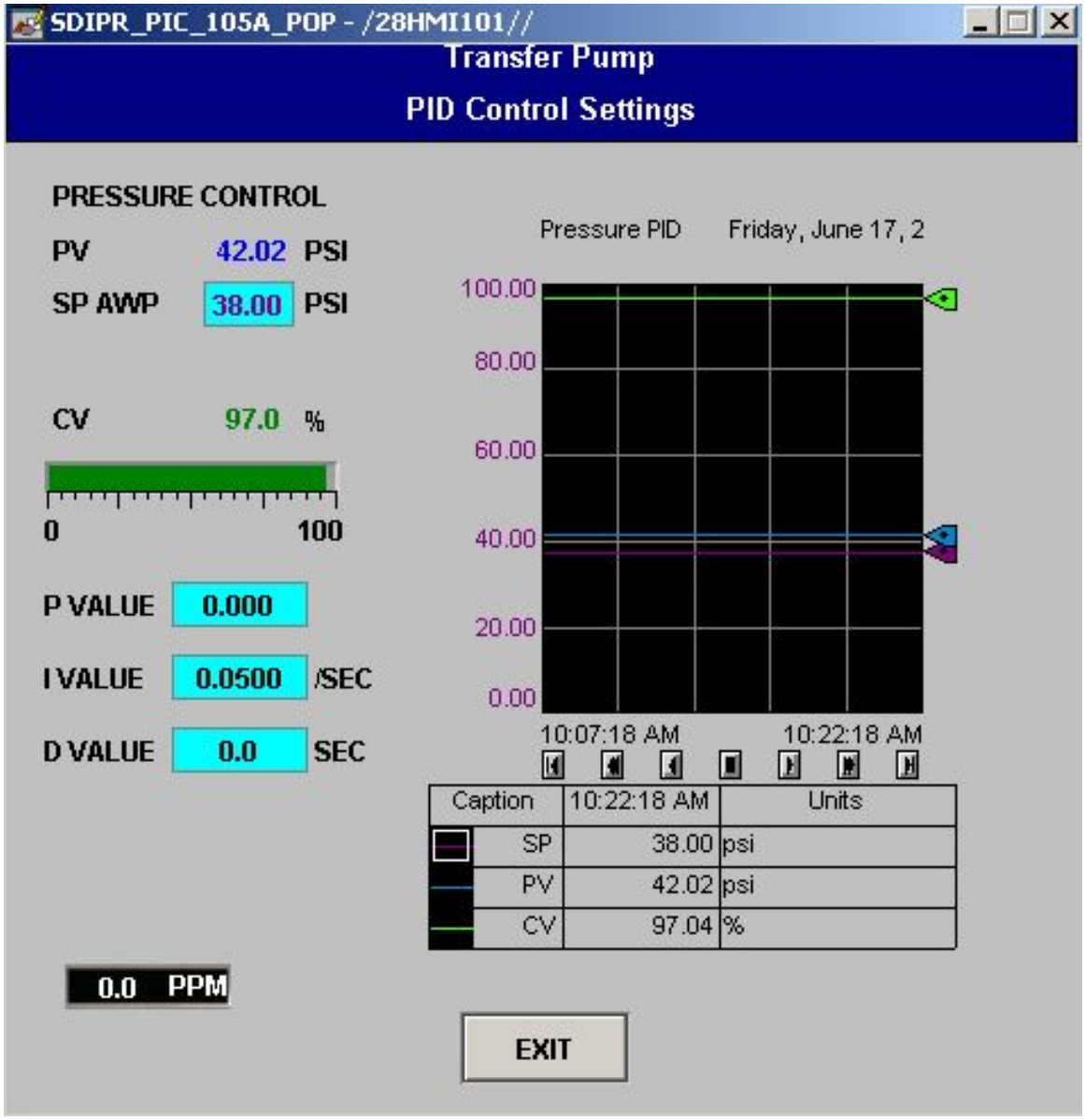


**Figure 110. Transfer Pump Screen**

### Programmable Logic Controllers

There are seven programmable logic controllers (PLCs) and two micro PLCs that control and transmit data and signals. The PLC aliases, names, processes, locations, and descriptions are summarized below in Table 30.

**Table 30. PLC Descriptions**

| Alias | PLC Name & Location | Process/ System | Description/ HMI | IP Address |
|---|---|---|---|---|
| 28-CP-001 | Aria_Skid (located on the MF skid) | Pall MF | 1769-L32E AB CompactLogix, PanelView-Plus 700 | 10.62.13.1 |
| 28-CP-101 | SD28PLC101 (in the control room) | PLC 101 | 1769-L35E AB CompactLogix | 10.62.13.11 |
| 28-CP-201 | North_City _HFUF (located on the UF skid) | H2O Innovation UF | 1769-L32E Compact Logix, PanelView-Plus 700 | 10.62.13.21 |
| 28-CP-401 | RO_Master (located On the RO skid) | Enaqua RO | 1769-L32E CompactLogix, PanelView-Plus 1000 | 10.62.13.41 |
| 28-CP-402 | MCC_Slave (above PLC101 cabinet) | Enaqua RO | 1769-L32E CompactLogix, PanelView-Plus 1000 | 10.62.13.42 |
| PLC_Ozone | Xylem_SMO _Generator (in the ozone container) | Xylem/ Wedeco Ozone | 1769-L72 AB ControlLogix, Panel View-Plus 700 | 10.62.13.50 |
| PLC_BAC | San_Diego _BAF (in the BAC control panel) | Xylem/Leopold BAC | 1769-L35E AB CompactLogix | 10.62.13.53 |
| PLC _Destruct | COD (inside cabinet between BAC filters) | Xylem Catalytical Ozone Destruct | 1766-L32BXB AB MicroLogix 1400, AB C300 | 10.62.13.52 |
| 28-CP-403 | CIP_Slave (Located next to CIP and flush pumps) | Enaqua RO | 1769-L32E AB CompactLogix | 10.62.13.61 |
| 28-CP-801 | UV_Main (inside UV control panel) | Trojan UV | 1769-L35E AB ControlLogix, Panel View-Plus 700 | 10.62.13.81 |
| 28-CP-802 | UV_CCB (inside UV control panel) | Trojan UV | Remote I/O | 10.62.13.83 |

### Human Machine Interface

There is a human machine interface (HMI) available on the main PLC 101. System information and operation of the facility is accessible on the HMI. The HMI aliases, names, processes, and descriptions are summarized below in the table below:

**Table 31. HMI Descriptions**

| Alias | HMI Name | Process/ System | Description/ HMI | IP Address |
|---|---|---|---|---|
| HMI_MF | MF HMI | Pall MF | PanelView-Plus 700 | 10.62.13. 2 |
| HMI101 | PLC 101 HMI | HMI to PLC 101 | PC-XP_Pro SP-3 | 10.62.13. 12 |
| HMI_UF | UF HMI | H2O Innovation UF | PanelView-Plus 700 | 10.62.13. 22 |
| HMI-RO-A | RO-A HMI | Enaqua RO | PanelView-Plus 1000 | 10.62.13. 43 |
| HMI_ Ozone | Wedeco_Ozone HMI | Xylem/Wedec Ozone | PanelView-Plus 700 | 10.62.13. 51 |
| HMI-RO-B | RO-B HMI | Enaquaa RO | PanelView-Plus 1000 | 10.62.13. 62 |
| HMI_UV | UV HMI | Trojan UV | PanelView-Plus 700 | 10.62.13. 82 |
| HMI102 | HMI102 | Client to HMI101 | Desktop PC Win7Ultimate | 10.62.13. 169 |

### Auxiliary Equipment

A summary of the auxiliary equipment aliases, processes, and descriptions are provided in the table below:

**Table 32. Auxiliary Equipment**

| Alias | Process/System | Description/HMI | IP Address |
|---|---|---|---|
| VFD_UF_BW | H2O Innovation UF | UF Backwash Pump VFD | 10.62.13.20 |
| SC1000 | Enaqua RO | SC1000 | 10.62.13.55 |
| GETOC | Xylem/Wedeco Ozone | GE TOC | 10.62.13.54 |
| 28-PP-1 | Pall MF | MF Power Monitor | 10.62.13.100 |
| 28-PP-2 | H2O Innovation UF | UF Power Monitor | 10.62.13.101 |
| 28-PP-3 | Enaqua RO | Ro A Feed Pump Power Monitor | 10.62.13.102 |
| 28-PP-4 | Enaqua RO | Ro A Feed Pump Power Monitor | 10.62.13.103 |
| 28-PP-5 | Enaqua RO | UV Power Monitor | 10.62.13.104 |
| 28-PP-6 | Enaqua RO | UF/RO CIP Pump Power Monitor | 10.62.13.105 |
| 28-PP-7 | Trojan UV | RO Flush Pump Power Monitor | 10.62.13.106 |
| STATION(Nanobeam) | Network link for HMI101 | M5 Nanobeam radio antenna | 10.62.13.182 |
| STATION(Nanobeam) | Network link for HMI101 | M5 Nanobeam radio antenna | 10.62.13.183 |

## Demo Plant Control Architecture

### Description of Masters/Slaves

Messaging and data transmission between the different processors and PLCs is shown in the control system architecture from final submittal sheets 28-I-3 and E-7. The AWT serves as the master and controls all processes. The AWT routes messages to the ozone, which acts as a submaster that routes messages between the BAC and destruct. Configuration of the AWT message blocks is summarized below in Table 33 and the ozone message blocks are summarized below in Table 34.

**Table 33. AWT Message Blocks**

| Unit Process PLC | Process Names | AWT Tags | Location in PLC | Type |
|---|---|---|---|---|
| EDR | EDR_AWT_Real_MSG<br>EDR_AWT_Int_MSG<br>AWT_EDR_Real_MSG<br>AWT_EDR_Int_MSG | EDR_Read[0]<br>EDR_AWT_Int[0]<br>EDR_Write[0]<br>AWT_EDR_Int[0] | F23:100<br>N22:180<br>F23:0<br>N22:190 | Read{Real]*32<br>Read{Integer]*10<br>Write[Real]*32<br>Write[Integer]*10 |
| MF | Msg_MF_Read<br>Msg_MF_Read1<br>Msg_MF_Write | MF_Read[0]<br>RealDataToMain[0]<br>MF_Write[0] | MF.MF_TO_MAIN[0]<br>RealDataToMain[0]<br>MF.MAIN_TO_MF[0] | Read[Real]*32<br>Read[Real]*5<br>Write[Real]*32 |
| UF | Msg_UF_Read<br>Msg_UF_Write | UF_Read[0]<br>UF_Write[0] | INFO_TO_MAIN[0]<br>INFO_FROM_MAIN[0] | Read[Real]*32<br>Write[Real]*32 |
| RO | Msg_RO_Read<br>Msg_RO_Write | RO_Read[0]<br>RO_Write[0] | MASTER_DATA[0]<br>MASTER_COMMAND[0] | Read[Real]*64<br>Write[Real]*64 |
| UV | Msg_UV_Read<br>Msg_UV_Write | UV_Read[0]<br>UV_Write[0] | N_SCADA_system[0]<br>N_SCADA_system_ctrl[0] | Read[Real]*32<br>Write[Real]*32 |

**Table 34. Ozone Message Blocks**

| Processor Names | AWT Tags | EDR PLC | Type |
|---|---|---|---|
| EDR_WEDECO_INT_MSG | EDR_WEDECO_INT[0] | N22:190 | Read[Integer]*10 |
| EDR_WEDECO_REAL_MSG | EDR_WEDECO_REAL[0] | F23:20 | Read[Real]*10 |
| WEDECO_EDR_INT_MSG | WEDECO_EDR_INT[0] | N22:180 | Write[Integer]*10 |
| WEDECO_EDR_REAL_MSG | WEDECO_EDR_REAL[0] | F23:110 | Write[Real]*10 |

### Communication Block Diagrams

DPWF communication block diagrams can be found in the Appendix. The record drawings and source documents are summarized below.

**Table 35. DPWF Communication Block Diagrams**

| Diagram | Document Source | Sheet Number |
|---|---|---|
| MF/UF, RO, and UV/AOP Communication Block Diagram (Control System Architecture) | Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility at North City WRP Drawings | 32 |
| Ozone and BAC Communication Block Diagram (Communication Block Diagram) | Implementation of the Advanced Water Purification Facility Extended Testing-Phase 2 Drawings | 17 |

### Permissive to Run

The permissive to run is controlled by the prevailing feed mode. Feed mode control, parameter setpoints for operation, and critical parameters for AWT and ozone operation are included in the Feed Mode Control Selection screen. In addition, safety latch resets for Ozone/BAC shutdown and high ozone feed pressure is also located on this screen. Feed mode control selection located on the left side of the screen controls run permissives.

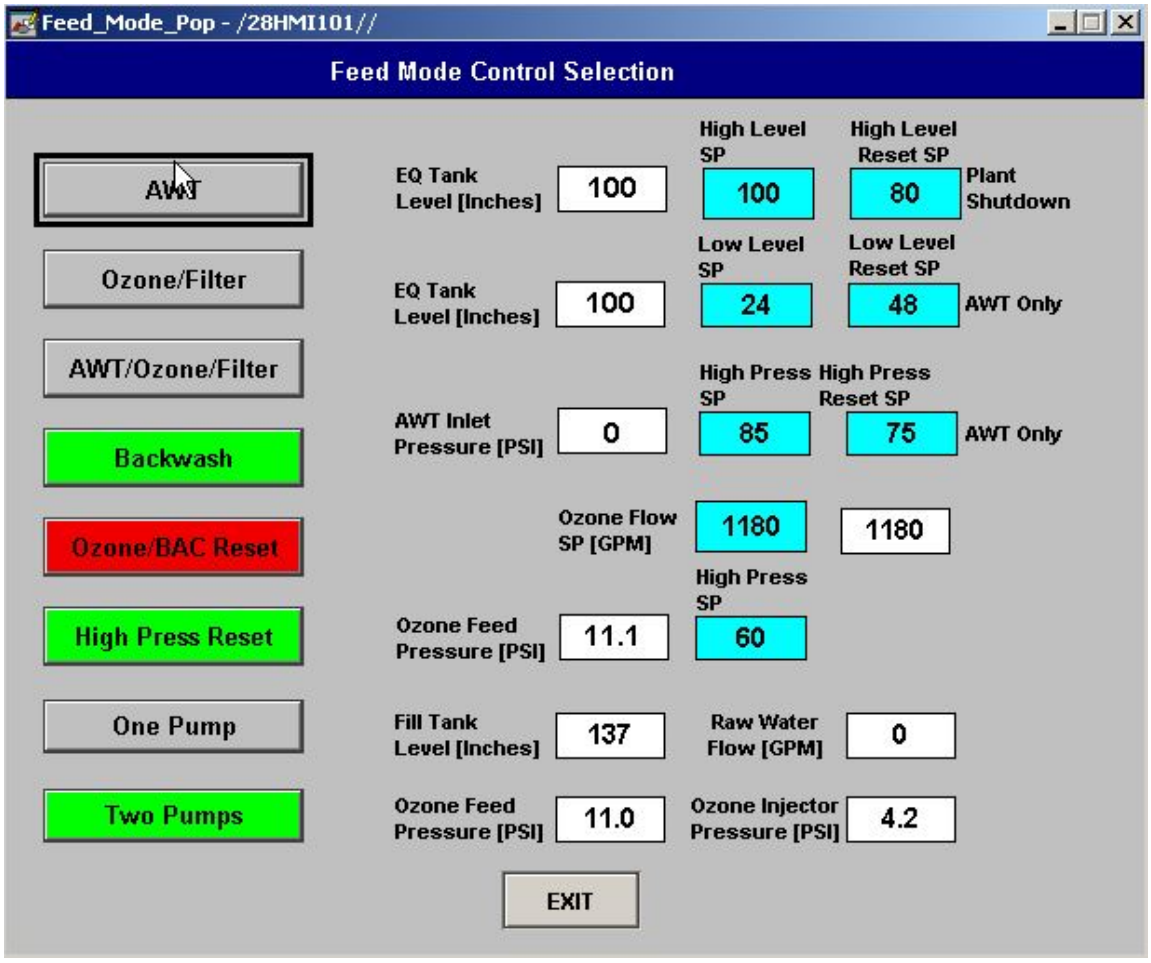


**Figure 111. DPWF Feed Mode Screen**

### Advanced Water Treatment (AWT)

In the “AWT” mode, the main PLC 101 sends out the PID control variable and permissive to feed pump(s) 105 and/or 106 variable frequency drive (VFD) and feed pump PID controls pump output to match the feed pump pressure setpoint and MF/UF flow setpoints.

### Ozone/Filter

In “Ozone/Filter” mode, the ozone PLC sends out a request to the main PLC 101 to start feed pump(s) 105 and/or 106 directly. The feed pump PID controls:

- Pump output to match the feed pump pressure setpoint
- The control valve to match the ozone flow setpoint controls feed to the ozone inlet

The ozone PLC opens the automated isolation valves on the ozone full flow injection system and closes the automated isolation valves on the ozone half flow injection system.

### AWT/Ozone/Filter

In “AWT/Ozone/Filter” mode, the ozone PLC sends out a request to the main PLC 101 and EDR PLC for feed pump(s) 105 and/or 106 to start. The feed pump PID controls:

- Pump output to match the feed pump pressure setpoint.
- The control valve to match the ozone flow setpoint controls feed to the ozone inlet.

The ozone PLC opens the automated isolation valves on the ozone full flow injection system and closes the automated isolation valves on the ozone half flow injection system.

When AWT startup is initiated, the main PLC sends out a permissive to the transfer pump and the transfer pump PID controls pump output to match AWP pressure setpoint.

### Backwash

In “Backwash” mode, the BAC PLC makes the call through the ozone PLC to the feed pump(s) 105 or 106, and the feed pump PID controls:

- Pump output to match the feed pump pressure setpoint.
- The control valve to match the ozone flow setpoint controls feed to the ozone inlet.

The ozone PLC opens the automated isolation valves on the ozone half flow injection system and closes the automated isolation valves on the ozone full flow injection system.

When a high flow rate backwash is requested, the BAC PLC will adjust the speed of the BAC backwash supply pump VFD.

### Distributed Control Systems

The tags, input, and output recorded in the distributed control system (DCS) for the facility is summarized below in Table 36 and Table 37.

**Table 36. DCS Tags**

| Double Integer | Description |
|---|---|
| 0 | MF/UF Mode |
| 1 | Pump speed required (in %) for pressure control |
| 2 | Spare |
| 3 | MF Flow (28-FIT-301) |
| 4 | MF Backwash Flow (28-FIT-001) |
| 5 | MF Effluent Turbidity (28-AIT-002) |
| 6 | UF Flow (28-FIT-302) |
| 7 | UF Backwash Flow (28-FIT-270) |
| 8 | UF Effluent Turbidity (28-AIT-260) |
| 9 | RO Influent Conductivity (28-AIT-400) |
| 10 | RO Train A Product Water Flow (28-FIT-402) |
| 11 | RO Train A Product Water Conductivity (28-AIT-401) |
| 12 | RO Train A Waste Flow (28-FIT-403) |
| 13 | RO Train B Product Flow (28-FIT-503) |
| 14 | RO Train B Product Water Conductivity (28-AIT-501) |
| 15 | RO Train B Waste Flow (28-FIT-504) |
| 16 | Discrete Status Bits |
| 17 | Watchdog Timer |
| 18 | Feed Pump Speed Command from AWT PID (Feed_Speed_Command) |
| 19 | AWT Feed Pressure (A28-PI-105) |
| 20 | Ozone Injector Flow Set Point (RemoteSP_Real[0]) |
| 21 | Spare |
| 22 | Spare |
| 23 | Spare |
| 24 | Spare |
| 25 | Spare |
| 26 | Spare |
| 27 | Spare |
| 28 | Spare |
| 29 | Spare |
| 30 | Spare |
| 31 | Spare |

**Table 37. Local I/O to PLC 101**

| Description | Tag Number |
|---|---|
| INFLUENT TURBIDITY ANALYZER FAIL | XA-101 |
| INFLUENT pH ANALYZER FAIL | XA-102 |
| A28_DI_HS_110_Remote | XA-306 |
| SUMP PUMP AUTO STATUS | HS-170 |
| SUMP PUMP RUNNING STATUS | YL-170 |
| SUMP PUMP FAIL STATUS | XA-170 |
| MF SYSTEM FAIL | XA-301 |
| UF SYSTEM FAIL | XA-302 |
| MF/UF FILTRATE STORAGE TANK FAIL STATUS | XA-307 |
| MF/UF FILTRATE STORAGE TANK LOW LEVEL | LSL-303 |
| MF/UF FILTRATE STORAGE TANK HIGH LEVEL | LSH-303 |
| MF/UF ORP ANALYZER FAIL | XA-304 |
| RO TOTAL CHLORINE FAIL | XA-305 |
| RO FLOW FAIL | XA-191 |
| SPARE XA-941 | XA-192 |
| SODIUM HYPOCHLORITE TANK LEVEL TRANSMITTER FAIL STATUS | XA-941 |
| SODIUM HYPOCHLORITE TANK LOW LEVEL | LSL-941 |
| SODIUM HYPOCHLORITE TANK HIGH LEVEL | LSH-941 |
| SULFURIC ACID PUMP 1 REMOTE STATUS | HS-910 |
| SULFURIC ACID PUMP 1 RUNNING STATUS | YS-910 |
| SULFURIC ACID PUMP 1 FAIL | XA-910 |
| SULFURIC ACID PRESSURE HIGH | PSH-912 |
| SODIUM HYPOCHLORITE PUMP 1 REMOTE STATUS | HS-940 |
| SODIUM HYPOCHLORITE PUMP 1 RUNNING STATUS | HS-940 |
| SODIUM HYPOCHLORITE PUMP 1 FAIL | XA-940 |
| SODIUM HYPOCHLORITE PUMP PRESSURE HIGH | PSH-942 |
| AMMONIUM HYDROXIDE TANK LEVEL TRANSMITTER FAIL STATUS | XA-931 |
| AMMONIUM HYDROXIDE TANK LOW LEVEL | LSL-931 |
| AMMONIUM HYDROXIDE TANK HIGH LEVEL | LSH-931 |

| Description | Tag Number |
|---|---|
| ANTISCALANT PUMP 1 REMOTE STATUS | HS-920 |
| ANTISCALANT PUMP 1 RUNNING STATUS | HS-920 |
| ANTISCALANT PUMP 1 FAIL | XA-920 |
| ANTISCALANT PRESSURE HIGH | PSH-932 |
| AMMONIUM HYDROXIDE PUMP 1 REMOTE STATUS HS-920 | HS-930 |
| AMMONIUM HYDROXIDE PUMP 1 RUNNING STATUS | HS-930 |
| AMMONIUM HYDROXIDE PUMP 1 FAIL | XA-930 |
| AMMONIUM HYDROXIDE PRESSURE HIGH | PSH-932 |
| 120VAC POWER FAIL IN UPS POWER | XA-181 |
| 120VAC/24VDC POWER SUPPLY 1 FAIL | XA=182 |
| 120VAC/24VDC POWER SUPPLY 2 FAIL | XA-183 |
| SULFURIC ACID TANK LEVEL TRANSMITTER FAIL STATUS | XA-911 |
| SULFURIC ACID TANK LOW LEVEL | LSL-911 |
| SULFURIC ACID TANK HIGH LEVEL | LSH-911 |
| HYDROGEN PEROXIDE TANK LEVEL TRANSMITTER FAIL STATUS | XA-811 |
| HYDROGEN PEROXIDE TANK LO-LO LEVEL | LSL-811 |
| HYDROGEN PEROXIDE TANK HIGH LEVEL | LSH-911 |
| Sulfuric Acid Containment Leak | LSH-913 |
| Sulfuric Acid Pipe Leak | LSH-914 |
| ROI AntiScalant Pump Running | Spare |
| DISINFECTION CARRIER WATER PUMP START/STOP COMMAND | HS-1108 |
| SULFURIC ACID PUMP 1 START/STOP COMMAND | HS-910 |
| SODIUM HYPOCHLORITE PUMP 1 START/STOP COMMAND | HS-940 |
| ANTISCALANT PUMP 1 START/STOP COMMAND | HS-920 |
| AMMONIUM HYDROXIDE PUMP START/STOP COMMAND | HS-930 |
| TRANSFER PUMP VFD START/STOP | TransPump_VFD_Call |
| INFLUENT TURBIDITY | AIT-101 |
| INFLUENT pH | AIT-102 |
| INFLUENT TEMPERATURE | AIT-102 |
| MF/UF SYSTEM TOTAL CHLORINE | AIT-306 |

| Description | Tag Number |
|---|---|
| MF SYSTEM FLOW | FIT-301 |
| UF SYSTEM FLOW | FIT-302 |
| MF/UF FILTRATE STORAGE TANK LEVEL | LIT-307 |
| MF/UF ORP | AIT-304 |
| RO TOTAL CHLORINE FAIL | AIT-305 |
| RO FLOW | FIT-191 |
| RO TOC | AIT-192 |
| SODIUM HYPOCHLORITE TANK LEVEL | LIT-941 |
| SULFURIC ACID PUMP 1 SPEED FEEDBACK | SI-910 |
| SODIUM HYPOCHLORITE PUMP 1 SPEED FEEDBACK | SC-940 |
| AMMONIUM HYDROXIDE TANK LEVEL | LIT-931 |
| ANTISCALANT PUMP 1 SPEED FEEDBACK | SC-920 |
| AMMONIUM HYDROXIDE PUMP 1 SPEED FEEDBACK | SC-930 |
| SULFURIC ACID TANK LEVEL | LIT-911 |
| PLANT INFLUENT TERT. FILTERS pH ANALYZER | AIT-103 |
| PRESSURE TRANSMITTER | PIT-105 |
| TRANSFER PUMP VFD SPEED | TransPumpVFD_Speed |
| SULFURIC ACID PUMP 1 SPEED CONTROL | SC-910 |
| SODIUM HYPOCHLORITE PUMP 1 SPEED CONTROL | SC-940 |
| ANTISCALANT PUMP 1 SPEED CONTROL | SC-920 |
| AMMONIUM HYDROXIDE PUMP 1 SPEED CONTROL | SC-930 |
| TRANSFER PUMP SPEED COMMAND | TransPump_VFD_Speed_AO |
| BLEACH AOP PUMP SPEED COMMAND | PostROCL2SpeedRef |

## Demonstration Pure Water Facility Controls and Communications

### Communications Mapping

Communication description- data is written from AWT PLC (CompactLogix) LocalENB TCP-IP to DataLink module GW1000 converting TCP-IP data to AB DHPlus to EDR Master PLC (SLC504) and read by the Ozone PLC (CompactLogix) via 1756-DH+ Bridge/IO Scanner. Similarly, data written from the Ozone PLC is converted to AB DHPlus format and read by the AWT Master PLC.

A heartbeat is sent and received between the PLC CPU's to ensure communications throughput.

The pathways for communication between the Ozone and BAC are shown below in Table 38 and Table 39.

**Table 38. Ozone to BAC Communication Pathways**

| Tag | Format | Description | Meaning |
|---|---|---|---|
| WEDCO_TAG[0] | DINT | Copy of Running Timer from BAC System | Heartbeat for Com. Lost |
| WEDCO_TAG[1].0 | Member of DINT | A Pump is Running | One of the Pumps is running |
| WEDCO_TAG[1].1 | Member of DINT | Ozone shutdown | I can not run |
| WEDCO_Tag[1].2 | Member of DINT | System Shutdown | I can not run |
| WEDCO_TAG[2] | DINT | Feed Flow | Feed Flow to Filters From the WEDCO PLC |

**Table 39. BAC to Ozone Communication Pathways**

| Tag | Format | Description | Meaning |
|---|---|---|---|
| LEOPOLD_TAG.DINT_DATA[0] | DINT | Running Timer | Heartbeat for Com. Loss |
| LEOPOLD_TAG.DINT_DATA[1].0 | Member of DINT | | Not Used |
| LEOPOLD_TAG.DINT_DATA[1].1 | Member of DINT | Start Feed Pump | Start a Pump to Feed the Filters through Ozone |
| LEOPOLD_TAG.DINT_DATA[1].2 | Member of DINT | | Not Used |
| LEOPOLD_TAG.DINT_DATA[1].3 | Member of DINT | Manual Mode | Both Filters are in Manual |

| Tag | Format | Description | Meaning |
|---|---|---|---|
| LEOPOLD_TAG.DINT_DATA[2] | DINT | Filter 1 state | 0=OFF, 1=FILTERING, 2=BACKWASHING, 3=Bumping |
| LEOPOLD_TAG.DINT_DATA[3] | DINT | Filter 2 state | 0=OFF, 1=FILTERING, 2=BACKWASHING, 3=Bumping |
| LEOPOLD_TAG.DINT_DATA[4] | DINT | Filter 1 hours | Hours filter has been filtering since last backwash |
| LEOPOLD_TAG.DINT_DATA[5] | DINT | Filter 1 minutes | Minutes filter has been filtering since last backwash |
| LEOPOLD_TAG.DINT_DATA[6] | DINT | Filter 2 hours | Hours filter has been filtering since last backwash |
| LEOPOLD_TAG.DINT_DATA[7] | DINT | Filter 2 minutes | Minutes filter has been filtering since last backwash. |
| LEOPOLD_TAG.REAL_DATA[0] | REAL | Filter 1 flowrate | In Engineering Units (0-630 GPM) |
| LEOPOLD_TAG.REAL_DATA[1] | REAL | Filter 1 headloss | In Inches (0-144IN/WC) |
| LEOPOLD_TAG.REAL_DATA[2] | REAL | Filter 1 NTU | In NTU (0-1.000 NTU) |
| LEOPOLD_TAG.REAL_DATA[3] | REAL | Filter 2 flowrate | In Engineering Units (0-630 GPM) |
| LEOPOLD_TAG.REAL_DATA[4] | REAL | Filter 2 headloss | In Inches (0-144In/WC) |
| LEOPOLD_TAG.REAL_DATA[5] | REAL | Filter 2 NTU | In NTU (0-1.000 NTU) |

| Tag | Format | Description | Meaning |
|---|---|---|---|
| LEOPOLD_TAG.REAL_DATA[6] | REAL | Feed tank level | Feed tank level In feet (0-15 feet) |
| LEOPOLD_TAG.REAL_DATA[7] | REAL | MF/UF Filtrate Tank level | Effluent/Waste Tank Level in feet (0-16 feet) |

The pathways for communication between Ozone, AWT, and EDR are shown below in Table 40 and Table 40.

**Table 40. AWT to Ozone PLC Communication Pathway**

| AWT PLC → | EDR PLC→ | Ozone PLC | Description | Format |
|---|---|---|---|---|
| AWT_EDR_INT[0] | N22:190 | EDR_WEDECO_INT[0] | AWT Discrete Bits (AWT-EDR-Int) | Integer |
| AWT_EDR_INT[0].0 | N22:190/0 | EDR_WEDECO_INT[0].0 | Remote Start to Ozone | Integer |
| AWT_EDR_INT[0].1 | N22:190/1 | EDR_WEDECO_INT[0].1 | Remote Set Point Trigger | Integer |
| AWT_EDR_INT[0].2 | N22:190/2 | EDR_WEDECO_INT[0].2 | Spare | Integer |
| AWT_EDR_INT[0].3 | N22:190/3 | EDR_WEDECO_INT[0].3 | Spare | Integer |
| AWT_EDR_INT[0].4 | N22:190/4 | EDR_WEDECO_INT[0].4 | Spare | Integer |
| AWT_EDR_INT[0].5 | N22:190/5 | EDR_WEDECO_INT[0].5 | Spare | Integer |
| AWT_EDR_INT[0].6 | N22:190/6 | EDR_WEDECO_INT[0].6 | Spare | Integer |
| AWT_EDR_INT[0].7 | N22:190/7 | EDR_WEDECO_INT[0].7 | Spare | Integer |
| AWT_EDR_INT[0].8 | N22:190/8 | EDR_WEDECO_INT[0].8 | Spare | Integer |
| AWT_EDR_INT[0].9 | N22:190/9 | EDR_WEDECO_INT[0].9 | Spare | Integer |
| AWT_EDR_INT[0].10 | N22:190/10 | EDR_WEDECO_INT[0].10 | Call Two Feed Pumps | Integer |
| AWT_EDR_INT[1] | N22:191 | EDR_WEDECO_INT[1] | Watchdog (Date-Time[5]) | Integer |
| AWT_EDR_INT[2] | N22:192 | EDR_WEDECO_INT[2] | Feed Mode Selected (Feed-Mode) 0=AWT, 1=Ozone/Filter, 2=AWT/Ozone/Filter, 3=Backwash. | Integer |
| EDR_Write[20] | F23:20 | EDR_WEDECO_REAL[20] | Ozone Injector Flow Set Point (RemoteSP-Real[0]) | Double Integer |

**Table 41. Ozone to AWT PLC Communication Pathway**

| Ozone PLC→ | EDR PLC→ | AWT PLC | Description | Format |
|---|---|---|---|---|
| WEDECO_EDR_REAL[0] | F23:110 | EDR_Read[10] | Pre-Injector Pressure (Injector-Pre-Pressure) | Double Integer |
| WEDECO_EDR_REAL[1] | F23:111 | EDR_Read[11] | Post-Injector Pressure (Injector-Post-Pressure) | Double Integer |
| WEDECO_EDR_REAL[2] | F23:112 | EDR_Read[12] | Injector Flow (Injector-Flow) | Double Integer |
| WEDECO_EDR_REAL[3] | F23:113 | EDR_Read[13] | Fill Tank Level (Fill_Tank_Lev) | Double Integer |
| WEDECO_EDR_REAL[4] | F23:114 | EDR_Read[14] | EQ Tank Level (Fill_Tank_Lev) | Double Integer |
| WEDECO_EDR_REAL[5] | F23:115 | EDR_Read[15] | Injector Flow Set Point [(EDR-Read-15) | Double Integer |
| WEDECO_EDR_REAL[6] | F23:116 | EDR_Read[16] | Spare | Double Integer |
| WEDECO_EDR_INT[0] | N22:180 | EDR_AWT_Int[0] | Ozone Discrete Bits | Integer |
| WEDECO_EDR_INT[0].0 | N22:180/0 | EDR_AWT_Int[0].0 | Start Feed Pumps | Integer |
| WEDECO_EDR_INT[0].1 | N22:180/1 | EDR_AWT_Int[0].1 | Ozone/Filters Shut Down | Integer |
| WEDECO_EDR_INT[0].2 | N22:180/2 | EDR_AWT_Int[0].2 | Filter in Backwash Stage 2 Call Two Feed Pumps | Integer |
| WEDECO_EDR_INT[0].3 | N22:180/3 | EDR_AWT_Int[0].3 | Dew Point Check on Start-up | Integer |
| WEDECO_EDR_INT[0].4 | N22:180/4 | EDR_AWT_Int[0].4 | Injector Pressure Transmitter XDCR Fail | Integer |
| WEDECO_EDR_INT[0].5 | N22:180/5 | EDR_AWT_Int[0].5 | Ozone Critical Alarm/Generator Off | Integer |
| WEDECO_EDR_INT[0].6 | N22:180/6 | EDR_AWT_Int[0].6 | BAC- Filter in Backwash | Integer |
| WEDECO_EDR_INT[0].7 | N22:180/7 | EDR_AWT_Int[0].7 | Phase Monitor Failure | Integer |
| WEDECO_EDR_INT[0].8 | N22:180/8 | EDR_AWT_Int[0].8 | Inverter Cab. Temp High/AC Failure | Integer |
| WEDECO_EDR_INT[0].9 | N22:180/9 | EDR_AWT_Int[0].9 | Rectifier DC Not OK | Integer |

| Ozone PLC→ | EDR PLC→ | AWT PLC | Description | Format |
|---|---|---|---|---|
| WEDECO_EDR_INT[0].10 | N22:180/10 | EDR_AWT_Int[0].10 | Destruct Alarms | Integer |
| WEDECO_EDR_INT[0].11 | N22:180/11 | EDR_AWT_Int[0].11 | TOC Deviation Alarm | Integer |
| WEDECO_EDR_INT[0].12 | N22:180/12 | EDR_AWT_Int[0].12 | High Ozone Feed Pressure | Integer |
| WEDECO_EDR_INT[0].13 | N22:180/13 | EDR_AWT_Int[0].13 | Spare | Integer |
| WEDECO_EDR_INT[0].14 | N22:180/14 | EDR_AWT_Int[0].14 | Spare | Integer |
| WEDECO_EDR_INT[0].15 | N22:180/15 | EDR_AWT_Int[0].15 | Spare | Integer |
| WEDECO_EDR_INT[1] | N22:181 | EDR_AWT_Int[1] | WEDECO RTC Seconds (Heartbeat) | Integer |
| WEDECO_EDR_INT[2] | N22:182 | EDR_AWT_Int[2] | BAC Filter 1 State | Integer |
| WEDECO_EDR_INT[3] | N22:183 | EDR_AWT_Int[3] | BAC Filter 2 State | Integer |
| WEDECO_EDR_INT[4] | N22:184 | EDR_AWT_Int[4] | Ozone Plant Pump Pressure | Integer |
| WEDECO_EDR_INT[5] | N22:185 | EDR_AWT_Int[5] | Spare | Integer |

The pathways for communication between AWT and EDR are shown below in Table 42 and Table 43.

**Table 42. EDR and AWT PLC Communication Pathway**

| EDR PLC→ | AWT PLC | Description | Format |
|---|---|---|---|
| F23:100 | EDR_Read[0] | Feed Pump Status (1 = Running, 0 = Stopped/Failed) | Double Integer |
| F23:101 | EDR_Read[1] | EDR Flow | Double Integer |
| F23:102 | EDR_Read[2] | Watchdog Timer | Double Integer |
| F23:103 | EDR_Read[3] | EDR Running Status (Bit 0 = EDR 4, Bit 1 = EDR 5, and Bit 2 = EDR 6) | Double Integer |
| F23:104 | EDR_Read[4] | Feed Conductivity (30-AIT-615) | Double Integer |
| F23:105 | EDR_Read[5] | Feed Turbidity(25-AIT-673 or 25-AIT-674) | Double Integer |
| F23:106 | EDR_Read[6] | Spare | Double Integer |

**Table 43. AWT to EDR Communication Pathway**

| AWT PLC→ | EDR PLC | Description | Format |
|---|---|---|---|
| EDR_Write[0] | F23:0 | MF/UF Mode | Double Integer |
| EDR_Write[1] | F23:1 | Pump Speed Set Point based on Feed Pressure (A28-PIC-105) | Double Integer |
| EDR_Write[2] | F23:2 | Spare | Double Integer |
| EDR_Write[3] | F23:3 | MF+UF Flow [GPM] (A28-FI-301/302) | Double Integer |
| EDR_Write[4] | F23:4 | MF Backwash Flow (A28-FI-001) | Double Integer |
| EDR_Write[5] | F23:5 | MF Effluent Turbidity (A28-AI-002) | Double Integer |
| EDR_Write[6] | F23:6 | UF Flow (A28_FI_302) | Double Integer |
| EDR_Write[7] | F23:7 | UF Backwash Flow (UF-Read-[12]) | Double Integer |
| EDR_Write[8] | F23:8 | UF Effluent Turbidity (A28-AI-260) | Double Integer |
| EDR_Write[9] | F23:9 | RO Influent Conductivity (A28-FI-402) | Double Integer |

| AWT PLC→ | EDR PLC | Description | Format |
|---|---|---|---|
| EDR_Write[10] | F23:10 | RO Train A Product Water (A28-AI-401) | Double Integer |
| EDR_Write[11] | F23:11 | RO Train A Product Water Conductivity (28-AIT-401) | Double Integer |
| EDR_Write[12] | F23:12 | RO Train A Waste Flow (28-FIT-403) | Double Integer |
| EDR_Write[13] | F23:13 | RO Train B Product Water Flow (28-FIT-503) | Double Integer |
| EDR_Write[14] | F23:14 | RO Train B Product Water Conductivity (28-AIT-501) | Double Integer |
| EDR_Write[15] | F23:15 | RO Train B Waste Flow (28-FIT-504) | Double Integer |
| EDR_Write[16] | F23:16 | Skid_On/Off_Status- Bit[s] 0=MF,1=UF, 2=RO1, 3=RO2, 4=UV (Skid-Running-Status) | Double Integer |
| EDR_Write[17] | F23:17 | Watchdog (Seconds-Past-Midnight-28-CP-101) | Double Integer |
| EDR_Write[18] | F23:18 | Feed Pump Speed Command from AWT PID (Feed-Speed-Command) | Double Integer |
| EDR_Write[19] | F23:19 | AWT Feed Pressure (A28-PI-105) | Double Integer |

### Demonstration Pure Water Facility Global Alarms

Alarms are arranged into different severity categories. Alarms with a severity category of 1000 will cause shutdown of the AWT and at times, the ozone and BAC system and an alarm callout will be sent out to notify operators. Alarms with a severity category of <500 will send an alarm callout to notify operators will be logged in the alarms summary and history. Alarms with severity category <500 serve as a warning for potential critical conditions and do not cause shutdowns. Alarm callouts are transmitted through the Win911 Alarm System. Critical alarm call outs, description, severity category, and system response to alarm is presented below in Table 44.

**Table 44. Demonstration Pure Water Facility Global Critical Alarms Summary**

| Alarm | Description | System Response | Shutdown and Alarm Unlatch Setpoints | Delay |
|---|---|---|---|---|
| RO Feed High High ORP | Prevents exposure of free chlorine to RO membranes | AWT shuts down | High High setpoint: 650 mV | 180 min. |
| RO Feed High High Free Chlorine | Prevents exposure of free chlorine to RO membranes | AWT shuts down | High High Setpoint: 0.3 ppm | 1 min. |
| Filtrate High High Chlorine | Prevents exposure of free chlorine to RO membranes | AWT shuts down | High High Setpoint: 4.5 ppm | 180 sec. |
| Ammonium Hydroxide Contain. Level High | Possible chemical spill or other liquid in containment | AWT shuts down | Physical contact at containment generates alarm | 3 sec. |
| Sodium Hypochlorite Contain. Level High | Possible chemical spill or other liquid in containment | AWT shuts down | Physical contact at containment generates alarm | 30 sec. |
| Feed Pumps Failure | Feed pump communication failure or fault | Ozone, BAC, and AWT shut down if in AWT/Ozone/Filter or Backwash mode. AWT shuts down if in AWT mode | Not a setpoint driven critical alarm | 30 sec. |
| Ozone_Filter_Shutdown _Alm | Alarm accompanies any alarm that shuts down ozone and BAC system | Ozone, BAC, and AWT shuts down if in AWT/Ozone/Filter or Backwash Mode. No system response if in AWT mode | Not a setpoint driven critical alarm | 30 sec. |
| Ozone Inverter Temp High Head | Ozone alarm shuts down ozone generator | Ozone, BAC, and AWT shuts down if in AWT/Ozone/Filter or Backwash Mode. No system response if in AWT mode | Not a setpoint driven critical alarm | 30 sec. |

| Alarm | Description | System Response | Shutdown and Alarm Unlatch Setpoints | Delay |
|---|---|---|---|---|
| OzoneDiconNotOK | Ozone alarm shuts down ozone generator | Ozone, BAC, and AWT shuts down if in AWT/Ozone/Filter or Backwash Mode. No system response if in AWT mode | Not a setpoint driven critical alarm | 30 sec. |
| OzoneInverterTempHigh Heat | Ozone alarm shuts down ozone generator | Ozone, BAC, and AWT shuts down if in AWT/Ozone/Filter or Backwash Mode. No system response if in AWT mode | Not a setpoint driven critical alarm | 30 sec. |
| OzoneCriticalAlarmGen eratorOff | Ozone alarm shuts down ozone generator | Ozone, BAC, and AWT shuts down if in AWT/Ozone/Filter or Backwash Mode. No system response if in AWT mode | Not a setpoint driven critical alarm | 30 sec. |
| Ozone_CommFailure | Ozone PLC communication failure with main PLC or EDR PLC | Ozone, BAC, and AWT shuts down if in AWT/Ozone/Filter or Backwash Mode. No system response if in AWT mode | Not a setpoint driven critical alarm | 0 sec. |
| OzonePhaseMoniitorFail ure | Ozone alarm shuts down ozone generator | Ozone, BAC, and AWT shuts down if in AWT/Ozone/Filter or Backwash Mode. No system response if in AWT mode | Not a setpoint driven critical alarm | 30 sec. |
| Critical Alarm Shutdown | Accompanies any critical alarm that causes shutdown | AWT shuts down | Not a setpoint driven critical alarm | 0 sec. |

| Alarm | Description | System Response | Shutdown and Alarm Unlatch Setpoints | Delay |
|---|---|---|---|---|
| MF Alarm Critical | Critical alarm on MF system | MF and non-lead RO train shuts down | Not a setpoint driven critical alarm | 0 sec. |
| UF Alarm Critical | Critical alarm on UF system | UF and non-lead RO train shuts down | Not a setpoint driven critical alarm | 0 sec. |
| UV Alarm Critical | Critical alarm on UV system | AWT shuts down | Not a setpoint driven critical alarm | 0 sec. |
| RO Train A Alarm Critical | Critical alarm on RO Train A | AWT shuts down | Not a setpoint driven critical alarm | 0 sec. |
| RO Train B Alarm Critical | Critical alarm on RO Train B | AWT shuts down | Not a setpoint driven critical alarm | 0 sec. |
| Filtrate Storage Tank Hi Hi Level | MF/UF filtrate storage tank level too high | AWT shuts down | High High setpoint: 19.5 ft | 0 sec. |
| Filtrate Storage Tank Lo Lo Level | MF/UF filtrate storage tank too low | AWT shuts down | Low Low setpoint: 3 ft | 0 sec. |
| Antiscalant Low Flow | Antiscalant pump status down | AWT shuts down | Not a setpoint driven critical alarm | 120 sec. |
| Ozone Comm Fail with AWT | Communication failure from ozone to AWT | AWT shuts down | Not a setpoint driven critical alarm | 5 sec. |
| AWT Comm Fail with Ozone | Communication failure from AWT to ozone | AWT shuts down | AWT shuts down | 5 sec. |
| Sulfuric Acid Tank Lo Lo Level | Sulfuric acid tank level too low | AWT shuts down | Low Low Setpoint: 1 ft | 20 sec. |

| Alarm | Description | System Response | Shutdown and Alarm Unlatch Setpoints | Delay |
|---|---|---|---|---|
| Ozone Feed Pressure High | Protects ozone and piping from high pressure spikes | Ozone, BAC, and AWT shut down if in AWT/Ozone/Filter or Backwash mode. No response in AWT mode | High High Setpoint: 65 psi | 5 sec. |
| AWT Feed Pressure High | Protects AWT and piping from high pressure spikes | AWT shuts down | High High setpoint: 80 psi<br>High Pressure reset: 70 psi | 0 sec. |
| Tertiary Effluent CL2 Residual Hi Hi | High chlorine residual in tertiary effluent | AWT shuts down | AWT mode High High Setpoint: 2 ppm<br>AWT/Ozone/Filter mode High High Setpoint: 3.5 ppm | 5 min. |
| Sulfuric Acid Tank Level Signal Fail | Sulfuric acid tank level unavailable | AWT shuts down if sulfuric acid dosing enabled | Not a setpoint driven critical alarm | 5 sec. |
| Pre-RO pH Level Signal Fail | RO Feed pH readings unavailable | AWT shuts down if sulfuric acid dosing enabled | Not a setpoint driven critical alarm | 5 sec. |
| RO Feed pH HiHi | RO Feed pH too high | AWT shuts down if sulfuric acid dosing enabled | High High setpoint: 6.8 | 5 sec. |
| Pre-RO pH Low Level | RO Feed pH too low | AWT shuts down if sulfuric acid dosing enabled | Low Low setpoint: 6 | 0 sec. |
| SulfuricAcidPump1Fail | Sulfuric acid pump status: fail | AWT shuts down if sulfuric acid dosing enabled | Not a setpoint driven critical alarm | 5 sec. |
| SulfuricAcidPressureHigh | Sulfuric acid pressure too high | AWT shuts down if sulfuric acid dosing enabled | Physical contact at pressure sensor | 5 sec. |

| Alarm | Description | System Response | Shutdown and Alarm Unlatch Setpoints | Delay |
|---|---|---|---|---|
| | | | location generates alarm condition | |
| Sulfuric Acid Containment Leak | Indication of possible chemical spill or other liquid in containment | AWT shuts down | Physical contact at containment generates alarm condition | 5 sec. |
| EQ Tank Low | EQ Tank level too low | AWP shuts down if in AWT/Ozone/Filter or Backwash Mode. No system response if in AWT mode | Low Low Setpoint: 24 inches<br>Low Level Reset Setpoint: 48 inches | 0 sec. |
| EQ Tank High | EQ Tank level too high | AWP shuts down if in AWT/Ozone/Filter or Backwash Mode. No system response if in AWT mode | High High setpoint: 100 inches<br>High Level Reset setpoint: 80 inches | 0 sec. |
| MF PLC Communications Failure | Communication error between MF PLC and main PLC | AWT shuts down in AWT/Ozone/Filter, Backwash, and AWT mode | Not a setpoint driven critical alarm | 0 sec. |
| UF PLC Communications Failure | Communication error between UF PLC and main PLC | AWT shuts down in AWT/Ozone/Filter, Backwash, and AWT mode | Not a setpoint driven critical alarm | 0 sec. |
| RO PLC Communications Failure | Communication error between RO PLC and main PLC | AWT shuts down in AWT/Ozone/Filter, Backwash, and AWT mode | Not a setpoint driven critical alarm | 0 sec. |
| UV PLC Communications Failure | Communication error between UV PLC and main PLC | AWT shuts down in AWT/Ozone/Filter, Backwash and AWT mode | Not a setpoint driven critical alarm | 180 sec. |

| Alarm | Description | System Response | Shutdown and Alarm Unlatch Setpoints | Delay |
|---|---|---|---|---|
| EDR Communications Failure | Communication error between EDR PLC and main PLC | All processes shut down in AWT/Ozone/Filter, Backwash, and AWT mode | Not a setpoint driven critical alarm | 0 sec. |
| Ozone Injection System Valves Failure to Open | Neither "Full Flow" nor "Half Flow" ozone injection system valves are fully open | AWP shuts down if in AWT/Ozone/Filter or Backwash Mode. No system response if in AWT mode | Not a setpoint driven critical alarm | 0 sec. |

### Demonstration Pure Water Facility Alarm Setpoints

The human machine interface (HMI) screens for controlling alarm severity and delay duration is shown below in Figure 112, Figure 113, and Figure 114.

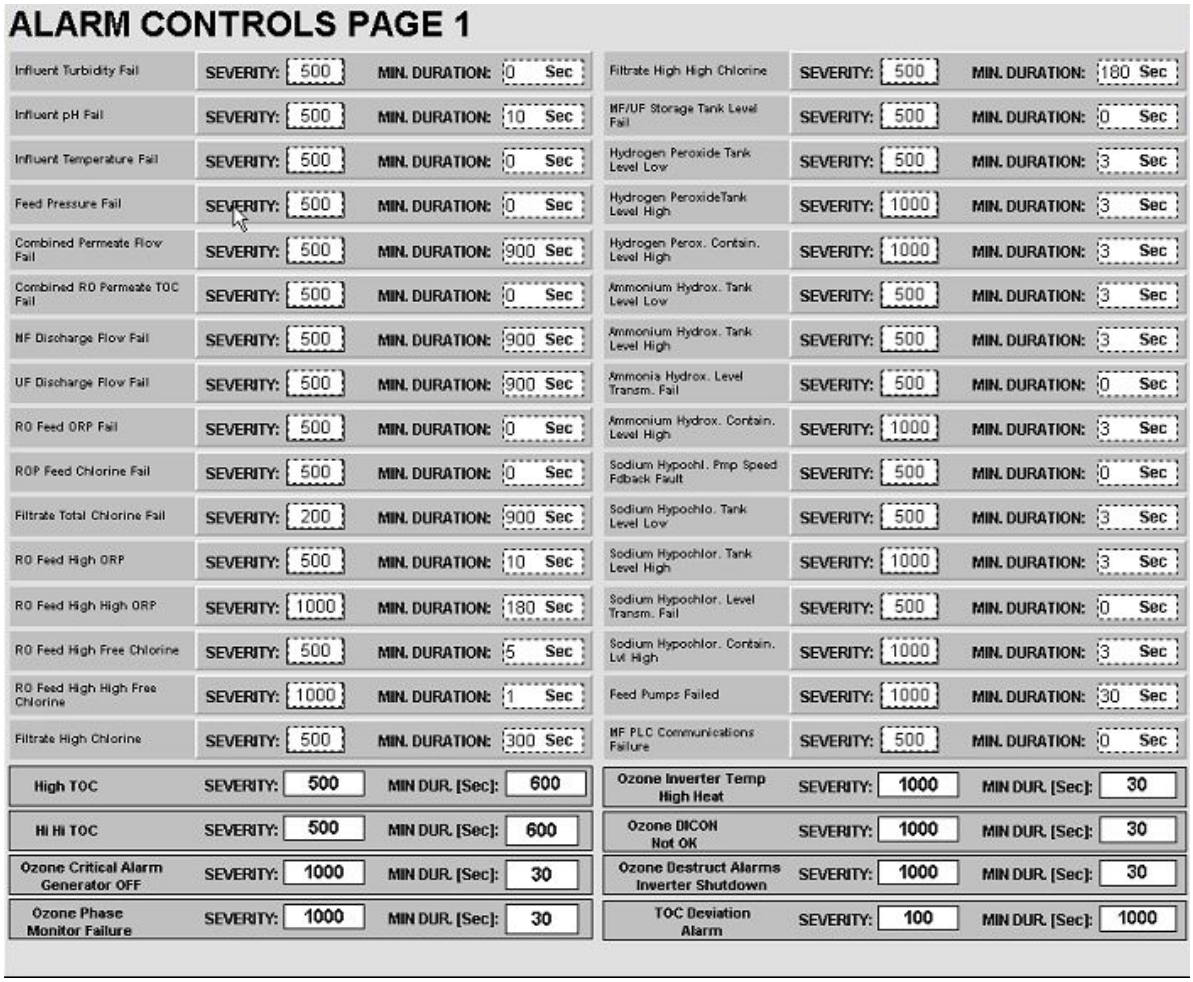


**Figure 112. Alarm Configuration Screen – Page 1**

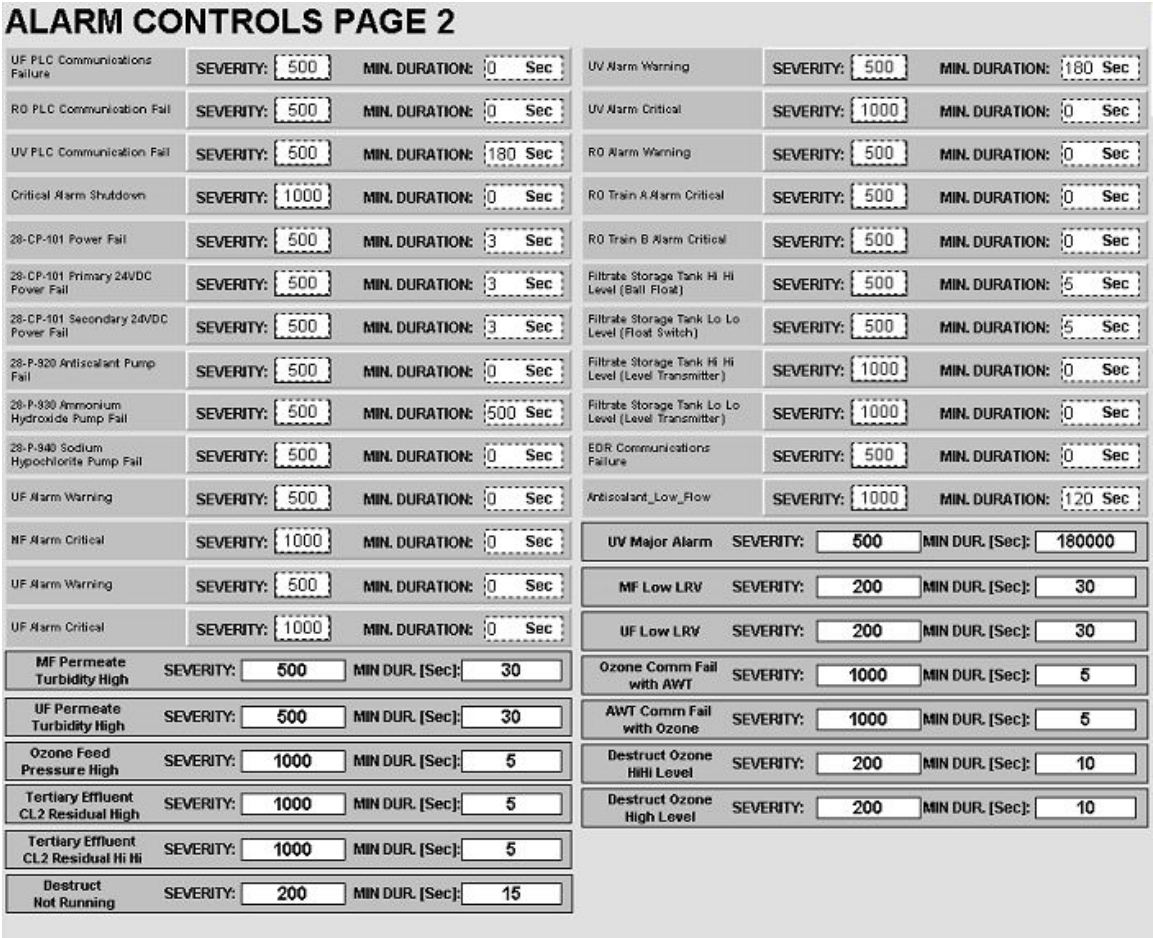


**Figure 113. Alarm Configuration Screen - Page 2**

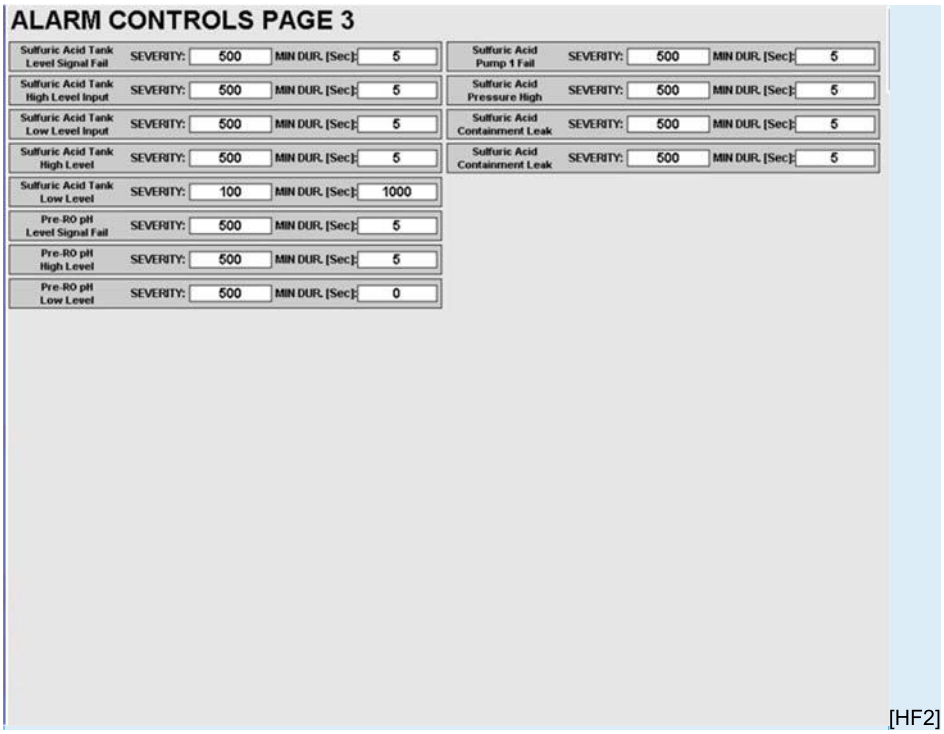


**Figure 114. Alarm Configuration Screen - Page 3**

### Demonstration Pure Water Facility Active Alarms

Active alarms on the system can be accessed on the Alarm Summary screen and a log of all alarms is available on the alarms history screen.

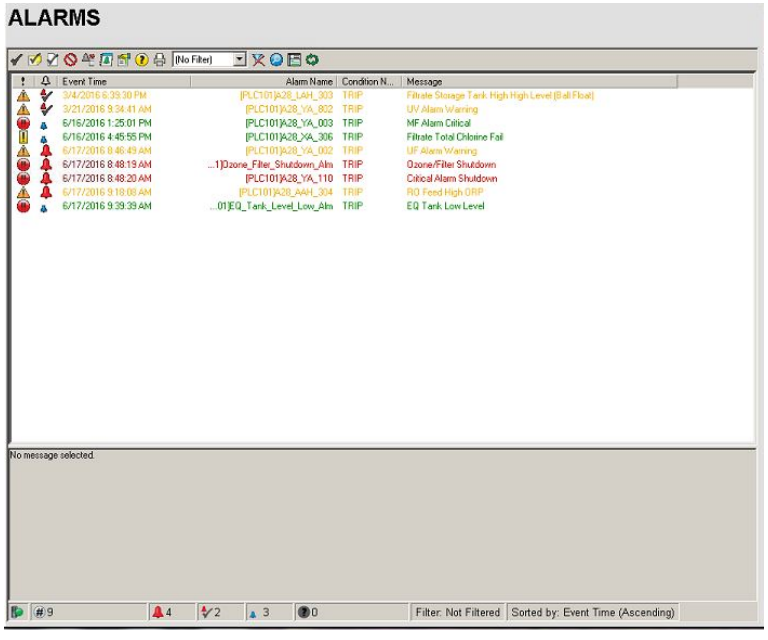


**Figure 115. Alarm Summary Screen**

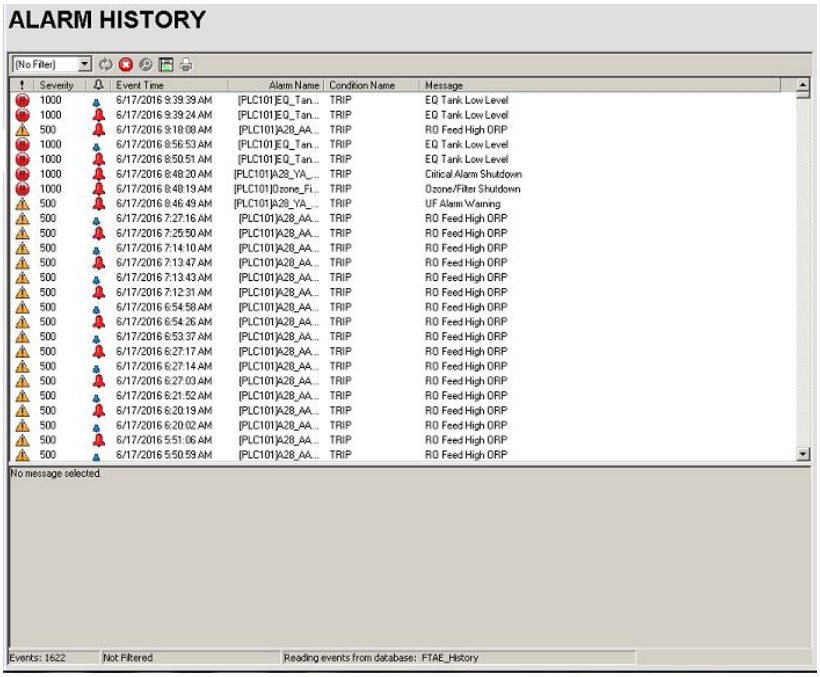


**Figure 116. Alarm History Screen**

### Demonstration Pure Water Facility Programmable Logic Controller Human Machine Interface Screens

There are three main HMI screens that provide an overview of operational parameters and monitoring of the AWT treatment processes, the ozone system, and the BAC system.

The overview screen includes critical operational parameters for the MF, UF, RO trains, UV, and chemical addition skid systems. Setpoints for setpoint-driven critical alarms can be altered in a separate pop up screen by clicking on the parameter. Start up and shutdown of the processes part of the AWT can be initiated from the overview screen. Below the system start and shutdown control buttons, there is a button to navigate to a list of active shutdown conditions and the cause for the last shutdown. The overview screen also provides navigation to other screens, including feed modes, alarm summary, alarm history, display list, trend, feed modes, feed pump, transfer pump, chemical control, ozone control, and BAC control screens.

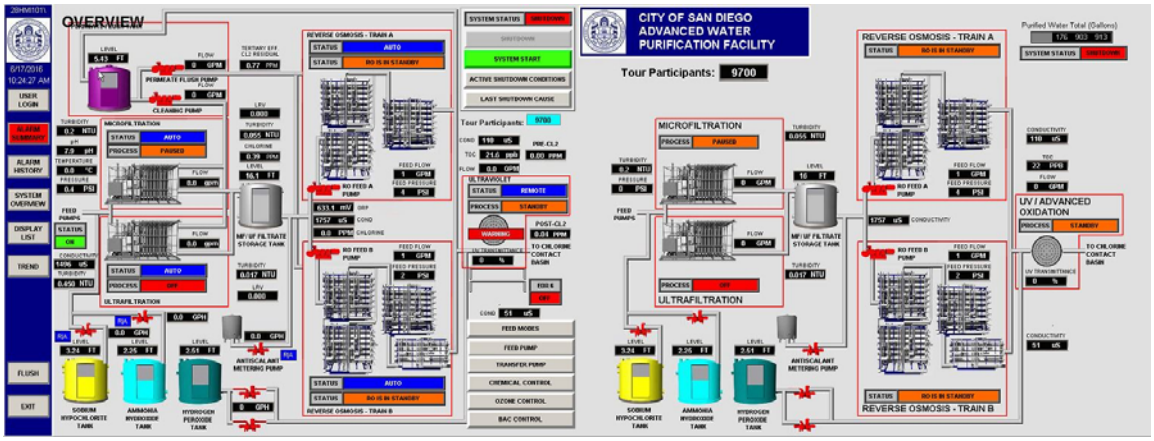


**Figure 117. DPWF Overview Screen**

### Ozone Programmable Logic Controller Screen

Ozone operational parameters can be viewed on the main programmable logic controller (PLC) on the Ozone Control screen. Setpoints and delay for detecting cooling water flow in the chiller system can be altered on this screen as well.

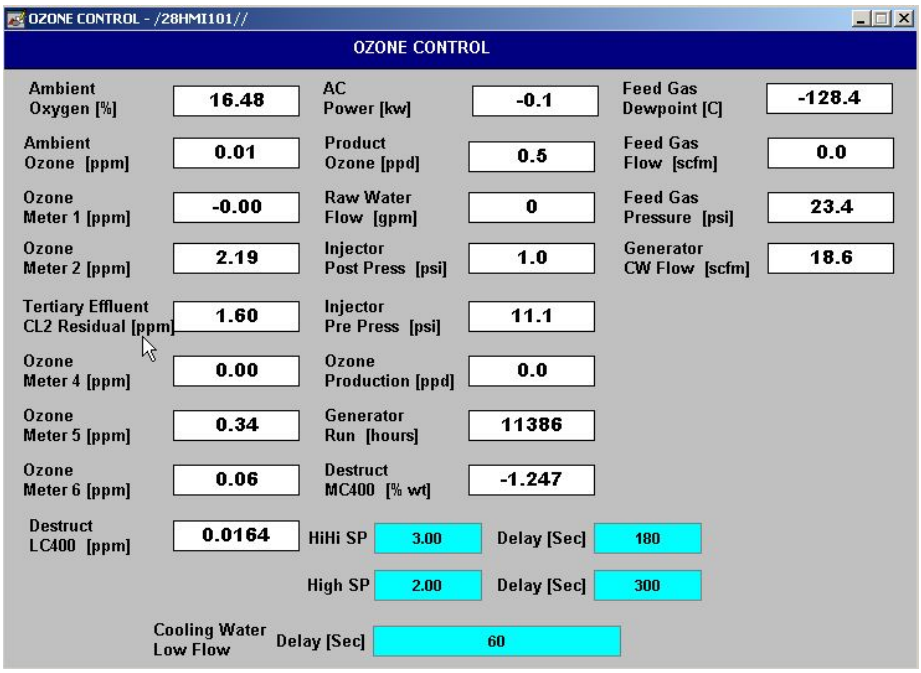


**Figure 118. Ozone Control Screen**

### Biological Activated Carbon Programmable Logic Controller Screen

Operational parameters for the BAC system can be viewed on the main PLC on the BAC Control screen.

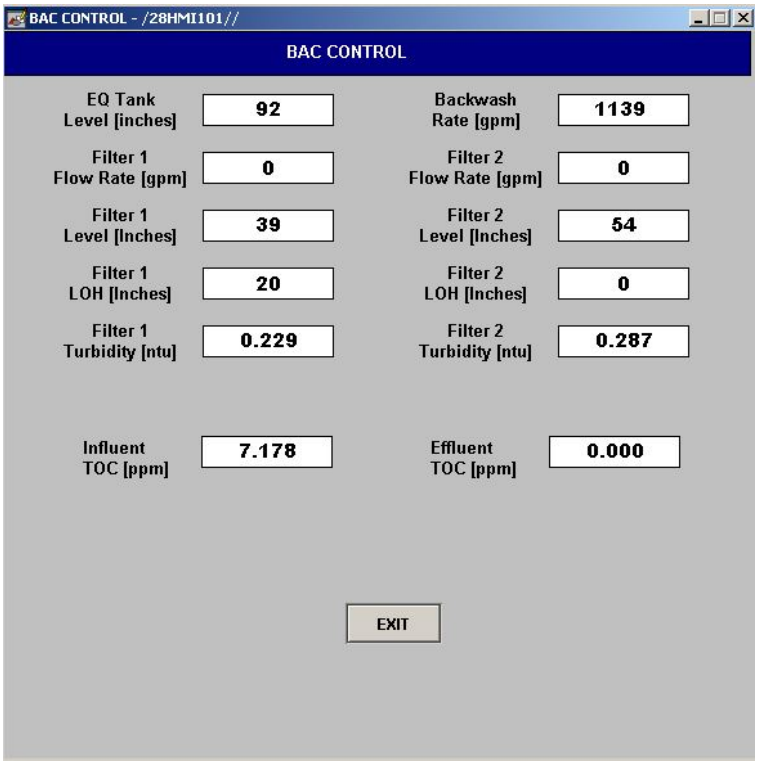


**Figure 119. BAC Control Screen**

### Microfiltration Programmable Logic Controller Screen

From the display list, the following screens can be accessed: MF System, UF System, RO System, System Architecture, Power, Runtimes & Totals, and Alarm Configuration Screens 1, 2, and 3. Limited remote controls are available on the unit process screens.

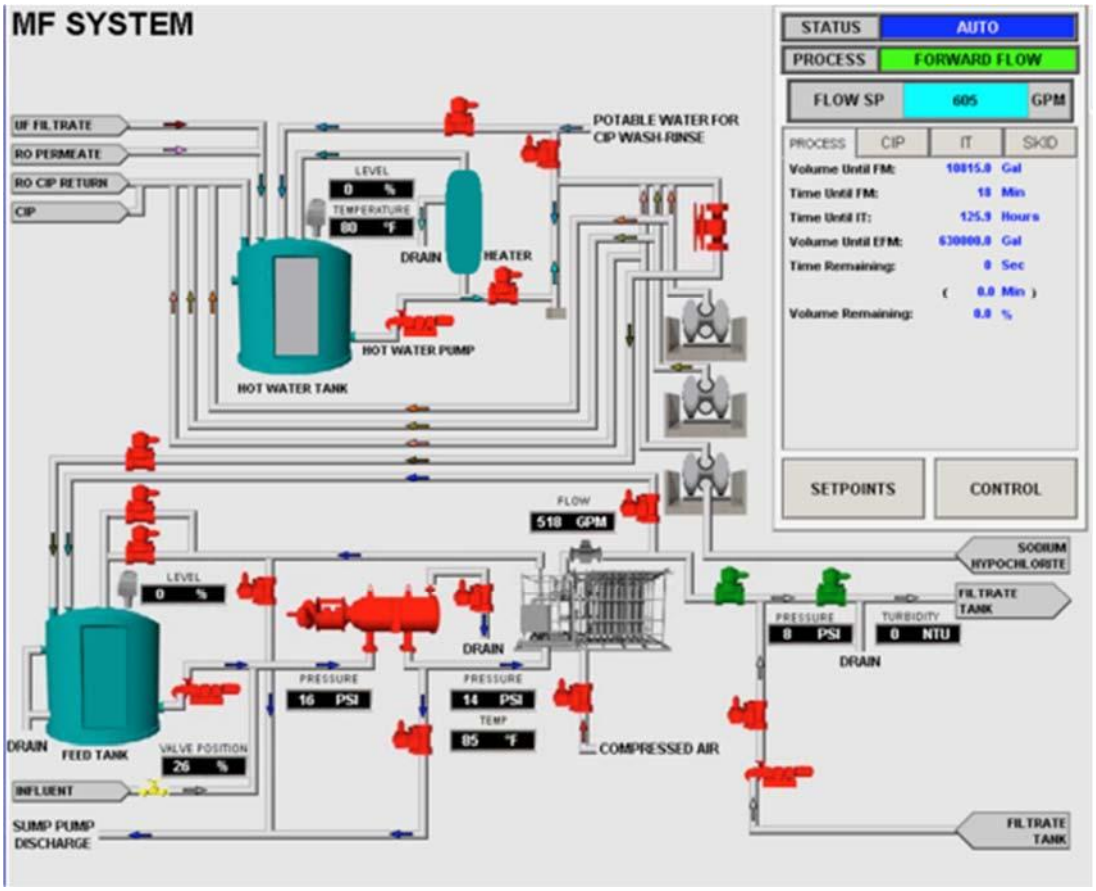


**Figure 120. MF PLC Screen**

### Ultrafiltration Programmable Logic Controller Screen

Setpoints, operational data, current system status, and remote start and shutdown controls are accessible on the UF System screen.

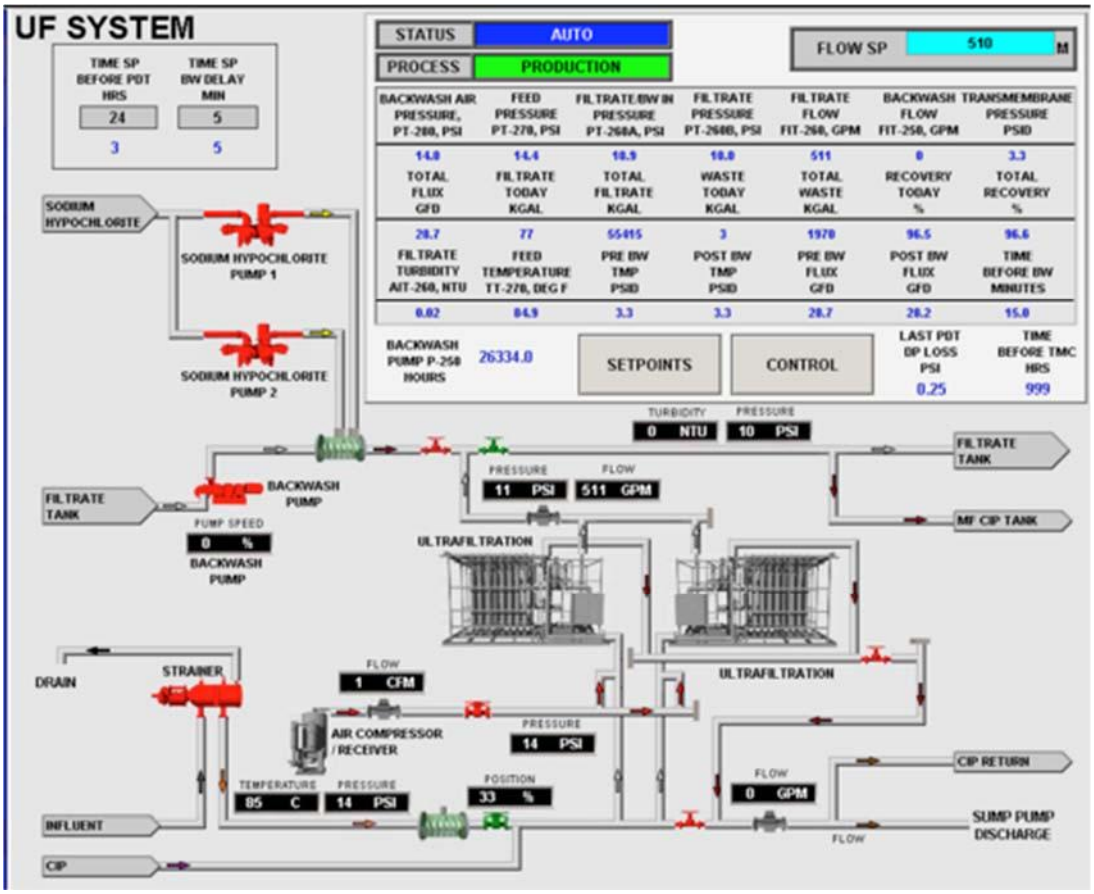


**Figure 121. UF PLC Screen**

### Reverse Osmosis Programmable Logic Controller Screen

Setpoints, operational data, current system status, and remote start and shutdown controls are accessible on the RO System screen. Selection of the lead RO train is also accessible on this screen. In the event of either MF or UF shutting down, the selected lead RO will remain while the other RO train will go through the shutdown sequence.

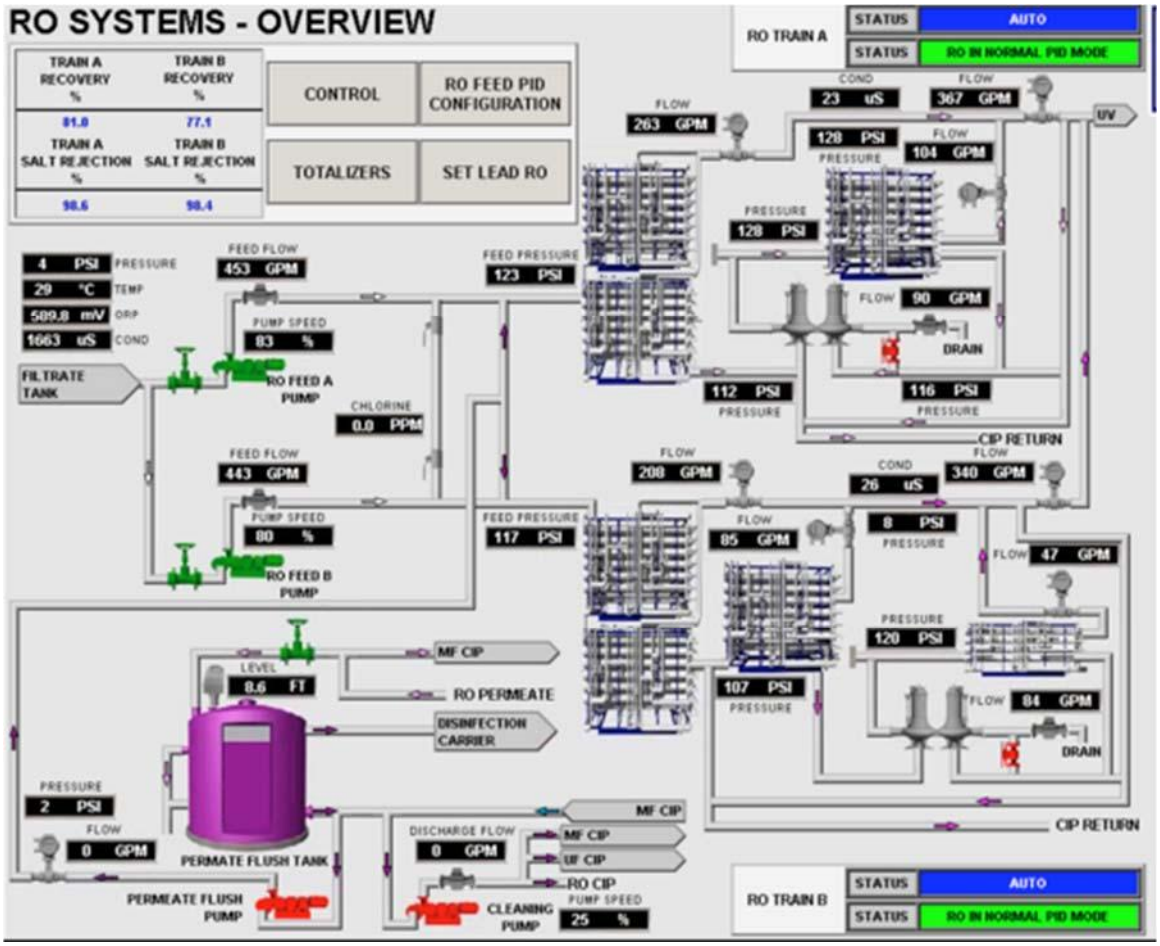


**Figure 122. RO PLC Screen**

### Ultraviolet Programmable Logic Controller Screen

Operational data and current system status is accessible on the UV System screen.

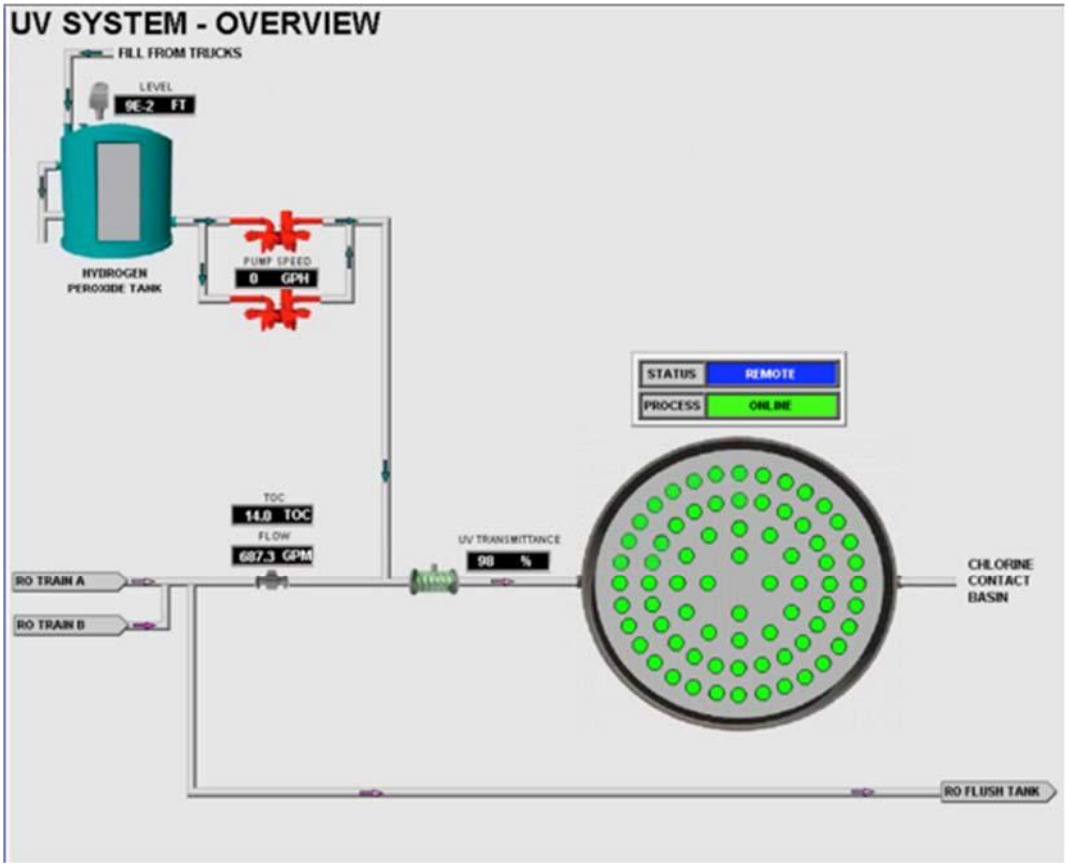


**Figure 123. PLC UV System Screen**

### Programmable Logic Controller Communication Architecture

A diagram of the control system architecture of the AWT portion of the facility is accessible on the Control System Architecture screen.

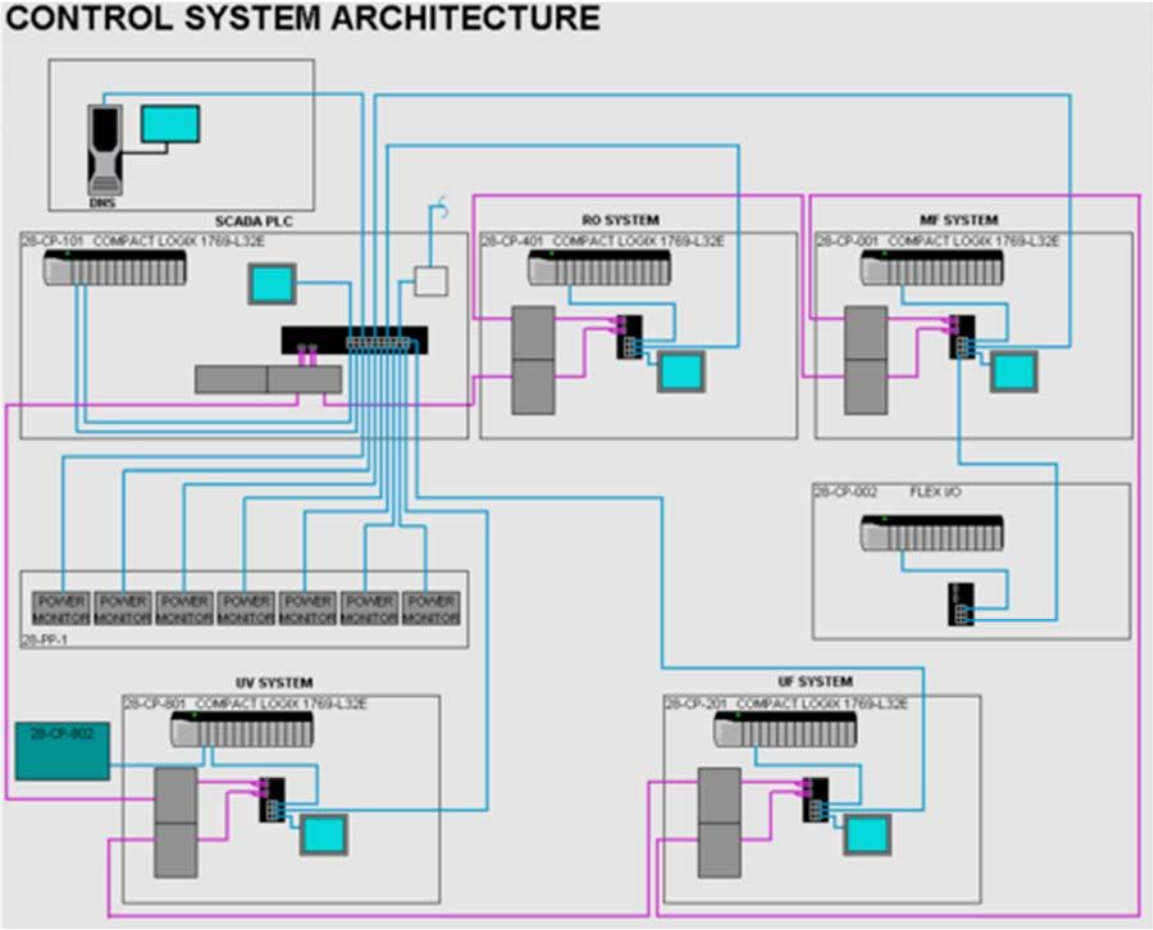


**Figure 124. PLC Control System Architecture Screen**

### Power monitors screen

Power monitor information for the MF (PP-2), UF (28-CP-201), RO Train A (28-VFD-400), RO Train B (28-VFD-500), UV (PP-4), RO cleaning pump (28-VFD-600), RO flush pump (28-VFD-700), and main PLC (MAIN) is available on the Power screen.

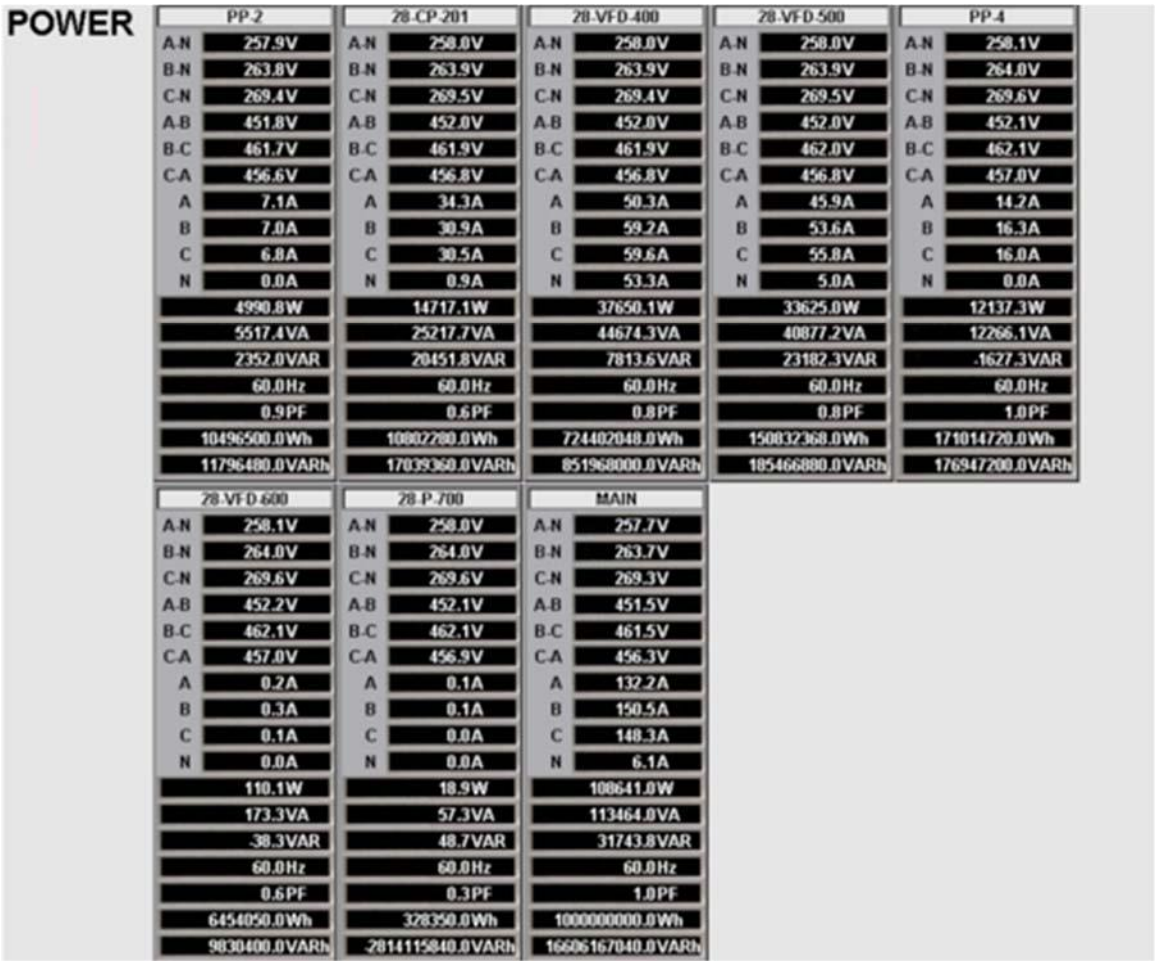


**Figure 125. PLC Power Monitor Screen**

### Runtime and flow totals screens

Runtime and flow totals data are available in the Runtimes & Totals screen. Totalizers for flow and runtime may also be reset on this page as well.

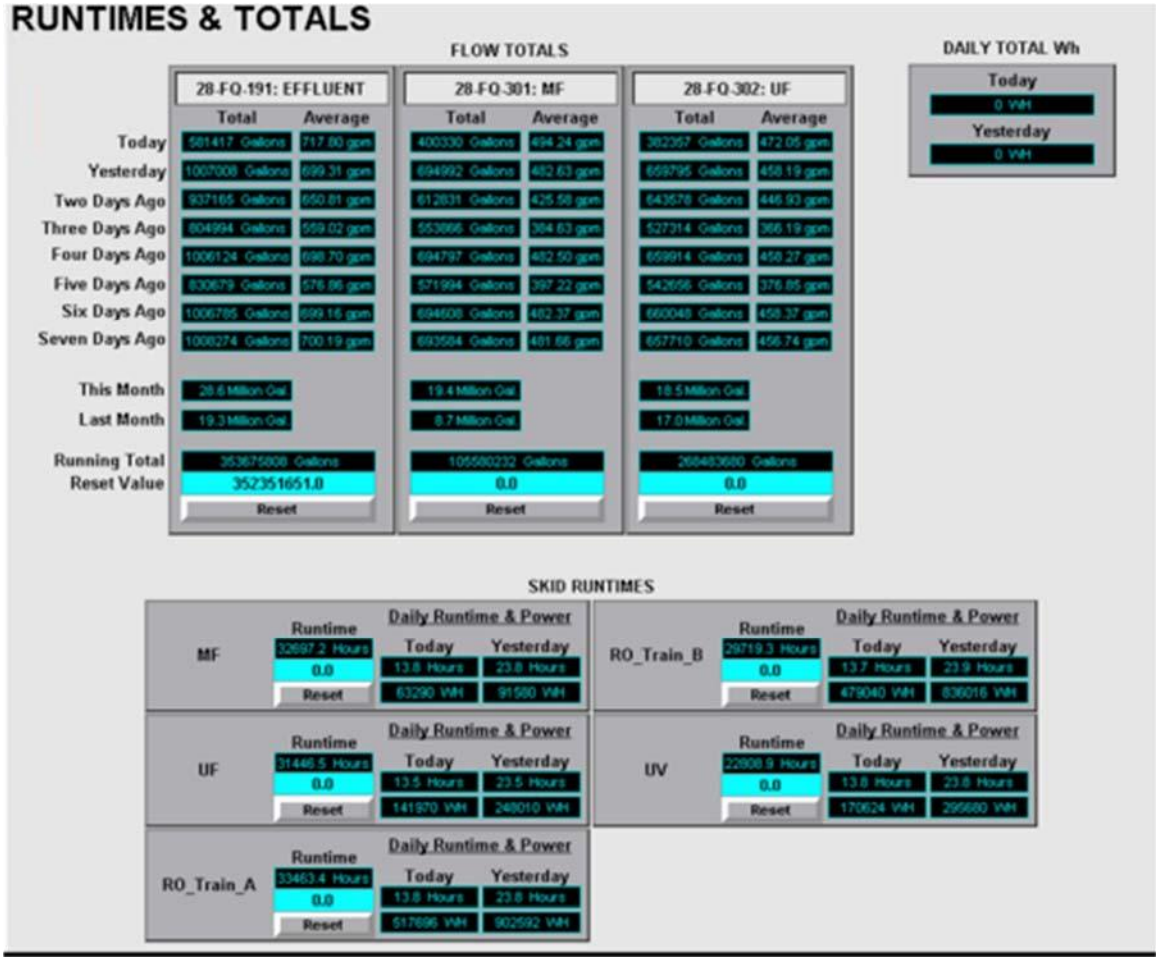


**Figure 126. PLC Runtimes & Totals Screen**

### Distributed[HF3] Control System Monitoring of the Demonstration Facility

Tags recommended for distributed control system (DCS) monitoring of the DPWF processes are provided below in Table 45 through 50. These variables, also mentioned as tags, have been used for process monitoring and data logging, troubleshooting and assessing performance.

**Table 45. Tags recommended for DCS monitoring of Ozone System**

| Description | Units | Tag Name | Tag Location | Scaling [EU] |
|---|---|---|---|---|
| Pre Injector Water Pressure | psi | [PLC_OZONE]INJECTOR_PRE_PRESSURE | PLC_Ozone | 0-72.52 |
| Post Injector Water Pressure | psi | [PLC_OZONE]INJECTOR_POST_PRESSURE | PLC_Ozone | 0-72.00 |
| Feed Water Flow | gpm | [PLC_OZONE]RAW_WATER_FLOW | PLC_Ozone | 0-1320.9 |
| Gas Flow | scfm | [PLC_OZONE]FEED_GAS_FLOW_RAW | PLC_Ozone | 0-16.22 |
| Gas Dewpoint | F | [PLC_OZONE]FEED_GAS_DEWPOINT | PLC_Ozone | (-)148.0-(+)68.0 |
| Gas Pressure | psi | [PLC_OZONE]FEED_GAS_PRESSURE | PLC_Ozone | 0-58 |
| Generator Power | kW | [PLC_OZONE]POWER_MONITOR_KW_RAW | PLC_Ozone | 0-40 |
| % Ozone Gas | % wt | [PLC_OZONE]PRODUCT_OZONE | PLC_Ozone | 0-20 |
| Generator Actual PPD | lbs/day | [PLC_OZONE]ACTUAL_OZONE_PRODUCTION | PLC_Ozone | 0-3.4E+38 |
| Generator Run Hours | hour | [PLC_OZONE]WORKINGHOURDINT | PLC_Ozone | 0-2.14E+9 |
| Destruct Ozone Offgas % | % wt | [PLC_OZONE]DESTRUCT_MC400 | PLC_Ozone | 0-5 |
| Destruct Ozone mg/L | mg/L | [PLC_OZONE]DESTRUCT_LC400 | PLC_Ozone | 0-10 |
| Ambient Ozone mg/L | mg/L | [PLC_OZONE]AMBIENT_OZONE_CONCENTRATION | PLC_Ozone | 0-5 |
| Ambient Oxygen % | % wt | [PLC_OZONE]AI_AMBIENT_OXYGEN_CONCENTRATION | PLC_Ozone | 0-100 |

| Description | Units | Tag Name | Tag Location | Scaling [EU] |
|---|---|---|---|---|
| BAC Influent Tank Level | inches | [PLC_BAC]Fill_Tank_Lev.EU | PLC_BAC | 0-172 |
| DO3 Meter 1 | mg/L | [PLC_OZONE]DO3_ANALYZER | PLC_Ozone | 0-3 |
| DO3 Meter 2 | mg/L | [PLC_OZONE]DO3_ANALYZER2 | PLC_Ozone | 0-5 |
| DO3 Meter 3 | mg/L | [PLC_OZONE]DO3_ANALYZER3 | PLC_Ozone | 0-5 |

**Table 46. Tags recommended for DCS monitoring of BAC System**

| Description | Units | Tag Name | Tag Location | Scaling [EU] |
|---|---|---|---|---|
| Filter 1 Flow | gpm | [PLC_BAC]F1_ROF.EU | PLC-BAC | 0-1000 |
| Filter 2 Flow | gpm | [PLC_BAC]F2_ROF.EU | PLC-BAC | 0-1000 |
| Filter 1 Level | inches | [PLC_BAC]F1_LEV.EU | PLC-BAC | 0-80 |
| Filter 2 Level | inches | [PLC_BAC]F2_LEV.EU | PLC-BAC | 0-80 |
| Filter 1 Effluent Valve Position | % open | [PLC_BAC]F1_Eff_Valve.SETPT_EU | PLC-BAC | 0-100 |
| Filter 2 Effluent Valve Position | % open | [PLC_BAC]F2_Eff_Valve.SETPT_EU | PLC-BAC | 0-100 |
| Filter 1 Run Time | hour | [PLC_BAC]F1_Run_Hour | PLC-BAC | 0-2.14E+9 |
| Filter 2 Run Time | hour | [PLC_BAC]F2_Run_Hour | PLC-BAC | 0-2.14E+9 |

| Description | Units | Tag Name | Tag Location | Scaling [EU] |
|---|---|---|---|---|
| Filter 1 Status | integer | [PLC_BAC]F1_Status | PLC-BAC | 0=Off,1=Filtering, 2=Backwashing,3=Bumping |
| Filter 2 Status | integer | [PLC_BAC]F2_Status | PLC-BAC | 0=Off,1=Filtering, 2=Backwashing,3=Bumping |
| Filter 1 Headloss | inches | [PLC_BAC]F1_LOH.EU | PLC-BAC | 0-144 |
| Filter 2 Headloss | inches | [PLC_BAC]F2_LOH.EU | PLC-BAC | 0-144 |
| BAC Influent Turbidity | NTU | [PLC_BAC]F2_TURB.EU | PLC-BAC | 0-1 |
| BAC Effluent Turbidity | NTU | [PLC_BAC]F1_TURB.EU | PLC-BAC | 0-1 |
| DO3 Meter 1 Backup | mg/L | [PLC_BAC]Ozone_CL2_M1_Res_SCL_FB_ 01.Out | PLC_BAC | 0-5 |
| DO3 Meter 2 Backup | mg/L | [PLC_BAC]Ozone_CL2_M2_Res_SCL_FB_ 02.Out | PLC_BAC | 0-10 |
| Tertiary Effluent Total Chlorine | mg/L | [PLC_BAC]Ozone_CL2_M3_Res_SCL_FB_ 03.Out | PLC_BAC | 0-5 |
| Tertiary Effluent TOC | mg/L | [PLC_BAC]TOC_Stream1 | PLC_BAC | 0-50 |
| BAC Effluent TOC | mg/L | [PLC_BAC]TOC_Stream2 | PLC_BAC | 0-50 |
| BAC Backwash Flow | GPM | TBD | PLC_BAC | 0-3,000 |
| BAC Backwash | ft | TBD | PLC_BAC | 0-14 |

| Description | Units | Tag Name | Tag Location | Scaling [EU] |
|---|---|---|---|---|
| Supply Tank Level | | | | |
| BAC Backwash Supply Pump Speed | % | TBD | PLC_BAC | 0-100 |

**Table 47. Tags recommended for monitoring of PLC 101**

| Description | Units | Tag Name | Tag Location | Scaling [EU] |
|---|---|---|---|---|
| MF/UF Feed Turbidity | NTU | [PLC_101]A28_AI_101.OUTPUT | PLC 101 | 0-99 |
| MF/UF Filtrate Total Chlorine | mg/L | [PLC101]A28_AI_306.OUTPUT | PLC 101 | 0-5 |
| MF/UF Feed pH | value | [PLC101]A28_AI_102a.OUTPUT | PLC 101 | 0-14 |
| Pre MF/UF Breaktank ORP | mV | [PLC101]A28.AI_304.Output | PLC 101 | (-)2100-(+)2100 |
| RO Feed Free Chlorine | mg/L | [PLC101]A28_AI_305.OUTPUT | PLC 101 | 0-5 |
| RO Combined Permeate TOC | mg/L | [PLC101]A28_AI_192.Output | PLC101 | 0-2453 |
| Combined RO Permeate Total Chlorine | mg/L | [PLC101]A28_CL_100.OUTPUT | PLC101 | 0-5 |
| UV/AOP Effluent Total Chlorine | mg/L | [PLC101]A28_CL_101.OUTPUT | PLC101 | 0-5 |
| RO Feed pH | pH | [PLC101]A28_AI_304A.Output | PLC101 | 0-14 |

**Table 48. Tags recommended for DCS monitoring of PLC 001**

| Description | Units | Tag Name | Tag Location | Scaling [EU] |
|---|---|---|---|---|
| MF Filtrate Flow | gpm | [PLC001]MF.FIT1.PV | PLC 001 | 0-1600 |
| MF TMP | psi | [PLC001]MF.Data.Temp_Norm_TMP | PLC 001 | 0-200 |
| MF Feed Pressure | psi | [PLC001]MF.PIT1.PV | PLC 001 | 0-100 |
| MF Filtrate Pressure | psi | [PLC001]MF.PIT2.PV | PLC 001 | 0-100 |
| MF Flux | gfd | [PLC001]MF.Data.Flux | PLC 001 | Calculation |
| MF Specific Flux | gfd/psi | [PLC001]MF.Data.Specific_Flux | PLC 001 | Calculation |
| MF last IT dP | psi/5 min | [PLC001]MF.Data.IT_DP | PLC 001 | Calculation |
| MF IT Starting Pressure | psi | [PLC001]MF.DATA.IT_TEST_STRT_PRESS | PLC 001 | 0-100 |
| MF IT End Pressure | psi | [PLC001]MF.DATA.IT_TEST_END_PRESS | PLC 001 | 0-100 |
| MF LRV | value | [PLC001]MF.LRV_PALL.LRV | PLC 001 | 0-10 |
| MF Filtrate Turbidity | NTU | [PLC001]MF.AIT2.PV | PLC 001 | 0-1 |
| MF Water Temperature | F | [PLC001]MF.TT1.PV | PLC 001 | 0-200 |
| MF Status (Disabled, Manual, Auto) | integer | [PLC001]MF.MODE.STATUS | PLC 001 | 0=Off,1=Manual,2=Auto |
| MF Process (BW, IT, etc.) | integer | [PLC001]MF.UNIT.PROC_ACT | PLC 001 | 0=Off,1=FF,2=RF,3=AS, 4=SB,5=IT,6=CIP,7=Flush, 8=EFM,9=Fill,10=Paused |
| MF IT Recent Day | day | [PLC001]MF.Data.IT_Recent_Day | PLC 001 | 0-6 |
| MF IT Hour | hour | [PLC001]MF.Data.IT_Recent_Hour | PLC 001 | 0-23 |
| MF IT Minute | minute | [PLC001]MF.Data.IT_Recent_Minute | PLC 001 | 0-59 |
| MF IT Month | month | [PLC001]MF.Data.IT_Recent_Month | PLC 001 | 1-12 |
| MF IT Year | year | [PLC001]MF.Data.IT_Recent_Year | PLC 001 | N/A |

**Table 49. Tags recommended for DCS monitoring of PLC 201**

| Description | Units | Tag Name | Tag Location | Scaling [EU] |
|---|---|---|---|---|
| UF Filtrate Flow | gpm | [PLC201]FIT_260.EU | PLC201 | 0-1000 |
| UF TMP | psi | [PLC201]CALC_UF_TMP | PLC201 | Calculation |
| UF Feed Pressure | | [PLC201]PIT_270.EU | PLC201 | 0-60 |
| UF Filtrate Pressure | | [PLC201]PIT_260B.EU | PLC201 | 0-60 |
| UF Flux | gfd | [PLC201]CALC_UF_FLUX | PLC201 | Calculation |
| UF Specific Flux | gfd/psi | [PLC201]CALC_UF_PERMEABILITY | PLC201 | Calculation |
| UF last PDT dP | psi/5 min | [PLC201]UF_PDT_DP | PLC201 | Calculation |
| UF PDT Starting Pressure | psi | [PLC201]UF_PDT_PRESS | PLC201 | 0-60 |
| UF PDT End Pressure | psi | [PLC201]UF_PDT_PRESS_SP | PLC201 | 0-60 |
| UF LRV | value | [PLC201]UF_LRV.OUT_LRV | PLC201 | Calculation |
| UF Filtrate Turbidity | NTU | [PLC201]AI_AI_260.EU | PLC201 | 0-1 |
| UF Water Temperature | C | [PLC201]TT_270_CELC | PLC201 | 0-200 |
| UF Current Process | integer | [PLC201]UF_STATUS | PLC201 | 0=Man,1=Auto |
| UF PDT Hours Remaining | hours | [PLC201]UF_PDT_HRS_REMAINING | PLC201 | 0-99 |

**Table 50. Tags recommended for DCS monitoring of PLC 401**

| Description | Units | Tag Name | Tag Location | Scaling [EU] |
|---|---|---|---|---|
| RO Feed Water Temperature | C | [PLC401]SCALED_ANALOG[1] | PLC401 | 0-100 |
| RO Feed Conductivity | uS/cm | [PLC401]SCALED_ANALOG[2] | PLC 401 | 0-10,000 |
| Train A Feed Flow | gpm | [PLC401]RO1A_Feed_Flow | PLC401 | 0-1000 |
| Train A Permeate Flow | gpm | [PLC401]scaled_analog[12] | PLC401 | 0-2730.5 |
| Train A Concentrate Flow | gpm | [[PLC401]scaled_analog[6] | PLC401 | 0-2730.5 |
| Train A Permeate Conductivity | uS/cm | [PLC401]scaled_analog[11] | PLC401 | 0-5000 |
| Train B Feed Flow | gpm | [PLC401]RO1B_Feed_Flow | PLC401 | 0-1000 |
| Train B Permeate Flow | gpm | [PLC401]scaled_analog[24] | PLC401 | 0-2730.5 |
| Train B Concentrate Flow | gpm | [PLC401]scaled_analog[18] | PLC401 | 0-2730.5 |
| Train B Permeate Conductivity | uS/cm | [PLC401]scaled_analog[22] | PLC401 | 0-5000 |

**Table 51. Tags recommended for DCS monitoring of PLC 801**

| Description | Units | Tag Name | Tag Location | Scaling [EU] |
|---|---|---|---|---|
| UV Ballast Power Level | % Power | [PLC801]N_SCADA_trn1_r1[1] | PLC801 | 0-100 |
| UV Water Flow | gpm | [PLC801]N_SCADA_System[4] | PLC801 | 0-694.44 |
| UV System UV Intensity | MW/cm2 | [PLC801]T[1].R[1].PDAT.UVI_SENSOR_MW | PLC801 | 0-100 |
| UV Feed UVT | % T at 1/cm | [PLC801]N_SCADA_System[3] | PLC801 | 0-100 |

**SECTION 40 90 06**
**BILL OF MATERIALS AND QUANTITIES**

**TABLE A-1**
**TRAINING**

| Item | No. of Sessions | Length, Days | No. of Persons | Other Requirement |
|---|---|---|---|---|
| Operator Training - 1 | 1 minimum | 1 | 8 | |
| Maintenance Training - 1 | 1 minimum | 1 | 8 | |
| | | | | |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A/E:** | **Carollo Engineers** | | | | | | | **MAGNETIC FLOWMETERS** | | | | **INSTRUMENT DATA SHEETS** | | | |
| | | | | | | | | | | | | **Spec. No.** | | | **Rev.** |
| **Contractor:** | | | | | | | | **No** | **By** | **Date** | **Revision** | 40 90 00 | | | |
| **Project:** | Demo Plant Relocation | | | | | | | | | | | **Contract** | | | **Date** |
| **Customer:** | City of San Diego | | | | | | | | | | | | | | |
| **Plant:** | NCWRP | | | | | | | | | | | **Req.** | | | **P.O.** |
| **Location:** | San Diego, CA | | | | | | | | | | | | | | |
| **BOM No.:** | | | | | | | | | | | | **By** | **Chk** | **App** | |
| **File:** | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | **Instrument Tag No.** | | | | N29FE/FIT520 | | | | | | | | | |
| | 2 | | **Service** | | | | Water | | | | | | | | | |
| | 3 | | **P&ID** | | | | 29-I-002 | | | | | | | | | |
| | 4 | C | **Line Size / Schedule** | | | | 12-inch | | | | | | | | | |
| | 5 | O | **Line Material** | | | | | | | | | | | | | |
| | 6 | N | **Connection Type/ Pressure Rating** | | | | 150# Flanged | | | | | | | | | |
| | 7 | N | **Connection Materials** | | | | | | | | | | | | | |
| | 8 | | **Tube Size** | | | | 12-inch | | | | | | | | | |
| E | 9 | | **Tube Material** | | | | Mfr Standard | | | | | | | | | |
| L | 10 | | **Liner Material** | | | | PTFE TEFLON | | | | | | | | | |
| E | 11 | M | **Electrode Type** | | | | Bullet Nosed | | | | | | | | | |
| M | 12 | E | **Electrode Material** | | | | 316 SS | | | | | | | | | |
| E | 13 | T | **Meter Casing** | | | | | | | | | | | | | |
| N | 14 | E | **Power Supply** | | **Phase** | | 120 VAC | | 1P | | | | | | | |
| T | 15 | R | **Grounding Type & Matl.** | | | | Gnd Rings | | | | | | | | | |
| | 16 | | **Enclosure Class** | | | | NEMA 4X | | | | | | | | | |
| | 17 | | **Other** | | | | Epoxy coated | | | | | | | | | |
| | 18 | | **Fluid** | | | | Water | | | | | | | | | |
| | 19 | F | **Max Flow** | | | | 3,000 GPM | | | | | | | | | |
| | 20 | L | **Min Velocity** | | | | | | | | | | | | | |
| | 21 | U | **Min Flow** | | **Norm Flow** | | 0 GPM | | | | | | | | | |
| | 22 | I | **Min Temp** | | **Max Temp** | | | | | | | | | | | |
| | 23 | D | **Min Press** | | **Max Press** | | | | | | | | | | | |
| | 24 | | **Vacuum Possibility** | | | | NO | | | | | | | | | |
| | 25 | | **Conductivity** | | | | | | | | | | | | | |
| T | 26 | | **Function** | | | | CONTINUOUS | | | | | | | | | |
| R | 27 | | **Mounting** | | | | Integral | | | | | | | | | |
| A | 28 | | **Enclosure Class** | | | | NEMA 4X | | | | | | | | | |
| N | 29 | | **Length Signal Cable** | | | | | | | | | | | | | |
| S | 30 | | **Type Span Adjustment** | | | | | | | | | | | | | |
| M | 31 | | **Power Supply** | | | | SEE LINE 14 | | | | | | | | | |
| I | 32 | | **Transmitter Output** | | | | 4-20 mA HART | | | | | | | | | |
| | | | **Relay Outputs** | | | | Form C | | | | | | | | | |
| T | 33 | | **Accuracy** | | | | 0.25% | | | | | | | | | |
| T | 34 | | **Calibrated Range** | | | | 0-3,000 GPM | | | | | | | | | |
| E | 35 | | **Empty Pipe Detection** | | | | No | | | | | | | | | |
| R | 36 | | **Bi-Directional Flow** | | | | No | | | | | | | | | |
| | 37 | | **Display Scale Size** | | **Range** | | | | | | | | | | | |
| | 38 | | **Alarm Contact No.** | | **Form** | | | | | | | | | | | |
| | 39 | | **Manufacturer** | | | | Endress & Hauser Promag53, Krohne Enviromag, or approved equal. | | | | | | | | | |
| | 40 | | **Element (Meter) Model No.** | | | | | | | | | | | | | |
| | 41 | | **Transmitter (Inst.) Model No.** | | | | | | | | | | | | | |

**Notes:** Refer to Section 40 90 00, Instrumentation and Control, for additional magnetic flow meter requirements.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **A/E:** | **Carollo Engineers** | | | | **FLOW SWITCHES** | | | | | | |
| | | | | | | | | | **Spec. No.** | | **Rev.** |
| **Contractor:** | | | | | **No** | **By** | **Date** | **Revision** | 40 90 00 | | |
| **Project:** | Demo Plant Relocation | | | | | | | | **Contract** | | **Date** |
| **Customer:** | City of San Diego | | | | | | | | | | |
| **Plant:** | NCWRP | | | | | | | | **Req.** | | **P.O.** |
| **Location:** | San Diego, CA | | | | | | | | | | |
| **BOM No.:** | | | | | | | | | **By** | **Chk** | **App** |
| **File:** | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **D** | **1** | **Type** | | | | Thermal: **X** Rotary Vane: Shuttle: Other | |
| **E** | **2** | **Setting** | | | | Set in Field: Factory Set: X Internal: External: Dial: | |
| **V** | **3** | **Dead Band** | | | | Fixed: Adj.: X Min.: Other: | |
| **I** | **4** | **Material** | | | | Bronze: SS: X Alloy St.: Other | |
| **C** | **5** | **Connection** | | | | 1/2-Inch NPT: 3/4-Inch NPT: **X** Other: | |
| | **6** | **Mounting** | | | | Local: **X** Surface: Flush: | |
| | **7** | **Accuracy** | | | | | |
| | **8** | **Other** | | | | | |
| | **9** | **Type** | | | | Mercury: Snap: Other X | |
| **S** | **10** | **Quantity** | | | | Single: **X** Dual: Other | |
| **W** | **11** | **Form** | | | | SPST: SPDT: DPDT: X Other | |
| **I** | **12** | **Rating:** | **Amps** | **Volts** | **Hertz** | 10 | 120 | 60 |
| **T** | **13** | **Other** | | | | | |
| **C** | **14** | **Load** | | | | Inductive: Non-Inductive: | |
| **H** | **15** | **Enclosure** | | | | General Purpose: Weatherproof: **X** None: Explosion proof: | |
| | **16** | **Enclosure Class** | | | | NEMA 4X | |
| | **17** | **Conduit Connection** | | | | MFR STD: X Other | |
| | **18** | **Other** | | | | | |
| | **19** | **Manufacturer** | | | | Kayden, or approved equal. | |
| | **20** | **Model No.** | | | | | |

| **Rev** | **Tag Number** | **Adj. Range** | **SP Process** | **Signal SP** | **Op. Temp.** | **P&ID** | **Service** | **Notes** |
|---|---|---|---|---|---|---|---|---|
| | N29FSL512 | **yes** | 100 GPM | | 32-100 deg F | 29-I-002 | BW Pump Discharge | |
| | N29FSL515 | **yes** | 100 GPM | | 32-100 deg F | 29-I-002 | Overflow Sump Pump Discharge | |
| | | | | | | | | |
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**Notes:** Refer to Section 40 90 00, Instrumentation and Control, for additional thermal flow switch requirements.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **A/E:** | **Carollo Engineers** | | | | **FLOW SWITCHES** | | | | | | |
| | | | | | | | | | **Spec. No.** | | **Rev.** |
| **Contractor:** | | | | | **No** | **By** | **Date** | **Revision** | 40 90 00 | | |
| **Project:** | Demo Plant Relocation | | | | | | | | **Contract** | | **Date** |
| **Customer:** | City of San Diego | | | | | | | | | | |
| **Plant:** | NCWRP | | | | | | | | **Req.** | | **P.O.** |
| **Location:** | San Diego, CA | | | | | | | | | | |
| **BOM No.:** | | | | | | | | | **By** | **Chk** | **App** |
| **File:** | | | | | | | | | | | |

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|---|---|---|---|---|---|---|
| **D** | **1** | **Type** | | | Thermal: Vane: X Shuttle: Other | |
| **E** | **2** | **Setting** | | | Set in Field: Factory Set: X Internal: External: Dial: | |
| **V** | **3** | **Dead Band** | | | Fixed: X Adj.: Min.: Other: | |
| **I** | **4** | **Material** | | | Bronze: SS: X Alloy St.: Other | |
| **C** | **5** | **Connection** | | | 1/2-Inch NPT: X 3/4-Inch NPT: Other: | |
| | **6** | **Mounting** | | | Local: **X** Surface: Flush: | |
| | **7** | **Accuracy** | | | | |
| | **8** | **Other** | | | | |
| | **9** | **Type** | | | Mercury: Snap: **X** Other | |
| **S** | **10** | **Quantity** | | | Single: **X** Dual: Other | |
| **W** | **11** | **Form** | | | SPST: SPDT: DPDT: X Other | |
| **I** | **12** | **Rating:** | **Amps** | **Volts** | **Hertz** | 3 / 30 VDC |
| **T** | **13** | **Other** | | | | |
| **C** | **14** | **Load** | | | Inductive: Non-Inductive: | |
| **H** | **15** | **Enclosure** | | | General Purpose: Weatherproof: **X** None: Explosion proof: | |
| | **16** | **Enclosure Class** | | | NEMA 4X | |
| | **17** | **Conduit Connection** | | | MFR STD: X Other | |
| | **18** | **Other** | | | | |
| | **19** | **Manufacturer** | | | W.E. Anderson, or approved equal. | |
| | **20** | **Model No.** | | | | |

| Rev | Tag Number | Adj. Range | SP Process | Signal SP | Op. Temp. | P&ID | Service | Notes |
|---|---|---|---|---|---|---|---|---|
| | N29FSL550 | | 2 GPM | | 32-100 degF | 29-I-002 | Emergency Eyewash/Shower | |
| | | | | | | | | |
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**Notes:** Refer to Section 40 90 00, Instrumentation and Control, for additional vane flow switch requirements.

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|---|---|---|---|---|---|---|---|---|---|---|
| **A/E:** | **Carollo Engineers** | | **RADAR PTOF LEVEL INSTRUMENTS** | | | | | | | |
| | | | | | | | **Spec. No.** | | | **Rev.** |
| **Contractor:** | | | **No** | **By** | **Date** | **Revision** | 40 90 00 | | | |
| **Project:** | Demo Plant Relocation | | | | | | **Contract** | | | **Date** |
| **Customer:** | City of San Diego | | | | | | | | | |
| **Plant:** | NCWRP | | | | | | **Req.** | | | **P.O.** |
| **Location:** | San Diego, CA | | | | | | | | | |
| **BOM No.:** | | | | | | | **By** | **Chk** | **App** | |
| **File:** | | | | | | | | | | |

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|---|---|---|---|---|---|---|
| **G** | **1** | **Instrument Tag Number** | N29LE/LIT511 | | | |
| **E** | **2** | **Service** | BW Tank Level | | | |
| **N** | **3** | **P&ID** | 29-I-002 | | | |
| | **4** | **Other** | | | | |
| | **5** | **Type** | Pulse Time of Flight (PTOF) | | | |
| **P** | **6** | **Housing Material** | Mfr standard | | | |
| **R** | **7** | **Measurement Range** | 0-14 FT | | | |
| **O** | **8** | **Op. Temp. Range** | | | | |
| **B** | **9** | **Manufacturer** | Same as Transmitter | | | |
| **E** | **10** | **Model** | | | | |
| | **11** | **Model Number** | | | | |
| | **12** | **Antenna Style** | Probe | | | |
| | **13** | **Other** | | | | |
| | **14** | **Other** | | | | |
| | **15** | **Other** | | | | |
| | **16** | **Other** | | | | |
| | **17** | **Type** | Pulse Time of Flight (PTOF) | | | |
| **T** | **18** | **Operating Mode** | Continuous | | | |
| **R** | **19** | **Enclosure** | NEMA 4X | | | |
| **A** | **20** | **Mounting** | Remote | | | |
| **N** | **21** | **Temperature Range** | 40-110 degF | | | |
| **S** | **22** | **Voltage Requirements** | 15 VA, maximum | | | |
| **M** | **23** | **Power** | 120V ac, 60 Hz. | | | |
| **I** | **24** | **Accuracy** | ± 0.25 inches | | | |
| **T** | **25** | **Calibrated Range** | 0-14 FT. | | | |
| **T** | **26** | **Display** | Multi Character LCD | | | |
| **E** | **27** | **Output** | 4-20 mA | | | |
| **R** | **28** | **Calibration** | | | | |
| | **29** | **Status Relay** | | | | |
| | **30** | **Manufacturer** | Endress & Hauser Micropilot/ Levelflex, Siemans SITRANS, or approved equal. | | | |
| | **31** | **Model No.** | | | | |
| | **32** | **Damping** | | | | |
| | **33** | **Elect. Entry** | | | | |
| | **34** | **Other** | | | | |
| **O** | **35** | | | | | |
| **P** | **36** | | | | | |
| **T** | **37** | | | | | |
| **S** | **38** | | | | | |

**Notes:** Refer to Section 40 90 00, Instrumentation and Control, for additional Radar PTOF level transmitter requirements.

| A/E: | Carollo Engineers | LEVEL SWITCHES | | | | Spec. No. | Rev. |
|---|---|---|---|---|---|---|---|
| Contractor: | | No | By | Date | Revision | 40 90 00 | |
| Project: | Demo Plant Relocation | | | | | Contract | Date |
| Customer: | City of San Diego | | | | | | |
| Plant: | NCWRP | | | | | Req. | P.O. |
| Location: | San Diego, CA | | | | | | |
| BOM No.: | | | | | | By | Chk. App. |
| File: | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| GENERAL | 1 | Type | Conductance: | Capacitance:X | Tuning Fork: | Ball Float: | Displacement: | |
| | 2 | Setting | Field Set: X | Factory Set: | | | | |
| | 3 | Dead Band | Fixed: X | Adj: | Other: | | | |
| | 4 | Material | | | | | | |
| | 5 | Dimensions | Field Set: | | | | | |
| | 6 | Mounting | Flange: X | Threaded: | Other: Suspended | | | |
| | 7 | Operating Pressure /Temperature | | | | | | |
| | 8 | Connection | MFR STD: | Other: Flanged | | | | |
| | 9 | Manufacturer | Magnetrol Kotron Sentinel, or approved equal. | | | | | |
| | 10 | Other | | | | | | |
| | 11 | Other | | | | | | |
| SWITCH | 12 | Type | Mechanical: | Reed: | Other: X | | | |
| | 13 | Quantity | Single: | Dual: | Other: X | | | |
| | 14 | Form | SPST: | SPDT: **X** | DPDT: | Other: | | |
| | 15 | Rating: Amps Volts Hertz | 10 | 120 | 60 | | | |
| | 16 | Load | Inductive: | | Non-Inductive: | | | |
| | 17 | Other | | | | | | |
| | 18 | Other | | | | | | |

| Rev. | Tag Number | Model No. | Setpoint | P&ID | Service | Notes |
|---|---|---|---|---|---|---|
| | N20LE/LSLL0512 | | 6 inches | 29-I-002 | BW Tank | Multipoint sw1 |
| | N20LE/LSL0512 | | 8 inches | 29-I-002 | BW Tank | Multipoint sw1 |
| | N20LE/LSH0512 | | 10 FT, 5 inches | 29-I-002 | BW Tank | Multipoint sw1 |
| | N20LE/LSHH0512 | | 13.5 FT. | 29-I-002 | BW Tank | Multipoint sw1 |
| | N20LE/LSLL0515 | | 1 Ft, 2.5 inches | 29-I-002 | Sump Tank | Multipoint sw2 |
| | N20LE/LSL0515 | | 1 Ft, 8.5 inches | 29-I-002 | Sump Tank | Multipoint sw2 |
| | N20LE/LSH0515 | | 5 FT. | 29-I-002 | Sump Tank | Multipoint sw2 |
| | N20LE/LSHH0515 | | 5.5 FT. | 29-I-002 | Sump Tank | Multipoint sw2 |
| | | | | | | |
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**Notes:** Refer to Section 40 90 00, Instrumentation and Control, for additional capacitance level switch requirements.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **A/E:** | **Carollo Engineers** | **PRESSURE GAUGES** | | | | | | | |
| | | | | | | **Spec. No.** | | **Rev.** | |
| **Contractor:** | | **No** | **By** | **Date** | **Revision** | 40 90 00 | | | |
| **Project:** | Demo Plant Relocation | | | | | **Contract** | | **Date** | |
| **Customer:** | City of San Diego | | | | | | | | |
| **Plant:** | NCWRP | | | | | **Req.** | | **P.O.** | |
| **Location:** | San Diego, CA | | | | | | | | |
| **BOM No.:** | | | | | | **By** | **Chk** | **App** | |
| **File:** | | | | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | **Type** | Direct Rdg.: √ | | Receiver: | | Other: |
| 2 | **Mounting** | Surface: Local: X | | | | Flush: |
| 3 | **Dial** | Diameter: 4.5” | | | Color: | |
| 4 | **Case** | Cast Iron: | Aluminum: | Phenolic: √ | Polished SS | Other: |
| 5 | **Ring** | Screwed: | Hinged: | Slip: | Std:X | Other: |
| 6 | **Blowout Protection** | None: | Disc: | Front: | Other: | Mfr. Std. X |
| 7 | **Lens** | Glass: √ | | | Plastic: | |
| 8 | **Options** | Siphon: N/A | | | Material: | |
| 9 | **Other** | Snubber: Yes | | | | |
| 10 | **Other** | Pressure Limit Valve: N/A | | | | |
| 11 | **Other** | Movement Damping: N/A | | | | |
| 12 | **Nominal Accuracy Required** | +/- 1% to 150% of indicating range | | | | |
| 13 | **Pressure Element** | Bourdon®: √ | | Bellows: | | Other: |
| 14 | **Element Material** | Bronze: | Steel: | | Type SS: 316 √ | Other: |
| 15 | **Socket Material** | Bronze: | Steel: | | SS: 316 | Other: |
| 16 | **Connection** | ¼ in.: | ½ in.: √ | | Bottom: | Other: |
| 17 | **Movement** | Dampened: | Standard: √ | | Other: | |
| 18 | **Diaphragm Seal** | Mfr.: | | Wetted Part Mat’l: | | Type: |
| 19 | **Other** | Other Mat’l: | | Fill Fluid: | | Model: |
| 20 | **Manufacturer** | Ashcroft 1279, Wika, or approved equal. | | | | |
| 21 | **Model No.** | | | | | |

| Rev | Tag Number | Range | P&ID | Service | Notes |
|---|---|---|---|---|---|
| | N29PI0511 | 0-60 PSI | 29-I-002 | BW Pump Discharge Pressure | |
| | N29PI0515 | 0-30 PSI | 29-I-002 | Sump Pump Discharge Pressure | |
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**Notes:** Refer to Section 40 90 00, Instrumentation and Control, for additional pressure gauge requirements.

# SECTION 43 31 13.13
# GRANULAR ACTIVATED CARBON (GAC) FILTER MEDIA

## PART 1 GENERAL

### 1.01 SUMMARY

A. This Specification describes the GAC products for use as filter media in biological filtration. The GAC shall be capable of removing turbidity, color, tastes, odors, and other organic contaminants from effluent from water pretreatment processes and shall be able to function in biological filters. The GAC shall be made from selected grades of bituminous coal capable of withstanding repeated backwash procedures without significant change in physical sizes and shall be suitable for terminal reactivation and re-use. Only coal-based GAC will be acceptable.

B. The Contractor shall relocate existing BAC media and re-install as described in this Specification and as indicated on Drawings. The Contractor shall remove any fines in the relocated media and replace additional media as a result of mishandling or loss.

### 1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   a. B100, Granular Filter Material.
   b. B604, Granular Activated Carbon (GAC).

### 1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Submit manufacturer’s product information not less than 30 days prior to shipment, including particle size distribution for the GAC media layer specified, total ash percent, and iodine number. Media sizes shall be in millimeters and include effective size and uniformity coefficient. Data on flow rate versus expansion of the media during fluidization backwashing at three different temperatures shall also be included.

2. Samples: Submit no less than 2-pound samples of GAC media following delivery of shipment, with a Certificate of Analysis which shall certify that sample shipped to the Site is from the same batch as that shipped to the Project Site, virgin carbon and in full compliance with the specifications noted in Article Specifications.

B. Informational Submittals:

1. Submit gradation test results of GAC media, including sieve analysis prior to loading and shipment.
2. Submit data showing successful application of the GAC in municipal water treatment plants including turbidity and organic contaminant removal, along with references.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS OF GRANULAR ACTIVATED CARBON

A. Manufacturers:

1. Calgon Carbon Corporation.
2. Norit Americas, Inc.
3. Or approved equal.

B. The manufacturer shall have project experience in supplying GAC to water treatment plants.

### 2.02 SPECIFICATIONS

A. The GAC shall be clean, hard, durable particles in conformance with AWWA B604, modified as follows:

1. Deliver GAC in bulk containers or bulk trailer.
2. The GAC shall be NSF Standard 61 certified virgin material manufactured from select grades of bituminous coal having the following properties:
   a. Particle Size Distribution: 8 by 20 carbon with maximum of 5 percent by weight larger than No. 8 mesh (2.36 mm) sieve and maximum of 4 percent by weight smaller than No. 20 mesh (0.841 mm) sieve.
   b. Granular activated carbon with effective size of 0.8 mm to 1.0 mm, Uniformity Coefficient of no greater than 1.5.
   c. Minimum abrasion number of 75 (75 percent as determined by the RO-Tap abrasion test).

d. Minimum adsorptive capacity as measured by iodine number of 750 mg iodine/g carbon.
e. Minimum surface area of 900 sq m/g.
f. Maximum water soluble ash of 0.5 percent by weight.
g. Maximum total ash content of 8 percent by weight.
h. Maximum moisture as packed of 2 percent by weight.
i. Real density of 2.1 g/$cm^3$.
j. Apparent density, backwashed and drained of 0.46 g/$cm^3$ to 0.65 g/$cm^3$.
k. Particle density, wetted in water of 1.3 g/$cm^3$ to 1.4 g/$cm^3$.
l. Pore volume of 0.75 $cm^3$/g to 0.85 $cm^3$/g.

3. Depth: 6.5 feet. See Drawings for filter dimensions.

2.03 SOURCE QUALITY CONTROL

A. Owner will test samples in accordance with procedures specified in AWWA B100 and AWWA B604.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. General:

1. GAC depletes oxygen from air and can be hazardous in a confined situation. Contractor shall be responsible for worker's safety and follow all local, state, and federal guidelines pertaining to confined space entry procedures. Obtain necessary permits for work in confined areas.
2. The GAC shall be installed as a wet slurry to minimize abrasion and dust.
3. Do not permit workers to walk or stand directly on media. Use boards that will sustain workers' weight without displacing media or gravel if specified.
4. Before GAC media is placed, mark top of GAC layer on side of filter.

B. GAC Media:

1. Prior to installation of GAC media, the filter box shall be disinfected. See Section 33 13 00, Disinfection of Water Utility Distribution Facilities.
2. Transport and place media carefully to prevent contamination of any sort.

3. Any filter media which becomes contaminated or dirty (i.e., contains more than 0.5 percent of foreign material by weight), either before or after it has been placed in the filters, shall be removed and replaced with clean media.
4. Install in following sequence:
   a. Place the GAC media in lifts of 12 inches up to total depth and finish off smooth after placement of each lift.
   b. After placement of each lift, backwash the bed with water only (no air) at a reduced rate (less than 2 gpm per square foot) to remove carbon fines. As the fines are removed and the media is clearly visible, gradually increase the backwash rate to 15 gpm per square foot and maintain for approximately 10 minutes. Reduce backwash rate to less than 5 gpm per square foot and hold for at least 30 seconds, and then slowly close the backwash valve.
   c. After placement of the last lift, perform a total of three backwashes according to the description above.
   d. Add new GAC after each backwash to obtain the required depth.
5. Final depth of GAC media after washing and scraping shall be the specified depth of 6.5 feet.

3.02 TESTING

A. After GAC media placement is complete the filter bed shall be fluidized at a rate of 15 gpm per square foot for approximately 10 minutes. After GAC has settled, Owner will take a full depth core sample within each filter bed using coring equipment. The cores will be dried and sieve analyzed to confirm gradation, effective size, and uniformity coefficient. Iodine number and total ash content will also be tested.

B. If GAC media does not meet Specifications, Contractor shall replace some or all of the GAC until Specifications are met.

3.03 MANUFACTURER'S SERVICES

A. A manufacturer's technical representative for the GAC media specified shall be present at the Job Site continuously during placement of media for installation supervision, inspection, and certification of the installation. The representative shall be a full-time, direct employee of the filter media supplier and shall have project experience in filter media installation. Maximum time onsite, excluding travel, is 3 days.

B. Provide a manufacturer's certificate of proper installation in accordance with Division 01, General Requirements.

**END OF SECTION**

# SECTION 43 40 01
# POLYETHYLENE STORAGE TANK

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Mechanical Engineers (ASME): B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
2. ASTM International (ASTM):
   a. C177, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   b. D638, Test Method for Tensile Properties of Plastics.
   c. D648, Test Method for Deflection Temperature of Plastics Under Flexural Load.
   d. D746, Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
   e. D790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
   f. D833, Standard Definitions of Terms Relating to Plastics.
   g. D1505, Test Method for Density of Plastics by the Density-Gradient Technique.
   h. D1525, Test Method for Vicat Softening Temperature of Plastics.
   i. D1621, Test Method for Compressive Properties of Rigid Cellular Plastics.
   j. D1622, Test Method for Apparent Density of Rigid Cellular Plastics.
   k. D1623, Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
   l. D1693, Test Method for Environmental Stress-Cracking of Ethylene Plastics.
   m. D1940, Method of Test for Porosity of Rigid Cellular Plastics.
   n. D1998, Specification for Polyethylene Upright Storage Tanks.
   o. E84, Test Method for Surface Burning Characteristics of Building Materials.

### 1.02 DEFINITIONS

A. XLHDPE: Cross-linked high-density polyethylene.

1.03 DESIGN REQUIREMENTS

A. Manufacturer shall design storage tanks, including wall thickness and methods and locations of support and anchorage. Design shall be prepared and sealed by designer meeting requirements of Article Quality Assurance.

B. Tank manufacturer must be capable of providing UL listing for nonmetallic aboveground tanks.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Fabricator's catalog information, descriptive literature, specifications, and identification of materials of construction. Provide catalog cuts for all off-the-shelf items.
   b. Detailed fabrication drawings shall be scale drawings showing the relative size, configuration, location, materials of construction, and details of all equipment and materials to be furnished including the tanks, fittings, access ladders, supports, and tank holddown and support systems. Both plan and elevation views shall be provided. All piping terminal points shall be clearly shown and fully dimensioned.
   c. Resin used for each tank and all supporting specifications for resins.
   d. Foundation and Anchor Bolt Drawings: Drawings shall be provided that show all data and details required for design of the tank foundations including locations and dimensions for knockouts and embedded items, and the size, type, location, embedment and projection of anchor bolts.
   e. Complete design calculations of the restraint system signed by a civil or structural engineer registered in the state where the Project is located.
   f. Tank data indicating pressure rating, diameter, straight shell lengths, overall lengths, wall thickness, and details of nozzle designs.
   g. Tank capacity chart indicating gallons for each inch of depth and cumulative total from bottom.
   h. Certified test data on representative samples of standard materials which demonstrate compliance with the physical properties specified herein.

i. Certified copy of all factory test results:
   1) Material, specific gravity rating at 600 psi at 100 degrees F.
   2) Design hoop stress.
   3) Wall thickness verification.
   4) Visual inspection.
   5) Impact test.
   6) Gel test.
   7) Hydrostatic test.

j. Installation instructions shall be completed, detailed, and sequenced instructions for original installation. Recommended methods for assembly and adjustment including all bolt torques shall be provided along with special precautions and the sequence of work. Rigging and lifting details shall also be included for all factory-fabricated assemblies and individual components weighing over 100 pounds.

k. All exceptions and any proposed revisions to the requirements of the Specifications shall be included with the Submittals.

2. Samples: Representative Samples of the high density cross-linked polyethylene with anti-oxidant resistant linear low density polyethylene liner tank shall be provided.

B. Informational Submittals:

1. Fabricator's Certificate of Compliance with fabrication requirements.
2. Quality Assurance Inspection:
   a. Initial QA Inspection Report.
   b. Certification of Factory Testing.
3. Special shipping, storage and protection, and handling instructions.
4. Fabricator's written/printed installation and tank support instructions.
5. Manufacturer's Certificate of Proper Installation.
6. Warranty.
7. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

## 1.05 QUALITY ASSURANCE

A. Fabricator's Quality Assurance Supervisor: Manufacturer with experienced personnel, physical facilities, and management capacity sufficient to produce custom-made rotationally molded polyethylene tanks of the size, exposure, and services with satisfactory performance record.

B. Tanks shall be manufactured by a firm with a nationally accepted quality standard (such as, ISO 9001).

1.06 DELIVERY, STORAGE, AND HANDLING

A. All materials fabricated to this Specification must be packaged, crated, or protected in such manner so as to prevent damage in handling and while in transit. Details of these procedures shall be the responsibility of manufacturer.

B. In addition, prepare and protect tanks for shipment as follows:

1. Mount tanks on padded cradles if shipped horizontally or on a suitable skid if shipped vertically.
2. Protect all flanged nozzles with wooden blinds bolted to the flange and having a diameter of 2 inches greater than the outside diameter of the flange.
3. Provide either rigid plugs inside the ends to prevent deflection or wooden boxes for all unflanged components. Brace the open ends of tanks with a suitable stiffening member to prevent deflection.
4. Do not ship components or other pieces loose inside the tanks.
5. Load tanks with at least 2 inches clearance between the tank (including fittings) and the bulkheads or bed of the vehicle.
6. Regardless of the mode of transportation, firmly fasten and pad all components to prevent shifting of the load or flexing of components while in transit.
7. Nozzles or other fittings shall not be used for lifting.

1.07 WARRANTY

A. Tanks shall have a minimum 5-year warranty from the tank manufacturer, covering the complete cost of repair and replacement of the tanks (not including any costs associated with altering, removing, or demolishing the existing facility structure for such removal which shall be borne by Contractor) during the first 5 years of service, should leakage occur through the tank or the tank fittings, or should the tank or tank fittings show signs of fatigue or failure as determined by Construction Manager.

1. Prorated warranties are not acceptable.

**PART 2 PRODUCTS**

2.01 GENERAL

A. All equipment specified herein shall be factory fabricated and assembled to the maximum extent possible requiring a minimum of field assembly. Field installation shall be limited to anchoring the tanks and making external piping connections.

B. All equipment specified herein shall be suitable for contact with the stored fluid.

C. Like items of materials and equipment shall be the end products of one manufacturer in order to provide standardization for appearance operation, maintenance spare parts, and manufacturer's service.

2.02 SCOPE OF SUPPLIES

A. Provide all materials, labor, equipment, and hardware to provide all polyethylene storage tanks with specified fittings and accessories, seismic and wind load restraint systems, anchor bolts, and flange flexible connectors for complete installation in the positions and orientations indicated on Drawings.

2.03 MANUFACTURERS

A. Poly Processing Company.

B. Snyder Industries, Inc.

C. Or approved equal.

2.04 GENERAL

A. Tanks shall be rotationally-molded, high density crosslinked polyethylene, flat bottom tanks. Each tank is a rotationally molded one-piece seamless constructed tank. The tanks are designed for aboveground, vertical installation and are designed to store approved fluid at atmospheric pressures. Each tank shall be adequately vented as prescribed by the manufacturer and where indicated, tanks shall be provided with entrance manways, reverse float level indicators, and connections for top mounted level transmitters. Tanks shall be marked to identify the manufacturer, date of manufacture, and serial number.

2.05 TANK DESIGN CRITERIA

A. Tanks:

1. Number: One.
2. Rated Volume: 1,400 gallons.
3. Diameter: 6 feet.
4. Configuration: Vertical, flat bottom.
5. Service: BAC Filtrate.
6. Height: 6.5 feet.

B. The minimum design specific gravity shall be 1.5.

C. Resin: Virgin high-density crosslinkable polyethylene in accordance with ASTM D1998.

1. Manufacturers and Products:
   a. Exxon Mobile Chemicals.
   b. Phillips Chemical; Marlex CL200.
   c. Paxon; Grade 7204 resin.
   d. Or approved equal.

D. Fittings: PVC.

E. Gaskets: EPDM.

F. Bolts: Type 316 stainless steel.

G. Ultra Violet Stabilizer: Add 0.5 percent stabilizer, in the type and amount recommended by the resin manufacturer.

H. Free of holes, blisters, crazing, cracking, delamination, undispersed raw materials, and any sign of contamination from foreign matter.

1. The finished tank wail shall be free of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking, and delaminations.
2. All cut edges where openings are cut into the tanks shall be trimmed smooth.

I. Resin shall meet or exceed the following properties:

| Parameter | ASTM Test | Requirement |
|---|---|---|
| Density (Resin) | D1505 | 0.942 - 0.948 gm/cc |
| Environmental Stress, Cracking Resistance (10% Igepal, F50) | D1693 | ≥1,000 hrs |
| Tensile Strength (Yield Stress 2” min.) | D638<br>Type IV Specimen | 2,600 psi |
| Elongation at Break (2” min.) | D638<br>Type IV Specimen | 450% |
| Vicat Softening Temperature | D1525 | >255 degrees F |
| Flexural Modulus | D790 | 100,000 psi |

| Parameter | ASTM Test | Requirement |
|---|---|---|
| Brittleness Temperature | D746 | ≤ -130 degrees F |
| Dart impact resistance (1/4" thick) | D1998 | 190 ft-lbs at -40°F |

J. Wall thickness for a given hoop stress is to be calculated in accordance with ASTM D1998. Tanks shall be designed using a hoop stress no greater than 600 psi. Wall thickness calculations shall assume that all tank contents have a specific gravity of not less than 1.9. In no case shall the tank thickness be less than design thickness.

1. The wall thickness of any cylindrical portion at any fluid level shall be determined by the following equation:

$$T = P \times OD/2SD \text{ OR } 0.433 \times SG \times OD \times H \times OD/2SD$$

Where:
- T = Wall Thickness, In
- P = Pressure, psi
- Sg = Specific Gravity, Gm/Cc
- H = Fluid Head, Ft
- OD = Outside Diameter, Ft
- SD = Hydrostatic Design Stress, 600 psi

2. The minimum wall thickness shall be sufficient to support its own weight in an upright position without external support but shall not be less than 0.187-inch-thick.

K. Tank Shell Thickness:

1. In accordance with ASTM D1998, Section 6.1.
2. Design tank wall thickness for liquid with specific gravity as specified.
3. Provide adequate thickness at all fittings and connection points for mounting of fittings to the tank without damage to the tank or causing excessive deflection.
4. Maximum allowable hoop stress used in tank wall thickness calculations per ASTM D1998 shall be based on test data in accordance with ASTM D2837.

L. The bottom head shall be integrally molded with the cylindrical wall. Knuckle radius shall be:

| Tank Diameter (Feet) | Minimum Knuckle Radius (Inches) |
|---|---|
| Less than or equal to 6 | 1 |
| Greater than 6 | 1-1/2 |

M. Gel Test:

1. Inner Portion of Tank Wall: Not less than 65 percent.
2. Entire Wall Thickness: Not less than 80 percent.

N. Restraint System:

1. Wind Load Restraint System:
   a. Wind Design Criteria: As specified in Section 01 88 15, Anchorage and Bracing.
   b. If the wind load restraint system includes the use of cables, tensioning and adjustment devices, such as turnbuckles, shall be used to allow for easy adjustment of the cables at the time of construction and as required in the future.
2. Metal Components, Include Anchor Bolts: Type 304 stainless steel.
3. Concrete anchors or flush shells shall not be used.

## 2.06 TANK SUPPORT AND RESTRAINT SYSTEM

A. Each tank and its associated attachments shall be structurally adequate for all tank design criteria specified herein.

B. Wind Load Restraint System:

1. Wind Design Criteria: As specified in Section 01 88 15, Anchorage and Bracing.
2. If the wind load restraint system includes the use of cables, tensioning and adjustment devices, such as turnbuckles, shall be used to allow for easy adjustment of the cables at the time of construction and as required in the future.
3. Metal Components, Including Anchor Bolts: Provide a minimum of four Type 304 stainless steel holddown lugs, complete with plate, anchor bolts, nuts, and washers for proper anchoring of the tank. Actual number of holddown lugs shall be calculated with the tank full.
4. Concrete anchors or flush shells shall not be used.

C. All exposed metal surfaces not constructed of stainless steel shall be painted in accordance with and as specified in Section 09 90 00, Painting and Coating.

## 2.07 FITTINGS

A. Terminate in Threaded, or Flanged Connections:

1. Flanges: 150-pound ASME B16.5.
2. Threaded Connections: ASME B16.4.

B. Fittings at upper tank sidewall or top: Compression threaded type, long shank, polyvinyl chloride flanged fittings with deep cut threads (not injection molded thread) and with dual wide nuts. All threads to be American pipe thread cut.

C. Fittings on Tank Top: Universal ball dome fitting by Polyprocessing, or approved equal by Snyder. For level sensor, provide 4-inch NPT fitting. Provide other top connections as shown on Drawings.

D. Flanged outlet drain fitting in the lower tank sidewall: Integrally molded into the bottom knuckle of the tank to allow full drainage of tank contents.

1. IMFO® or SUMO®-type fittings.

E. All materials used in tank fitting assemblies shall be compatible with stored fluid. No wetted fittings or appurtenances shall be of metallic construction.

## 2.08 ACCESSORIES AND APPURTENANCES

A. U-Vents: Each tank must be vented for the material and flow and withdrawal rates expected. Vents should comply with OSHA 1910.106(F)(iii)(2)(IV)(9). U-vents shall be sized by the tank. U-vents shall be constructed of PVC or material compatible with the fluid stored.

B. Flange Adapters: Adapters may be used to adapt threaded or socket fitting components to 150-pound flange connections. Adapters shall be of material compatible with the fluid stored.

C. Instrumentation: As indicated on Drawings.

D. All tank accessories and appurtenances shall be compatible with the stored materials and shall be designed to withstand the hydrostatic pressure resulting from a full tank.

## 2.09 TANK FABRICATION

A. Rotationally molded construction in accordance with ASTM D1998.

B. Provide for each tank the following shop finishing:

1. Shipping Label Identifying:
   a. Tank tag number.
   b. Fluid service.

2. Permanent Labels:
   a. Identification label.
   b. NFPA label specifically coded for the tank contents in accordance with NFPA 30.
   c. Paint or affix label onto the tank wall to be clearly visible from outside the tank enclosure.

2.10 SOURCE QUALITY CONTROL

A. General: The tank fabricators shall have a quality control procedure adequate to ensure that all fabrication complies with these Specifications.

B. Each tank shall be leak tested by the manufacturer prior to shipment by filling with clean water for a period of at least 4 hours with all fittings installed and blinded.

1. There shall be no measurable drop in liquid surface.
2. Any leaks shall be noted and repaired, and the tank shall be retested for an additional 4 hours minimum.
   a. Reason for leak and method of repair shall be recorded and submitted to the Construction Manager.
3. Any defects or leaks that have not been adequately repaired will be cause for rejection of the tank.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. General:

1. Transportation, handling, storage of the tanks, and installation shall be in accordance with the manufacturer's printed instructions.
2. Repair any damage to tank components due to transportation or installation.
3. Install piping to tank with sufficient flexibility to allow tank movement of 1-inch in any direction without damage to piping.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Service:

1. Inspect the installed tanks for proper installation.
2. Instruct Owner's personnel on operations and maintenance of the tanks.
3. Quality control shall include a final inspection by Contractor and a written record of this final inspection.

4. After testing, the tanks shall be thoroughly cleaned and dried.
5. 1 person-day for inspection and certification of the installation.

3.03 TANK SCHEDULE

A. Tank schedule as follows:

| **Tag Number** | **NC29T511** |
|---|---|
| Location | Overflow Sump |
| Service | BAC Filtrate |
| Capacity, gallons | 1,300 |
| Type | Crosslinked HDPE |
| Installation | Vertical |
| Diameter, feet | 6 |
| Height, feet | 6.5 |

**END OF SECTION**

# SECTION 44 42 56.10
# HORIZONTAL END SUCTION CENTRIFUGAL PUMPS

## PART 1 GENERAL

### 1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers' Association (ABMA).
2. Hydraulic Institute Standards.
3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
4. Occupational Safety and Health Administration (OSHA).

### 1.02 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

### 1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Make, model, weight, and horsepower of each equipment assembly.
   b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
   c. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over entire operating range of pump from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at guarantee point.
   d. Detailed mechanical and electrical drawings showing equipment dimensions, size, and locations of connections and weights of associated equipment.
   e. Power and control wiring diagrams, including terminals and numbers.
   f. Complete motor nameplate data, as defined by NEMA, motor manufacturer.
   g. Factory finish system data sheets.
   h. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Factory Functional Test Reports.
3. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that factory finish system is identical to the requirements specified herein.
4. Special shipping, storage and protection, and handling instructions.
5. Manufacturer's printed installation instructions.
6. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
7. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
8. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
9. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 91 14, Testing, Integration, and Startup.

1.04 EXTRA MATERIALS

A. Furnish for each pump:

1. Complete set bearings.
2. Complete set gaskets and O-ring seals.
3. Complete set of shaft sleeves.
4. Complete set keys, dowels, pins, etc.
5. Complete mechanical seal.
6. Impeller.
7. Impeller shaft.
8. Head shaft.

## PART 2 PRODUCTS

2.01 GENERAL

A. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.

B. Where adjustable speed drives are required, furnish a coordinated operating system complete with pump, drive, and speed controller.

2.02 SUPPLEMENTS

A. Some specific requirements are attached to this section as supplements.

2.03 ACCESSORIES

A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.

B. Lifting Lugs: Equipment weighing over 100 pounds.

C. OSHA-approved coupling guard for direct coupled or belt driven pumps.

D. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications, to be provided by the Contractor.

2.04 FACTORY FINISHING

A. Prepare, prime, and finish with manufacturer's standard polyurethane topcoat in accordance with Section 09 90 00, Painting and Coating.

2.05 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments: Test all equipment actually furnished.

C. Factory Test Report: Include performance test logs, certified correct by a registered professional engineer.

D. Functional Test:

1. Perform manufacturer's standard motor test on equipment. Include vibration test, as follows:
   a. Dynamically balance rotating parts of each pump and its driving unit before final assembly.
   b. Limits:
      1) Driving Unit Alone: Less than 80 percent of NEMA MG 1 limits.
      2) Complete Rotating Assembly Including Coupling, Drive Unit, and Motor: Less than 90 percent of limits established in the Hydraulic Institute Standards.

E. Performance Test:

1. Perform under simulated operating conditions.
2. In accordance with Hydraulic Institute Standards.
3. Test for a continuous 3-hour period without malfunction.
4. Test Log:
   a. Record the following:
      1) Total head.
      2) Capacity.
      3) Horsepower requirements.
      4) Flow measured by factory instrumentation and storage volumes.
      5) Average distance from suction well water surface to pump discharge centerline for duration of test.
      6) Pump discharge pressure converted to feet of liquid pumped and corrected to pump discharge centerline.
      7) Driving motor voltage and amperage measured for each phase.
5. Adjust, realign, or modify units and retest in accordance with Hydraulic Institute Standards if necessary.

F. Motor Test: See Section 26 20 00, Low-Voltage AC Induction Motors.

G. Hydrostatic Tests: Pump casing(s) tested at 150 percent of shutoff head. Test pressure maintained for not less than 5 minutes.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 1/4 inch per foot. Use double wedges to provide a level bearing surface for pump and driver base. Accomplish wedging so there is no change of level or springing of baseplate when anchor bolts are tightened.

C. Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.

D. After pump and driver have been set in position, aligned, and shimmed to proper elevation, grout the space between the bottom of the baseplate and the concrete foundation with a poured, nonshrinking grout of the proper category, as specified in Section 03 62 00, Grouting. Remove wedges after grout is set and pack void with grout.

E. Connect suction and discharge piping without imposing strain to pump flanges.

F. Anchor Bolts: Accurately place using equipment templates and as specified in Section 05 50 00, Metal Fabrications.

## 3.02 FIELD FINISHING

A. Finish equipment as specified in Section 09 90 00, Painting and Coating.

## 3.03 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each pump.

1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
2. Vibration Test:
   a. Test with unit installed and in normal operation, and discharging to the connected piping systems at rates between low discharge head and high discharge head conditions specified and with actual building structures and foundations provided shall not develop vibration exceeding the limits specified in HIS 9.6.4.
   b. If units exhibit vibration in excess of the limits specified, adjust or modify as necessary. Replace units which cannot be adjusted or modified to conform as specified.
3. Flow Output: Measured by plant instrumentation and storage volumes.

B. Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.

C. Performance Test: In accordance with Hydraulic Institute Standards.

## 3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:

1. Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:
   a. 2 person-days for installation assistance and inspection.

b. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
c. 1/2 person-day for prestartup classroom or Site training.
d. 1/2 person-day for facility startup.

B. See Section 01 91 14, Testing, Integration, and Startup.

3.05 SUPPLEMENT

A. The supplements listed below, following "End of Section," are a part of this Specification.

1. BAC Backwash Supply Pump Data Sheet.
2. Overflow Pump Data Sheet.

**END OF SECTION**

# BAC BACKWASH SUPPLY PUMP DATA SHEET

Tag Number: NC29P511

Pump Name: BAC Backwash Supply Pump

Manufacturer and Model Number: (1) Flowserve Corporation, 3K10x8-14RV M3 ST
(2) ITT Goulds Pump, similar to scheduled model
(3) Or approved equal

## SERVICE CONDITIONS

Liquid Pumped (Material and Percent): BAC Filtrate (100 percent)

Pumping Temperature (Fahrenheit): Normal: 60 Max 85 Min 50

Specific Gravity at 60 Degrees F: 1 Viscosity Range:

pH: 6-8

Abrasive (Y/N) N Possible Scale Buildup (Y/N): N

Min. NPSH Available (Ft. Absolute): 41.77

## PERFORMANCE REQUIREMENTS AT PRIMARY DESIGN POINT

Capacity (US gpm): Rated: 2,970

Total Dynamic Head (Ft): Rated: 29.5

Min. Hydraulic Efficiency (%):79

Maximum Shutoff Pressure (Ft): 61.5

Max. Pump Speed at Design Point (rpm): 1,180

Constant (Y/N): N Adjustable (Y/N): Y

**PERFORMANCE REQUIREMENTS AT SECONDARY DESIGN POINTS**

Capacity 1 (US gpm): Rated: 900 Total Dynamic Head 1 (Ft): 18.5

Min. Hydraulic Efficiency 1 (%): 67

Capacity 2 (US gpm): Rated: 3,500 Total Dynamic Head 2 (Ft): 46.5

Min. Hydraulic Efficiency 2 (%): 79

**DESIGN AND MATERIALS**

ANSI (Y/N) Y Standard (Y/N) Y Design: Frame-mounted (Y/N) Y
Close-Coupled Casing (Y/N) N Back Pullout (Y/N) Y

Discharge Orientation: Top Rotation (view from driver): CW

Casing Materials: Ductile Iron

Impeller Type: Reverse vane Material: Ductile Iron

Shaft Material: BB 1144 Steel Shaft Sleeve Material: N/A

Shaft Seal: _____ Packing (Y/N) _____ Material: _____

Mechanical (Y/N) Y Type: Flowserve ICS

Lubrication: Flood

ABMA L-10 Bearing Life (Hrs): 100,000 Lubrication: Grease

Coupling: Falk (Y/N) Y Fast (Y/N) _____
Spring-Grid (Y/N) _____

Gear Type (Y/N) Y Spacer (Y/N) N Manufacturer Falk

Baseplate: Material: Fabricated Steel

Drive Type: Direct-Coupled: Falk coupling

Adjustable Speed Drive Range: 700 min to 1,180 max, See Section 26 29 23, Low-Voltage Adjustable Frequency Drive System.

**DRIVE MOTOR** (See Section 26 20 00, Low-Voltage AC Induction Motors.)

Horsepower: 40 Voltage: 460 Phase: 3 Synchronous Speed (rpm): 1,200

Service Factor: 1.15 Inverter Duty (Y/N) Y

Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

Enclosure: DIP ____ EXP ____ ODP ____ TEFC __Y__ CISD-TEFC ____
TENV ____ WPI ____ WPII ____ SUBM ____

Mounting Type: Horizontal Y Nonreverse Ratchet (Y/N) N

**REMARKS** _____

# OVERFLOW PUMP DATA SHEET

Tag Number: N29P0515

Pump Name: Overflow Pump

Manufacturer and Model Number: (1) Flowserve Corporation, 2K6x4-10HRV M3 ST
(2) ITT Goulds Pump, similar to scheduled model
(3) Or approved equal

## SERVICE CONDITIONS

Liquid Pumped (Material and Percent): BAC Filtrate (100 percent)

Pumping Temperature (Fahrenheit): Normal: 60 Max 85 Min 50

Specific Gravity at 60 Degrees F: 1 Viscosity Range:

pH: 6-8

Abrasive (Y/N) N Possible Scale Buildup (Y/N): N

Min. NPSH Available (Ft. Absolute): 38.03

## PERFORMANCE REQUIREMENTS AT PRIMARY DESIGN POINT

Capacity (US gpm): Rated: 500

Total Dynamic Head (Ft): Rated: 20

Min. Hydraulic Efficiency (%): 64

Maximum Shutoff Pressure (Ft): 23.97

Max. Pump Speed at Design Point (rpm): 1,180

Constant (Y/N): N Adjustable (Y/N): Y

**PERFORMANCE REQUIREMENTS AT SECONDARY DESIGN POINTS**

Capacity 1 (US gpm): Rated: 300 Total Dynamic Head 1 (Ft): 23

Min. Hydraulic Efficiency 1 (%): 54

Capacity 2 (US gpm): Rated: 700 Total Dynamic Head 2 (Ft): 14.5

Min. Hydraulic Efficiency 2 (%): 59

**DESIGN AND MATERIALS**

ANSI (Y/N) Y Standard (Y/N) Y Design: Frame-mounted (Y/N) Y
Close-Coupled Casing (Y/N) N Back Pullout (Y/N) Y

Discharge Orientation: Top Rotation (view from driver): CW

Casing Materials: Ductile Iron

Impeller: Type: Reverse vane Material: Ductile Iron

Shaft Material: BB 1144 Steel Shaft Sleeve Material: N/A

Shaft Seal: _____ Packing (Y/N) _____ Material: _____

Mechanical (Y/N) Y Type: Flowserve ICS

Lubrication: Flood

ABMA L-10 Bearing Life (Hrs): 100,000 Lubrication: Grease

Coupling: Falk (Y/N) Y Fast (Y/N) _____
Spring-Grid (Y/N) _____

Gear Type (Y/N) Y Spacer (Y/N) N Manufacturer Falk

Baseplate: Material: Fabricated Steel

Drive Type: Direct-Coupled: Falk coupling

Adjustable Speed Drive Range: N/A

**DRIVE MOTOR** (See Section 26 20 00, Low-Voltage AC Induction Motors)

Horsepower: 5 Voltage: 460 Phase: 3 Synchronous Speed (rpm): 1,200

Service Factor: 1.15 Inverter Duty (Y/N) N

Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

Enclosure: DIP ____ EXP ____ ODP ____ TEFC _Y__ CISD-TEFC ____
TENV ____ WPI ____ WPII ____ SUBM ____

Mounting Type: Horizontal Y_____ Nonreverse Ratchet (Y/N) N_____

**REMARKS** _____

_____

_____

_____

# SUPPLEMENTARY SPECIAL PROVISIONS

# APPENDICES

# APPENDIX A

# FIRE HYDRANT METER PROGRAM

| CITY OF SAN DIEGO CALIFORNIA DEPARTMENT INSTRUCTIONS | NUMBER **DI** 55.27 | DEPARTMENT Water Department |
|---|---|---|
| **SUBJECT**<br><br>**FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)** | **PAGE** 1**OF** 10 | **EFFECTIVE DATE**<br><br>October 15, 2002 |
| | **SUPERSEDES** **DI** 55.27 | **DATED** April 21, 2000 |

1. **PURPOSE**

1.1 To establish a Departmental policy and procedure for issuance, proper usage and charges for fire hydrant meters.

2. **AUTHORITY**

2.1 All authorities and references shall be current versions and revisions.

2.2 San Diego Municipal Code (NC) Chapter VI, Article 7, Sections 67.14 and 67.15

2.3 Code of Federal Regulations, Safe Drinking Water Act of 1986

2.4 California Code of Regulations, Titles 17 and 22

2.5 California State Penal Code, Section 498B.0

2.6 State of California Water Code, Section 110, 500-6, and 520-23

2.7 Water Department Director

**Reference**

2.8 State of California Guidance Manual for Cross Connection Programs

2.9 American Water Works Association Manual M-14, Recommended Practice for Backflow Prevention

2.10 American Water Works Association Standards for Water Meters

2.11 U.S.C. Foundation for Cross Connection Control and Hydraulic Research Manual

3. **DEFINITIONS**

3.1 **Fire Hydrant Meter:** A portable water meter which is connected to a fire hydrant for the purpose of temporary use. (These meters are sometimes referred to as Construction Meters.)

3.2 **Temporary Water Use:** Water provided to the customer for no longer than twelve (12) months.

3.3 **Backflow Preventor:** A Reduced Pressure Principal Assembly connected to the outlet side of a Fire Hydrant Meter.

## 4. POLICY

4.1 The Water Department shall collect a deposit from every customer requiring a fire hydrant meter and appurtenances prior to providing the meter and appurtenances (see Section 7.1 regarding the Fees and Deposit Schedule). The deposit is refundable upon the termination of use and return of equipment and appurtenances in good working condition.

4.2 Fire hydrant meters will have a 2 ½" swivel connection between the meter and fire hydrant. The meter shall not be connected to the 4" port on the hydrant. All Fire Hydrant Meters issued shall have a Reduced Pressure Principle Assembly (RP) as part of the installation. Spanner wrenches are the only tool allowed to turn on water at the fire hydrant.

4.3 The use of private hydrant meters on City hydrants is prohibited, with exceptions as noted below. All private fire hydrant meters are to be phased out of the City of San Diego. All customers who wish to continue to use their own fire hydrant meters must adhere to the following conditions:

a. Meters shall meet all City specifications and American Water Works Association (AWWA) standards.

b. Customers currently using private fire hydrant meters in the City of San Diego water system will be allowed to continue using the meter under the following conditions:

1. The customer must submit a current certificate of accuracy and calibration results for private meters and private backflows annually to the City of San Diego, Water Department, Meter Shop.

2. The meter must be properly identifiable with a clearly labeled serial number on the body of the fire hydrant meter. The serial number shall be plainly stamped on the register lid and the main casing. Serial numbers shall be visible from the top of the meter casing and the numbers shall be stamped on the top of the inlet casing flange.

3. All meters shall be locked to the fire hydrant by the Water Department, Meter Section (see Section 4.7).

4. All meters shall be read by the Water Department, Meter Section (see Section 4.7).

5. All meters shall be relocated by the Water Department, Meter Section (see Section 4.7).

6. These meters shall be tested on the anniversary of the original test date and proof of testing will be submitted to the Water Department, Meter Shop, on a yearly basis. If not tested, the meter will not be allowed for use in the City of San Diego.

7. All private fire hydrant meters shall have backflow devices attached when installed.

8. The customer must maintain and repair their own private meters and private backflows.

9. The customer must provide current test and calibration results to the Water Department, Meter Shop after any repairs.

10. When private meters are damaged beyond repair, these private meters will be replaced by City owned fire hydrant meters.

11. When a private meter malfunctions, the customer will be notified and the meter will be removed by the City and returned to the customer for repairs. Testing and calibration results shall be given to the City prior to any re-installation.

12. The register shall be hermetically sealed straight reading and shall be readable from the inlet side. Registration shall be in hundred cubic feet.

13. The outlet shall have a 2 ½ "National Standards Tested (NST) fire hydrant male coupling.

14. Private fire hydrant meters shall not be transferable from one contracting company to another (i.e. if a company goes out of business or is bought out by another company).

4.4 All fire hydrant meters and appurtenances shall be installed, relocated and removed by the City of San Diego, Water Department. All City owned fire hydrant meters and appurtenances shall be maintained by the City of San Diego, Water Department, Meter Services.

4.5 If any fire hydrant meter is used in violation of this Department Instruction, the violation will be reported to the Code Compliance Section for investigation and appropriate action. Any customer using a fire hydrant meter in violation of the requirements set forth above is subject to fines or penalties pursuant to the Municipal Code, Section 67.15 and Section 67.37.

4.6 **Conditions and Processes for Issuance of a Fire Hydrant Meter**

Process for Issuance

a. Fire hydrant meters shall only be used for the following purposes:

1. Temporary irrigation purposes not to exceed one year.

2. Construction and maintenance related activities (see Tab 2).

b. No customer inside or outside the boundaries of the City of San Diego Water Department shall resell any portion of the water delivered through a fire hydrant by the City of San Diego Water Department.

c. The City of San Diego allows for the issuance of a temporary fire hydrant meter for a period not to exceed 12 months (365 days). An extension can only be granted in writing from the Water Department Director for up to 90 additional days. A written request for an extension by the consumer must be submitted at least 30 days prior to the 12 month period ending. No extension shall be granted to any customer with a delinquent account with the Water Department. No further extensions shall be granted.

d. Any customer requesting the issuance of a fire hydrant meter shall file an application with the Meter Section. The customer must complete a "Fire Hydrant Meter Application" (Tab 1) which includes the name of the company, the party responsible for payment, Social Security number and/or California ID, requested location of the meter (a detailed map signifying an exact location), local contact person, local phone number, a contractor's license (or a business license), description of specific water use, duration of use at the site and full name and address of the person responsible for payment.

e. At the time of the application the customer will pay their fees according to the schedule set forth in the Rate Book of Fees and Charges, located in the City Clerk's Office. All fees must be paid by check, money order or cashiers check, made payable to the City Treasurer. Cash will not be accepted.

f. No fire hydrant meters shall be furnished or relocated for any customer with a delinquent account with the Water Department.

g. After the fees have been paid and an account has been created, the

meter shall be installed within 48 hours (by the second business day). For an additional fee, at overtime rates, meters can be installed within 24 hours (within one business day).

4.7 **Relocation of Existing Fire Hydrant Meters**

a. The customer shall call the Fire Hydrant Meter Hotline (herein referred to as "Hotline"), a minimum of 24 hours in advance, to request the relocation of a meter. A fee will be charged to the existing account, which must be current before a work order is generated for the meter's relocation.

b. The customer will supply in writing the address where the meter is to be relocated (map page, cross street, etc). The customer must update the original Fire Hydrant Meter Application with any changes as it applies to the new location.

c. Fire hydrant meters shall be read on a monthly basis. While fire hydrant meters and backflow devices are in service, commodity, base fee and damage charges, if applicable, will be billed to the customer on a monthly basis. If the account becomes delinquent, the meter will be removed.

4.8 **Disconnection of Fire Hydrant Meter**

a. After ten (10) months a "Notice of Discontinuation of Service" (Tab 3) will be issued to the site and the address of record to notify the customer of the date of discontinuance of service. An extension can only be granted in writing from the Water Department Director for up to 90 additional days (as stated in Section 4.6C) and a copy of the extension shall be forwarded to the Meter Shop Supervisor. If an extension has not been approved, the meter will be removed after twelve (12) months of use.

b. Upon completion of the project the customer will notify the Meter Services office via the Hotline to request the removal of the fire hydrant meter and appurtenances. A work order will be generated

for removal of the meter.

c. Meter Section staff will remove the meter and backflow prevention assembly and return it to the Meter Shop. Once returned to the Meter Shop the meter and backflow will be tested for accuracy and functionality.

d. Meter Section Staff will contact and notify Customer Services of the final read and any charges resulting from damages to the meter and backflow or its appurtenance. These charges will be added on the customer's final bill and will be sent to the address of record. Any customer who has an outstanding balance will not receive additional meters.

e. Outstanding balances due may be deducted from deposits and any balances refunded to the customer. Any outstanding balances will be turned over to the City Treasurer for collection. Outstanding balances may also be transferred to any other existing accounts.

## 5. EXCEPTIONS

5.1 Any request for exceptions to this policy shall be presented, in writing, to the Customer Support Deputy Director, or his/her designee for consideration.

## 6. MOBILE METER

6.1 Mobile meters will be allowed on a case by case basis. All mobile meters will be protected by an approved backflow assembly and the minimum requirement will be a Reduced Pressure Principal Assembly. The two types of Mobile Meters are vehicle mounted and floating meters. Each style of meters has separate guidelines that shall be followed for the customer to retain service and are described below:

a) **Vehicle Mounted Meters**: Customer applies for and receives a City owned Fire Hydrant Meter from the Meter Shop. The customer mounts the meter on the vehicle and brings it to the Meter Shop for

inspection. After installation is approved by the Meter Shop the vehicle and meter shall be brought to the Meter Shop on a monthly basis for meter reading and on a quarterly basis for testing of the backflow assembly. Meters mounted at the owner's expense shall have the one year contract expiration waived and shall have meter or backflow changed if either fails.

b) **Floating Meters**: Floating Meters are meters that are not mounted to a vehicle. **(Note: All floating meters shall have an approved backflow assembly attached.)** The customer shall submit an application and a letter explaining the need for a floating meter to the Meter Shop. The Fire Hydrant Meter Administrator, after a thorough review of the needs of the customer, (i.e. number of jobsites per day, City contract work, lack of mounting area on work vehicle, etc.), may issue a floating meter. At the time of issue, it will be necessary for the customer to complete and sign the "Floating Fire Hydrant Meter Agreement" which states the following:

    1) The meter will be brought to the Meter Shop at 2797 Caminito Chollas, San Diego on the third week of each month for the monthly read by Meter Shop personnel.

    2) Every other month the meter will be read and the backflow will be tested. This date will be determined by the start date of the agreement.

If any of the conditions stated above are not met the Meter Shop has the right to cancel the contract for floating meter use and close the account associated with the meter. The Meter Shop will also exercise the right to refuse the issuance of another floating meter to the company in question.

Any Fire Hydrant Meter using reclaimed water shall not be allowed use again with any potable water supply. The customer shall incur the cost of replacing the meter and backflow device in this instance.

## 7. FEE AND DEPOSIT SCHEDULES

7.1 **Fees and Deposit Schedules:** The fees and deposits, as listed in the Rate Book of Fees and Charges, on file with the Office of the City Clerk, are based on actual reimbursement of costs of services performed, equipment and materials. Theses deposits and fees will be amended, as needed, based on actual costs. Deposits, will be refunded at the end of the use of the fire hydrant meter, upon return of equipment in good working condition and all outstanding balances on account are paid. Deposits can also be used to cover outstanding balances.

All fees for equipment, installation, testing, relocation and other costs related to this program are subject to change without prior notification. The Mayor and Council will be notified of any future changes.

## 8. UNAUTHORIZED USE OF WATER FROM A HYDRANT

8.1 Use of water from any fire hydrant without a properly issued and installed fire hydrant meter is theft of City property. Customers who use water for unauthorized purposes or without a City of San Diego issued meter will be prosecuted.

8.2 If any unauthorized connection, disconnection or relocation of a fire hydrant meter, or other connection device is made by anyone other than authorized Water Department personnel, the person making the connection will be prosecuted for a violation of San Diego Municipal Code, Section 67.15. In the case of a second offense, the customer's fire hydrant meter shall be confiscated and/or the deposit will be forfeited.

8.3 Unauthorized water use shall be billed to the responsible party. Water use charges shall be based on meter readings, or estimates when meter readings are not available.

8.4 In case of unauthorized water use, the customer shall be billed for all applicable charges as if proper authorization for the water use had been obtained, including but not limited to bi-monthly service charges, installation charges and removal charges.

8.5 If damage occurs to Water Department property (i.e. fire hydrant meter, backflow, various appurtenances), the cost of repairs or replacements will be charged to the customer of record (applicant).

**Water Department Director**

Tabs: 1. Fire Hydrant Meter Application
2. Construction & Maintenance Related Activities With No Return To Sewer
3. Notice of Discontinuation of Service

## APPENDIX

**Administering Division:** Customer Support Division

**Subject Index:**
Construction Meters
Fire Hydrant
Fire Hydrant Meter Program
Meters, Floating or Vehicle Mounted
Mobile Meter
Program, Fire Hydrant Meter

**Distribution:** DI Manual Holders

# Application for Fire Hydrant Meter (EXHIBIT A)

City of San Diego PUBLIC UTILITIES Water & Wastewater

(For Office Use Only)

| NS REQ | FAC# |
|---|---|
| DATE | BY |

METER SHOP (619) 527-7449

| Application Date | Requested Install Date: |
|---|---|
| | |

## Meter Information

| Fire Hydrant Location: (Attach Detailed Map//Thomas Bros. Map Location or Construction drawing.) Zip: | T.B. | G.B. (CITY USE) |
|---|---|---|
| Specific Use of Water: | | |
| Any Return to Sewer or Storm Drain, If so , explain: | | |
| Estimated Duration of Meter Use: | ☐ | Check Box if Reclaimed Water |

## Company Information

| Company Name: | | | |
|---|---|---|---|
| Mailing Address: | | | |
| City: | State: | Zip: | Phone: ( ) |
| *Business license# | *Contractor license# | | |
| A Copy of the Contractor's license OR Business License is required at the time of meter issuance. | | | |
| Name and Title of Billing Agent: (PERSON IN ACCOUNTS PAYABLE) | | | Phone: ( ) |
| Site Contact Name and Title: | | | Phone: ( ) |
| Responsible Party Name: | | | Title: |
| Cal ID# | | | Phone: ( ) |
| Signature: | | Date: | |

Guarantees Payment of all Charges Resulting from the use of this Meter. Insures that employees of this Organization understand the proper use of Fire Hydrant Meter

| ☐ Fire Hydrant Meter Removal Request | | Requested Removal Date: |
|---|---|---|
| Provide Current Meter Location if Different from Above: | | |
| Signature: | Title: | Date: |
| Phone: ( ) | Pager: ( ) | |

| ☐ City Meter | ☐ Private Meter | | |
|---|---|---|---|
| Contract Acct #: | Deposit Amount: $ 936.00 | Fees Amount: $ 62.00 | |
| Meter Serial # | Meter Size: 05 | Meter Make and Style: 6-7 | |
| Backflow # | Backflow Size: | Backflow Make and Style: | |
| Name: | Signature: | Date: | |

## WATER USES WITHOUT ANTICIPATED CHARGES FOR RETURN TO SEWER

Auto Detailing
Backfilling
Combination Cleaners (Vactors)
Compaction
Concrete Cutters
Construction Trailers
Cross Connection Testing
Dust Control
Flushing Water Mains
Hydro Blasting
Hydro Seeing
Irrigation (for establishing irrigation only; not continuing irrigation)
Mixing Concrete
Mobile Car Washing
Special Events
Street Sweeping
Water Tanks
Water Trucks
Window Washing

**Note**:

1. If there is any return to sewer or storm drain, then sewer and/or storm drain fees will be charges.

Date

Name of Responsible Party
Company Name and Address
Account Number:_____

Subject: Discontinuation of Fire Hydrant Meter Service

Dear Water Department Customer:

The authorization for use of Fire Hydrant Meter #_____, located at *(Meter Location Address)* ends in 60 days and will be removed on or after *(Date Authorization Expires)*. Extension requests for an additional 90 days must be submitted in writing for consideration 30 days prior to the discontinuation date. If you require an extension, please contact the Water Department, or mail your request for an extension to:

City of San Diego
Water Department
Attention: Meter Services
2797 Caminito Chollas
San Diego, CA 92105-5097

Should you have any questions regarding this matter, please call the Fire Hydrant Hotline at (619)_____-_____.

Sincerely,

Water Department

# APPENDIX B

# 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 C

## SAMPLE CITY INVOICE WITH SPEND CURVE

City of San Diego, CM&FS Div., 9753 Chesapeake Drive, SD CA 92123

**Project Name:**

Work Order No or Job Order No.

City Purchase Order No.

Resident Engineer (RE):

RE Phone#: Fax#:

**Contractor's Name:**

Contractor's Address:

Contractor's Phone #:

Contractor's fax #:

Contact Name:

**Invoice No.**

**Invoice Date:**

Billing Period: ( To )

| Item # | Item Description | Contract Authorization | | | | Previous Totals To Date | | This Estimate | | Totals to Date | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Unit | Price | Qty | Extension | %/QTY | Amount | % / QTY | Amount | % / QTY | Amount |
| 1 | | | | | $ - | | $ - | | $ - | 0.00 | $ - |
| 2 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 3 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 4 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 5 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 6 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 7 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 8 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 5 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 6 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 7 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 8 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 9 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 10 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 11 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 12 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 13 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 14 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 15 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 16 | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| 17 | **Field Orders** | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| | **CHANGE ORDER No.** | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| | | | | | $ - | | $ - | | $ - | 0.00% | $ - |
| | Total Authorized Amount (including approved Change Order) | | | | **$ -** | | **$ -** | | $ - | **Total Billed** | $ - |

**SUMMARY**

| | | |
|---|---|---|
| A. Original Contract Amount | $ | - |
| B. Approved Change Order #00 Thru #00 | $ | - |
| C. Total Authorized Amount (A+B) | $ | - |
| D. Total Billed to Date | $ | - |
| E. Less Total Retention (5% of D ) | $ | - |
| F. Less Total Previous Payments | $ | - |
| **G. Payment Due Less Retention** | | **$0.00** |
| H. Remaining Authorized Amount | | $0.00 |

**I certify that the materials have been received by me in the quality and quantity specified**

_____

**Resident Engineer**

_____

**Construction Engineer**

**Retention and/or Escrow Payment Schedule**

| | |
|---|---|
| Total Retention Required as of this billing (Item E) | $0.00 |
| Previous Retention Withheld in PO or in Escrow | $0.00 |
| **Add'l Amt to Withhold in PO/Transfer in Escrow:** | ***$0.00*** |
| **Amt to Release to Contractor from PO/Escrow:** | |

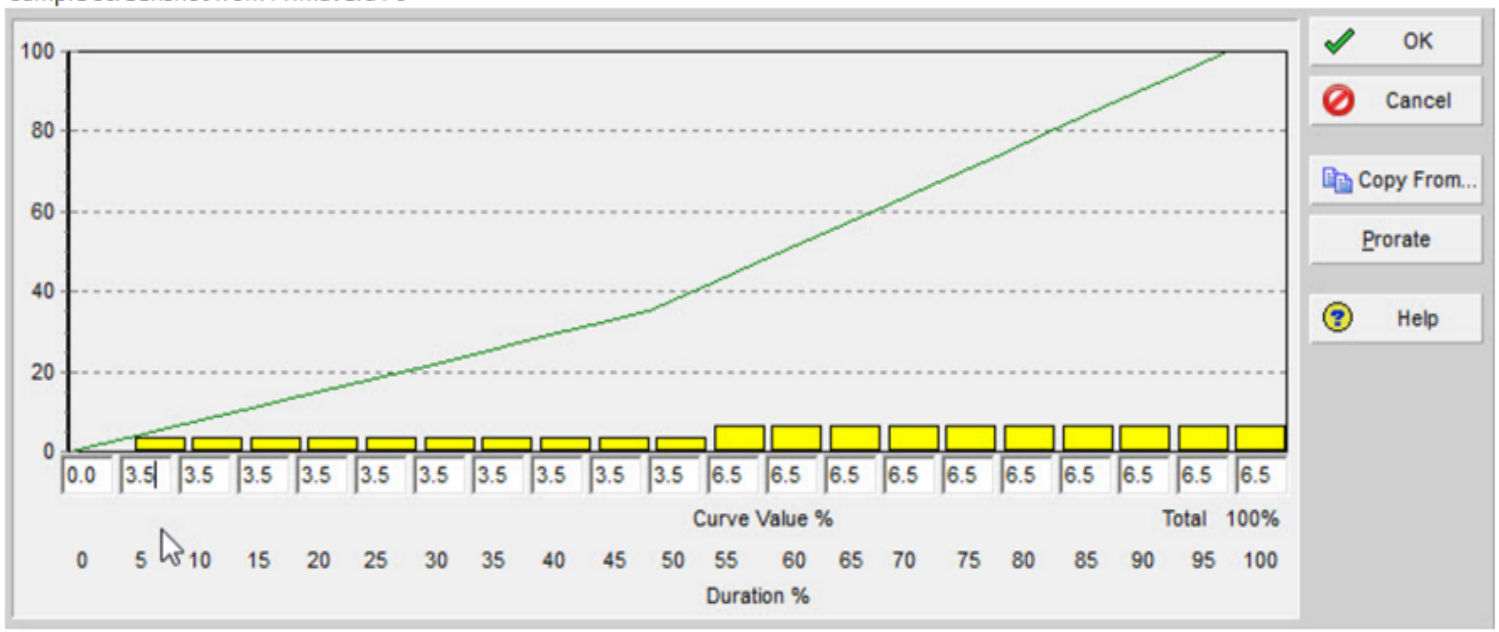
Contractor Signature and Date: _____

# Sample Project Spend Curve

Sample Date Entries Required

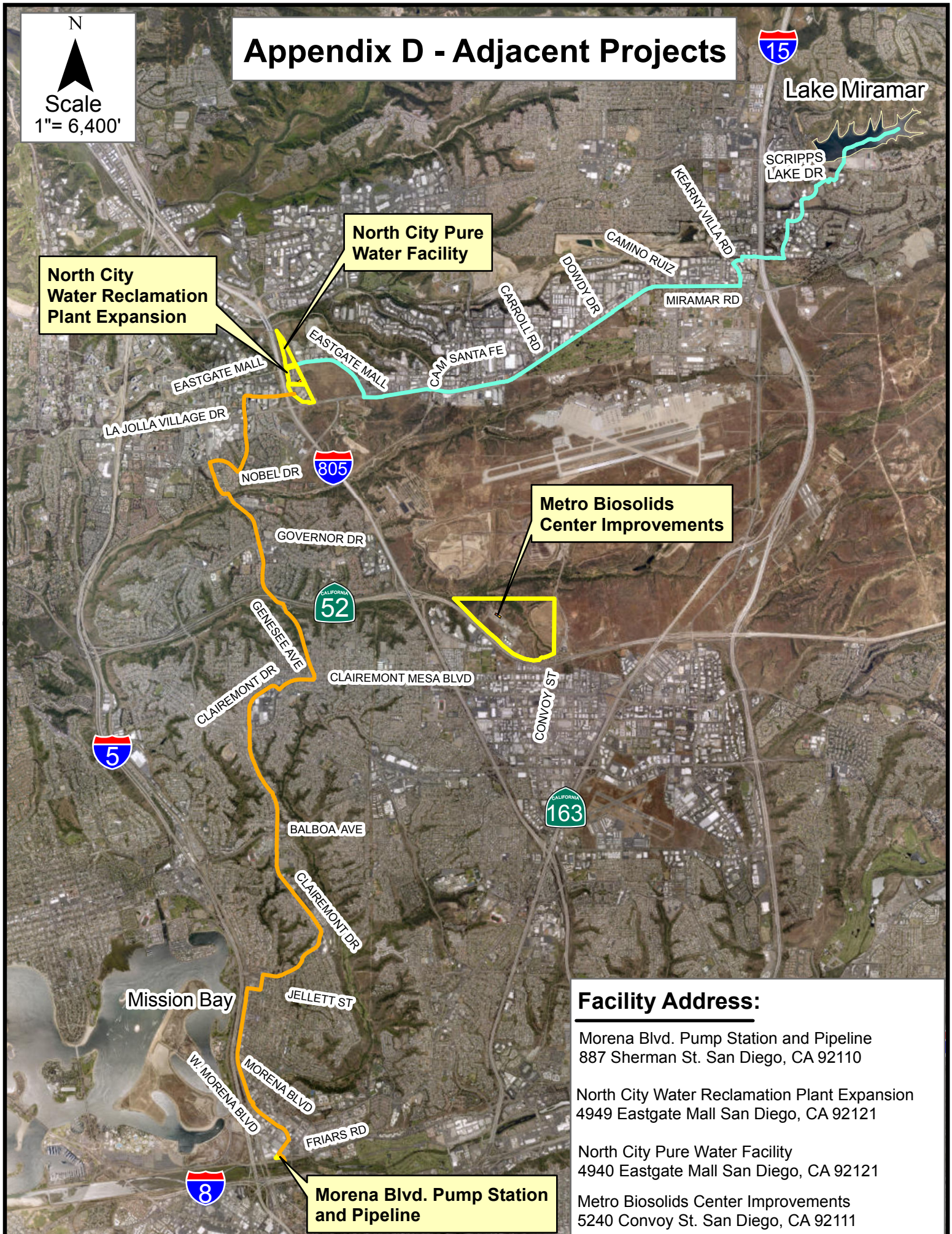
| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Incremental Curve Value | 0.0% | 3.5% | 3.5% | 3.5% | 3.5% | 3.5% | 3.5% | 3.5% | 3.5% | 3.5% | 3.5% | 6.5% | 6.5% | 6.5% | 6.5% | 6.5% | 6.5% | 6.5% | 6.5% | 6.5% |
| Duration % Increment | 0% | 5% | 10% | 15% | 20% | 25% | 30% | 35% | 40% | 45% | 50% | 55% | 60% | 65% | 70% | 75% | 80% | 85% | 90% | 95% | 100% |

Sample Screenshot from Primavera P6



# APPENDIX D

# ADJACENT PROJECTS




## Facility Address:

Morena Blvd. Pump Station and Pipeline
887 Sherman St. San Diego, CA 92110

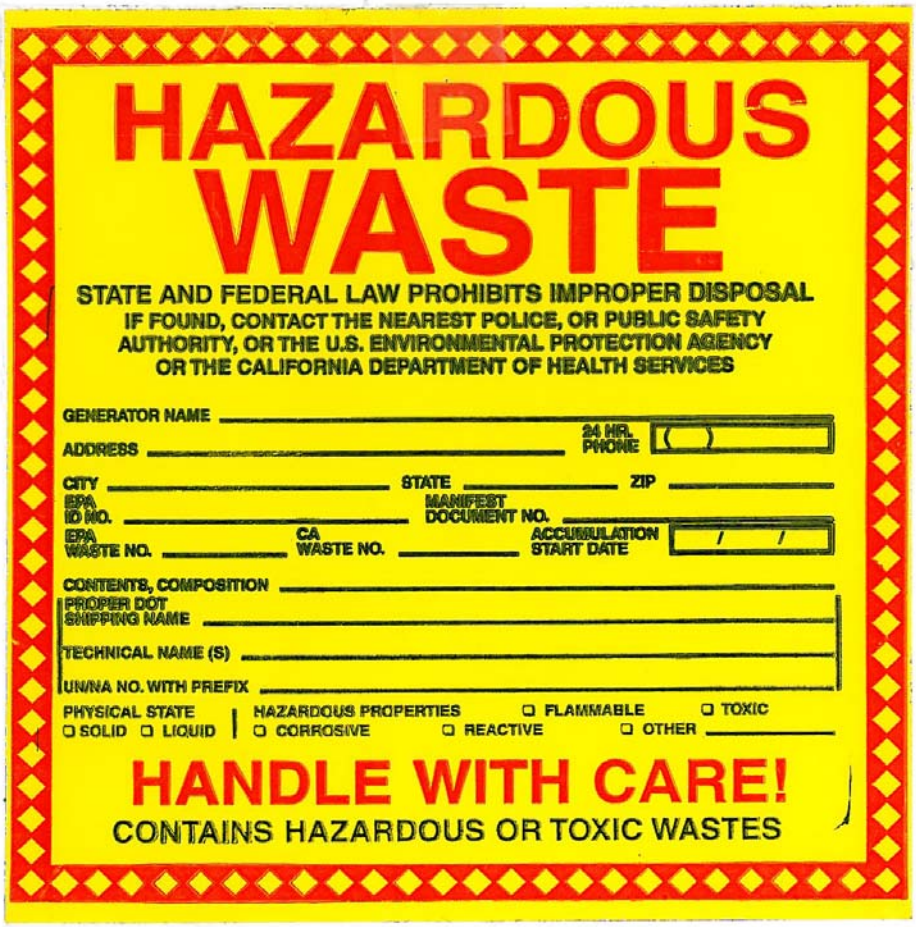
North City Water Reclamation Plant Expansion
4949 Eastgate Mall San Diego, CA 92121

North City Pure Water Facility
4940 Eastgate Mall San Diego, CA 92121

Metro Biosolids Center Improvements
5240 Convoy St. San Diego, CA 92111

# APPENDIX E

# HAZARDOUS LABEL/FORMS


HAZARDOUS
WASTE
STATE AND FEDERAL LAW PROHIBITS IMPROPER DISPOSAL
IF FOUND, CONTACT THE NEAREST POLICE, OR PUBLIC SAFETY
AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY
OR THE CALIFORNIA DEPARTMENT OF HEALTH SERVICES
GENERATOR NAME
ADDRESS
24 HR. PHONE
CITY
STATE
ZIP
EPA ID NO.
MANIFEST DOCUMENT NO.
EPA WASTE NO.
CA WASTE NO.
ACCUMULATION START DATE
CONTENTS, COMPOSITION
PROPER DOT SHIPPING NAME
TECHNICAL NAME (S)
UN/NA NO. WITH PREFIX
PHYSICAL STATE
SOLID LIQUID
HAZARDOUS PROPERTIES
CORROSIVE
REACTIVE
FLAMMABLE
TOXIC
OTHER
HANDLE WITH CARE!
CONTAINS HAZARDOUS OR TOXIC WASTES

# INCIDENT/RELEASE ASSESSMENT FORM [1]

## If you have an emergency, Call 911

*Handlers of hazardous materials are required to report releases. The following is a tool to be used for assessing if a release is reportable. Additionally, a non-reportable release incident form is provided to document why a release is not reported (see back).*

| **Questions for Incident Assessment:** | | YES | NO |
|---|---|---|---|
| 1. | Was anyone killed or injured, or did they require medical care or admitted to a hospital for observation? | ❒ | ❒ |
| 2. | Did anyone, other than employees in the immediate area of the release, evacuate? | ❒ | ❒ |
| 3. | Did the release cause off-site damage to public or private property? | ❒ | ❒ |
| 4. | Is the release greater than or equal to a reportable quantity (RQ)? | ❒ | ❒ |
| 5. | Was there an uncontrolled or unpermitted release to the air? | ❒ | ❒ |
| 6. | Did an uncontrolled or unpermitted release escape secondary containment, or extend into any sewers, storm water conveyance systems, utility vaults and conduits, wetlands, waterways, public roads, or off site? | ❒ | ❒ |
| 7. | Will control, containment, decontamination, and/or clean up require the assistance of federal, state, county, or municipal response elements? | ❒ | ❒ |
| 8. | Was the release or threatened release involving an unknown material or contains an unknown hazardous constituent? | ❒ | ❒ |
| 9. | Is the incident a threatened release (a condition creating a substantial probability of harm that requires immediate action to prevent, reduce, or mitigate damages to persons, property, or the environment)? | ❒ | ❒ |
| 10. | Is there an increased potential for secondary effects including fire, explosion, line rupture, equipment failure, or other outcomes that may endanger or cause exposure to employees, the general public, or the environment? | ❒ | ❒ |

If the answer is YES to any of the above questions – report the release to the California Office of Emergency Services at 800-852-7550 and the local CUPA daytime: (619) 338-2284, after hours: (858) 565-5255. Note: other state and federal agencies may require notification depending on the circumstances.

*Call 911 in an emergency*

If all answers are NO, complete a Non Reportable Release Incident Form (page 2 of 2) and keep readily available. Documenting why a "no" response was made to each question will serve useful in the event questions are asked in the future, and to justify not reporting to an outside regulatory agency.

If in doubt, report the release.

[1] This document is a guide for accessing when hazardous materials release reporting is required by Chapter 6.95 of the California Health and Safety Code. It does not replace good judgment, Chapter 6.95, or other state or federal release reporting requirements.

# NON REPORTABLE RELEASE INCIDENT FORM

1. RELEASE AND RESPONSE DESCRIPTION Incident #_____

| Date/Time Discovered | Date/Time Discharge | Discharge Stopped ☐ Yes ☐ No |
|---|---|---|
| Incident Date / Time: | | |
| Incident Business / Site Name: | | |
| Incident Address: | | |
| Other Locators (Bldg, Room, Oil Field, Lease, Well #, GIS) | | |
| Please describe the incident and indicate specific causes and area affected. Photos Attached?: ☐Yes ☐No | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Indicate actions to be taken to prevent similar releases from occurring in the future. | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

2. ADMINISTRATIVE INFORMATION

| | |
|---|---|
| Supervisor in charge at time of incident: | Phone: |
| Contact Person: | Phone: |

3. CHEMICAL INFORMATION

| | |
|---|---|
| Chemical | Quantity ☐ GAL ☐ LBS ☐ $FT^3$ |
| Chemical | Quantity ☐ GAL ☐ LBS ☐ $FT^3$ |
| Chemical | Quantity ☐ GAL ☐ LBS ☐ $FT^3$ |
| Clean-Up Procedures & Timeline: | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| Completed By: | Phone: |
| Print Name: | Title: |

# EMERGENCY RELEASE FOLLOW - UP NOTICE REPORTING FORM

**A**

| BUSINESS NAME | FACILITY EMERGENCY CONTACT & PHONE NUMBER ( ) - |
|---|---|

**B**

| INCIDENT DATE MO DAY YR | TIME OES NOTIFIED (use 24 hr time) | OES CONTROL NO. |
|---|---|---|

**C**

| INCIDENT ADDRESS LOCATION | CITY / COMMUNITY | COUNTY ZIP |
|---|---|---|

**D**

| CHEMICAL OR TRADE NAME (print or type) | CAS Number |
|---|---|

| CHECK IF CHEMICAL IS LISTED IN 40 CFR 355, APPENDIX A ☐ | CHECK IF RELEASE REQUIRES NOTIFI - CATION UNDER 42 U.S.C. Section 9603 (a) ☐ |
|---|---|

| PHYSICAL STATE CONTAINED ☐ SOLID ☐ LIQUID ☐ GAS | PHYSICAL STATE RELEASED ☐ SOLID ☐ LIQUID ☐ GAS | QUANTITY RELEASED |
|---|---|---|

| ENVIRONMENTAL CONTAMINATION ☐ AIR ☐ WATER ☐ GROUND ☐ OTHER | TIME OF RELEASE | DURATION OF RELEASE ___DAYS ___HOURS ___MINUTES |
|---|---|---|

**E**

ACTIONS TAKEN

**F**

KNOWN OR ANTICIPATED HEALTH EFFECTS (Use the comments section for addition information)

☐ ACUTE OR IMMEDIATE (explain) _____

☐ CHRONIC OR DELAYED (explain) _____

☐ NOTKNOWN (explain)

**G**

ADVICE REGARDING MEDICAL ATTENTION NECESSARY FOR EXPOSED INDIVIDUALS

**H**

COMMENTS (INDICATE SECTION (A - G) AND ITEM WITH COMMENTS OR ADDITIONAL INFORMATION)

**I**

CERTIFICATION: I certify under penalty of law that I have personally examined and I am familiar with the information submitted and believe the submitted information is true, accurate, and complete.

REPORTING FACILITY REPRESENTATIVE (print or type) _____

SIGNATURE OF REPORTING FACILITY REPRESENTATIVE _____ DATE: _____

# EMERGENCY RELEASE FOLLOW-UP NOTICE
# REPORTING FORM INSTRUCTIONS

**GENERAL INFORMATION:**

Chapter 6.95 of Division 20 of the California Health and Safety Code requires that written emergency release follow-up notices prepared pursuant to 42 U.S.C. § 11004, be submitted using this reporting form. Non-permitted releases of reportable quantities of Extremely Hazardous Substances (listed in 40 CFR 355, appendix A) or of chemicals that require release reporting under section 103(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [42 U.S.C. § 9603(a)] must be reported on the form, as soon as practicable, but no later than 30 days, following a release. The written follow-up report is required in addition to the verbal notification.

**BASIC INSTRUCTIONS:**

- The form, when filled out, reports follow-up information required by 42 U.S.C § 11004. Ensure that all information requested by the form is provided as completely as possible.
- If the incident involves reportable releases of more than one chemical, prepare one report form for each chemical released.
- If the incident involves a series of separate releases of chemical(s) at different times, the releases should be reported on separate reporting forms.

**SPECIFIC INSTRUCTIONS:**

Block A: Enter the name of the business and the name and phone number of a contact person who can provide detailed facility information concerning the release.

Block B: Enter the date of the incident and the time that verbal notification was made to OES. The OES control number is provided to the caller by OES at the time verbal notification is made. Enter this control number in the space provided.

Block C: Provide information pertaining to the location where the release occurred. Include the street address, the city or community, the county and the zip code.

Block D: Provide information concerning the specific chemical that was released. Include the chemical or trade name and the Chemical Abstract Service (CAS) number. Check all categories that apply. Provide best available information on quantity, time and duration of the release.

Block E: Indicate all actions taken to respond to and contain the release as specified in 42 U.S.C. § 11004(c).

Block F: Check the categories that apply to the health effects that occurred or could result from the release. Provide an explanation or description of the effects in the space provided. Use Block H for additional comments/information if necessary to meet requirements specified in 42 U.S.C. § 11004(c).

Block G: Include information on the type of medical attention required for exposure to the chemical released. Indicate when and how this information was made available to individuals exposed and to medical personnel, if appropriate for the incident, as specified in 42 U.S.C. § 11004(c).

Block H: List any additional pertinent information.

Block I: Print or type the name of the facility representative submitting the report. Include the official signature and the date that the form was prepared.

**MAIL THE COMPLETED REPORT TO:**

**State Emergency Response Commission (SERC)**
**Attn: Section 304 Reports**
**Hazardous Materials Unit**
**3650 Schriever Avenue**
**Mather, CA 95655**

NOTE: Authority cited: Sections 25503, 25503.1 and 25507.1, Health and Safety Code. Reference: Sections 25503(b)(4), 25503.1, 25507.1, 25518 and 25520, Health and Safety Code.

# APPENDIX F

# SAMPLE OF PUBLIC NOTICE

# FOR SAMPLE REFERENCE ONLY

The City of SAN DIEGO

## CONSTRUCTION NOTICE

## PROJECT TITLE

Work on your street will begin within one week to replace the existing water mains servicing your community.

**The work will consist of:**

- Saw-cutting and trench work on Ingulf Street from Morena Boulevard to Galveston Street to install new water mains, water laterals and fire hydrants.
- Streets where trenching takes place will be resurfaced and curb ramps will be upgraded to facilitate access for persons with disabilities where required.
- This work is anticipated to be complete in your community by December 2016.

**How your neighborhood may be impacted:**

- Water service to some properties during construction will be provided by a two-inch highline pipe that will run along the curb. To report a highline leak call 619-515-3525.
- Temporary water service disruptions are planned. If planned disruptions impact your property, you will receive advance notice.
- Parking restrictions will exist because of the presence of construction equipment and materials.
- "No Parking" signs will be displayed 72 hours in advance of the work.
- Cars parked in violation of signs will be TOWED.

**Hours and Days of Operation:**
Monday through Friday X:XX AM to X:XX PM.

**City of San Diego Contractor:**
Company Name, XXX-XXX-XXXX

To contact the City of San Diego: SD Public Works
619-533-4207 | engineering@sandiego.gov | sandiego.gov/CIP

This information is available in alternative formats upon request.

The City of SAN DIEGO

CONSTRUCTION NOTICE

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Company Name, XXX-XXX-XXXX

To contact the City of San Diego: SD Public Works
619-533-4207 | engineering@sandiego.gov | sandiego.gov/CIP

This information is available in alternative formats upon request.

# APPENDIX G

# 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

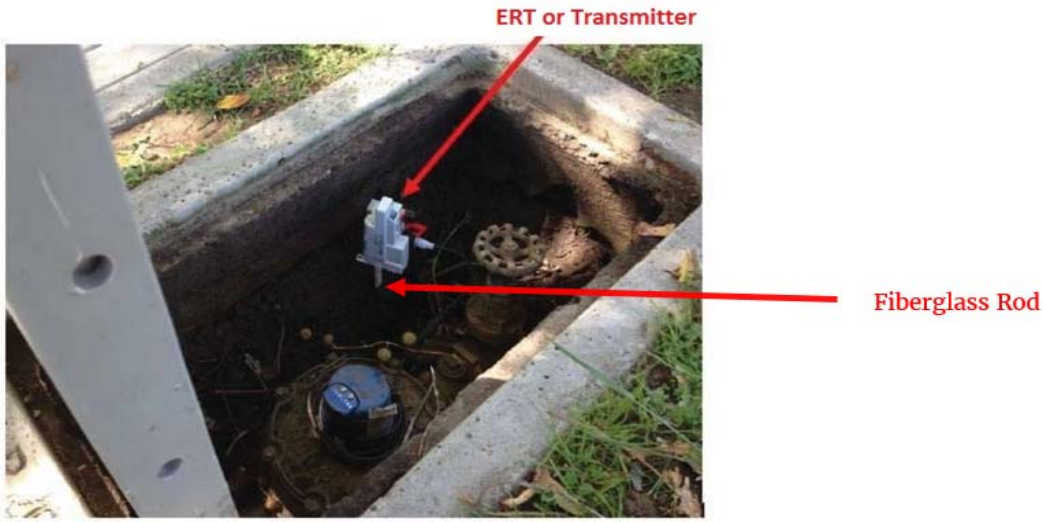



Photo 6 below is an example of disturbance that shall be avoided:

## Photo 6

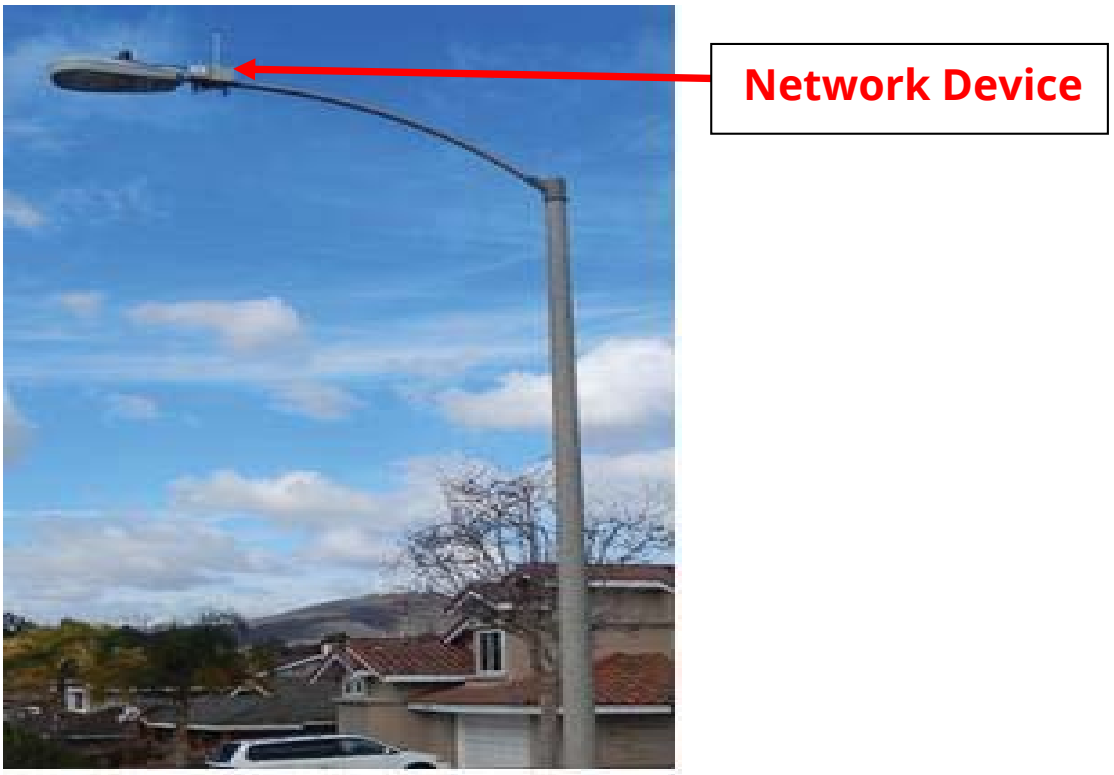
**You are responsible when working in and around meter boxes.** If you encounter these endpoints, use proper care and do not disconnect them from the registers on top of the water meter. If the lid has an antenna drilled through, do not change or tamper with the lid and inform the Resident Engineer immediately 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




## 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.**

# 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 **AECOM Energy & Construction, Inc.**, herein called "Contractor" for construction of **North City Water Reclamation Plant Expansion - Early Site Work and Ozone/BAC Relocation**; Bid No. **K-19-1724-DBB-3**; in the amount of **Sixteen Million Four Hundred Three Thousand Three Hundred Dollars and Zero Cents ($16,403,300.00)**, which is comprised of the Base Bid plus Alternate A.

IN CONSIDERATION of the payments to be made hereunder and the mutual undertakings of the parties hereto, City and Contractor agree as follows:

1. The following are incorporated into this contract as though fully set forth herein:

   (a) The attached Faithful Performance and Payment Bonds.

   (b) The attached Proposal included in the Bid documents by the Contractor.

   (c) Reference Standards listed in the Instruction to Bidders and the Supplementary Special Provisions (SSP).

   (d) Phased Funding Schedule Agreement.

   (e) That certain documents entitled **North City Water Reclamation Plant Expansion - Early Site Work and Ozone/BAC Relocation,** on file in the office of the City Clerk as Document No. **B-15142, B-15139**, 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 **North City Water Reclamation Plant Expansion - Early Site Work and Ozone/BAC Relocation**, Bid Number**K-19-1724-DBB-3,** 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 **Municipal Code 22.3102** authorizing such execution.

**THE CITY OF SAN DIEGO**

By _____

Print Name: James Nagelvoort
Director
Public Works Department

Date: 4/9/19

**APPROVED AS TO FORM**

Mara W. Elliott, City Attorney

By _____

Print Name: Christine Leone
Deputy City Attorney

Date: 4/23/19

**CONTRACTOR**

By _____

Print Name: Matthew Kuzmick

Title: Vice President

Date: 1/23/2019

City of San Diego License No.: B2019002484

State Contractor's License No.: 178

DEPARTMENT OF INDUSTRIAL RELATIONS (DIR) REGISTRATION NUMBER: 1000036611

## 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 bidd.

## 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

---

## AMERICANS 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 Americans with Disabilities Act (ADA) outlined in the WHITEBOOK, Section 7-13.2, "American With Disabilities Act", of the project specifications, and that:

This company has in place workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of the policy as outlined

## CONTRACTOR CERTIFICATION

## CONTRACTOR STANDARDS – PLEDGE OF COMPLIANCE

I declare under penalty of perjury that I am authorized to make this certification on behalf of the company submitting this bid/proposal, that as Contractor, I am familiar with the requirements of City of San Diego Municipal Code § 22.3004 regarding Contractor Standards as outlined in the WHITEBOOK, Section 7-13.4, ("Contractor Standards"), of the project specifications, and that Contractor has complied with those requirements.

I further certify that each of the Contractor's subcontractors has completed a Pledge of Compliance attesting under penalty of perjury of having complied with City of San Diego Municipal Code § 22.3004.

.

## CONTRACTOR CERTIFICATION

---

## EQUAL BENEFITS ORDINANCE CERTIFICATION

I declare under penalty of perjury that I am familiar with the requirements of and in compliance with the City of San Diego Municipal Code § 22.4300 regarding Equal Benefits Ordinance.

## CONTRACTOR CERTIFICATION

### Equal Pay Ordinance Certification

Contractor shall comply with the Equal Pay Ordinance (EPO) codified in the San Diego Municipal Code (SDMC) at section 22.4801 through 22.4809, unless compliance is not required based on an exception listed in SDMC section 22.4804.

Contractor shall require all of its subcontractors to certify compliance with the EPO in their written subcontracts.

Contractor must post a notice informing its employees of their rights under the EPO in the workplace or job site.

By signing this Contract with the City of San Diego, Contractor acknowledges the EPO requirements and pledges ongoing compliance with the requirements of SDMC Division 48, section 22.4801 et seq., throughout the duration of this Contract.

# AFFIDAVIT OF DISPOSAL

**(To be submitted upon completion of Construction pursuant to the contracts Certificate of Completion)**

**WHEREAS**, on the _____ DAY OF _____, 2_____ the undersigned entered into and executed a contract with the City of San Diego, a municipal corporation, for:

**North City Water Reclamation Plant Expansion – Early Site Work and Ozone/BAC Relocation**
(Name of Project)

as particularly described in said contract and identified as Bid No. **K-19-1724-DBB-3**; SAP No. (WBS/IO/CC) **B-15142, B-15139**; and **WHEREAS**, the specification of said contract requires the Contractor to affirm that "all brush, trash, debris, and surplus materials resulting from this project have been disposed of in a legal manner"; and **WHEREAS**, said contract has been completed and all surplus materials disposed of:

_____

_____

**NOW, THEREFORE**, in consideration of the final payment by the City of San Diego to said Contractor under the terms of said contract, the undersigned Contractor, does hereby affirm that all surplus materials as described in said contract have been disposed of at the following location(s)

_____

_____

and that they have been disposed of according to all applicable laws and regulations.

Dated this _____ DAY OF _____, _____.

By:_____
Contractor

**ATTEST**:

State of _____ County of _____

On this_____ DAY OF __, 2_, before the undersigned, a Notary Public in and for said County and State, duly commissioned and sworn, personally appeared_____ known to me to be the _____ Contractor named in the foregoing Release, and whose name is subscribed thereto, and acknowledged to me that said Contractor executed the said Release.

Notary Public in and for said County and State

**LIST OF SUBCONTRACTORS**

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *** TO BE SUBMITTED IN ELECTRONIC FORMAT ONL Y*** SEE INSTRUCTIONS TO BIDDERS, FOR FURTHER INFORMATION**

In accordance with the requirements of the "Subletting and Subcontracting Fair Practices Act", Section 4100, of the California Public Contract Code (PCC), the Bidder is to list below the name, address and license number of each Subcontractor who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement, in an amount of or in excess of 0.5% of the Contractor's total Bid. Failure to comply with this requirement may result in the Bid being rejected as non-responsive. The Contractor is to list only one Subcontractor for each portion of the Work. The Bidder's attention is directed to the Special Provisions - General; Paragraph 2-3 Subcontracts, which stipulates the percentage of the Work to be performed with the Bidder's own forces. The Bidder is to also list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which the Bidders are seeking recognition towards achieving any mandatory, voluntary, or both subcontracting participation percentages.

| NAME, ADDRESS AND TELEPHONE NUMBER OF SUBCONTRACTOR | CONSTRUCTOR OR DESIGNER | DIR REGISTRATION NUMBER | SUBCONTRACTOR LICENSE NUMBER | TYPE OF WORK | DOLLAR VALUE OF SUBCONTRACT | MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB① | WHERE CERTIFIED② | CHECK IF JOINT VENTURE PARTNERSHIP |
|---|---|---|---|---|---|---|---|---|
| Name:_____<br>Address:_____<br>City:_____ State:_____<br>Zip:_____ Phone:_____<br>Email:_____ | | | | | | | | |
| Name:_____<br>Address:_____<br>City:_____ State:_____<br>Zip:_____ Phone:_____<br>Email:_____ | | | | | | | | |

① As appropriate, Bidder shall identify Subcontractor as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

| | | | |
|---|---|---|---|
| Certified Minority Business Enterprise | MBE | Certified Woman Business Enterprise | WBE |
| Certified Disadvantaged Business Enterprise | DBE | Certified Disabled Veteran Business Enterprise | DVBE |
| Other Business Enterprise | OBE | Certified Emerging Local Business Enterprise | ELBE |
| Certified Small Local Business Enterprise | SLBE | Small Disadvantaged Business | SDB |
| Woman-Owned Small Business | WoSB | HUBZone Business | HUBZone |
| Service-Disabled Veteran Owned Small Business | SDVOSB | | |

② As appropriate, Bidder shall indicate if Subcontractor is certified by:

| | | | |
|---|---|---|---|
| City of San Diego | CITY | State of California Department of Transportation | CALTRANS |
| California Public Utilities Commission | CPUC | | |
| State of California's Department of General Services | CADoGS | City of Los Angeles | LA |
| State of California | CA | U.S. Small Business Administration | SBA |

**The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.**

**NAMED EQUIPMENT/MATERIAL SUPPLIER LIST**

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *** TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY *** SEE INSTRUCTIONS TO BIDDERS FOR FURTHER INFORMATION**

| NAME, ADDRESS AND TELEPHONE NUMBER OF VENDOR/SUPPLIER | MATERIALS OR SUPPLIES | DIR REGISTRATION NUMBER | DOLLAR VALUE OF MATERIAL OR SUPPLIES | SUPPLIER (Yes/No) | MANUFACTURER (Yes/No) | MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB① | WHERE CERTIFIED② |
|---|---|---|---|---|---|---|---|
| Name:_____<br>Address:_____<br>City:_____ State:_____<br>Zip:_____ Phone:_____<br>Email:_____ | | | | | | | |
| Name:_____<br>Address:_____<br>City:_____ State:_____<br>Zip:_____ Phone:_____<br>Email:_____ | | | | | | | |

① As appropriate, Bidder shall identify Vendor/Supplier as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

| | | | |
|---|---|---|---|
| Certified Minority Business Enterprise | MBE | Certified Woman Business Enterprise | WBE |
| Certified Disadvantaged Business Enterprise | DBE | Certified Disabled Veteran Business Enterprise | DVBE |
| Other Business Enterprise | OBE | Certified Emerging Local Business Enterprise | ELBE |
| Certified Small Local Business Enterprise | SLBE | Small Disadvantaged Business | SDB |
| Woman-Owned Small Business | WoSB | HUBZone Business | HUBZone |
| Service-Disabled Veteran Owned Small Business | SDVOSB | | |

② As appropriate, Bidder shall indicate if Vendor/Supplier is certified by:

| | | | |
|---|---|---|---|
| City of San Diego | CITY | State of California Department of Transportation | CALTRANS |
| California Public Utilities Commission | CPUC | | |
| State of California's Department of General Services | CADoGS | City of Los Angeles | LA |
| State of California | CA | U.S. Small Business Administration | SBA |

**The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.**

# SUBCONTRACTORS ADDITIVE/DEDUCTIVE ALTERNATE

**(Use Additional Sheets As Needed)**

**ALTERNATE A**

| SUBCONTRACTOR NAME, LOCATION, PHONE & EMAIL | CONSTRUCTOR OR DESIGNER | DIR REGISTRATION NUMBER | SUBCONTRACTOR LICENSE NUMBER | TYPE OF WORK | DOLLAR VALUE OF SUBCONTRACT | MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB① | WHERE CERTIFIED | CHECK IF JOINT VENTURE PARTNERSHIP |
|---|---|---|---|---|---|---|---|---|
| Name: CMC Rebar<br>Address: 3880 Murphy Canyon Road Site 100<br>City: San Diego State: CA.<br>Zip: 92123 Phone: 858-737-7700<br>Email: Keith.dixon@cmc.com | Constructor | 1000062653 | 1047398 | Reinforcing Steel | 50,323 | OBE | N/A | N/A |
| Name:<br>Address:<br>City: State:<br>Zip: Phone:<br>Email: | | | | | | | | |
| Name:<br>Address:<br>City: State:<br>Zip: Phone:<br>Email: | | | | | | | | |

① As appropriate, Bidder shall identify Subcontractor as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

| | | | |
|---|---|---|---|
| Certified Minority Business Enterprise | MBE | Certified Woman Business Enterprise | WBE |
| Certified Disadvantaged Business Enterprise | DBE | Certified Disabled Veteran Business Enterprise | DVBE |
| Other Business Enterprise | OBE | Certified Emerging Local Business Enterprise | ELBE |
| Certified Small Local Business Enterprise | SLBE | Small Disadvantaged Business | SDB |
| Woman-Owned Small Business | WoSB | HUBZone Business | HUBZone |
| Service-Disabled Veteran Owned Small Business | SDVOSB | | |

② As appropriate, Bidder shall indicate if Subcontractor is certified by:

| | | | |
|---|---|---|---|
| City of San Diego | CITY | State of California Department of Transportation | CALTRANS |
| California Public Utilities Commission | CPUC | | |
| State of California's Department of General Services | CADoGS | City of Los Angeles | LA |
| State of California | CA | U.S. Small Business Administration | SBA |

**The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.**

# SUBCONTRACTORS ADDITIVE/DEDUCTIVE ALTERNATE

**(Use Additional Sheets As Needed)**

**ALTERNATE A**

| SUBCONTRACTOR NAME, LOCATION, PHONE & EMAIL | CONSTRUCTOR OR DESIGNER | DIR REGISTRATION NUMBER | SUBCONTRACTOR LICENSE NUMBER | TYPE OF WORK | DOLLAR VALUE OF SUBCONTRACT | MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB① | WHERE CERTIFIED | CHECK IF JOINT VENTURE PARTNERSHIP |
|---|---|---|---|---|---|---|---|---|
| Name: Hardy & Harper Inc.<br>Address: 1312 E. Warner Ave.<br>City: Santa Ana State: CA.<br>Zip: 92705 Phone: 714-444-1851<br>Email: thambright@hardyandharper.com | Constructor | 1000000076 | 215952 | AC Paving | $18,800 | OBE | N/A | N/A |
| Name:<br>Address:<br>City: State:<br>Zip: Phone:<br>Email: | | | | | | | | |
| Name:<br>Address:<br>City: State:<br>Zip: Phone:<br>Email: | | | | | | | | |

① As appropriate, Bidder shall identify Subcontractor as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

| | | | |
|---|---|---|---|
| Certified Minority Business Enterprise | MBE | Certified Woman Business Enterprise | WBE |
| Certified Disadvantaged Business Enterprise | DBE | Certified Disabled Veteran Business Enterprise | DVBE |
| Other Business Enterprise | OBE | Certified Emerging Local Business Enterprise | ELBE |
| Certified Small Local Business Enterprise | SLBE | Small Disadvantaged Business | SDB |
| Woman-Owned Small Business | WoSB | HUBZone Business | HUBZone |
| Service-Disabled Veteran Owned Small Business | SDVOSB | | |

② As appropriate, Bidder shall indicate if Subcontractor is certified by:

| | | | |
|---|---|---|---|
| City of San Diego | CITY | State of California Department of Transportation | CALTRANS |
| California Public Utilities Commission | CPUC | | |
| State of California's Department of General Services | CADoGS | City of Los Angeles | LA |
| State of California | CA | U.S. Small Business Administration | SBA |

**The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.**

# SUBCONTRACTORS ADDITIVE/DEDUCTIVE ALTERNATE

**(Use Additional Sheets As Needed)**

**ALTERNATE A**

| SUBCONTRACTOR NAME, LOCATION, PHONE & EMAIL | CONSTRUCTOR OR DESIGNER | DIR REGISTRATION NUMBER | SUBCONTRACTOR LICENSE NUMBER | TYPE OF WORK | DOLLAR VALUE OF SUBCONTRACT | MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB① | WHERE CERTIFIED | CHECK IF JOINT VENTURE PARTNERSHIP |
|---|---|---|---|---|---|---|---|---|
| Name: SOUTHERN CONTRACTING CO.<br>Address: 559 TWIN OAKS VALLEY RD.<br>City: SAN MARCOS State: CA<br>Zip: 92079 Phone: 760 744 6475<br>Email: MHUGHES@SOUTHERNCONTRACTING.COM | CONSTRUCTOR | 1000002172 | 222252 | ELECTRICAL | $ 228,000.00 | OBE | N/A | N/A |
| Name:<br>Address:<br>City: State:<br>Zip: Phone:<br>Email: | | | | | | | | |
| Name:<br>Address:<br>City: State:<br>Zip: Phone:<br>Email: | | | | | | | | |

① As appropriate, Bidder shall identify Subcontractor as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

| | | | |
|---|---|---|---|
| Certified Minority Business Enterprise | MBE | Certified Woman Business Enterprise | WBE |
| Certified Disadvantaged Business Enterprise | DBE | Certified Disabled Veteran Business Enterprise | DVBE |
| Other Business Enterprise | OBE | Certified Emerging Local Business Enterprise | ELBE |
| Certified Small Local Business Enterprise | SLBE | Small Disadvantaged Business | SDB |
| Woman-Owned Small Business | WoSB | HUBZone Business | HUBZone |
| Service-Disabled Veteran Owned Small Business | SDVOSB | | |

② As appropriate, Bidder shall indicate if Subcontractor is certified by:

| | | | |
|---|---|---|---|
| City of San Diego | CITY | State of California Department of Transportation | CALTRANS |
| California Public Utilities Commission | CPUC | | |
| State of California's Department of General Services | CADoGS | City of Los Angeles | LA |
| State of California | CA | U.S. Small Business Administration | SBA |

**The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.**

# 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. **MANDATORY DISCLOSURE OF BUSINESS INTERESTS FORM**

D. **SUBCONTRACTOR LISTING (OTHER THAN FIRST TIER)**

E. **LOBBY PROHIBITION, CERTIFICATION AND DISCLOSURE**

F. **DISADVANTAGED BUSINESS ENTERPRISE (DBE) PROGRAM DBE SUBCONTRACTOR PERFORMANCE FORM**

G. **DISADVANTAGEG BUSINESS ENTERPRISE (DBE) PROGRAM SUBCONTRACTOR UTILIZATION FORM**

**Bids will not be accepted until ALL the above-named forms are submitted as part of the bid submittal**

## BID BOND

**See Instructions to Bidders, Bidder Guarantee of Good Faith (Bid Security)**

KNOW ALL MEN BY THESE PRESENTS,

That AECOM Energy & Construction, Inc. as Principal, and

Federal Insurance Company 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

North City Water Reclamation Plant Expansion - Early Site Work and Ozone/BAC Relocation

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 November, 20 18

AECOM Energy & Construction, Inc. (SEAL)
(Principal)

By: _____
(Signature)
Paul Cocotis, General Manager

Federal Insurance Company (SEAL)
(Surety)

By: K Davis
(Signature)
Kari Davis, Attorney-In-Fact

(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 Los Angeles

On NOV 21 2018 before me, M. Gonzales, Notary Public, personally appeared Kari Davis 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.

(seal)

Signature M. Gonzales

M. Gonzales, Notary Public

M. GONZALES
Notary Public - California
Los Angeles County
Commission # 2213628
My Comm. Expires Oct 5, 2021

**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 Alameda }

On Nov 26, 2019 before me, Courtney Marie Sohn - Notary Public,
*Date* *Here Insert Name and Title of the Officer*

personally appeared Paul Cocotis
*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.

COURTNEY MARIE SOHN
Notary Public - California
Alameda County
Commission # 2178266
My Comm. Expires Jan 2, 2021

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 Courtney Marie Sohn
*Signature of Notary Public*

*Place Notary Seal and/or Stamp Above*

**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: _____ | Signer's Name: _____ |
| ☐ Corporate Officer – Title(s): _____ | ☐ Corporate Officer – Title(s): _____ |
| ☐ Partner – ☐ Limited ☐ General | ☐ Partner – ☐ Limited ☐ General |
| ☐ Individual ☐ Attorney in Fact | ☐ Individual ☐ Attorney in Fact |
| ☐ Trustee ☐ Guardian of Conservator | ☐ Trustee ☐ Guardian of Conservator |
| ☐ Other: _____ | ☐ Other: _____ |
| Signer is Representing: _____ | Signer is Representing: _____ |

CHUBB

# Power of Attorney

## Federal Insurance Company | Vigilant Insurance Company | Pacific Indemnity Company

**Know All by These Presents**, That **FEDERAL INSURANCE COMPANY**, an Indiana corporation, **VIGILANT INSURANCE COMPANY**, a New York corporation, and **PACIFIC INDEMNITY COMPANY**, a Wisconsin corporation, do each hereby constitute and appoint Tenzer V. Cunningham, Kari Davis, Martha Gonzales, Joaquin Perez and Brenda Wong of Los Angeles, California----------

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

**In Witness Whereof**, said **FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY**, and **PACIFIC INDEMNITY COMPANY** have each executed and attested these presents and affixed their corporate seals on this **5th** day of **December, 2017**.

Dawn M. Chloros, Assistant Secretary

Stephen M. Haney, Vice President

STATE OF NEW JERSEY

County of Hunterdon ss.

On this **5th** day of **December, 2017** before me, a Notary Public of New Jersey, personally came Dawn M. Chloros, to me known to be Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY, the companies which executed the foregoing Power of Attorney, and the said Dawn M. Chloros, being by me duly sworn, did depose and say that she is Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY and knows the corporate seals thereof, that the seals affixed to the foregoing Power of Attorney are such corporate seals and were thereto affixed by authority of said Companies; and that she signed said Power of Attorney as Assistant Secretary of said Companies by like authority; and that she is acquainted with Stephen M. Haney, and knows him to be Vice President of said Companies; and that the signature of Stephen M. Haney, subscribed to said Power of Attorney is in the genuine handwriting of Stephen M. Haney, and was thereto subscribed by authority of said Companies and in deponent's presence.

Notarial Seal

KATHERINE J. ADELAAR
NOTARY PUBLIC OF NEW JERSEY
No. 2318865
Commission Expires July 16, 2019

Notary Public

## CERTIFICATION

Resolutions adopted by the Boards of Directors of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY on August 30, 2016:

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

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

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

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

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

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

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

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

(i) the foregoing Resolutions adopted by the Board of Directors of the Companies are true, correct and in full force and effect,
(ii) the Companies are duly licensed and authorized to transact surety business in all 50 of the United States of America and the District of Columbia and are authorized by the U.S. Treasury Department; further, Federal and Vigilant are licensed in the U.S. Virgin Islands, and Federal is licensed in Guam, Puerto Rico, and each of the Provinces of Canada except Prince Edward Island; and
(iii) the foregoing Power of Attorney is true, correct and in full force and effect.

Given under my hand and seals of said Companies at Whitehouse Station, NJ, this

NOV 21 2018

Dawn M. Chloros, Assistant Secretary

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

## CONTRACTOR'S CERTIFICATION OF PENDING ACTIONS

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of all instances within the past 10 years where a complaint was filed or pending against the Bidder in a legal or administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers, and a description of the status or resolution of that complaint, including any remedial action taken.

CHECK ONE BOX ONLY.

☐ The undersigned certifies that within the past 10 years the Bidder has NOT been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers.

☒ The undersigned certifies that within the past 10 years the Bidder has been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers. A description of the status or resolution of that complaint, including any remedial action taken and the applicable dates is as follows:

| DATE OF CLAIM | LOCATION | DESCRIPTION OF CLAIM | LITIGATION (Y/N) | STATUS | RESOLUTION/REMEDIAL ACTION TAKEN |
|---|---|---|---|---|---|
| SEE ATTACHED FOLLOWING PAGES | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Contractor Name: AECOM Energy and Construction Inc

Certified By W. Andrew Sloane, III Title Vice President

Name

W. Andrew Sloane, III Date 12/12/18

Signature

**USE ADDITIONAL FORMS AS NECESSAR**

| Date of Claim | Location | Description of Claim | Litigated Y/N | Status | Resolution/Remedial Action Taken |
|---|---|---|---|---|---|
| Sep-08 | OH | Discrimination (Employee) | N | Dismissed | Dismissed |
| Dec-08 | IL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jul-05 | NJ | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jan-09 | IA | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jan-09 | TN | Discrimination (Employee) | N | Settled | Settled |
| Feb-09 | PA | Discrimination (Employee) | N | Dismissed | Dismissed |
| Mar-09 | MD | Discrimination (Employee) | N | Dismissed | Dismissed |
| Apr-09 | NJ | Discrimination (Employee) | N | Dismissed | Dismissed |
| Apr-09 | MD | Discrimination (Employee) | N | Dismissed | Dismissed |
| May-09 | OH | Discrimination (Employee) | N | Settled | Settled |
| May-09 | CA | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jun-09 | WI | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jul-09 | TX | Discrimination (Employee) | N | Settled | Settled |
| Jul-09 | SC | Discrimination (Employee) | N | Dismissed | Dismissed |
| Aug-09 | NJ | Discrimination (Employee) | Y | Settled | Settled |
| Sep-09 | MO | Discrimination (Employee) | N | Dismissed | Dismissed |
| Sep-09 | MD | Discrimination (Employee) | N | Dismissed | Dismissed |
| Sep-09 | ID | Discrimination (Employee) | N | Dismissed | Dismissed |
| Oct-09 | ID | Discrimination (Employee) | N | Dismissed | Dismissed |
| Nov-09 | WI | Discrimination (Employee) | N | Dismissed | Dismissed |
| Dec-09 | TN | Discrimination (Employee) | N | Dismissed | Dismissed |

| | | | | | |
|---|---|---|---|---|---|
| Dec-09 | SC | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jan-10 | OH | Sexual Harassment (Employee) | N | Dismissed | Dismissed |
| Feb-10 | OH | Discrimination (Employee) | N | Settled | Settled |
| Mar-10 | SC | Discrimination (Employee) | N | Dismissed | Dismissed |
| Mar-10 | IL | Discrimination (Employee) | N | Settled | Settled |
| Apr-10 | FL | Discrimination (Employee) | N | Settled | Settled |
| May-10 | MO | Discrimination (Employee) | N | Dismissed | Dismissed |
| May-10 | IL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jul-10 | FL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jul-10 | FL | Discrimination (Employee) | Y | Settled | Settled |
| Jul-10 | TN | Discrimination (Employee) | N | Dismissed | Dismissed |
| Sep-10 | OH | Discrimination (Employee) | N | Dismissed | Dismissed |
| Sep-10 | IL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Sep-10 | NJ | Discrimination (Employee) | N | Dismissed | Dismissed |
| Nov-10 | PA | Discrimination (Employee) | N | Dismissed | Dismissed |
| Dec-10 | PA | Discrimination (Employee) | N | Dismissed | Dismissed |
| Dec-10 | WI | Discrimination (Employee) | N | Settled | Settled |
| Dec-10 | FL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Dec-10 | NJ | Discrimination (Employee) | N | Settled | Settled |
| Jan-11 | NJ | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jan-11 | NJ | Discrimination (Employee) | N | Dismissed | Dismissed |
| Feb-11 | CO | Discrimination (Employee) | N | Dismissed | Dismissed |
| Apr-11 | NJ | Discrimination (Employee) | N | Dismissed | Dismissed |

| | | | | | |
|---|---|---|---|---|---|
| May-11 | IL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jul-11 | IL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jul-11 | WI | Discrimination (Employee) | N | Dismissed | Dismissed |
| Aug-11 | VA | Discrimination (Employee) | N | Dismissed | Dismissed |
| Aug-11 | NJ | Discrimination (Employee) | N | Dismissed | Dismissed |
| Aug-11 | CO | Discrimination (Employee) | N | Settled | Settled |
| Sep-11 | MI | Discrimination (Employee) | N | Dismissed | Dismissed |
| Oct-11 | IL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Nov-11 | TX | Discrimination (Employee) | N | Settled | Settled |
| Nov-11 | NJ | Discrimination (Employee) | N | Dismissed | Dismissed |
| Feb-12 | IL | Discrimination (Employee) | N | Settled | Settled |
| May-12 | KY | Discrimination (Employee) | N | Settled | Settled |
| May-12 | IN | Discrimination (Employee) | N | Settled | Settled |
| May-12 | IL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jun-12 | IL | Discrimination (Employee) | N | Settled | Settled |
| Sep-12 | FL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Nov-12 | IL | Discrimination (Employee) | N | Settled | Settled |
| Feb-13 | TN | Discrimination (Employee) | N | Dismissed | Dismissed |
| Mar-13 | MI | Discrimination (Employee) | N | Settled | Settled |
| Apr-13 | FL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Apr-13 | NJ | Discrimination (Employee) | N | Dismissed | Dismissed |
| May-13 | IL | Discrimination (Employee) | N | Dismissed | Dismissed |
| May-13 | IL | Discrimination (Employee) | N | Dismissed | Dismissed |

| | | | | | |
|---|---|---|---|---|---|
| Aug-13 | TX | Discrimination (Employee) | N | Dismissed | Dismissed |
| Mar-14 | IL | Discrimination (Employee) | N | Settled | Settled |
| Apr-14 | NY | Discrimination & Whistleblower (Employee) | N | Dismissed | Dismissed |
| Jun-14 | OK | Discrimination & Retaliation (Employee) | N | Dismissed | Dismissed |
| Nov-14 | NJ | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jun-15 | GA | Discrimination (Employee) | N | Dismissed | Dismissed |
| Oct-15 | IA | Discrimination (Employee) | N | Dismissed | Dismissed |
| Oct-15 | OH | Discrimination (Employee) | N | Dismissed | Dismissed |
| Nov-15 | TN | Discrimination & Sexual Harassment (Employee) | N | Settled | Settled |
| Dec-15 | LA | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jul-16 | IA | Discrimination (Employee) | N | Dismissed | Dismissed |
| Aug-16 | CT | Discrimination (Employee) | N | Settled | Settled |
| Feb-17 | NJ | Discrimination (Employee) | N | Dismissed | Dismissed |
| Mar-17 | WA | Discrimination (Employee) | N | Settled | Settled |
| Oct-17 | IL | Discrimination (Employee) | N | Settled | Settled |
| Oct-17 | KY | Discrimination (Employee) | N | Dismissed | Dismissed |
| Nov-17 | CA | Discrimination (Employee) | N | Settled | Settled |
| Dec-17 | FL | Discrimination (Employee) | N | Dismissed | Dismissed |
| Jan-18 | NJ | Discrimination (Employee) | N | Pending | Pending |
| Feb-18 | FL | Discrimination (Employee) | N | Withdrawn | Withdrawn |
| Mar-18 | WI | Discrimination (Employee) | N | Pending | Pending |
| Apr-18 | CA | Discrimination (Employee) | N | Dismissed | Dismissed |

| | | | | | |
|---|---|---|---|---|---|
| Apr-18 | CA | Discrimination (Employee) | N | Pending | Pending |
| Aug-18 | GA | Discrimination (Employee) | N | Pending | Pending |

*Due to the sensitive and confidential nature of the information requested, AECOM Energy & Construction, Inc. is withholding the names of employees who are the subject of the listed actions. Additional information can be provided upon request.

# MANDATORY DISCLOSURE OF BUSINESS INTERESTS FORM

## BIDDER/PROPOSER INFORMATION

| Legal Name | | DBA | |
|---|---|---|---|
| AECOM Energy and Construction Inc | | | |
| Street Address<br>16481 Scientific Way | City<br>Irvine | State<br>CA | Zip<br>92618 |
| Contact Person, Title<br>Matthew Kuzmick, Executive Vice Present | Phone<br>(949) -398-6060 | Fax<br>(949) 333-1500 | |

Provide the name, identity, and precise nature of the interest* of all persons who are directly or indirectly involved** in this proposed transaction (SDMC § 21.0103).

* The precise nature of the interest includes:

- the percentage ownership interest in a party to the transaction,
- the percentage ownership interest in any firm, corporation, or partnership that will receive funds from the transaction,
- the value of any financial interest in the transaction,
- any contingent interest in the transaction and the value of such interest should the contingency be satisfied, and
- any philanthropic, scientific, artistic, or property interest in the transaction.

** Directly or indirectly involved means pursuing the transaction by:

- communicating or negotiating with City officers or employees,
- submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City, or
- directing or supervising the actions of persons engaged in the above activity.

| Matthew Kuzmick | Executive Vice President |
|---|---|
| Name | Title/Position |
| Thousand Oaks, CA | N/A |
| City and State of Residence | Employer (if different than Bidder/Proposer) |
| Submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City and directing or supervising the actions of persons engaged in the above activity. | |
| Interest in the transaction | |

| Jolynn S. Buresh | Estimating and Proposal Coordinator |
|---|---|
| Name | Title/Position |
| Laguna Hills, CA | N/A |
| City and State of Residence | Employer (if different than Bidder/Proposer) |
| Submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City | |
| Interest in the transaction | |

## * Use Additional Pages if Necessary *

Under penalty of perjury under the laws of the State of California, I certify that I am responsible for the completeness and accuracy of the responses contained herein, and that all information provided is true, full and complete to the best of my knowledge and belief. I agree to provide written notice to the Mayor or Designee within five (5) business days if, at any time, I learn that any portion of this Mandatory Disclosure of Business Interests Form requires an updated response. Failure to timely provide the Purchasing Agent with written notice is grounds for Contract termination.

| W. Andrew Sloane, III, Vice President | W. Andrew Sloane | 12/12/18 |
|---|---|---|
| Print Name, Title | Signature | Date |

**Failure to sign and submit this form with the bid/proposal shall make the bid/proposal non-responsive. In the case of an informal solicitation, the contract will not be awarded unless a signed and completed Mandatory Disclosure of Business Interests Form is submitted.**

# MANDATORY DISCLOSURE OF BUSINESS INTERESTS FORM

## BIDDER/PROPOSER INFORMATION

| Legal Name | | DBA | |
|---|---|---|---|
| AECOM Energy and Construction Inc | | | |
| **Street Address** | **City** | **State** | **Zip** |
| 16481 Scientific Way | Irvine | CA | 92618 |
| **Contact Person, Title** | **Phone** | **Fax** | |
| Matthew Kuzmick, Executive Vice Present | (949) -398-6060 | (949) 333-1500 | |

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- submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City, or
- directing or supervising the actions of persons engaged in the above activity.

| Trina Clay | Estimating Coordinator |
|---|---|
| Name | Title/Position |
| Trabuco Canyon, CA | N/A |
| City and State of Residence | Employer (if different than Bidder/Proposer) |
| Submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City | |
| Interest in the transaction | |

| Joseph Henry | Estimating Manager |
|---|---|
| Name | Title/Position |
| Huntington Beach, CA | N/A |
| City and State of Residence | Employer (if different than Bidder/Proposer) |
| Submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City and directing or supervising the actions of persons engaged in the above activity. | |
| Interest in the transaction | |

## * Use Additional Pages if Necessary *

Under penalty of perjury under the laws of the State of California, I certify that I am responsible for the completeness and accuracy of the responses contained herein, and that all information provided is true, full and complete to the best of my knowledge and belief. I agree to provide written notice to the Mayor or Designee within five (5) business days if, at any time, I learn that any portion of this Mandatory Disclosure of Business Interests Form requires an updated response. Failure to timely provide the Purchasing Agent with written notice is grounds for Contract termination.

| W. Andrew Sloane, III, Vice President | | 12/12/18 |
|---|---|---|
| Print Name, Title | Signature | Date |

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# MANDATORY DISCLOSURE OF BUSINESS INTERESTS FORM

## BIDDER/PROPOSER INFORMATION

| Legal Name | | DBA | |
|---|---|---|---|
| AECOM Energy and Construction Inc | | | |
| **Street Address** | **City** | **State** | **Zip** |
| 16481 Scientific Way | Irvine | CA | 92618 |
| **Contact Person, Title** | **Phone** | **Fax** | |
| Matthew Kuzmick, Executive Vice Present | (949) -398-6060 | (949) 333-1500 | |

Provide the name, identity, and precise nature of the interest* of all persons who are directly or indirectly involved** in this proposed transaction (SDMC § 21.0103).

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- submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City, or
- directing or supervising the actions of persons engaged in the above activity.

| Mark Zhang | Project Manager |
|---|---|
| Name | Title/Position |
| San Diego, CA | N/A |
| City and State of Residence | Employer (if different than Bidder/Proposer) |

Communicating or negotiating with City officers or employees, submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City, directing or supervising the actions of persons engaged in the above activity

Interest in the transaction

| David Leonard | Estimator/Project Manager |
|---|---|
| Name | Title/Position |
| Wildomar, CA | N/A |
| City and State of Residence | Employer (if different than Bidder/Proposer) |

Submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City, directing or supervising the actions of persons engaged in the above activity.

Interest in the transaction

## * Use Additional Pages if Necessary *

Under penalty of perjury under the laws of the State of California, I certify that I am responsible for the completeness and accuracy of the responses contained herein, and that all information provided is true, full and complete to the best of my knowledge and belief. I agree to provide written notice to the Mayor or Designee within five (5) business days if, at any time, I learn that any portion of this Mandatory Disclosure of Business Interests Form requires an updated response. Failure to timely provide the Purchasing Agent with written notice is grounds for Contract termination.

| W. Andrew Sloane, III, Vice President | W. Andrew Sloane III | 12/12/18 |
|---|---|---|
| Print Name, Title | Signature | Date |

**Failure to sign and submit this form with the bid/proposal shall make the bid/proposal non-responsive. In the case of an informal solicitation, the contract will not be awarded unless a signed and completed Mandatory Disclosure of Business Interests Form is submitted.**

# MANDATORY DISCLOSURE OF BUSINESS INTERESTS FORM

## BIDDER/PROPOSER INFORMATION

| Legal Name | | DBA | |
|---|---|---|---|
| AECOM Energy and Construction Inc | | | |
| **Street Address** | **City** | **State** | **Zip** |
| 16481 Scientific Way | Irvine | CA | 92618 |
| **Contact Person, Title** | **Phone** | **Fax** | |
| Matthew Kuzmick, Executive Vice Present | (949) -398-6060 | (949) 333-1500 | |

Provide the name, identity, and precise nature of the interest* of all persons who are directly or indirectly involved** in this proposed transaction (SDMC § 21.0103).

* The precise nature of the interest includes:

- the percentage ownership interest in a party to the transaction,
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- submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City, or
- directing or supervising the actions of persons engaged in the above activity.

| Nick Bernabe | Project Manager |
|---|---|
| Name | Title/Position |
| San Diego, CA | N/A |
| City and State of Residence | Employer (if different than Bidder/Proposer) |
| Submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City, directing or supervising the actions of persons engaged in the above activity. | |
| Interest in the transaction | |

| W. Andrew Sloane, III, Vice President | Vice President |
|---|---|
| Name | Title/Position |
| Irvine, CA | N/A |
| City and State of Residence | Employer (if different than Bidder/Proposer) |
| Submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City | |
| Interest in the transaction | |

## * Use Additional Pages if Necessary *

Under penalty of perjury under the laws of the State of California, I certify that I am responsible for the completeness and accuracy of the responses contained herein, and that all information provided is true, full and complete to the best of my knowledge and belief. I agree to provide written notice to the Mayor or Designee within five (5) business days if, at any time, I learn that any portion of this Mandatory Disclosure of Business Interests Form requires an updated response. Failure to timely provide the Purchasing Agent with written notice is grounds for Contract termination.

| W. Andrew Sloane, III, Vice President | W. Andrew Sloane | 12/12/18 |
|---|---|---|
| Print Name, Title | Signature | Date |

**Failure to sign and submit this form with the bid/proposal shall make the bid/proposal non-responsive. In the case of an informal solicitation, the contract will not be awarded unless a signed and completed Mandatory Disclosure of Business Interests Form is submitted.**

## SUBCONTRACTOR LISTING
## (OTHER THAN FIRST TIER)

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

| NAME, ADDRESS AND TELEPHONE NUMBER OF SUBCONTRACTOR | CONSTRUCTOR OR DESIGNER | DIR REGISTRATION NUMBER | SUBCONTRACTOR LICENSE NUMBER | TYPE OF WORK |
|---|---|---|---|---|
| Name:_____<br>Address:_____<br>City:_____<br>State:_____<br>Zip:_____<br>Phone:_____<br>Email: _____ | | | | |
| Name:_____<br>Address:_____<br>City:_____<br>State:_____<br>Zip:_____<br>Phone:_____<br>Email: _____ | NONE | | | |
| Name:_____<br>Address:_____<br>City:_____<br>State:_____<br>Zip:_____<br>Phone:_____<br>Email: _____ | | | | |
| Name:_____<br>Address:_____<br>City:_____<br>State:_____<br>Zip:_____<br>Phone:_____<br>Email: _____ | | | | |

**** USE ADDITIONAL FORMS AS NECESSARY ****

# 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.

# DISCLOSURE OF LOBBYING ACTIVITIES Approved by OMB

Complete this form to disclose lobbying activities pursuant to 31 U.S.C. 1352 0348-0046

(See reverse for public burden disclosure)

| 1. Type of Federal Action: | 2. Status of Federal Action: | 3. Report Type: |
|---|---|---|
| ☐ a. Contract<br>a. Grant<br>b. Cooperative agreement<br>c. Loan<br>d. Loan guarantee<br>e. Loan insurance | ☐ a. bid/offer/application<br>b. initial award<br>c. post-award | ☐ a. initial finding<br>b. material change<br>**For Material Change Only**<br>year_____ quarter _____<br>date of last report_____ |

| 4. Name and Address of Reporting Entity: | 5. If Reporting Entity in No. 4 is a Subawardee, Enter Name and Address of Prime: |
|---|---|
| ☐ Prime ☐ Subawardee<br>Tier _____, *if known:*<br><br>Congressional District, *if known:* | Congressional District, *if known:* |
| **6. Federal Department/Agency:** | **7. Federal Program Name/Description:**<br><br>CFDA Number, *if applicable:* _____ |
| **8. Federal Action Number,** if known: | **9. Award Amount,** if known:<br>$ |
| **10. a. Name and Address of Lobbying Entity**<br>(if individual, last name, first name, M) | **b. Individuals Performing Services** (including address if different from No. 10a)<br>(last name, first name, MI): |

(attach Continuation Sheet(s) SF-LLL4, *if necessary*)

| 11. Amount of Payment (check all that apply) | 13. Type of Payment (check all that apply) |
|---|---|
| $_____ ☐ **actual** ☐ **planned** | ☐ a. retainer<br>☐ b. one-time lee<br>☐ c. commission<br>☐ d. contingent fee<br>☐ e. deferral<br>☐ f. other: specify:_____ |
| **12. Form of Payment** (check all that apply)<br>☐ a, cash<br>☐ b. in-kind: specify: nature _____<br>Value_____ | |

**14. Brief Description of Services Performed or to be Performed and Date(s) of Service, Including officer(s), employee(s), or Member(s), contacted, for Payment indicated in item 11:**

(attach Continuation Sheet(s) SF-LLLA, *if necessary*)

**15. Continuation Sheet(s) SF-LLLA attached:** ☐ Yes ☐ No

| 16. | Information requested through this for misauthorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when this transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less that $10,000 and not more than $100,000 for each such failure. | Signature: W. Andrew Sloane, III<br>Print Name: W. Andrew Sloane, III<br>Title: Vice President<br>Telephone No.: 9493331500 Date: 12/12/18<br>**NO LOBBYING TO DISCLOSE** WAS |
|---|---|---|

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# DISCLOSURE OF LOBBYING ACTIVITIES Approved by
## CONTINUATION SHEET

OMB0348-0046

Reporting Entity: _____ Page _____of_____

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Standard Form - LLL-A

## *Disadvantaged Business Enterprise (DBE) Program*
## *DBE Subcontractor Performance Form*

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

| | | |
|---|---|---|
| Subcontractor Name<br>3531 Trucking Inc | | Project Name<br>North City Water Reclamation Plant Expansion |
| Bid / Proposal No.<br>K-19-1724-DBB-3 | Assistance Agreement ID No. (if known) | Point of Contact<br>Miguel Miranda |
| Address<br>PO Box 1062 Glendora CA 91740 | | |
| Telephone No.<br>626-644-6221 | | Email Address<br>Miguel@3531truckinginc.com |
| Prime Contractor Name<br>AECOM Energy & Construction, Inc. | | Issuing/Funding Entity |

| Contract Item Number | Description of Work Submitted from the Prime Contractor Involving Construction, Services, Equipment or Supplies | Price of Work Submitted to the Prime Contractor |
|---|---|---|
| 4, 6, 15 (Partial) | Trucking | $10,000 |

DBE Certified By: ● DOT _ SBA
✓ Other: Metro

Meets/exceeds EPA certification standards?
(YES) NO Unknown

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.2015 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.
[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

***FORM 4500-3 (DBE Subcontractor Performance Form)***

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

| Prime Contractor Signature | Print Name |
|---|---|
| Matt Kuzmick | Matt Kuzmick |
| **Title** | **Date** |
| Vice President | 12/05/18 |

| Subcontractor Signature | Print Name |
|---|---|
| | Miguel Miranda |
| **Title** | **Date** |
| President | 12/10/2018 |

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

***FORM 4500-3 (DBE Subcontractor Performance Form)***

Back To Query Form

## Search Returned 1 Records

Wed Dec 12 10:28:27 PST 2018

**Query Criteria**
Certification Types: DBE
DBA Name: 3531

| | |
|---|---|
| **Firm ID** | 42097 |
| **DBA Name** | 3531 TRUCKING, INC. |
| **Firm Name** | 3531 TRUCKING, INC. |
| **Address Line1** | 1239 BONNIE COVE |
| **Address Line2** | |
| **City** | GLENDORA |
| **State** | CA |
| **Zip Code1** | 91740 |
| **Zip Code2** | |
| **Mailing Address Line1** | P. O. BOX 1062 |
| **Mailing Address Line2** | |
| **Mailing City** | GLENDORA |
| **Mailing State** | CA |
| **Mailing Zip Code1** | 91740 |
| **Mailing Zip Code2** | |
| **Certification Type** | DBE |
| **EMail** | MMiranda921@yahoo.com |
| **Contact Name** | MIGUEL MIRANDA |
| **Area Code** | 626 |
| **Phone Number** | 644-6221 |
| **Extension** | |
| **Alt Area Code** | |
| **Alt Phone Number** | |
| **Extension** | |
| **Fax Area Code** | |
| **Fax Phone Number** | |
| **Agency Name** | LOS ANGELES COUNTY METRO TRANSPORTATION AUTHORITY (MTA) |
| **Counties** | 10; 19; 30; 33; 36; 40; 42; 56; |
| **Districts** | 05; 06; 07; 08; 12; |
| **DBE NAICS** | 484220; |
| **ACDBE NAICS** | |
| **Work Codes** | C9774 TRUCKER; |
| **Licenses** | |
| **Trucks** | HAUL TRUCK - 1; |
| **Gender** | M |
| **Ethnicity** | HISPANIC |
| **Firm Type** | DBE |

## *Disadvantaged Business Enterprise (DBE) Program*

## *DBE Subcontractor Performance Form*

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

| | | |
|---|---|---|
| Subcontractor Name<br>Alcorn Fence Company | | Project Name<br>North City Water Reclamation Plant Expansion |
| Bid / Proposal No.<br>K-19-1724-DBB-3 | Assistance Agreement ID No. (if known) | Point of Contact |
| Address<br>9901 Glenoaks Boulevard, Sun Valley, CA 91352 | | |
| Telephone No.<br>323-875-1342 | | Email Address<br>maric@alcornfence.com |
| Prime Contractor Name<br>AECOM Energy & Construction, Inc. | | Issuing/Funding Entity |

| Contract Item Number | Description of Work Submitted from the Prime Contractor Involving Construction, Services, Equipment or Supplies | Price of Work Submitted to the Prime Contractor |
|---|---|---|
| 9P | Supply and install approximately 197' of 6' High chain link fence per SDM-112 and (2) 15' x Wide Double Swing gates per SDM-114 Page PK4-CG-101 | $23,333.00 |
| | install approximately 115' LF of BV Chain link fence per SDM-112. This is only for the 115' on page PK4-CG-107. No other fence replacement. Removal is ecxcluded from Alcorn's scope of work. | $11,950.00<br>Total:$35,283.00 |

| | |
|---|---|
| DBE Certified By: _ DOT _ SBA<br>Other: _____ | Meets/exceeds EPA certification standards?<br>YES NO Unknown |

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

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

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

| Prime Contractor Signature | Print Name |
|---|---|
| Matt Kuzmick | Matt Kuzmick |
| Title | Date |
| Vice President | 12/05/18 |

| Subcontractor Signature | Print Name |
|---|---|
| Maricela Ceja | Maricela Ceja |
| Title | Date |
| Assistant Secretary | 12/12/2018 |

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

***FORM 4500-3 (DBE Subcontractor Performance Form)***

CALIFORNIA Water Boards

## *Disadvantaged Business Enterprise (DBE) Program*

## *DBE Subcontractor Performance Form*

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

| | | |
|---|---|---|
| Subcontractor Name<br>Nickolas Steel, Inc. | | Project Name<br>North City Water Reclamation Plant Expansion |
| Bid / Proposal No.<br>K-19-1724-DBB-3 | Assistance Agreement ID No. (if known) | Point of Contact<br>Elan Mlagenovich |
| Address<br>816 S. Cucamonga Ave. Ontario, CA 91761 | | |
| Telephone No.<br>714-738-4647 | | Email Address<br>elan@nicksteelinc.com |
| Prime Contractor Name<br>AECOM Energy & Construction, Inc. | | Issuing/Funding Entity |

| Contract Item Number | Description of Work Submitted from the Prime Contractor Involving Construction, Services, Equipment or Supplies | Price of Work Submitted to the Prime Contractor |
|---|---|---|
| 11 | MISC. METALS | # 151,301 |
| ALT A | MISC. METALS | $ 58,815 |

| | |
|---|---|
| DBE Certified By: _ DOT ✓ _ SBA<br>Other: MWD, Port of Long, San Diego County Water Authority | Meets/exceeds EPA certification standards?<br>✓ YES NO Unknown |

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

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

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

| Prime Contractor Signature | Print Name |
|---|---|
| Matt Kuzmick | Matt Kuzmick |
| Title | Date |
| Vice President | 12/05/18 |

| Subcontractor Signature | Print Name |
|---|---|
| Elan Mlagenovich | Elan Mlagenovich |
| Title | Date |
| Vice President | 12-6-18 |

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

***FORM 4500-3 (DBE Subcontractor Performance Form)***

NETConnect Connecting you to Government Bids throughout Southern California

Certified Small Business Enterprise

**Vendor Account Number:** 169448

Mr. Nick Mlagenovich
Nickolas Steel
816 S. Cucamonga Ave
Ontario, CA 91761

Thank you for submitting your Vendor Application seeking Small Business Enterprise recognition with the Coalition of Southern California Public Agencies. Per our evaluation of the information you provided in your application and the North American Industry Classification System codes you identified, your status as a Small Business Enterprise (SBE) has been approved. This certification is recognized by the following organizations:

***Metropolitan Water District of Southern California***
***Port of Long Beach***
***San Diego County Water Authority***
***Los Angeles Unified School District***
***Los Angeles Community College District***

Metropolitan is pleased to issue this SBE Certificate subject to the terms and conditions identified below:

**NAICS code(s) for which SBE status is recognized:**

**332722 - Bolt, Nut, Screw, Rivet, and Washer Manufacturing**
**332312 - Fabricated Structural Metal Manufacturing**
**332321 - Metal Window and Door Manufacturing**
**331491 - Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding**
**332323 - Ornamental and Architectural Metal Work Manufacturing**

**SBE Certificate Effective Date: 08/30/18**
**SBE Certificate Expiration Date: 08/30/21**

Work Performed by your firm that falls within the above-mentioned NAICS code(s) will be counted as SBE participation for work performed on contracts procured by the above agencies.

The agencies reserve the right to withdraw this certification if at any time it is determined that certification was knowingly obtained by false, misleading or incorrect information and reserve the right to audit all statements. If any firm attempts to falsify or misrepresent information to obtain certification, the firm may be disqualified from participation in any contracts for a period of up to five years.

**SBE Certification is valid for a period of three (3) years. To maintain SBE status, firms must update their existing SBE Vendor Application on or before the expiration date mentioned above. All information is subject to verification.**

If there are any changes in your status that may impact your certification, you are required to update your account information online. A copy of your information can be viewed by logging into your Vendor Profile, and visiting the Small Business Certification tab.

Sincerely,
John J. Arena
Metropolitan Water District of Southern California
Business Outreach Program Manager

700 N. Alameda Street, Los Angeles, California 90012 Mailing Address: Box 54153, Los Angeles, CA 90054-0153
Telephone (213) 217-7444

Water Boards

## *Disadvantaged Business Enterprise (DBE) Program*
## *DBE Subcontractor Performance Form*

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

| | | |
|---|---|---|
| Subcontractor Name: Sampo Engineering, Inc. | | Project Name: North City Water Reclamation Plant Expansion |
| Bid / Proposal No.: K-19-1724-DBB-3 | Assistance Agreement ID No. (if known): | Point of Contact: |
| Address: 171 Saxony Rd #213, Encinitas, CA 92024 | | |
| Telephone No.: 760-436-0600 x110 | | Email Address: vince@sampoengineering.com |
| Prime Contractor Name: AECOM Energy & Construction, Inc. | | Issuing/Funding Entity: |

| Contract Item Number | Description of Work Submitted from the Prime Contractor Invoiving Construction, Services, Equipment or Supplies | Price of Work Submitted to the Prime Contractor |
|---|---|---|
| 4, 8 (Partial) | Land Surveying Services Time & Material | $30,000.00 T&M |

DBE Certified By: ✓ DOT _ SBA
Other: _____

Meets/exceeds EPA certification standards?
YES NO (Unknown)

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

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

| Prime Contractor Signature | Print Name |
|---|---|
| Matt Kuzmick | Matt Kuzmick |
| **Title** | **Date** |
| Vice President | 12/05/18 |

| Subcontractor Signature | Print Name |
|---|---|
| V—t L. | Vincent L. Sampo |
| **Title** | **Date** |
| President | 12-12-18 |

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

***FORM 4500-3 (DBE Subcontractor Performance Form)***

Back To Query Form

## Search Returned 1 Records

Tue Dec 11 15:16:45 PST 2018

**Query Criteria**
Certification Types: DBE
Firm ID: 37488

| | |
|---|---|
| **Firm ID** | 37488 |
| **DBA Name** | SAMPO ENGINEERING, INC. |
| **Firm Name** | |
| **Address Line1** | 171 SAXONY ROAD, SUITE 213 |
| **Address Line2** | |
| **City** | ENCINITAS |
| **State** | CA |
| **Zip Code1** | 92024 |
| **Zip Code2** | |
| **Mailing Address Line1** | |
| **Mailing Address Line2** | |
| **Mailing City** | |
| **Mailing State** | |
| **Mailing Zip Code1** | |
| **Mailing Zip Code2** | |
| **Certification Type** | DBE |
| **EMail** | info@sampoengineering.com |
| **Contact Name** | VINCENT LOUIS SAMPO |
| **Area Code** | 760 |
| **Phone Number** | 436-0660 |
| **Extension** | 10 |
| **Alt Area Code** | |
| **Alt Phone Number** | |
| **Extension** | |
| **Fax Area Code** | 760 |
| **Fax Phone Number** | 436-0659 |
| **Agency Name** | DEPARTMENT OF TRANSPORTATION |
| **Counties** | 19; 30; 33; 36; 37; |
| **Districts** | 07; 08; 11; 12; |
| **DBE NAICS** | 221310; 237210; 237990; 541330; 541340; 541360; 541370; 561410; |
| **ACDBE NAICS** | |
| **Work Codes** | E4940 WATER SUPPLY; C8710 ENGINEERING; C8765 DRAFTING; E4970 IRRIGATION SYSTEMS; C8760 LAND SURVEYOR; H6550 SUBDIVIDERS & DEVELOPERS; C9826 LAND SURVEYING; C2065 IRRIGATION SYSTEM; C8720 CIVIL ENGINEERING; |
| **Licenses** | EC Civil Engineer; LS Land Surveyor; |
| **Trucks** | |
| **Gender** | M |

CALIFORNIA
Water Boards

## *Disadvantaged Business Enterprise (DBE) Program*

## *DBE Subcontractor Performance Form*

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

| Subcontractor Name | | Project Name |
|---|---|---|
| SoCal Stormwater Runoff Solution Services Inc | | North City Water Reclamation Plant Expansion |
| Bid / Proposal No. | Assistance Agreement ID No. (if known) | Point of Contact |
| K-19-1724-DBB-3 | | Mary Mofid |
| Address | | |
| 14930 Ventura Blvd Suite#310, Sherman Oaks, CA 91403 | | |
| Telephone No. | | Email Address |
| 310-343-8313 | | mary@socalstormwatersolutions.com |
| Prime Contractor Name | | Issuing/Funding Entity |
| AECOM Energy & Construction, Inc. | | N/A |

| Contract Item Number | Description of Work Submitted from the Prime Contractor Involving Construction, Services, Equipment or Supplies | Price of Work Submitted to the Prime Contractor |
|---|---|---|
| Bid Item No.12 & 13 except the installation, Inspection & implementation of the SWPPP | Preparation of Stormwater Pollution Prevention Plan (SWPPP) Including Revisions as Specified in Project Documents Development and QSD Certified<br>Prepare/Submit Application to Obtain NOI (Notice of Intent) & SWPPP Upload to SMARTS<br>Submission of Stormwater Annual Report In SMARTS Due Sept 1st of Each Reporting Year (June 30-July 1)<br>Prepare/Submit Application to Obtain NOT (Notice of Termination) | $3,445.00 |

| DBE Certified By: | Meets/exceeds EPA certification standards? |
|---|---|
| ___ DOT ___ SBA<br>___ Other: SBE | YES NO ✔ Unknown |

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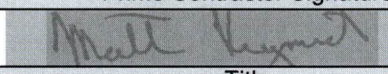
[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

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

| Prime Contractor Signature | Print Name |
|---|---|
|  | Matt Kuzmick |
| Title | Date |
| Vice President | 12/05/18 |

| Subcontractor Signature | Print Name |
|---|---|
| Mary Mofid | Mary Mofid |
| Title | Date |
| Office Manager | 12/12/2018 |

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

***FORM 4500-3 (DBE Subcontractor Performance Form)***

# CITY OF LOS ANGELES
CALIFORNIA

ERIC GARCETTI
MAYOR

JOHN L. REAMER, JR.
Inspector of Public Works
and
Director
BUREAU OF
CONTRACT ADMINISTRATION
1149 S. BROADWAY, SUITE 300
LOS ANGELES, CA 90015
(213) 847-1922
http://bca.lacity.org

July 10, 2018

Rambod Mohseni
Socal Stormwater Runoff Solution Services, Inc.
14930 Ventura Blvd., Ste. 310
Sherman Oaks, CA 91430

SLB-File # 4056
Expiration Date: **July 10, 2020**

**SMALL, LOCAL BUSINESS (SLB) CERTIFICATION APPROVAL**

Dear Mr. Mohseni:

Pursuant to the provisions of the the City of Los Angeles Administrative Code Article 4 of Chapter 1 of Division 10 and the policy of the City of Los Angeles Bureau of Contract Administration, Office of Contract Compliance (OCC), we are pleased to inform you that your firm has been certified as a **SLB** and has been placed in the City of Los Angeles Small, Local Business directory as a firm specializing in **Inspection and Plan Drawing Preparation.**

This certification is valid for two years from the date of this letter. If you still wish to maintain your certification, you must submit a Biennial Affidavit of Eligibility to our office one month prior to expiration. If the company's principal office has moved outside the County of Los Angeles, and/or its annual gross receipts including affiliates if any, exceed $3 million, you are required to notify this office of the move, and/or change in annual receipts in writing. Please include your file number on each page of correspondence relating to this matter.

The City reserves the right to withdraw this certification at any time if it is determined certification was knowingly obtained by false, misleading or incorrect information. The City also reserves the right to request additional information and/or conduct on-site visits at any time during the certification period to verify any documentation submitted with your application. By accepting certification, the firm of **Socal Stormwater Runoff Solution Services, Inc.** hereby consents to the examination of its books, records and documents by the City.

For information on City of Los Angeles contracting opportunities, please register at http://LABAVN.org. If your company is registered in LABAVN, our office will update your current certification and all other appropriate certifications in your company profile.

If you have not registered, please go to http://LABAVN.org and register your company. You will need to add a request for this approved certification in your company profile. Our office will verify this certification in your LABAVN profile.

Should you have any questions, please contact Angela Tumbucon at (213) 847-2665 or e-mail at angela.tumbucon@lacity.org

Sincerely,

ATumbucon

for LYNDA McGLINCHEY, Certification Manager
Office of Contract Compliance
Bureau of Contract Administration


1700 W. Fifth St.
San Bernardino, CA 92411
909-379-7100
www.omnitrans.org

Certified Small Business Enterprise

**Vendor Account Number:** 634903
Ram Mohseni
Socal Stormwater Runoff Solution Services Inc.
14930 Ventura Blvd STE 310
Sherman Oaks, CA 91403

Thank you for seeking Small Business Enterprise (SBE) recognition with Omnitrans. Per our evaluation of the information provided in your firm's SBE application and the North American Industry Classification System Codes identified, your status as an SBE has been approved.

Omnitrans is pleased to issue the SBE Certification subject to the terms and conditions identified below:

**NAICS code(s) for which SBE status is recognized: 541620**
**SBE Certificate Effective Date: 07/05/18**
**SBE Certificate Expiration Date: 07/05/21**

Work performed by your firm falling within the above-mentioned NAICS code(s) will be counted as SBE participation for work performed on contracts procured by Omnitrans.

SBE Certification is valid for a period of three (3) years. To maintain SBE status, firms must update their existing SBE Vendor Applications on or before the expiration date mentioned above. All information is subject to verification.

As an SBE certified firm, any changes impacting certification status are required to be disclosed by updating both the vendor profile and the information under the Small Business Certification tab.

Sincerely,

Eugenia F. Pinheiro
Contracts Manager

# Company Information

Return to Profile

**Company Information**

| | |
|---|---|
| BAVN Company ID: | 65584 |
| Company Name | Socal Stormwater Runoff Solution Services |
| Company Address | 11728 Wilshire Blvd<br>APT No.B404<br>Los Angeles, CA 90025 |
| Phone | 3103438313 |
| Fax | |
| Company Website URL | |
| Non-Profit | No |
| Tax ID | 45-5623834 |
| BTRC Number | 2169 |
| Registed as a | Subcontractor |
| Ethnicity of the Owner | |
| Certification: | SBE(Harbor),VSBE(Harbor), LBE(Harbor) |
| Company Description | |

# City of San Diego

**CITY CONTACT:** Juan E. Espindola, **Contract Specialist, Email**: JEEspindola@sandiego.gov
**Phone No.** (619) 533-4491

# ADDENDUM A

e - Bidding

# FOR

## NORTH CITY WATER RECLAMATION PLANT EXPANSION - EARLY SITE WORK AND OZONE/BAC RELOCATION

BID NO.: **K-19-1724-DBB-3**
SAP NO. (WBS/IO/CC): **B-15142, B-15139**
CLIENT DEPARTMENT: **2000**
COUNCIL DISTRICT: **1**
PROJECT TYPE: **BI**

---

**BID DUE DATE:**

**2:00 PM**

**DECEMBER 5, 2018**

**CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS**

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

# ENGINEER OF WORK

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

**NCWRP EXPANSION AND NCPWF INFLUENT PUMP STATION AND PIPELINE - PACKAGE 4 NCWRP EARLY SITEWORK AND OZONE/BAC RELOCATION**

**Julian Hoyle**

1) Registered Engineer


DIGITALLY SIGNED: 09/27/2018

**Amer Barhoumi**

2) For City Engineer

## 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. INSTRUCTIONS TO BIDDERS

1. To Item 7, Insurance Requirements, page 12, **DELETE** in its entirety and **SUBSTITUTE** with the following:

**7. INSURANCE REQUIREMENTS:**

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

**7.2** Refer to sections 7-3, "LIABILITY INSURANCE", and 7-4, "WORKERS' COMPENSATION INSURANCE" of the Supplementary Special Provisions (SSP) for the insurance requirements which must be met.

2. Item 8, Reference Standards, page 13, **DELETE** in its entirety and **SUBSTITUTE** with the following:

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

| Title | Edition | Document Number |
|---|---|---|
| Standard Specifications for Public Works Construction ("The GREENBOOK") http://www.greenbookspecs.org/ | 2015 | PWPI070116-01 |
| City of San Diego Standard Specifications for Public Works Construction ("The WHITEBOOK")* https://www.sandiego.gov/publicworks/edocref/greenbook | 2015 | PWPI070116-02 |
| City of San Diego Standard Drawings* https://www.sandiego.gov/publicworks/edocref/standarddraw | 2016 | PWPI070116-03 |
| Citywide Computer Aided Design and Drafting (CADD) Standards https://www.sandiego.gov/publicworks/edocref/drawings | 2016 | PWPI092816-04 |

| Title | Edition | Document Number |
|---|---|---|
| California Department of Transportation (CALTRANS) Standard Specifications – http://www.dot.ca.gov/des/oe/construction-contract-standards.html | 2015 | PWPI092816-05 |
| CALTRANS Standard Plans http://www.dot.ca.gov/des/oe/construction-contract-standards.html | 2015 | PWPI092816-06 |
| California Manual on Uniform Traffic Control Devices Revision 1 (CA MUTCD Rev 1) - http://www.dot.ca.gov/trafficops/camutcd/ | 2014 | PWPIO92816-07 |
| **NOTE**: *Available online under Engineering Documents and References at: http://www.sandiego.gov/publicworks/edocref/index.shtml | | |

## C. ATTACHMENTS

1. To Attachment A, Scope of Work, Item 1, Scope of Work, page 23, Sub-item 1.2, numeral 1.2.1, **ADD** the following:

   Milestone 1A – Completion of New Plant Electrical Service and Switchgear.

2. To Attachment A, Scope of Work, Item 1, Scope of Work, page 23, Sub-item 1.3 numeral 1.3.1, Early Sitework, **ADD** the following:

   **1.3.1 Early Sitework:** Milestone 1A – New Plant Electrical Service and Switchgear

   **1.3.1.A** Shall be complete within 180 days from NTP.

3. To Attachment D, Environmental Protection Agency (EPA) and Clean Water State Revolving Fund (CWSRF) Fund Agency Provisions, Item 9 Wage Rates, pages 46 through 73, **DELETE** in its entirety and **SUBSTITUTE** with pages 21 through 48 of this Addendum.

## D. SUPPLEMENTARY SPECIAL PROVISIONS

1. To Section 2 - Scope and Control of Work, Item 2-15, **ADD** the following:

**2.15.3** In preparation of the Contract Documents, the designer has relied upon the following reports and documentation at the Work Site:

a) The Stormwater Pollution Prevention Plan for the North City Water Reclamation Plant Expansion Package 4 – Early Site Work and Ozone-BAC Relocation, dated June 2017, prepared by O'Day Consultants Inc. The Contractor shall implement and update this SWPPP as required by the Contract Documents. Located at: PK1-NCPWF_SWPPA80511. FileCloud.

b) The Priority Development Project (PDP) Stormwater Quality Management Plan for the North City Water Reclamation Plant Expansion Package, Permit Number 585316, DWB 40381, dated June 29, 2018, prepared by O'Day Consultants Inc. Located at: 2018-09-18_NCWRP Exp_SWQMP. FileCloud.

c) Record Drawings, including the following:

1) North City Water Reclamation Plant D Sheet 26982. Located at: NCWRP D-26982. FileCloud

2) North City Water Reclamation Plant EDR Expansion Design Concept Drawings. Located: 2003-11-13_NCWRP EDR Expansion Design concept Drawings. FileCloud.

3) North City Water Reclamation Electrodialysis Reversal System 6 and AWT Pad Installation D Sheet 36268. Located at: 2010-11-22-NCWRP

Electrodialysis Reversal System 6 and AWT Pad Installation D Sheet 36268. File Cloud.

4) North City Cogeneration Facility Expansion – Site Development D Sheet 37093. Located at: North City Cogen Fac Exp D 37093. FileCloud.

5) None of the contents of such Drawings is Technical Data on whose accuracy Contractor may rely.

d) The Storm Water Pollution Prevention Plan for the North City Pure Water Facility Package 1 – Mass Grading and Clearing, dated May 2018, prepared by O'Day Consultants, Inc. The Contractor shall implement and update this SWPPP as required by the Contract Documents.

e) The Priority Development Project (PDP) Storm Water Quality Management Plan for the North City Pure Water Facility, Permit Number 585312, dated October 10, 2018, prepared by O'Day Consultants Inc.

2.15.4 The reports and documents listed above are available for review at the following file cloud link:

https://filecloud.sandiego.gov/url/c7m45mtz9k8pdxxp

2. To Section 6 – Prosecution, Progress and Acceptance of Work, page 119 item 6.3.2.2.1, Payment, **DELETE** in its entirety.

3. To Section 6 – Prosecution, Progress and Acceptance of Work, page 120, item 6.3.2.3.1, Payment, **DELETE** in its entirety.

4. To Section 6 – Prosecution, Progress and Acceptance of Work, page 121, Item 6-9, Liquidated Damages, sub-item 3, table **ADD** the following:

| **Milestone No.** | **Milestone Description** | **Required Completion Date or Calendar Days** | **Amount of Liquidated Damages** |
|---|---|---|---|
| Milestone 1A: | New Plant Electrical Service and Switchgear | 180 Working Days after NTP | $4,000/day |

5. To Section 6 – Prosecution, Progress and Acceptance of Work, page 121, Item 6-9, Liquidated Damages, sub-item 3, table, Milestone 6, **DELETE** in its entirety and **SUBSTITUTE** with the following:

| **Milestone No.** | **Milestone Description** | **Required Completion Date or Calendar Days** | **Amount of Liquidated Damages** |
|---|---|---|---|
| Milestone 6 | Final Completion | 305 Working Days after Notice to Proceed | $1,000/day |

6. To Section 7 – Responsibilities of the Contractor, page 130, Item 7-8.6 Water Pollution Control, Sub-item 6, **DELETE** in its entirety and **SUBSTITUTE** with the following:

    6. This Contract is subject to 2 SWPPPs, as follows:

        1. The NCWRP site, based on a preliminary assessment by the City is subject to SWPPP Risk Level 2.

        2. The NCPWF site, based on a preliminary assessment by the City is subject to SWPPP Risk Level 3.

7. To Technicals, Section 01 26 00, Contract Modification Procedures, pages 140 through 145, **DELETE** in its entirety.

8. To Technicals, Section 01 29 00 Payment Procedures, Part 1 General, page 151, Item 15, Site Electrical (Bid Item No. 7) Lump Sum, **ADD** letter D:

   D. For Time-Critical New Medium Voltage Switchgear (72SWGR) payment of 10% of bid amount will be made upon submittal approval, and an additional 80% of the bid amount upon delivery of the Switchgear to the site.

9. To Technicals, Section 01 29 00 Payment Procedures, Part 1 General, page 153 Item 26, Field Surveys (Bid Item No. 18) Lump Sum, **DELETE** in its entirety.

10. To Technicals, Section 01 29 00 Payment Procedures, Part 1 General, **ADD** Items 32 and 33:

    32 NCPWF STORM WATER POLLUTION PREVENTION PLAN (SWPPP) – IMPLEMENTATION (BID ITEM NO. 22) LUMP SUM

       A. No measurement shall be made for this Item.

       B. Payment is made for this Item for the implementation of the NCPWF SWPPP measures required under this Contract and shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 22. Payment for this Item shall include the implementation of the 100 percent SWPPP based on the draft SWPPP and shall include all necessary additional BMP's as required for compliance with the permitting agency. Payment shall include implementation, monitoring, upkeep, and removal of all necessary BMP's as required in the approved SWPPP.

    33 NCPWF STORM WATER POLLUTION PREVENTION PLAN (SWPPP) – PERMIT FEE (BID ITEM NO. 23) ALLOWANCE

       A. No measurement shall be made for this Item.

       B. Payment is made for this item as an allowance towards the SWPPP Permit Fee to the NCWRP Expansion. Payment for this item shall be made as the allowance amount named in the Bid Schedule under Bid Item No. 23.

11. To Technicals, Section 01 31 13 Project Coordination, Part 1 General, page 157, Item 4, SDG&E Coordination, Sub-item A, numeral 3, **ADD** letter i:

    i. Contractor shall abide by "Guide for Encroachment SDG&E Transmission Rights of Way" April 2009 when within the SDG&E easement.

12. To Technicals, Section 01 31 13 Project Coordination, Part 1 General, page 157, Item 5 Project Milestones, Sub-item A, Project Milestones, numeral 1, **ADD** letter f:

    f. Milestone 1A – New Plant Electrical Service and Switchgear:

        1) Electrical ductbanks for new service.

        2) Electrical ductbanks and conductor from new service to Switchgear 68.

        3) All testing required to energize the new services.

        4) All coordination with SDG&E for the new electrical services.

13. Technicals, Section 01 31 13 Project Coordination, Part 1 General, page 165, Item 8 Work Sequencing/Constraints, letter D Early Sitework, **ADD** numeral 5:

    5. The Contractor shall submit for approval the New Plant Switchgear Submittal within 10 Working Days from NTP. Coordination with SDG&E shall take place at the time the Limited Notice to Proceed is issued by the City. Grading of the Secondary Clarifiers cannot be completed until the new plant electrical feed is operational. Phased grading operations at the Secondary Clarifiers shall be performed with no disruption to the electrical service of the plant.

14. To Technicals, Section 01 31 13 Project Coordination, Part 3, Execution, page 171, **ADD** numeral 2:

    2. SUPPLEMENT

        A. The supplement listed below, following "End of Section," is part of this Specification.

1. San Diego Gas & Electric Permission to Grade and Construct Improvements.

15. To Technicals, Section 01 31 13 Project Coordination, **ADD** the SUPPLEMENT titled San Diego Gas and Electric Permission to Grade and Construct Improvements. Please use the following link to access the Supplement. Located at: 01_31_131I_Sup01_Attachment A_SDGE_Permission to Grade and Construct. File Cloud listed below:

    https://filecloud.sandiego.gov/url/c7m45mtz9k8pdxxp

16. To Technicals, Section 01 32 00 Construction Progress Documentation, Part 1 General, page 179, Item 6 Baseline Schedule, sub-item G, Early Completion, **DELETE** in its entirety.

17. To Technicals, Section 01 32 00 Construction Progress Documentation, Part 1 General, page 181, Item 8 Schedule Preparation, Sub-item F **DELETE** in its entirety and **SUBSTITUTE** with the following:

    F. Reference schedule to working days with beginning of Contract Time as Day "1".

18. To Technicals, Section 01 32 00 Construction Progress Documentation, Part 1 General, page 190, Item 13 Adjustment of Contract Times, Sub-item G Float, numeral 4, **DELETE** in its entirety and **SUBSTITUTE** with the following:

    4. If early completion is shown in the Contractor's schedules, then the time between the identified Contractor's early completion schedule and Final Completion shall be considered as project float. The Contractor shall not be entitled to any extensions of time or recovery for any delay incurred because of an extension in an early completion date until all Contract float is used or consumed and performance and completion of the Work extends beyond the corresponding contract time."

19. To Technicals, Section 01 33 00 Submittal Procedures, Part 1 General, page 195, Item 2 Procedures, Letter F. Processing Time, **ADD** the following:

5. Processing Time for Deferred Submittals:
    a. Time for review shall commence on Construction Manager's receipt of submittal.
    b. Construction Manager will act upon Contractor's submittal and transmit copies to the Agencies or other entities for review.
    c. Responses shall be provided to the Contractor not later than 21 working days after receipt, unless otherwise specified.
    d. Resubmittals will be subject to same review time.
    e. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.

20. To Technicals, Section 01 33 00 Submittal Procedures, Part 1 General, page 197, Item 4 Informational Submittals, sub-item F: Deferred Submittal: See Drawing for list of deferred submittals, **DELETE** in its entirety and **SUBSTITUTE** with the following:

    F. Deferred Submittal: See Contract Documents for list of deferred submittals.

        1. Contractor-design drawings and product data related to permanent construction.

            a. Written and graphic information.
            b. Drawings.
            c. Cut sheets.
            d. Data sheets.
            e. Submittals requested in individual specification section.
            f. List of assumptions.
            g. List of performance and design criteria.
            h. Summary of loads or load diagram, if applicable.
            i. Calculations.
            j. List of applicable codes and regulations.
            k. Signed and sealed by the Contractor's Engineer for the deferred submittal when required within the Contract Documents.

        2. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or

its anchorage, submit required supporting data and shop drawings for review and acceptance by Design Engineer. Documentation of review and approval provided on Design Engineer's comment form, along with completed submittal, will be filed with permitting agency by Design engineer and approved by permitting agency prior to installation.

21. To Technicals, Section 01 50 00 Temporary Facility and Controls, Part 2 Product, page 235, Item 1. Construction Manager Field Offices sub-item C. **DELETE** and **SUBSTITUTE** with the following:

    C. "Ownership of all equipment and furniture furnished under this article will remain that of the City of San Diego. The lease for the Construction Manager's trailers and monthly utility costs shall be transferrable to another Contractor at the conclusion of the project. It is the intent to keep the trailer on site for a minimum of three (3) additional years. The initial deposit will be returned to the Contractor at the time of the transfer of the lease."

22. To Technicals, Section 01 50 00 Temporary Facility and Controls, Part 3 Execution, page 237, Item 1 Construction Manager's FIELD OFFICE, sub-item L. Telecommunications, **DELETE** in its entirety and **SUBSTITUTE** with the following:

    **A. Site/Room Requirements**

    1. Provide and install a 4' × 4' × ¾" fire-rated plywood backboard

        1.1. Provide and install a 120V AC dedicated outlet on a dedicated 15Amp circuit breaker. Single standard 3 prong 120V AC, 15Amp dedicated receptacle. Within 5' of equipment mount

        1.2. Provide and install new #6 ground wire bonded to an MGN (except in CA) or UFER Ground terminated to a grounding bus bar 2" Sleeve(s).

        1.3. Backboard shall be mounted to wall with proper drywall anchors and not just screws

        1.4. Active equipment shall not be installed within 3' of

electrical panels

1.5. Active equipment shall not be installed within 3' of water sources (sinks, wash basins)

1.6. All equipment shall be installed in accordance with all ADA code (leaving 36'' open fare way).

2. Provide and install two (2), 5-15P outlets on 120 volt, 15 amp circuits. Within three feet of the network racks

3. Provide and install all labor, materials and equipment to connect to the City's SANNET fiber network. This includes fiber and conduit from the proposed trailer location to a manhole north of the existing guard shack.

**B. Network Cabling Requirements**

1. Provide and install fourteen (14) network wall plates with two (2) data jacks per wall plate for a total twenty-eight (28) data jacks.

1.1. All data jacks shall be clearly and professionally labeled with matching labels at the face-plate and at the patch panel. Naming convention shall be based upon the matrix attached. Handwritten labels are not acceptable.

1.2. All data jacks shall be home runs from the face-plate to a Category 6 patch panel to the nearest IDF.

1.3. Cabling between the wall jack to the patch panel shall be plenum rated cable where required by code. The Category 6 cables shall be "Blue" in color. Use T568A wiring pattern terminating into Keystone Jack, Category 6, 110 type, 90 degree at the wall jack. The wall jack shall match the color of the face-plate.

1.4. The cabling between the wall plate and the patch panel, the cabling will terminate into the patch panel using a T568A wiring pattern into a Keystone Jack, Category 6, 110 type, 90 degree at the patch panel. The keystone shall match the color of the

patch panel.

1.5. All data jacks shall be tested and certified. The vendor will provide a complete testing report for all data jacks.

2. Install one (1), 48-port Category 6 Patch Panel

2.1. Each patch panel will be a 2U, 48-port Category 6 Patch Panel.

3. Install a Wall mounted cabinet

3.1. Rack Size - 19"
3.2. Height (Rack Units) - 12U
3.3. Dimensions (WxDxH) - 25.1 in x 23.6 in x 17.7 in

Network printer

Provide a Sharp MX Network Printer or greater capable of 11X17 printing and network accessible.
- Contract for immediate site service, 1 Each.

Multi-Function Device (MFD)

Provide a Konica BizHub or greater capable of color printing, 11X17 printing, scan to email and fax capabilities.
- Contract for immediate site service, 1 Each.

The contractor shall provide an Internet, T1 line or greater. The internet circuit shall be provided for the duration of the project to the CM with an Ethernet handoff. Provide a public routable IP address scheme with a subnet mask of /29 for routable addresses. The Contractor shall provide LAN Line telephone service and voicemail and will perform maintenance including move, add, and changes for the duration of the project. Each network component and UPS device will carry the stated maintenance types until thirty (30) days after Final Acceptance.

Contractor shall provide all consumable supplies necessary for complete operation of the equipment specified under this section shall be furnished by Contractor until thirty (30) days after Final Acceptance. These supplies include, but are not limited to, ink and toner cartridges, plain paper, first-aid supplies, and fire extinguishers and certifications.

Provide appropriate jacks, wiring, and equipment required for a

complete telecommunications system.

Arrange and provide for telecommunication service for use during construction. Pay costs of installation, maintenance, and monthly service of internet connection.

Maintain in good repair and appearance, and provide weekly cleaning service and replenishment, as required, of paper towels, paper cups, hand soap, toilet paper, first-aid kit supplies, and bottled water

23. To Technicals, Section 01 50 00 Temporary Facility and Controls, Part 3 Execution, page 241, Item 2 Temporary Utilities, sub-item D Water, numeral 2, **DELETE** in its entirety and **SUBSTITUTE** with the following: first sentence to read:

    2. Owner will provide a place of temporary connection for construction at the NCWRP site. Contractor to provide temporary facilities and piping required to bring water to point of use and remove when no longer needed. Install an acceptable metering device and pay for water used at Owner's current rate

24. To Technicals, Section 01 50 00 Temporary Facility and Controls, Part 3 Execution, page 241, Item 2 Temporary Utilities, sub-item B, **DELETE** in its entirety and **SUBSTITUTE** with the following:

    B. Lighting:

        1. Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.
        2. "Provide and install as a minimum orange construction fencing or equivalent along the perimeter of the NCPWF site. Reference MMRP BIO-10e for additional requirements."

25. To Technicals, Section 01 50 00 Temporary Facility and Controls, Part 3 Execution, page 247, Item 6 Access Roads and Detours, **ADD** letter H:

    H. Construction of the NCWRP temporary access road shown on drawing CG-110 and 111 shall be constructed prior to closure of any designated existing plant road."

26. To Technicals, Section 01 57 13 Temporary Erosion and Sediment Control, Part 1 General, page 278, Item 3 System Description, sub-item D, **ADD** numeral 7:

    7. The Work shall include the implementation measures for two SWPPP's.

        a. The Stormwater Pollution Prevention Plan for the North City Water Reclamation Plant Expansion Package 4 – Early Site Work and Ozone-BAC Relocation, dated June 2017, prepared by O'Day Consultant's, Inc.

        b. The Stormwater Pollution Prevention Plan for the North City Pure Water Facility Package 1 – Mass Grading and Clearing, dated May 2018, prepared by O'Day Consultant's, Inc.

27. To Technicals, Section 31 23 23.15 Trench Backfill, Item 1.02 Definitions, page 751, sub-item K, **DELETE** in its entirety and SUBSTITUTE with the following:

    K. Standards Specifications. When referenced in this section, shall mean the latest editions of the "Greenbook" Standard Specifications for Public Works Construction and the City of san Diego Supplement "White book" Standard Specifications for Public Works Construction.

    This specification shall take precedence if there is a conflict between this Specification and the Greenbook/Whitebook.

## E. ADDITIONAL CHANGES

1. The following are additional changes to the Line Items in the PlanetBids Tab:

    For clarity where applicable, **ADDITIONS**, if any, have been **<u>Underlined</u>** and **DELETIONS**, if any, have been ~~**Stricken out.**~~

| Section | Item Code | Description | Uo M | Qty | Payment Reference | Extension |
|---|---|---|---|---|---|---|
| ~~Main Bid~~ | ~~541370~~ | ~~FIELD SURVEYS~~ | ~~LS~~ | ~~1~~ | ~~Section 01 29 00~~ | |

| Section | Item Code | Description | Uo M | Qty | Payment Reference | Extension |
|---|---|---|---|---|---|---|
| Main Bid | 237110 | NCPWF STORM WATER POLLUTION PREVENTION PLAN (SWPPP) – IMPLEMENTATION | LS | 1 | Section 01 29 00 | |
| Main Bid | 541330 | STORM WATER POLLUTION PREVENTION PLAN (SWPPP) – PERMIT FEE ALLOWANCE | AL | 1 | Section 01 29 00 | 5000 |

## F. PLANS

**The revised plans listed below are located at the following file cloud link:**

https://filecloud.sandiego.gov/url/c7m45mtz9k8pdxxp

1. To Drawing Number 40381-4028-D, Sheet 28, No. PK4-C-001, Site Civil Staging Plan: **DELETE** in its entirety and **REPLACE** with sheet No. 28 located in the FileCloud link provided herein.

2. To Drawing Number 40381-4037-D, Sheet No. 37, No. PK4-CG-101, Site Grading & Location Plan – Area 1, **DELETE** in its entirety and **REPLACE** with sheet No. 37 located in the FileCloud link provided herein.

3. To Drawing Number 40381-4041-D, Sheet No. 41, No. PK4-CG-110, Site Grading & Location Plan – Area10, **DELETE** in its entirety and **REPLACE** with sheet No. 41 located in the FileCloud link provided herein.

4. To Drawing Number 40381-4059-D, Sheet No. 59, No. PK4-YX-101, Yard Piping & Electrical Demolition Plan – Area 1, **DELETE** in its entirety and **REPLACE** with sheet No. 59 located in the FileCloud link provided herein.

5. To Drawing Number 40381-4060-D, Sheet No. 60, No. PK4-YX-102, Yard Piping & Electrical Demolition Plan – Area 2, **DELETE** in its entirety and **REPLACE** with sheet No. 60 located in the FileCloud link provided herein.

6. To Drawing Number 40381-4061-D, Sheet No. 61, No. PK4-YX-106, Yard Piping & Electrical Demolition Plan – Area 6, **DELETE** in its entirety and **REPLACE** with sheet No. 61 located in the FileCloud link provided herein.

7. To Drawing Number 40381-4062-D, Sheet No. 62, No. PK4-YX-107, Yard Piping & Electrical Demolition Plan – Area 7, **DELETE** in its entirety and **REPLACE** with sheet No. 62 located in the FileCloud link provided herein.

8. To Drawing Number 40381-4066-D, Sheet No. 66, No. PK4-YU-101, Yard Utilities – Relocation Plan – Area 1, **DELETE** in its entirety and **REPLACE** with sheet No. 66 located in the FileCloud link provided herein.

9. To Drawing Number 40381-4068-D, Sheet No. 68, No. PK4-YU-105, Yard Utilities – Relocation Plan – Area 5, **DELETE** in its entirety and **REPLACE** with sheet No. 68 located in the FileCloud link provided herein.

10. To Drawing Number 40381-4069-D, Sheet No. 69, No. PK4-YU-106, Yard Utilities – Relocation Plan – Area 6, **DELETE** in its entirety and **REPLACE** with sheet No. 69 located in the FileCloud link provided herein.

11. To Drawing Number 40381-4070-D, Sheet No. 70, No. PK4-YU-107, Yard Utilities – Relocation Plan – Area 7, **DELETE** in its entirety and **REPLACE** with sheet No. 70 located in the FileCloud link provided herein.

12. To Drawing Number 40381-4071-D Sheet No. 71, No. PK4-YU-111, Yard Utilities – Relocation Plan – Area 11, **DELETE** in its entirety and **REPLACE** with sheet No. 71 located in the FileCloud link provided herein.

13. To Drawing Number 40381-4073-D, Sheet No. 73, No. PK4-ES-101, Electrical Site Plan – Area 1, **DELETE** in its entirety and **REPLACE** with sheet No. 73 located in the FileCloud link provided herein.

14. To Drawing Number 40381-4074-D, Sheet No. 74, No. PK4-ES-102, Electrical Site Plan – Area 2, **DELETE** in its entirety and **REPLACE** with sheet No. 74 located in the FileCloud link provided herein.

15. To Drawing Number 40381-4075-D, Sheet No. 75, No. PK4-ES-106, Electrical Site Plan – Area 6, **DELETE** in its entirety and **REPLACE** with sheet No. 75 located in the FileCloud link provided herein.

16. To Drawing Number 40381-4076-D, Sheet No. 76, Drawing No. PK4-ES-107, Electrical Site Plan – Area 7, **DELETE** in its entirety and **REPLACE** with sheet No. 76 located in the FileCloud link provided herein.

17. To Drawing Number 40381-4077-D Sheet No. 77, Drawing No. PK4-ES-112, Electrical Site Plan – Area 12, **DELETE** in its entirety and **REPLACE** with sheet No. 77 located in the FileCloud link provided herein.

18. To Drawing Number 40381-4079-D, Sheet No. 79, No. PK4-ES-402, Electrical Site Ductbank Schedule, **DELETE** in its entirety and **REPLACE** with sheet No. 79 located in the FileCloud link provided herein.

19. To Drawing Number 40381-4080-D, Sheet No. 80, No. PK4-ES-451, Electrical Site Circuit & Raceway Schedule, **DELETE** in its entirety and **REPLACE** with sheet No. 80 located in the FileCloud link provided herein.

20. To Drawing Number 40381-4081-D Sheet No. 81, No. PK4-ES-501, Electrical Site Manhole Schedule, **DELETE** in its entirety and **REPLACE** with sheet No. 81 located in the FileCloud link provided herein.

21. To Drawing Number 40425-06-D, Sheet No. 6, No. G-011, Process Flow Diagram, **DELETE** in its entirety and **REPLACE** with sheet No. 6 located in the FileCloud link provided herein.

22. To Drawing Number 40425-21-D, Sheet No. 21, Drawing No. G-705, Electrical Conduit Schedule I Control, **DELETE** in its entirety and **REPLACE** with sheet No. 21 located in the FileCloud link provided herein.

23. To Drawing Number 40425-22-D, Sheet No. 22, No. G-706, Electrical Conduit Schedule II, **DELETE** in its entirety and **REPLACE** with sheet No. 22 located in the FileCloud link provided herein.

24. To Drawing Number 40425-23-D, Sheet No. 23, No. G-707, Electrical Conduit Schedule III Control, **DELETE** in its entirety and **REPLACE** with sheet No. 23 located in the FileCloud link provided herein.

25. To Drawing Number 40425-24-D, Sheet No. 24, No. G-708, Electrical Conduit Schedule IV Control, **DELETE** in its entirety and **REPLACE** with sheet No. 24 located in the FileCloud link provided herein.

26. To Drawing Number 40425-43-D, Sheet No. 43, No. C-002, Yard Piping Plan, **DELETE** in its entirety and **REPLACE** with sheet No. 43 located in the FileCloud link provided herein.

27. To Drawing Number 40425-44-D Sheet No. 44, No. C-003, Civil Profile, **DELETE** in its entirety and **REPLACE** with sheet No. 44 located in the FileCloud link provided herein.

28. To Drawing Number 40425-62-D, Sheet No. 62, No.29-M-003, Ozone and BAC Filter Process Piping Plan, **DELETE** in its entirety and **REPLACE** with sheet No. 62 located in the FileCloud link provided herein.

29. To Drawing Number 40425-87-D, Sheet No. 87, No. 34-M-001, Tie-In Connection to Effluent Pump Station, **DELETE** in its entirety and **REPLACE** with sheet No. 87 located in the FileCloud link provided herein.

30. To Drawing Number 40425-88-D, Sheet No. 88, No. 34-M-002, Effluent PS Piping Section, **DELETE** in its entirety and **REPLACE** with sheet No. 88 located in the FileCloud link provided herein.

31. To Drawing Number 39636-1-D, Sheet No. 1, Cover Sheet, **DELETE** in its entirety and **REPLACE** with sheet No. 1 located in the FileCloud link provided herein:

    https://filecloud.sandiego.gov/url/c7m45mtz9k8pdxxp

32. To Drawing No. 39636-8-D through 39636-12-D, Sheet No. 8 through Sheet No. 12, Civil Mass Grading and Clearing Plan Area 1 through 5: Under General Notes, **DELETE** Note No. 3 in its entirety.

33. To Drawing No. 39636-15-D and 39636-16-D, Sheet No. 15 and Sheet No. 16, Civil Mass Grading and Clearing Plan, Storm Drain 1 and 2: Under General Notes, **DELETE** Note No. 3 in its entirety.

James Nagelvoort, Director
Public Works Department

Dated: *November 21, 2018*
San Diego, California

JN/JB/Lad

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

General Decision Number: CA180001 11/02/2018 CA1

Superseded General Decision Number: CA20170001

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 $10.35 for calendar year 2018 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.35 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2018. The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

| Modification Number | Publication Date |
|---|---|
| 0 | 01/05/2018 |
| 1 | 01/12/2018 |
| 2 | 01/19/2018 |
| 3 | 02/09/2018 |
| 4 | 03/02/2018 |
| 5 | 05/04/2018 |
| 6 | 06/29/2018 |
| 7 | 07/06/2018 |
| 8 | 07/13/2018 |
| 9 | 07/20/2018 |
| 10 | 08/17/2018 |
| 11 | 08/24/2018 |
| 12 | 08/31/2018 |

| | |
|---|---|
| 13 | 09/07/2018 |
| 14 | 09/28/2018 |
| 15 | 10/05/2018 |
| 16 | 11/02/2018 |

ASBE0005-002 07/01/2018

| | Rates | Fringes |
|---|---|---|
| Asbestos Workers/Insulator (Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems) | $ 39.72 | 20.81 |
| Fire Stop Technician (Application of Firestopping Materials for wall openings and penetrations in walls, floors, ceilings and curtain walls) | $ 27.92 | 18.31 |

ASBE0005-004 07/02/2018

| | 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) | $ 19.93 | 11.72 |

BOIL0092-003 03/01/2018

| | Rates | Fringes |
|---|---|---|
| BOILERMAKER | $ 44.07 | 33.52 |

BRCA0004-008 11/01/2017

| | Rates | Fringes |
|---|---|---|
| BRICKLAYER; MARBLE SETTER | $ 37.46 | 16.69 |

BRCA0018-004 07/01/2017

| | Rates | Fringes |
|---|---|---|
| MARBLE FINISHER | $ 30.93 | 12.95 |
| TILE FINISHER | $ 25.98 | 11.23 |
| TILE LAYER | $ 37.76 | 16.37 |

BRCA0018-010 09/01/2017

| | Rates | Fringes |
|---|---|---|
| TERRAZZO FINISHER | $ 29.75 | 12.91 |
| TERRAZZO WORKER/SETTER | $ 36.75 | 13.82 |

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CARP0409-002 07/01/2016

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

Amounts in "Rates' column are per day

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CARP0409-008 08/01/2010

| | Rates | Fringes |
|---|---|---|
| Modular Furniture Installer | $ 17.00 | 7.41 |

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CARP0547-001 07/01/2016

| | Rates | Fringes |
|---|---|---|
| CARPENTER | | |
| (1) Bridge | $ 40.33 | 17.03 |
| (2) Commercial Building | $ 35.10 | 17.03 |
| (3) Heavy & Highway | $ 40.20 | 17.03 |
| (4) Residential Carpenter | $ 28.08 | 17.03 |
| (5) Residential Insulation Installer | $ 18.00 | 8.16 |
| MILLWRIGHT | $ 46.70 | 17.03 |
| PILEDRIVERMAN | $ 40.33 | 17.03 |

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CARP0547-002 07/01/2017

| | Rates | Fringes |
|---|---|---|
| Drywall | | |
| (1) Work on wood framed construction of single family residences, apartments or condominiums under four stories | | |
| Drywall Installer/Lather | $ 22.95 | 18.85 |
| Drywall Stocker/Scrapper | $ 12.50 | 12.27 |
| (2) All other work | | |
| Drywall Installer/Lather | $ 32.00 | 17.63 |
| Drywall Stocker/Scrapper | $ 12.50 | 12.27 |

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ELEC0569-001 06/04/2018

| | Rates | Fringes |
|---|---|---|
| Electricians (Tunnel Work) | | |
| Cable Splicer | $ 50.81 | 3%+13.63 |
| Electrician | $ 50.06 | 3%+13.63 |
| Electricians: (All Other Work, Including 4 Stories Residential) | | |
| Cable Splicer | $ 45.25 | 3%+13.63 |
| Electrician | $ 44.50 | 3%+13.63 |

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ELEC0569-004 06/04/2018

| | Rates | Fringes |
|---|---|---|
| ELECTRICIAN (Sound & Communications Sound Technician) | $ 31.75 | 3%+11.78 |

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

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ELEC0569-005 06/04/2018

| | Rates | Fringes |
|---|---|---|
| Sound & Communications | | |
| Sound Technician | $ 31.75 | 3%+11.78 |

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

All of the above shall include the installation and transmission over fiber optics.

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

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* ELEC0569-006 10/01/2018

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

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

STREET LIGHT & TRAFFIC SIGNAL WORK:

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

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

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ELEC0569-008 06/04/2018

| | Rates | Fringes |
|---|---|---|
| ELECTRICIAN (Residential, 1-3 Stories) | $ 33.38 | 3%+6.61 |

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ELEC1245-001 06/01/2018

| | Rates | Fringes |
|---|---|---|
| LINE CONSTRUCTION | | |
| (1) Lineman; Cable splicer | $ 56.79 | 17.91 |
| (2) Equipment specialist (operates crawler tractors, commercial motor vehicles, backhoes, trenchers, cranes (50 tons and below), overhead & | | |

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     underground distribution
     line   equipment).....$ 45.36           16.74
     (3) Groundman.....$ 34.68           16.36
     (4) Powderman.....$ 49.55         3%+17.65

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

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 ELEV0018-001 01/01/2018

                                  Rates          Fringes

ELEVATOR MECHANIC.....$ 53.85           32.645

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.

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 ENGI0012-003 07/01/2018

                                  Rates          Fringes

OPERATOR:  Power Equipment
(All Other Work)
     GROUP  1.....$ 45.30           25.25
     GROUP  2.....$ 46.08           25.25
     GROUP  3.....$ 46.37           25.25
     GROUP  4.....$ 47.86           25.25
     GROUP  5.....$ 48.96           25.25
     GROUP  6.....$ 48.08           25.25
     GROUP  8.....$ 48.19           25.25
     GROUP  9.....$ 49.29           25.25
     GROUP 10.....$ 48.31           25.25
     GROUP 11.....$ 49.41           25.25
     GROUP 12.....$ 48.48           25.25
     GROUP 13.....$ 48.58           25.25
     GROUP 14.....$ 48.61           25.25
     GROUP 15.....$ 48.69           25.25
     GROUP 16.....$ 48.81           25.25
     GROUP 17.....$ 48.98           25.25
     GROUP 18.....$ 49.08           25.25
     GROUP 19.....$ 49.19           25.25
     GROUP 20.....$ 49.31           25.25
     GROUP 21.....$ 49.48           25.25
     GROUP 22.....$ 49.58           25.25
     GROUP 23.....$ 49.69           25.25
     GROUP 24.....$ 49.81           25.25
     GROUP 25.....$ 49.98           25.25
OPERATOR:  Power Equipment
(Cranes, Piledriving &
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Hoisting)

| | | |
|---|---|---|
| GROUP 1 | $ 46.65 | 25.25 |
| GROUP 2 | $ 47.43 | 25.25 |
| GROUP 3 | $ 47.72 | 25.25 |
| GROUP 4 | $ 47.86 | 25.25 |
| GROUP 5 | $ 48.08 | 25.25 |
| GROUP 6 | $ 48.19 | 25.25 |
| GROUP 7 | $ 48.31 | 25.25 |
| GROUP 8 | $ 48.48 | 25.25 |
| GROUP 9 | $ 48.65 | 25.25 |
| GROUP 10 | $ 49.65 | 25.25 |
| GROUP 11 | $ 50.65 | 25.25 |
| GROUP 12 | $ 51.65 | 25.25 |
| GROUP 13 | $ 52.65 | 25.25 |

OPERATOR: Power Equipment
(Tunnel Work)

| | | |
|---|---|---|
| GROUP 1 | $ 47.15 | 25.25 |
| GROUP 2 | $ 47.93 | 25.25 |
| GROUP 3 | $ 48.22 | 25.25 |
| GROUP 4 | $ 48.39 | 25.25 |
| GROUP 5 | $ 48.58 | 25.25 |
| GROUP 6 | $ 48.69 | 25.25 |
| GROUP 7 | $ 48.81 | 25.25 |

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

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

SEE ZONE DEFINITIONS AFTER CLASSIFICATIONS

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

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

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

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

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

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

GROUP 6: Articulating material hauler; Asphalt plant engineer; Batch plant operator; Bit sharpener; Concrete joint machine operator (canal and similar type); Concrete planer operator; Dandy digger; Deck engine operator; Derrickman (oilfield type); Drilling machine operator, bucket or auger types (Calweld 100 bucket or similar types - Watson 1000 auger or similar types - Texoma 330, 500 or 600 auger or similar types - drilling depth of 45' maximum); Drilling machine operator; Hydrographic seeder machine operator (straw, pulp or seed), Jackson track maintainer, or similar type; Kalamazoo Switch tamper, or similar type; Machine tool operator; Maginnis internal full slab vibrator, Mechanical berm, curb or gutter(concrete or asphalt); Mechanical finisher operator (concrete, Clary-Johnson-Bidwell or similar); Micro tunnel system (below ground); Pavement breaker operator (truck mounted); Road oil mixing machine operator; Roller operator (asphalt or finish), rubber-tired earth moving equipment (single engine, up to and including 25 yds. struck); Self-propelled tar pipelining machine operator; Skiploader operator (crawler and wheel type, over 3/4 yd. and up to and including 1-1/2 yds.); Slip form pump operator (power driven hydraulic lifting device for concrete forms); Tractor operator-bulldozer, tamper-scraper (single engine, up to 100 h.p. flywheel and similar types, up to and including D-5 and similar types); Tugger hoist operator (1 drum); Ultra high pressure waterjet cutting tool system operator; Vacuum blasting machine operator

GROUP 8: Asphalt or concrete spreading operator (tamping or finishing); Asphalt paving machine operator (Barber Greene or similar type); Asphalt-rubber distribution operator;

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

GROUP 9: Heavy Duty Repairman

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

and similar over 25 yds. and up to 50 yds. struck), Tower crane repairman; Tractor loader operator (crawler and wheel type over 6-1/2 yds.); Woods mixer operator (and similar Pugmill equipment)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

CRANES, PILEDRIVING AND HOISTING EQUIPMENT CLASSIFICATIONS

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

GROUP 2: Truck crane oiler

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

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

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

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

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

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

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

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

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

GROUP 12: Crane operator (over 200 tons up to and including 300 tons mrc); Derrick barge operator (over 200 tons up to and including 300 tons mrc); Hoist operator, stiff legs,

Guy derrick or similar type (over 200 tons, up to and including 300 tons mrc); Mobile tower crane operator (over 200 tons, up to and including 300 tons mrc)

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

TUNNEL CLASSIFICATIONS

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

GROUP 2: Power-driven jumbo form setter operator

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

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

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

GROUP 6: Heavy Duty Repairman

GROUP 7:  Tunnel mole boring machine operator

ENGINEERS ZONES

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

That area within the following Boundary:  Begin in San Bernardino County, approximately 3 miles NE of the intersection of I-15 and the California State line at that point which is the NW corner of Section 1, T17N,m R14E, San Bernardino Meridian.  Continue W in a straight line to that point which is the SW corner of the northwest quarter of Section 6, T27S, R42E, Mt. Diablo Meridian.  Continue North to the intersection with the Inyo County Boundary at that point which is the NE corner of the western half of the northern quarter of Section 6, T25S, R42E, MDM.  Continue W along the Inyo and San Bernardino County boundary until the intersection with Kern

County, as that point which is the SE corner of Section 34, T24S, R40E, MDM. Continue W along the Inyo and Kern County boundary until the intersection with Tulare County, at that point which is the SW corner of the SE quarter of Section 32, T24S, R37E, MDM. Continue W along the Kern and Tulare County boundary, until that point which is the NW corner of T25S, R32E, MDM. Continue S following R32E lines to the NW corner of T31S, R32E, MDM. Continue W to the NW corner of T31S, R31E, MDM. Continue S to the SW corner of T32S, R31E, MDM. Continue W to SW corner of SE quarter of Section 34, T32S, R30E, MDM. Continue S to SW corner of T11N, R17W, SBM. Continue E along south boundary of T11N, SBM to SW corner of T11N, R7W, SBM. Continue S to SW corner of T9N, R7W, SBM. Continue E along south boundary of T9N, SBM to SW corner of T9N, R1E, SBM. Continue S along west boundary of R1E, SMB to Riverside County line at the SW corner of T1S, R1E, SBM. Continue E along south boundary of T1s, SBM (Riverside County Line) to SW corner of T1S, R10E, SBM. Continue S along west boundary of R10E, SBM to Imperial County line at the SW corner of T8S, R10E, SBM. Continue W along Imperial and Riverside county line to NW corner of T9S, R9E, SBM. Continue S along the boundary between Imperial and San Diego Counties, along the west edge of R9E, SBM to the south boundary of Imperial County/California state line. Follow the California state line west to Arizona state line, then north to Nevada state line, then continuing NW back to start at the point which is the NW corner of Section 1, T17N, R14E, SBM

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

That area within the following Boundary: Begin approximately 5 miles north of the community of Cholame, on the Monterey County and San Luis Obispo County boundary at the NW corner of T25S, R16E, Mt. Diablo Meridian. Continue south along the west side of R16E to the SW corner of T30S, R16E, MDM. Continue E to SW corner of T30S, R17E, MDM. Continue S to SW corner of T31S, R17E, MDM. Continue E to SW corner of T31S, R18E, MDM. Continue S along West side of R18E, MDM as it crosses into San Bernardino Meridian numbering area and becomes R30W. Follow the west side of R30W, SBM to the SW corner of T9N, R30W, SBM. Continue E along the south edge of T9N, SBM to the Santa Barbara County and Ventura County boundary at that point whch is the SW corner of Section 34.T9N, R24W, SBM, continue S along the Ventura County line to that point which is the SW corner of the SE quarter of Section 32, T7N, R24W, SBM. Continue E along the south edge of T7N, SBM to the SE corner to T7N, R21W, SBM. Continue N along East side of R21W, SBM to Ventura County and Kern County boundary at the NE corner of T8N, R21W. Continue W along the Ventura County and Kern County boundary to the SE corner of T9N, R21W. Continue North along the East edge of R21W, SBM to the NE corner of T12N, R21W, SBM. Continue West along the north edge of T12N, SBM to the SE corner of T32S, R21E, MDM. [T12N SBM is a think strip between T11N SBM and T32S MDM]. Continue North along the East side of R21E, MDM to the Kings County and Kern County border at the NE corner of T25S, R21E, MDM, continue West along the Kings County and Kern

County Boundary until the intersection of San Luis Obispo County. Continue west along the Kings County and San Luis Obispo County boundary until the intersection with Monterey County. Continue West along the Monterey County and San Luis Obispo County boundary to the beginning point at the NW corner of T25S, R16E, MDM.

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

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

REMAINING AREA NOT DEFINED ABOVE RECIEVES BASE RATE

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ENGI0012-004 08/01/2015

| | 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 |

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IRON0377-002 07/01/2018

| | Rates | Fringes |
|---|---|---|

Ironworkers:
     Fence Erector.....$ 31.58 22.41
     Ornamental, Reinforcing
     and Structural.....$ 38.00 31.05

PREMIUM PAY:

$6.00 additional per hour at the following locations:

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

$4.00 additional per hour at the following locations:

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

$2.00 additional per hour at the following locations:

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

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LABO0089-001 07/01/2018

| | Rates | Fringes |
|---|---|---|
| LABORER (BUILDING and all other Residential Construction) | | |
| Group 1 | $ 31.31 | 19.29 |
| Group 2 | $ 31.99 | 19.29 |
| Group 3 | $ 32.70 | 19.29 |
| Group 4 | $ 33.50 | 19.29 |
| Group 5 | $ 35.43 | 19.29 |
| 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 condominums - excluding (a) projects that exceed three stories over a garage level, (b) any utility work such as telephone, gas, water, sewer and other utilities and (c) any fine grading work, utility work or paving work in the future street and public right-of-way; but including all rough grading work at the job site behind the existing right of way

LABORER CLASSIFICATIONS

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

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

GROUP 3: Buggymobile; Concrete cutting torch; Concrete cutting torch; Concrete pile cutter; Driller, jackhammer, 2 1/2 feet drill steel or longer; Dri Pak-it machine; High sealer (including drilling of same); Hydro seeder and similar type; Impact wrench, mult-plate; Kettlemen, potmen and mean applying asphalt, lay-kold, creosote, line caustic and similar type materials (applying means applying, dipping, brushing or handling of such materials for pipe wrapping and waterproofing); Operators of pneumatic, gas, electric tools, vibratring machines, pavement breakers, air blasting, come-along, and similar mechanical tools not separately classified herein; Pipelayers back up man coating, grouting, making of joints, sealing, caulking, diapering and inclduing rubber gasket joints, pointing and any and all other services; Rotary Scarifier or multiple head concrete chipping scaarifier; Steel header board man and guideline setter; Tampers, Barko, Wacker and similar type; Trenching machine, handpropelled

GROUP 4: Asphalt raker, luterman, ironer, apshalt dumpman and asphalt spreader boxes (all types); Concrete core cutter (walls, floors or ceilings), Grinder or sander; Concrete saw man; cutting walls or flat work, scoring old or new concrete; Cribber, shorer, lagging, sheeting and trench

bracing, hand-guided lagging hammer; Laser beam in connection with laborer's work; Oversize concrete vibrator operator 70 pounds and over; Pipelayer performing all services in the laying, installation and all forms of connection of pipe from the point of receiving pipe in the ditch until completion of oepration, including any and all forms of tubular material, whether pipe, metallic or non-metallic, conduit, and any other stationary type of tubular device used for the conveying of any substance or element, whether water, sewage, solid, gas, air or other product whatsoever and without regard to the nature of material from which the tubular material is fabricated; No joint pipe and stripping of same; Prefabricated manhole installer; Sandblaster (nozzleman), Porta shot-blast, water blasting

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

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LABO0089-002 11/01/2017

| | Rates | Fringes |
|---|---|---|
| LABORER (MASON TENDER) | $ 30.00 | 16.47 |

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LABO0089-004 07/01/2017

HEAVY AND HIGHWAY CONSTRUCTION

| | Rates | Fringes |
|---|---|---|
| Laborers: | | |
| Group 1 | $ 31.63 | 18.58 |
| Group 2 | $ 32.09 | 18.58 |
| Group 3 | $ 32.50 | 18.58 |
| Group 4 | $ 33.34 | 18.58 |
| Group 5 | $ 37.46 | 18.58 |

LABORER CLASSIFICATIONS

GROUP 1: Laborer: General or Construction Laborer, Landscape Laborer. Asphalt Rubber Material Loader. Boring Machine Tender (outside), Carpenter Laborer (cleaning, handling, oiling & blowing of panel forms and lumber), Concrete Laborer, Concrete Screeding for rough strike-off, Concrete water curing. Concrete Curb & Gutter laborer, Certified Confined Space Laborer, Demolition laborer & Cleaning of Brick and lumber,Expansion Joint Caulking; Environmental Remediation, Monitoring Well, Toxic waste and Geotechnical Drill tender, Fine Grader, Fire Watcher, Limbers, Brush Loader, Pilers and Debris Handlers. flagman. Gas Oil and

Water Pipeline Laborer. Material Hoseman (slabs, walls, floors, decks); Plugging, filling of shee bolt holes; Dry packing of concrete and patching; Post Holer Digger (manual); Railroad maintenance, repair trackman, road beds; Rigging & signaling; Scaler, Slip-Form Raisers, Filling cracks on any surface, tool Crib or Tool House Laborer, Traffic control (signs, barriers, barricades, delineator, cones etc.), Window Cleaner

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

GROUP 3: Asphalt, installation of all frabrics; Buggy Mobile Man, Bushing hammer;  Compactor (all types), Concrete Curer - Impervious membrane, Form Oiler, Concrete Cutting Torch, Concrete Pile Cutter,Driller/Jackhammer with drill steel 2 1/2 ft or longer, Dry Pak-it machine, Fence erector including manual post hole digging,  Gas oil or water Pipeline Wrapper - 6 ft pipe and over, Guradrail erector, Hydro seeder, Impact Wrench man (multi plate), kettleman-Potman Hot Mop includes applying Asphalt, Lay-Kold, Creosote, lime caustic and similar types of materials (dipping, brushing or handling) and waterproofing.  Laser Beam in connection with Laborer work. High Scaler, Operators of Pneumatic Gas or Electric Tools, Vibrating Machines, Pavement Breakers, Air Blasting, Come-Alongs and similar mechanical tools, Remote-Controlled Robotic Tools in connection with Laborers work.  Pipelayer Backup Man (Coating, grouting,m makeing of joints, sealing, caulking, diapering including rubber gasket joints, pointing and other services).  Power Post Hole Digger, Rotary Scarifier (multiple head concrete chipper scarifier), Rock Slinger, Shot Blast equipment (8 to 48 inches), Steel Headerboard Man and Guideline Setter, Tamper/Wacker operator and similar types, Trenching Machine hand propelled.

GROUP 4:  Any worker exposed to raw sewage.  Asphalt Raker,

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

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

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LABO0300-005 01/01/2018

| | Rates | Fringes |
|---|---|---|
| Asbestos Removal Laborer | $ 33.19 | 17.78 |

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

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LABO0345-001 07/01/2018

| | Rates | Fringes |
|---|---|---|
| LABORER (GUNITE) | | |
| GROUP 1 | $ 42.18 | 18.27 |
| GROUP 2 | $ 41.23 | 18.27 |
| GROUP 3 | $ 37.69 | 18.27 |

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

work performed above the 75'-0" level shall be compensated for at 35 cents per hour above the applicable classification wage rate.

GUNITE LABORER CLASSIFICATIONS

GROUP 1: Rodmen, Nozzlemen

GROUP 2: Gunmen

GROUP 3: Reboundmen

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LABO1184-001 07/01/2018

| | Rates | Fringes |
|---|---|---|
| Laborers: (HORIZONTAL DIRECTIONAL DRILLING) | | |
| (1) Drilling Crew Laborer | $ 35.70 | 14.03 |
| (2) Vehicle Operator/Hauler | $ 35.87 | 14.03 |
| (3) Horizontal Directional Drill Operator | $ 37.72 | 14.03 |
| (4) Electronic Tracking Locator | $ 39.72 | 14.03 |
| Laborers: (STRIPING/SLURRY SEAL) | | |
| GROUP 1 | $ 35.86 | 16.21 |
| GROUP 2 | $ 37.16 | 16.21 |
| GROUP 3 | $ 39.17 | 16.21 |
| GROUP 4 | $ 40.91 | 16.21 |

LABORERS - STRIPING CLASSIFICATIONS

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

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

GROUP 3: Traffic delineating device applicator: Layout and application of pavement markers, delineating signs, rumble and traffic bars, adhesives, guide markers, other traffic delineating devices including traffic control. This category includes all traffic related surface preparation (sandblasting, waterblasting, grinding) as part of the application process. Traffic protective delineating system installer: removes, relocates, installs, permanently affixed roadside and parking delineation barricades,

fencing, cable anchor, guard rail, reference signs, monument markers; operation of all related machinery and equipment; power broom sweeper

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

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LABO1414-003 08/08/2018

| | Rates | Fringes |
|---|---|---|
| LABORER | | |
| PLASTER CLEAN-UP LABORER | $ 33.82 | 19.40 |
| PLASTER TENDER | $ 36.37 | 19.40 |

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.

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PAIN0036-001 07/01/2018

| | Rates | Fringes |
|---|---|---|
| Painters: (Including Lead Abatement) | | |
| (1) Repaint (excludes San Diego County) | $ 27.59 | 14.92 |
| (2) All Other Work | $ 31.12 | 15.04 |

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

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* PAIN0036-010 10/01/2018

| | Rates | Fringes |
|---|---|---|
| DRYWALL FINISHER/TAPER | | |
| (1) Building & Heavy Construction | $ 33.39 | 16.80 |
| (2) Residential Construction (Wood frame apartments, single family homes and multi-duplexes | | |

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     up to and  including four
     stories).....................$ 24.02            17.01
----------------------------------------------------------------
* PAIN0036-012 10/01/2018

                                   Rates          Fringes

GLAZIER..........................$ 43.55            19.72
----------------------------------------------------------------
 PAIN0036-019 01/01/2018

                                   Rates          Fringes

SOFT FLOOR LAYER.................$ 30.02            13.68
----------------------------------------------------------------
 PLAS0200-005 08/01/2018

                                   Rates          Fringes

PLASTERER........................$ 36.86            18.00

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

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 PLAS0500-001 07/01/2018

                                   Rates          Fringes

CEMENT MASON/CONCRETE FINISHER
     GROUP 1.....................$ 26.34            21.12
     GROUP 2.....................$ 27.99            21.12
     GROUP 3.....................$ 30.07            21.12

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

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

  GROUP 2: Work classified as type I and II construction

  GROUP 3: All other work

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 PLUM0016-006 09/01/2018

                                   Rates          Fringes

PLUMBER, PIPEFITTER,
STEAMFITTER
     Camp Pendleton..............$ 54.63            22.16
     Plumber and Pipefitter
      All other work except
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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.....$ 50.13 22.16

Work ONLY on new additions and remodeling of commercial buildings, bars, restaurants, and stores not to exceed 5,000 sq. ft. of floor space.....$ 48.58 21.18

Work ONLY on strip malls, light commercial, tenant improvement and remodel work.....$ 37.10 19.51

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PLUM0016-011 09/01/2018

| | Rates | Fringes |
|---|---|---|
| PLUMBER/PIPEFITTER | | |
| Residential | $ 40.23 | 18.08 |

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PLUM0078-001 07/01/2016

| | Rates | Fringes |
|---|---|---|
| PLUMBER | | |
| Landscape/Irrigation Fitter | $ 44.16 | 25.19 |
| Sewer & Storm Drain Work | $ 44.16 | 25.19 |

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ROOF0045-001 07/01/2018

| | Rates | Fringes |
|---|---|---|
| ROOFER | $ 31.00 | 8.62 |

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SFCA0669-001 04/01/2018

| | Rates | Fringes |
|---|---|---|
| SPRINKLER FITTER | $ 40.57 | 21.18 |

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SHEE0206-001 07/01/2017

| | Rates | Fringes |
|---|---|---|
| SHEET METAL WORKER | | |
| Camp Pendleton | $ 38.88 | 26.52 |
| Except Camp Pendleton | $ 36.88 | 26.52 |
| Sheet Metal Technician | $ 27.70 | 8.43 |

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

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TEAM0166-001 07/03/2017

| | Rates | Fringes |
|---|---|---|
| Truck drivers: | | |
| GROUP 1 | $ 15.90 | 34.69 |
| GROUP 2 | $ 23.49 | 34.69 |
| GROUP 3 | $ 23.69 | 34.69 |
| GROUP 4 | $ 23.89 | 34.69 |
| GROUP 5 | $ 24.09 | 34.69 |
| GROUP 6 | $ 24.59 | 34.69 |
| GROUP 7 | $ 26.09 | 34.69 |

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

TRUCK DRIVER CLASSIFICATIONS

GROUP 1: Fuel Man, Swamper

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

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

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

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

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

GROUP 7: Repairman

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

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

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

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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.

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WAGE DETERMINATION APPEALS PROCESS

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

be:

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

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

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

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

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

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

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

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

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

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

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END OF GENERAL DECISION

# City of San Diego

**CITY CONTACT:** Juan E. Espindola, **Contract Specialist, Email**: JEEspindola@sandiego.gov
**Phone No.** (619) 533-4491

# ADDENDUM B

e - Bidding

## FOR

## NORTH CITY WATER RECLAMATION PLANT EXPANSION - EARLY SITE WORK AND OZONE/BAC RELOCATION

| | |
|---|---|
| BID NO.: | **K-19-1724-DBB-3** |
| SAP NO. (WBS/IO/CC): | **B-15142, B-15139** |
| CLIENT DEPARTMENT: | **2000** |
| COUNCIL DISTRICT: | **1** |
| PROJECT TYPE: | **BI** |

**BID DUE DATE:**

**2:00 PM**

**DECEMBER 12, 2018**

**CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS**

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

# ENGINEER OF WORK

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

**NCWRP EXPANSION AND NCPWF INFLUENT PUMP STATION AND PIPELINE - PACKAGE 4 NCWRP EARLY SITEWORK AND OZONE/BAC RELOCATION**

**Julian Hoyle**

1) Registered Engineer


DIGITALLY SIGNED: 12/3/2018

**Amer Barhoumi**

2) For City Engineer

## 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. Package 1 "Mass Grading and Clearing" drawings look to be a scanned document. Please provide a clean PDF without the background distortion the document currently has.

A1. A newly scanned pdf copy of the Package 1 Mass Grading and Clearing Plans has been uploaded on PlanetBids.

Q2. Will the site be available for a second site visit?

A2. Due to no additional request from other potential bidders, a second site visit will not be available.

Q3. With the relocation of the demonstration plant to the new location. Please provide the maximum loading constraints for the existing concrete basin deck.

A3. Based on an evaluation that was completed, the chlorine contact tanks have been determined to be structurally adequate to support the relocation of the ozone system. However, it should be noted that heavy vehicles and equipment (such as cranes) are prohibited from being parked on top of the chlorine contact tanks.

Q4. There was a discussion at the pre-bid meeting that the existing high-pressure gas line that is shown in Package 1, drawing PK1-CG-103 and PK1-CG-105 will need to be relocated. Please provide details on the relocation requirements.

A4. The high pressure gas line shown in Package 1 does not need to be relocated for the early site work due to its existing depth. However, it is the contractor's responsibility to verify and coordinate with San Diego Gas & Electric protect it in place as required in accordance to general note 1 as referenced in Sheet No. 10 and Sheet No. 12, Drawing No.

39636-10-D and 39636-12-D. In addition, the contractors shall refer to SG&E's Guide for Encroachment of Transmission on Rights of Way to ensure protection of SDG&E utilities as required when working at the North City Pure Water Facility site: Attachment provided in the following link: https://filecloud.sandiego.gov/url/5nhp8mapttytt4uh

Q5. There was a discussion at the pre-bid that there is a bird nesting season to be aware of for Package 1. Who is responsible to pay for the monitoring during this time? Is this construction restraint in line with the milestone requirements?

A5. Biological Resources monitoring will be performed by the City/Construction Manager, and any impacts will need to be mitigated if nesting birds are found. Also refer to Drawing No. 39636-3-D.

Q6. Volume 4, drawing PK4-CG-110, note 8 indicates that the contractor is to provide infrastructure required for vehicle charging for temporary parking spaces. How many spaces are required? The spaces indicated drawing is currently the entry to the operations building. Please provide the details for reconfiguring the curb and gutter, driveway, striping associated with these temporary parking spaces. Currently the extent of reconfiguring access to this area for vehicular traffic does show any demolition or new construction for vehicle access or pedestrian safety.

A6. Please use the following link to obtain the updated drawing

https://filecloud.sandiego.gov/url/5nhp8mapttytt4uh

Q7. The following conduit numbers appear on the electrical drawings 29-E-001 through 29-E-007, but do not appear on the electrical conduit schedule G-705 through G-708:

- C-29-550
- C-29-670
- S-29-250
- S-29-340
- S-29-392
- S-29-680

A7. Please use the link below to access the updated drawings:

https://filecloud.sandiego.gov/url/5nhp8mapttytt4uh

Q8. Also, the following conduit numbers appear in the electrical conduit schedule G-705 through G-708, but do not appear in the drawings 29-E-001 through 29-E-007:

- S-29-820
- S-29-920
- S-29-930
- S-29-940
- S-29-950

A8. Please use the link below to access the updated drawings:

https://filecloud.sandiego.gov/url/5nhp8mapttytt4uh

Q9. Lastly, the following conduit numbers are used twice on the same page:

- L-29-360 on drawing page 29-E-004
- N-29-360 on drawing page 29-E-004
- N-29-400 on drawing page 29-E-004
- P-29-400 on drawing page 29-E-004
- S-29-340 on drawing page 29-E-007

A9. Please use the link below to access the updated drawings:

https://filecloud.sandiego.gov/url/5nhp8mapttytt4uh

Q10. Package 4, drawings PK4-CG-102 and PK4-CG-106 show the existing 60" SDR line running from bottom to top of the pages. PK-CG-106 references detail 6/CG-501. Detail 6/CG-501 shows a zone of influence 30 degrees from edge of pipe to the surface level above. Is the "approximate 60" SDR Influence area" identified on PK4-CG-106 reflective of the new contour lines or the existing surface levels? If this reflects the new surface contour levels what is the depth of the 60" SDR line so the contractor can extract what that "influence area" is at the existing contour levels.

A10. The approximate 60" SDR influence area identified on PK4-CG-106 is reflective of the new contour lines and the finish grade per the plans for this construction package. Please refer to section D on drawing PK4-CG-502 for additional detail.

Q11. Package 4, drawings PK4-CG-102 and PK4-CG-106 show the existing 60" SDR line running from bottom to top of the pages. PK-CG-106 references section D/CG-502. Section D/CG-502 references "Pile Cap, See S-101". S-101 shows approximately 20 feet of pile cap. There is a note "Future slab by others". Is it in this contract for the contractor to install only the extents of the pile cap shown only on S-101?

A11. Yes, the contractor for this construction package is responsible for the installation of the pile cap in the extents shown on drawing PK4-S-101.

Q12. Who is paying for soils compaction testing and concrete testing?

A12. The Contractor is required to perform soil compaction testing and concrete testing as defined in the Contract Documents to meet the quality control aspects of the project. The cost of these tests shall be borne by the Contractor. The Owner will hire a third party to perform the testing required under the project special inspection requirements, which is separate from the testing required to be performed by the Contractor in accordance with the Contract Documents.

Q13. Will there be a need on the subject project for earth-retention shoring?

A13. Contractor shall determine whether shoring will be required as a construction means and method based on the requirements and information provided in the contract documents and reference documents.

Q14. Where are details 0315-131, 0315-231, 0315-239, 0330-040 and 0552-001 shown as called out on drawing PK4-SS-101 in the drawing notes?

A14. The details are located on drawings PK4-SD-000 thru PK4-SD-019.

Q15. On Sheet PK4-CG-106, there is a call out in the middle of the page, "SDR Cover Structure: See S-101". However, there is no details provided on PK4-S-101. Please provide clarification.

A15. The installation referenced as "SDR Cover Structure" on PK4-CG-106 is the installation and pipe cap detail shown on PK4-S-101.

Q16. What are we protecting with the SDS-116 note on PK4-CG-102 at bottom center of page. It just looks like an 18' concrete cap. Is this area exposed? Please clarify.

A16. SDS-116 provides additional protection for the existing 18" SDR pipe due to its proximity to the new retaining wall.

Q17. Can you define what is the locations for temporary fencing? (A map/drawing would be good) The yard piping and earthwork covers a lot of area and could run into a great deal of speculation/assumptions. (cost that would not be covered at bid time).

A17. Temporary fencing is required to secure the construction site from unauthorized entry and to protect the public and plant personnel from construction activities. This is a contractor means and method on where fencing is deemed appropriate. In reference to the NCPWF, see Addendum 'A', item 24.

Q18. Is retaining wall #3 to be included with the other retaining walls or is it in the alternate I bid item?

A18. Retaining Wall #3 is part of the bid alternate item associated with the relocation of the existing power generation. However, if BMP#5 is built, parts of that wall (or a temporary wall) may need to be constructed so as not to undermine BMP #5.

Q19. What is the retaining wall along the temporary access road on drawings PK4 CG 110 and 111 made of? Is it the same height for the entire length? What is the size of the footing? Cut shown on A / CG-502.

A19. The existing (permanent) retaining wall near the temporary access road is concrete. The height of the existing (permanent) wall varies. See the NCWRP Record Drawings provided as a reference document, drawings N01-CW-307 and N01-CW-308. The retaining wall parallel to the temporary access road required to be installed by the Contractor referenced as "CONCRETE REINFORCED TYPE 1" is a concrete reinforced type 1 wall per SDRSD C-11. See revised drawing PK4-CG-111 included as part of this Addendum.

Q20. Are all the new retaining walls concrete? Please confirm no masonry is required?

A20. The new retaining walls are concrete.

Q21. Please confirm we are only doing the SDR cover shown on PK4 CG 106 and PK4 S 101 at the retaining wall and the six concrete piers. There is a note on PK4 S 101 that says future slab by others.

A21. Yes, the contractor for this construction package is responsible only for the installation in the extents shown on the drawings.

Q22. Are the retaining walls getting any kind of waterproofing applied to them on either side?

A22. Waterproofing is not required.

Q23. Is the note on PK4 S 101 in detail A pointing at the railings and referring to SS-001 and SS-002, please provide these drawing as they are not shown on the drawing index page PK4 G 007.

A23. The note in Detail A on PK4-S-101 "Retaining Wall See DWGS SS-001 & SS-002" should refer to drawings PK4-SS-101 and PK4-SS-102. This drawing will be revised by addenda.

Q24. Can we get one overall site plan for the project? It's difficult to grasp the entire scope of work with three differ bid packages.

A24. Please use the link below to access the overall site plan for the project:

https://filecloud.sandiego.gov/url/5nhp8mapttytt4uh

Q25. Can all the details be put in one area? It seems that some cannot be found or please supply the information where all the details came from. San Diego Standard details and where ever else.

A25. All the details are located within the drawing sets.

Q26. When will there be a geotechnical report for all locations of excavations for trenching and earthwork?

A26. The geotechnical reports for the North City Water Reclamation Plant and the Pure Water Facility site are referenced in section 2-7 Subsurface Data. The reports are available by visiting the following link:

https://filecloud.sandiego.gov/url/b3miekz7ft9ssgyb.

Q27. Civil Yard Piping Plan C-002 Sheet 43 of 88 Key Note 13

a. Install 40" Diameter Steel Pipe Sleeve with linking seal around new 36" EDRP at future Influent basin for use by others.

What is the thickness of the steel 40" casing pipe and what kind of steel and how much is needed?

b. Do you need casing spacers?
c. Can this be split steel 40" casing / sleeve?
d. 36" Pipe is an inside diameter that could make the outside of 36" pipe 38"+ Do you want to change it to 42" steel pipe sleeve/casing for more room?

A27a. See revised drawing C-002 included in Addendum A. Steel sleeve shall be stainless steel type 304L with a minimum wall thickness of 3/8-inches.

A27b. See revised drawing C-002 included in Addendum A.

A27c. Casing no longer needed. See revised drawing C-002 included in Addendum #A for clarification.

A27d. See revised drawing C-002 included in Addendum A.

Q28. Civil Yard Piping Plan C-002 Sheet 43 of 88 Key Note 13 Mechanical Tie-In Connection 34-M-001 Sheet 87 of 88, Key Note # 1

Detail 4 C-005 & 34-M-002 Sheet 88 of 88, Key Note # 4

Detail 4 C-005

There is still no place that shows the 40" Sleeve only a 36" pipe.

Same questions

a. Install 40” Diameter Steel Pipe Sleeve with linking seal around new 36” EDRP at future Influent basin for use by others.

   What is the thickness of the steel 40” casing pipe and what kind of steel and how much is needed?

b. 36” Pipe is an inside diameter that could make the outside of 36” pipe 38”+ Do you want to change it to 42” steel pipe sleeve/casing for more room?
c. Is the 40” sleeve (needs to be 42” ) only as long as the wall thickness?
d. What is the thickness of the 36” pipe?

A28. The casing was shown on section A on drawing 34-M-002 by key note 4. It is no longer needed. See revised drawing C-002 included in Addendum A

A28a. See revised drawing C-002 included in Addendum A. Steel shall be stainless steel, type 304L, with a minimum thickness of 3/8-inches.

A28b. See revised drawing C-002 included in Addendum A.

A28c. See revised drawing C-002 included in Addendum A.

A28d. Refer to specification section 33 05.01.09.

Q29. Sheet 43 of 88 C-002 Civil Yard Piping Plan Key Note 3 & 5

a. Dealing with the existing manhole is this a coated manhole?
b. If no do we coat this manhole per SDS 106 requires for the new manhole?
c. If yes Per SDS-106 then do we just fix the coating that is been scared?

A29. It has a coating and repair where necessary.

Q30. Sheet 43 of 88 C-002 Civil Yard Piping Plan Key Note 3, 4, 5 & 6

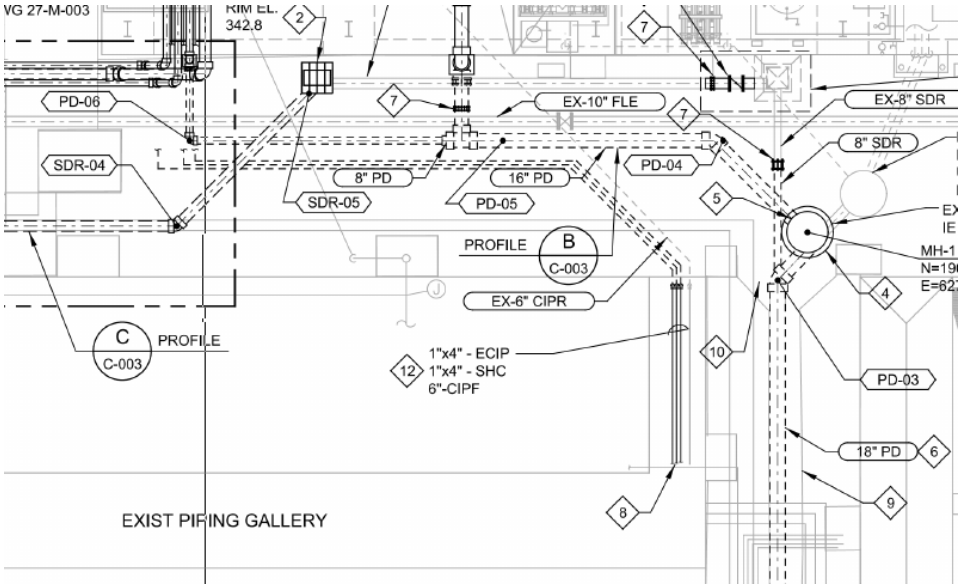
a. What is your plan for the storm water to drain while the remove 12” piping and replace with 18” piping? The water will coming from many locations though out this area that will still be live.

b. Should there be a bypass plan or information for this issue?

c. Can you extend the time for questions as it taking a long time to find all the items for questions?

A30. Refer to the Table in Article 1.07.C.9 of Section 01 31 13 Project Coordination, which clarifies the bypass pump plan for these tie-ins.

Q31. Please clarify the following: Note 12; are the three lines, 4" ECIP, 4" SHC and 6" CIPF existing below grade or are these new lines?




A31. These are relocations of existing lines that are required to be installed by the Contractor.

Q32. Could you please push this project back another week from the 29th of November to Dec, 6th 2018.

A large group of our suppliers are taking off most of next week for Thanksgiving as well a lot of subcontractors that will be quoting this project.

This is a very intricate exposed piping project with many cross references of spec's and plans. As well the exposed piping remove and relocates. (Please consider this request as more time will allow us to give you a better price)

A32. The bid due date has been extended to December 12, 2018.

Q33. Per Dwg 29-S-005 for the Galv Platform, there are call outs to Detail S412 & S414 for the Gratings. It looks like we cannot find these two details on the plans. Could you please provide these details?

A33. The call outs are revised to A412 and A414. The details can be found on sheet G-404. See revised drawing included in this Addendum.

Q34. Please provide details 4005-524 and 4005-525 called out on notes 14 and 15 on drawing 27-M-003.

A34. References have been revised. See revised drawing 27-M-003 included on page 18 of this Addendum.

Q35. I may have missed it but where is the work shown for bid item 16, Bioretention Basins and Appurtenances?

A35. The bioretention basin for this work (BMP 5) is shown under CG-107 and CG-501.

Q36. Reference is made to Drawing PKl-CY-101. Storm Drain Line 2 profile, STA 1+50.02 includes a CB callout using Standard Plan SDD-119 on 24" RCP. Note 6 on Standard Plan SDD-119 limits pipe diameter to 18" and otherwise requires modification to the Standard Plan. Please provide appropriate modification for use on larger diameter pipe.

A36. Please see revised drawing PK1-CY-101 included on page 17 of this Addendum.

Q37. Reference is made to Drawings PKl-CY-100 and 101. Should costs for storm drains 1 and 2 be included under Bit Item 4?

A37. A37. These drawings are part of the NCPWF Early Sitework and should be under Bid Item 17.

Q38. Reference is made to Bid Schedule Item No. 8 description in part is " retaining wall east of proposed secondary clarifiers facility 23 ... ". Refer to drawings PK4-CG-102, 106 and 107 locating retaining walls #1, #2 and #3. Only retaining wall #1 is east of future secondary clarifiers. Does Bid Item No 8 include only cost associated with retaining wall #1? Under which Bid Item should retaining walls #2 and #3 be included?

A38. The retaining wall Bid Items identification will be clarified on page 16 of this Addendum.

Q39. Reference is made to Drawing PK4-CG-107 and 112. Should the cost of construction of the 18" storm drain along the south side of the privatization easement be included in Bid Item 4 or Additive Alternate a-Bid Item No 1?

A39. The storm drain is part of Bid Item No. 4.

Q40. Reference is made to Drawing PK4-CG-110, which includes the call out SDRSD C-11 for a retaining wall along the temporary access road. C-11 details a pile or spread footing supported battered reinforced concrete retaining wall. Drawing PK4-CG-111 includes the call out SDRSD C-1 for the same retaining wall.

C-1 details a masonry retaining wall on a concrete footing. Which is correct? Under which Bid Item is this retaining wall paid?

A40. The retaining wall is to be provided under Bid Item No. 15 as described in Section 01 29 00 Paragraph 23. The retaining wall type is clarified with a revised drawing PK4-CG-111 included on page 16 of this Addendum.

Q41. Reference is made to Specification Section 01 29 00 Payment Procedures, paragraph 23, (BID ITEM NO. 15). The payment description is that of an allowance account. The Bid Schedule indicates a lump sum amount. Please verify that his is payed as a lump sum bid item.

A41. The payment description for Line Item 15 – TEMPORARY ROAD WITH RELOCATED WATER LINE AND STORM DRAIN (BID ITEM NO. 15) LUMP SUM in Section 01 29 00 is shown as a lump sum. The description is revised to remove the allowance terminology in this Addendum (see Supplementary Special Provisions).

Q42. Please clarify the following for North City Water Reclamation Plant Expansion bid. Package 4, drawing PK4-CG-001, shows grading quantities. Specifically, there is Cut Quantities of 98,000 CYD and Export Quantities of 98,000 CYD. There is a note indicating that “this project proposes to export 6,700 cubic yards of material from this site”. Please identify where the remaining 91,300 CYD will be placed on site.

A42. Approximately 98,000 CYD of excavated material is required to be hauled offsite. See revised drawing PK4-CG-001 included on page 17 of this Addendum.

Q43. Reference 1-2 of the Supplementary Special Provisions: TERMS AND DEFINITIONS. To the "WHITEBOOK", item 54, "Normal Working Hours", ADD the following:

The Normal Working Hours are 6:30 p.m. to 3:30 p.m.
We believe the normal working hours should be 6:30AM to 3:30PM.
Please advise.

A43. The working hours are from 6:30 a.m. to 3:30 p.m.

Q44. For the electrical work associated with bid items 10 & 11, can you please clarify whether or not these are inclusive to those bid items OR are part of the overall plant electrical included in bid item 7?

A44. The electrical work associated with bid items 10 & 11 are inclusive to those bid items as indicated in those individual bid item descriptions and are not included in the bid item for the overall plant electrical work.

Q45. Please reference drawing PK4-SS-101, detail 2/CG-107 Retaining Wall 2, and PK4-SS-102 section A/SS-101. The proposed retaining wall on detail 2 (retaining wall 2) has a maximum height of 26.75' from top of footing. Reinforcement design references section A. Section A is detailed for walls from 16' to 20'-6". Please confirm what detail is to be used for this wall.

A45. Please see revised drawing PK4-SS-101 included on page 17 of this Addendum.

Q46. We would like to submit a RFI in reference to specification section 33 16 13.13. Per Section 2.05.A.1 you're asking for this tank to be UL142 however UL 142 only allows a 12' diameter tank at the volume requested. Can we build this per UL142 guidelines and not label it?

A46. The tank in question is a horizontal cylindrical tank. Dimensional constraints and the structural capacity of the supporting concrete tank structure dictated a 14 ft. diameter. Note that section 1.05A of 33 16 13.13 requires tank design by a registered civil or structural engineer licensed in CA. The design shall be consistent with all the fabrication and material requirements of UL 142 and the dimensional requirements indicated on the contract drawings. Table 13.1 does not prohibit the tank dimensions indicated on the contract drawings.

Q47. Please reference spec section 01 50 00 page 268. The furniture specified is a manufacturer called McDowell. This company can not be found in google or Amazon. Please provide a contact or alternate manufacturer part numbers.

A47. Use a comparable manufacturer with comparable furniture if the listed manufacturer is unavailable.

Q48. Please reference spec section 01 50 00 page 268. The furniture specified is a manufacturer called McDowell. This company cannot be found in google or Amazon. Please provide a contact or alternate manufacturer part numbers.

A48. Use a comparable manufacturer with comparable furniture if the listed manufacturer is unavailable

## C. CLARIFICATIONS

1. The callouts for BW on drawings PK4-CG-102, PK4-CG-106, and PK4-CG-107 represent the finished grade elevation on the low side of the retaining wall.

2. To avoid any ambiguities with the solicitation documents on PlanetBids under bid tab *Documents/Attachments* and the plans and specifications that are currently referenced in FileCloud link https://filecloud.sandiego.gov/url/b3miekz7ft9ssgyb, the following duplicate files will be deleted from the FileCloud subfolders:

   1 NCWRP Expansion Package 4 Drawings_CH2M - revised 101118 final.zip

   2 NCWRP Expansion Package 4 Drawings_Carollo.zip

   4 NCWRP Expansion package 4 Technical Specs-Vol 2 and 3.zip

   8 NCPWF Package 1 documents_Carollo.zip

## D. SUPPLEMENTARY SPECIAL PROVISIONS

1. To Technicals, Section 01 29 00 Payment Procedures, Part 1 General, Item 16, Retaining Wall East of Proposed Secondary Clarifiers Facility 23 (BID Item No. 8) Lump Sum, page 151, **DELETE** in its entirety and **SUBSTITUTE** with the following:

16. RETAINING WALLS 1 AND 2 (BID ITEM NO. 8) LUMP SUM

    A. Includes all structural, civil, and geotechnical interface for construction of concrete retaining wall. Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Bid Item No. 8.

2. To Technicals, Section 01 29 00 Payment Procedures, Part 1 General, Item 23, Temporary road with relocated water line and storm drain (BID Item No. 15) Lump Sum, page 152, **DELETE** in its entirety and **SUBSTITUTE** with the following:

    23. Temporary road with relocated water line and storm drain (BID ITEM NO. 15) LUMP SUM

        A. Includes stormwater piping, curb and gutter, pavement, relocated waterline, associated valves, grading, retaining wall. Payment for this item shall be made as the lump sum amount named in the Bid Schedule under Bid Item No. 15.

3. To Technicals, Section 01 29 00 Payment Procedures, Part 1, General, Item 29 relocation of power generation and prep for future power generation pad (additive alternate a – Bid ITtem No. 1) Additive/Deductive alternate Lump Sum, page 153, **DELETE** in its entirety and **SUBSTITUTE** with the following:

    29. Relocation of power generation and prep for future power generation pad (additive alternate a - BID ITEM NO. 22) ADDITIVE/DEDUCTIVE alternate LUMP SUM

        A. Includes relocation of existing power generation, Retaining Wall 3, storage container, all equipment associated with this facility. All wiring, utilities, grading, stormwater, structural, electrical and I&C interface. This also includes all grading and preparation for the future pad Payment under this Bid Item shall be made as the lump sum price named in the Bid Schedule under Additive Alternate A, Bid Item No. 22.

## E. PLANS

The revised plans listed below are located at the following file cloud link:

https://filecloud.sandiego.gov/url/5nhp8mapttytt4uh

NCWRP EXPANSION AND NCPWF INFLUENT PUMP STATION AND PIPELINE PACKAGE 4 – EARLY SITE WORK AND OZONE/BIOLOGICAL ACTIVATED CARBON (BAC) RELOCATION

1. To Drawing Number 40381-4035-D, Sheet No. 35, No. PK4-CG-001, Grading Cover Sheet, DELETE in its entirety and REPLACE with sheet No. 35 located in the FileCloud link provided herein.

2. To Drawing Number 40381-4042-D, Sheet No. 42, No. PK4-CG-111, Site Grading & Location Plan – Area 11, **DELETE** in its entirety and **REPLACE** with sheet No. 42 located in the FileCloud link provided herein.

3. To Drawing Number 40381-4050-D, Sheet No. 50, No. PK4-S-101, Site Structural Plan and Sections, **DELETE** in its entirety and **REPLACE** with sheet No. 50 located in the FileCloud link provided herein.

4. To Drawing Number 40381-4053-D, Sheet No. 53, No, PK4-SS-101, Site Structural Retaining Wall Profile, **DELETE** in its entirety and **REPLACE** with sheet No. 53 located in the FileCloud link provided herein.

NORTH CITY PURE WATER FACILITY CONSTRUCTION PACKAGE 1

5. To Drawing Number 39636-16-D, Sheet No. 16, No. PK1-CY-101, Mass Grading and Clearing Plan Storm Drain 2 Plan and Profile, **DELETE** in its entirety and **REPLACE** with sheet No. 16 located in the FileCloud link provided herein.

DEMONSTRATION PURE WATER FACILITY OZONE AND BIOLOGICALLY ACTIVE CARBON (BAC) RELOCATION PROJECT

6. To Drawing Number 40425-15-D, Sheet No. 15, No. G-501, General Mechanical Details 1, **DELETE** in its entirety and **REPLACE** with sheet No. 15 located in the FileCloud link provided herein.

7. To Drawing Number 40425-49-D, Sheet No. 49, No. 27-M-001, EDR Feed Pump Plan, **DELETE** in its entirety and **REPLACE** with sheet No. 49 located in the FileCloud link provided herein.

8. To Drawing Number 40425-51-D, Sheet No. 51, No. 27-M-003, EDR6 Mechanical Plan, **DELETE** in its entirety and **REPLACE** with sheet No. 51 located in the FileCloud link provided herein.

9. To Drawing Number 40425-52-D, Sheet No. 52, No. 27-M-004, EDR6 Mechanical Section, **DELETE** in its entirety and **REPLACE** with sheet No. 52 located in the FileCloud link provided herein.

10. To Drawing Number 40425-58-D, Sheet No. 58, No. 29-S-005, BAC Filter and Ozone Platform Framing Plans, **DELETE** in its entirety and **REPLACE** with sheet No. 58 located in the FileCloud link provided herein.

James Nagelvoort, Director
Public Works Department

Dated: *December 3, 2018*
San Diego, California

JN/JB/Lad

# City of San Diego

**CITY CONTACT:** Juan E. Espindola, **Contract Specialist, Email**: JEEspindola@sandiego.gov
**Phone No.** (619) 533-4491

# ADDENDUM C

e - Bidding

# FOR

## NORTH CITY WATER RECLAMATION PLANT EXPANSION - EARLY SITE WORK AND OZONE/BAC RELOCATION

| | |
|---|---|
| BID NO.: | **K-19-1724-DBB-3** |
| SAP NO. (WBS/IO/CC): | **B-15142, B-15139** |
| CLIENT DEPARTMENT: | **2000** |
| COUNCIL DISTRICT: | **1** |
| PROJECT TYPE: | **BI** |

**BID DUE DATE:**

**2:00 PM**

**DECEMBER 12, 2018**

**CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS**

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

# ENGINEER OF WORK

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

**NCWRP EXPANSION AND NCPWF INFLUENT PUMP STATION AND PIPELINE - PACKAGE 4 NCWRP EARLY SITEWORK AND OZONE/BAC RELOCATION**

**Julian Hoyle**

1) Registered Engineer


DIGITALLY SIGNED: 12/05/2018

**Amer Barhoumi**

2) For City Engineer

## 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. ADDENDUM

1. To Addendum B, Section B, Bidder's Questions, question Q1 and answer A1 **DELETE** in their entirety and **SUBSTITUTE** with the following:

   Q1. Package 1 "Mass Grading and Clearing" drawings look to be a scanned document. Please provide a clean PDF without the background distortion the document currently has.

   A1. A newly scanned pdf copy of the Package 1 Mass Grading and Clearing Plans can be downloaded from this FileCloud link: https://filecloud.sandiego.gov/url/e6avayug4s649n2s

James Nagelvoort, Director
Public Works Department

Dated: *December 6, 2018*
San Diego, California

## Bid Results

## Bidder Details

**Vendor Name** AECOM Energy & Construction, Inc.
**Address** 16481 Scientific Way
Irvine, CA 92618
United States

**Respondee** Jolynn Buresh
**Respondee Title** Estimating and Proposal Coordinator
**Phone** 949-333-1500 Ext. 519
**Email** jburesh@shimmick.com
**Vendor Type** PQUAL,CADIR
**License #** 178
**CADIR** 1000036611

## Bid Detail

**Bid Format** Electronic
**Submitted** December 12, 2018 1:58:45 PM (Pacific)
**Delivery Method**
**Bid Responsive**
**Bid Status** Submitted
**Confirmation #** 160826
**Ranking** 0

## Respondee Comment

## Buyer Comment

## Attachments

| File Title | File Name | File Type |
|---|---|---|
| Contractor's Certification of Pending Actions 12-12-18 | UPLOADED Contractors Certification of Pending Actions 12-12-18.pdf | Contractor's Certification of Pending Actions |
| Mandatory Disclosure of Business Interest Form 12-12-18 | UPLOADED Mandatory Disclosure of Business Interests Form 12-12-18.pdf | Mandatory Disclosure of Business Interests Form |
| Subcontracting Listing (other than first tier) | Subcontract Listing (other than first tier).pdf | Subcontractor Listing (OTHER THAN FIRST TIER) |
| Lobbying Disclosure Form 12-12-18 | UPLOADED Lobby Prohibition, Certification and Disclosure 12-12-18.pdf | Lobby Prohibition, Certification and Disclosure (p. 1344-1346) |
| COMBINED 4500-3 | COMBINED 4500-3.pdf | DBE Program - Subcontractor Performance Form |
| DBE Subcontractor Utilization Form 4500-4 | DBE Subcontractor Utilization Form 4500-4.pdf | DBE Program - Subcontractor Utilization Form |
| Alternate Bid Subcontractor | UPLOADED Alternate Bid Subcontractor Listing 12-12-18.pdf | Subcontractor Additive/Deductive Alternate Form (p.1338) |
| AECOM - Bid Bond | UPLOADED City of San Diego - North City Water Reclamation Plant Expansion Bid Bond.pdf | Bid Bond |

## Line Items

| Type | Item Code | UOM | Qty | Unit Price | Line Total | Comment |
|---|---|---|---|---|---|---|
| | **Main Bid** | | | | | |
| 1 | BONDS (PAYMENT AND PERFORMANCE) | | | | | |
| | 237110 | LS | 1 | $300,000.00 | $300,000.00 | |

## Bid Results

| Type | Item Code | UOM | Qty | Unit Price | Line Total | Comment |
|---|---|---|---|---|---|---|
| 2 | MOBILIZATION AND DEMOBILIZATION | | | | | |
| | 237110 | LS | 1 | $485,000.00 | $485,000.00 | |
| 3 | SHEETING, SHORING, AND BRACING | | | | | |
| | 237110 | LS | 1 | $230,000.00 | $230,000.00 | |
| 4 | SITE CIVIL GRADING, EXCAVATION AND STORMWATER PIPING | | | | | |
| | 238910 | LS | 1 | $4,000,000.00 | $4,000,000.00 | |
| 5 | YARD PIPING | | | | | |
| | 237110 | LS | 1 | $800,000.00 | $800,000.00 | |
| 6 | RELOCATED, DEMOLITION AND ABANDONMENT OF UTILITIES | | | | | |
| | 237110 | LS | 1 | $350,000.00 | $350,000.00 | |
| 7 | SITE ELECTRICAL | | | | | |
| | 237110 | LS | 1 | $3,309,500.00 | $3,309,500.00 | |
| 8 | RETAINING WALL EAST OF PROPOSED SECONDARY CLARIFIERS FACILITY 23 | | | | | |
| | 237110 | LS | 1 | $1,800,000.00 | $1,800,000.00 | |
| 9 | FENCING, SECURITY AND SITE CIVIL ACCESS ROAD | | | | | |
| | 237110 | LS | 1 | $50,000.00 | $50,000.00 | |
| 10 | ELECTRO-DIALYSIS REVERSAL FACILITY 27 | | | | | |
| | 237110 | LS | 1 | $400,000.00 | $400,000.00 | |
| 11 | OZONE AND BAC FILTER FACILITY 29 | | | | | |
| | 237110 | LS | 1 | $2,000,000.00 | $2,000,000.00 | |
| 12 | STORM WATER POLLUTION PREVENTION PLAN (SWPPP) - IMPLEMENTATION | | | | | |
| | 237110 | LS | 1 | $180,000.00 | $180,000.00 | |
| 13 | STORM WATER POLLUTION PREVENTION PLAN (SWPPP) - PERMIT FEE ALLOWANCE (EOCP - TYPE I) | | | | | |
| | 541330 | AL | 1 | $5,000.00 | $5,000.00 | |
| 14 | TRAFFIC CONTROL | | | | | |
| | 237310 | LS | 1 | $20,000.00 | $20,000.00 | |
| 15 | TEMPORARY ROAD WITH RELOCATED WATER LINE AND STORM DRAIN | | | | | |
| | 237310 | LS | 1 | $225,000.00 | $225,000.00 | |
| 16 | BIORETENTION BASINS AND APPURTENANCES | | | | | |
| | 561730 | LS | 1 | $60,000.00 | $60,000.00 | |
| 17 | CP1 -NORTH CITY PURE WATER FACILITY MASS GRADING | | | | | |
| | 237310 | LS | 1 | $650,000.00 | $650,000.00 | |

## Bid Results

| Type | Item Code | UOM | Qty | Unit Price | Line Total | Comment |
|---|---|---|---|---|---|---|
| 18 | FIELD ORDERS (EOCP - TYPE II) | | | | | |
| | | AL | 1 | $698,800.00 | $698,800.00 | |
| 19 | SECURITY GUARD ALLOWANCE (EOCP - TYPE I) | | | | | |
| | 238210 | AL | 1 | $125,000.00 | $125,000.00 | |
| 20 | NCPWF STORM WATER POLLUTION PREVENTION PLAN (SWPPP) - IMPLEMENTATION | | | | | |
| | 237110 | LS | 1 | $40,000.00 | $40,000.00 | |
| 21 | STORM WATER POLLUTION PREVENTION PLAN (SWPPP) - PERMIT FEE ALLOWANCE | | | | | |
| | 541330 | AL | 1 | $5,000.00 | $5,000.00 | |
| | | | | **Subtotal** | **$15,733,300.00** | |
| | **Alternate Items A** | | | | | |
| 22 | RELOCATION OF POWER GENERATION AND PREP FOR FUTURE POWER GENERATION PAD (ADDITIVE/DEDUCTIVE ALTERNATE ITEM) | | | | | |
| | 237110 | LS | 1 | $670,000.00 | $670,000.00 | |
| | | | | **Subtotal** | **$670,000.00** | |
| | | | | **Total** | **$16,403,300.00** | |

## Subcontractors

| Name & Address | Description | License Num | CADIR | Amount | Type |
|---|---|---|---|---|---|
| **HARDY & HARPER INC**<br>1312 E WARNER AVE<br>SANTA ANA, CA 92705<br>United States | AC Pave | 215952 | 1000000076 | $128,000.00 | |
| **Southern Contracting Company**<br>559 North Twin Oaks Valley Road<br>San Marcos, CA 92069<br>United States | Electrical | 222252 | 1000002172 | $2,493,000.00 | PQUAL,CADIR |
| **Condon Johnson**<br>480 ROLAND WAY SUITE 200<br>OAKLAND, CA 94621<br>United States | CIDH and Shoring | 300068 | 1000004443 | $351,000.00 | |
| **CMC Rebar West**<br>3880 Murphy Canyon Rd.<br>Suite 100<br>San Diego, CA 92123<br>United States | Rebar | 1047398 | 1000062653 | $479,525.00 | |

| Line Totals (Unit Price * Quantity) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Item Num | Section | Item Code | Description | Reference | Unit of Measure | Quantity | AECOM Energy & Construction, Inc. - Unit Price | AECOM Energy & Construction, Inc. - Line Total |
| 1 | Main Bid | 237110 | BONDS (PAYMENT AND | Section 01 29 00 | LS | 1 | $300,000.00 | $300,000.00 |
| 2 | Main Bid | 237110 | MOBILIZATION AND DEN | Section 01 29 00 | LS | 1 | $485,000.00 | $485,000.00 |
| 3 | Main Bid | 237110 | SHEETING, SHORING, AN | Section 01 29 00 | LS | 1 | $230,000.00 | $230,000.00 |
| 4 | Main Bid | 238910 | SITE CIVIL GRADING, EXC | Section 01 29 00 | LS | 1 | $4,000,000.00 | $4,000,000.00 |
| 5 | Main Bid | 237110 | YARD PIPING | Section 01 29 00 | LS | 1 | $800,000.00 | $800,000.00 |
| 6 | Main Bid | 237110 | RELOCATED, DEMOLITIO | Section 01 29 00 | LS | 1 | $350,000.00 | $350,000.00 |
| 7 | Main Bid | 237110 | SITE ELECTRICAL | Section 01 29 00 | LS | 1 | $3,309,500.00 | $3,309,500.00 |
| 8 | Main Bid | 237110 | RETAINING WALL EAST C | Section 01 29 00 | LS | 1 | $1,800,000.00 | $1,800,000.00 |
| 9 | Main Bid | 237110 | FENCING, SECURITY AND | Section 01 29 00 | LS | 1 | $50,000.00 | $50,000.00 |
| 10 | Main Bid | 237110 | ELECTRO-DIALYSIS REVE | Section 01 29 00 | LS | 1 | $400,000.00 | $400,000.00 |
| 11 | Main Bid | 237110 | OZONE AND BAC FILTER | Section 01 29 00 | LS | 1 | $2,000,000.00 | $2,000,000.00 |
| 12 | Main Bid | 237110 | STORM WATER POLLUTI | Section 01 29 00 | LS | 1 | $180,000.00 | $180,000.00 |
| 13 | Main Bid | 541330 | STORM WATER POLLUTI | Section 01 29 00 | AL | 1 | $5,000.00 | $5,000.00 |
| 14 | Main Bid | 237310 | TRAFFIC CONTROL | Section 01 29 00 | LS | 1 | $20,000.00 | $20,000.00 |
| 15 | Main Bid | 237310 | TEMPORARY ROAD WITH | Section 01 29 00 | LS | 1 | $225,000.00 | $225,000.00 |
| 16 | Main Bid | 561730 | BIORETENTION BASINS A | Section 01 29 00 | LS | 1 | $60,000.00 | $60,000.00 |
| 17 | Main Bid | 237310 | CP1 -NORTH CITY PURE V | Section 01 29 00 | LS | 1 | $650,000.00 | $650,000.00 |
| 18 | Main Bid | | FIELD ORDERS (EOCP - T | Section 01 29 00 | AL | 1 | $698,800.00 | $698,800.00 |
| 19 | Main Bid | 238210 | SECURITY GUARD ALLOV | Section 01 29 00 | AL | 1 | $125,000.00 | $125,000.00 |
| 20 | Main Bid | 237110 | NCPWF STORM WATER I | Section 01 29 00 | LS | 1 | $40,000.00 | $40,000.00 |
| 21 | Main Bid | 541330 | STORM WATER POLLUTI | Section 01 29 00 | AL | 1 | $5,000.00 | $5,000.00 |
| | | | | | | | Subtotal | $15,733,300.00 |
| 22 | Alternate It | 237110 | RELOCATION OF POWER | Section 01 29 00 | LS | 1 | $670,000.00 | $670,000.00 |
| | | | | | | | Subtotal | $670,000.00 |
| | | | | | | | Total | $16,403,300.00 |